Firm Failure and Financial Crisis: The Experience of South Korea

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Abstract

In this paper we try to analyze the link between some industrial policies in South Korea and the 1997 financial crisis. We argue that while the industrial policies have greatly promoted the development of many local industries, they also have encouraged local firms to get over-optimistic, to over-invest, and to over-produce. That increases the risks the firms are facing. When a bad time occurs, many of the firms will face difficulty. When a sufficiently large number of them have difficulty, their troubles become the troubles of the economy.

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1 Introduction

In November 1997, South Korea, one of the four newly industrialized economies in Asia and one of the fastest growing ones in the world, shocked the world and its citizens when it announced that it was seeking the assistance of the International Monetary Fund in meeting foreign debts burden. It is true that about four months ago, Thailand delivered the bombshell when it devalued the baht, and that many other countries in Asia have been under waves of speculative attacks.[1] However, many people thought that South Korea were able to withstand such pressure as its economy has been growing impressively for a long time and its fundamentals appeared to be strong.[2]

However, as a hindsight, the crisis was not surprising. Since 1996, there were signs that many Korean firms, especially big ones, were having troubles.[3] Many of them had hard time in repaying the loans they borrowed from banks and other local financial intermediaries. In the past, with the encouragement and support from the government, these banks were more than happy to offer loans to these big corporations, which had been growing rapidly. Furthermore, cheap loans from many foreign capital markets were available. For these banks, it seemed to be easy money to make by borrowing from abroad at low interest rates and lending to local firms at much higher rates. Afterall, the economy has been doing so well and these firms have been growing impressively. Why would one worry about the ability of these firms to repay the loan? If something went wrong, how could the government not do something? How could the government let these firms fail?

Then came the mid-nineties. One firm after another one got into troubles. Failure of a firm caused some problems to the banks that provided loans to the firm. Initially when only a few firms failed, probably no one had taken that as a warning sign and realized that there were some problems with the fundamentals of the economy. When more and more local firms could not

[1] For reports on some Asian countries during the financial crisis, see Wong (1998) or the web site: http://faculty.washington.edu/karyiu/Asia/.

[2] See, for example, *Economist* (1995) for some of the praises of the Korean economy and its growth on the eve of the Asian crisis.

[3] See Smith (1998: 68–69) for some of the difficulties South Korea faced before the crisis.

repay their loans, banks suddenly found that they were flooded with bad debts and could not meet the foreign debt requirements.

The crisis in South Korea seems to be puzzling. For an economy that has been growing so fast and appearing to be healthy, how could a crisis like the recent one happen? Is there any relationship between the growth of the economy and the crisis that happened? Have some of the factors that contributed to the growth of the economy been responsible for the crisis? How has the crisis affected the economy and its future growth? What kind of lesson can one learn from the experience of South Korea?

The purpose of this paper is to analyze some of the causes of the crisis in Korea. The argument it suggests is that some of industrial policies imposed by the Korean government in the past decades could be some of the reasons for the crisis. These policies, which have been encouraging local firms to grow, produce more, and export more, are responsible for the rapid growth of the economy in the past. However, it is argued in this paper that these policies have the side effects of making the firms over-optimistic about the future and the market conditions. They tend to over-invest, over-produce, and over-expand. Often, their expansion is regarded as success of the policies, if one use the volume of their exports and the degree of penetration into foreign markets as indices. However, to support such expansion, the firms need to borrow from local and foreign financial intermediaries. At the same time, cheap and foreign loans are nearly everywhere to be found, especially in big countries like the United States and Japan. Together with the false sense of security coming from implicit and explicit government guarantees and the fixity of the exchange rate, these loans raised by these firms and local banks from abroad were mostly short-term with lower rates and denominated in foreign currencies.

Over-expansion and over-production of these local firms also mean that these firms are taking too much risks and borrowing too much. When the market conditions turned out to be less than what they expect, some of them could run into troubles. For a short time, they might be able to get help from local banks by borrowing even more. In a longer time, their problems accumulate and more and more firms might run into similar troubles. The banks suddenly discovered that some of the debts turned bad while more firms were requesting for more loans. Then the banks now had their own problems: If they could not recieve repayments from local firms, they did not have money to repay the foreign loans they raised from abroad earlier. The foreign lenders, sensing that the Korean economy was in trouble and

alarmed by recent troubles in other Asian countries, refused to rollover the loans. Added to this is the let go of the won by the government after a series of speculative attacks, but the devaluation of the local currency exploded the burden faced by local banks and firms. Now a large number of local banks were facing the possibility of default, their problems became the problem of the country.

This paper, which provides a theoretical framework to link these events together, argues that the crisis, which obviously is a combination of many external and internal factors, can be explained partly in terms of the expansionary policies imposed by the government starting from the sixties. These policies were designed with the purpose of encouraging the expansion of some local firms and their exports, but they had the side effects of over-expansion of the firms. Over-expansion leads to over-investment and over-borrowing. The result is that firms took over-risky projects and banks supported over-risky projects. When bad times came, the economy experienced not only firm failure, but also illiquidity of domestic banks and inability to repay foreign debts.

However, it should be noted that it is not the purpose of this paper to provide a complete theory of the Korean crisis, which is too complicated to be fully explained in one single paper. At best, this paper looks at only one side and some of the features of the crisis. However, this paper does want to point out that the industrial policies that encourage local expansion and promote exports have the danger of encouraging firms to over-borrow. This increases the risks these firms are going to take, but the risks can easily be translated into the risks of the economy when a large number of local big firms are failing at the same time.

Section 2 of this paper introduces a simple model, in which some local firms are competing with a foreign firm for the market in the rest of the world. Section 3 explains how the government can use an interest subsidy policy to encourage local firms to produce more and a foreign firm to produce less. The optimal subsidy is derived, but it is argued that the sign of the subsidy depends on, among other things, the number of local firms. Section 4 examines the case when production is facing uncertainty created in the rest of the world. Section 5 provides some criticism of this policy. In particular, we argue that the policy encourages cross-sector investment and thus a rise in the number of firms in an industry, and that herd behavior and implicit and explicit government bailout assurance could encourage firms to be too optimistic or too willing to invest and produce. As a result, when a bad time

comes, local firms could be in trouble. Section 6 is more explicit in explaining how firm failure may lead to a financial crisis. The last section concludes.

2 Rivalry between Home and Foreign Firms

To analyze the present issues, we first construct a model with some simplifying assumptions. Consider a product (for example, car) and three countries, which are labeled home (South Korea), foreign (Japan), and the rest of the world (ROW). Production of the product exists only in home and foreign, while there is demand for the product only in ROW.[4] The product is being supplied by $n \geq 1$ identical firms in the home market and one single firm in a foreign market. For the time being, the number of home firms is assumed to be fixed. These firms compete in a Cournot fashion. Because there is no demand for the product in home and foreign, outputs of these firms are exported to ROW.

The production of the product takes two periods. Let us first describe the home market. In period 1, local firms have to hire workers (and possibly other factors) to start the production process, which is completed in period 2. The payments to the workers have to be made in period 1, which the firms borrow from an internal financial market (such as banks). Denote the amount of labor employed by firm i by ℓ_i, $i = 1, ..., n$, and let the prevailing wage rate be w, which the firm takes as given. Therefore the loan made by the firm is $w\ell_i$. Denoting the interest rate of the loan by r, the firm has to pay back $w\ell_i(1 + r)$ in period 2. Let other costs of production be equal to f, which for simplicity is assumed to be not firm-specific and not related to the firm's output level. These costs are paid by the firm in period 2, after the sale of its output.

The labor input of the firm is dependent on its output level:

$$\ell_i = \alpha + \beta x_i, \tag{1}$$

where x_i is the output level, and α and β are positive constants. The advantage of this technology function is that if the wage rate is independent of output, then the marginal cost is constant. The foreign firm has a similar

[4]The assumption of no domestic consumption in the home and foreign countries, which is found in many papers in the literature, is made to simplify the analysis. However, it has been under criticism. See Wong (1995, Chapter 12 for a discussion.)

technology structure so that its labor input can be written as

$$\ell^* = \alpha^* + \beta^* x^*, \tag{2}$$

where an asterisk is used to denote the variables of the foreign firm/economy. The total supply is equal to

$$X = x^* + \sum_{i=1}^{n} x_i.$$

The demand for the product in the rest of the world in period 2 can be described by function $p = p(q)$, where p is the market price and q the demand. For the time being, we neglect any uncertainty so that the demand function is known with certainty. Denote derivatives of a function by primes; for example, $p' \equiv \mathrm{d}p/\mathrm{d}q$.

Condition A: (a) $p' < 0$; (b) $p'' < \sigma$, where σ is a sufficiently small, positive real number.

Part (a) of condition A means that the demand curve is downward sloping, and by part (b) p'' is either negative, zero, or not too positive, implying that the marginal revenue, MR, decreases with output.[5] For example, the condition is satisfied if the market demand is linear. In equilibrium, the demand is equal to the outputs supplied by all the firms:

$$q = x^* + \sum_{i=1}^{n} x_i. \tag{3}$$

The (future value of the) profit function of home firm i in period 2 is

$$\pi_i(x_1, x_2, ...x_n, x^*; r) = p(q)x_i - w\ell_i(1+r) - f. \tag{4}$$

Taking outputs by all other firms as given, firm i chooses x_i to maximize its profit. The first-order condition is

$$p'x_i + p = w\beta(1+r). \tag{5}$$

[5]Note that $MR = p'x + p$. Differentiating the marginal revenue to give $MR' = p''x + 2p'$, which is negative when given condition A.

Condition (5) can be solved for the reaction function of the firm. Since all n home firms are identical, they have the same reaction function. The first-order condition profit maximization of the foreign firm is

$$p'x^* + p = w^*\beta^*(1 + r^*). \tag{6}$$

Conditions (5) and (6) can be solved for the Nash equilibrium outputs of the home and foreign firms. Since the n home firms are identical, in equilibrium they produce the same level of output, $x_i = x$, $i = 1, ..., n$. Denote the Nash equilibrium outputs of one home firm and the foreign firm by x^n and x^{*n}, respectively. These outputs are functions of technology, wage, and policy parameters, but for the purpose of this paper, we emphasize the interest rate the home firms are facing.

3 An Interest Rate Policy

After describing the behavior of the firms, we now introduce an industrial policy in the home economy: the provision of low interest loans.[6] Suppose that the interest rate that the home firms are facing has included a subsidy of $(r_0 - r) > 0$. This means that in the absence of the subsidy, the interest rate the firms have to pay would be $r_0 > r$. The question we have is whether this interest rate policy makes sense.

To make the present model more applicable for explaining the crisis in South Korea, we assume that the funds to be lent to the home firms come from the world capital market at a cost of r_0, which the home country takes as given.[7] Therefore choosing a subsidy rate is the same as choosing r. To determine the optimal interest rate policy, we first have to find out how the Nash equilibrium derived earlier is affected by a change in r.

Noting that the Nash equilibrium is dependent on the interest rate policy, we can write the firms' outputs as functions of r: $x^n = x^n(r)$ and $x^{*n} = x^{*n}(r)$. Since the home economy is assumed to be small in the world, we assume that the foreign interest rate is fixed and is not shown as an argument

[6]For a description of this policy and its features, see Kim (1995: 82–86) and Cathie (1997: 24–25).

[7]The cost of loans, r_0, include the cost of administration and any possible profits of local banks. Specifically, it will be the interest rate faced by the home firms in the absence of any government subsidization policy.

in the above Nash output functions. Differentiate (5) and (6), and rearrange terms to give

$$\begin{bmatrix} (n+1)p' + nx^n p & p' + x^n p'' \\ np' + nx^{*n} p'' & 2p' + x^{*n} p'' \end{bmatrix} \begin{bmatrix} \mathrm{d}x^n \\ \mathrm{d}x^{*n} \end{bmatrix} = \begin{bmatrix} w\beta \mathrm{d}r \\ 0 \end{bmatrix}. \tag{7}$$

Define the determinant of the matrix in (7) by

$$D \equiv [(n+1)p' + nx^n p][2p' + x^{*n} p''] - (np' + nx^{*n} p'')(p' + x^n p'') > 0,$$

where condition A has been used. Condition (7) is solved using Cramer's rule to yield the effect of a change in r on the firms' outputs:

$$\frac{\mathrm{d}x^n}{\mathrm{d}r} = \frac{w\beta(2p' + x^{*n} p'')}{D} < 0 \tag{8}$$

$$\frac{\mathrm{d}x^{*n}}{\mathrm{d}r} = -\frac{nw\beta(p' + x^{*n} p'')}{D} > 0. \tag{9}$$

Conditions (8) and (9) imply that a rise in the interest rate will hurt home firms' output but raise the foreign firm's output. The effect of a change in r on the labor input is equal to: $\mathrm{d}\ell^n/\mathrm{d}r = \beta$ and $\mathrm{d}\ell^{*n}/\mathrm{d}r = \beta^*$. Making use of conditions (8) and (9), the effect of an increase in r on home firm i's profit can be obtained by differentiating condition (4). Rearranging terms, we have

$$\frac{\mathrm{d}\pi_i}{\mathrm{d}r} = \frac{\partial \pi_i}{\partial x_i^n}\frac{\mathrm{d}x_i^n}{\mathrm{d}r} + \sum_{i \neq j} \frac{\partial \pi_i}{\partial x_j^n}\frac{\mathrm{d}x_j^n}{\mathrm{d}r} + \frac{\partial \pi_i}{\partial x^{*n}}\frac{\mathrm{d}x^{*n}}{\mathrm{d}r} + \frac{\partial \pi_i}{\partial r}. \tag{10}$$

To simplify (10), note that from the profit-maximizing condition of the firm $\partial \pi_i / \partial x_i^n = 0$. We then substitute (8) and (9), making use of the profit function in (4) into (10) to yield

$$\begin{aligned} \frac{\mathrm{d}\pi_i}{\mathrm{d}r} &= (n-1)x^n p' \left[\frac{(2p' + x^{*n} p'')w\beta}{D}\right] - nx^n p' \left[\frac{(p' + x^{*n} p'')w\beta}{D}\right] - w\ell_i^n \\ &= \frac{w\beta x^n p'[(n-2)p' - x^{*n} p'']}{D} - w\ell_i^n. \end{aligned} \tag{11}$$

On the RHS of (11), the second term represents the direct effect (negative) of an increase in r on a home firm's profit, while the first term is the indirect effect through changes in the outputs of other home firms and the foreign

firm. In general, the sign in condition (11) is ambiguous. It depends on, among other things, the number of home firms, n. For example, if $n \leq 2$, then $\mathrm{d}\pi_i/\mathrm{d}r < 0$, meaning that a rise in the interest rate will hurt the firm's profit. If $n > 2$, then the sign of $\mathrm{d}\pi_i/\mathrm{d}r$ is in general ambiguous.

We now examine the welfare effect of the interest rate policy. Following the tradition in the literature, we define the national welfare of the home industry as

$$W = n[\pi - w\ell(r_0 - r)]. \tag{12}$$

In defining W as stated in (12), we neglect any domestic consumption.[8] It should also be noted that such definition of welfare emphasizes efficiency rather than equity.

For each home firm, π is its profit, and $w\ell(r_0 - r)$ is the subsidy payment. As a result, $\pi - w\ell(r_0 - r)$ is the net contribution to national welfare. Since there are n identical home firms, W as defined in (12) is used to represent national welfare. Differentiating condition (12) with respect to r and rearranging terms, with n treated as a constant, we get

$$\begin{aligned} \frac{1}{n}\frac{\mathrm{d}W}{\mathrm{d}r} &= \frac{\mathrm{d}\pi_i}{\mathrm{d}r} - \frac{\mathrm{d}}{\mathrm{d}r}\left[w\ell(r_0 - r)\right] \\ &= \frac{w\beta x^n p'[(n-2)p' - x^{*n}p'']}{D} - \frac{w^2\beta^2(r_0 - r)(2p' + x^{*n}p'')}{D}. \end{aligned} \tag{13}$$

The first-order condition for a maximum welfare is

$$\frac{x^n p'[(n-2)p' - x^{*n}p'']}{D} - \frac{w\beta(r_0 - r)(2p' + x^{*n}p'')}{D} = 0,$$

which, after rearranging terms, gives

$$(r_0 - r^{opt}) = \frac{x^n p'[(n-2)p' - x^{*n}p'']}{w\beta(2p' + x^{*n}p'')}, \tag{14}$$

where r^{opt} is the optimal interest rate provided by the government to the firms. In other words, $r_0 - r^{opt}$ is the optimal interest rate subsidy. Condition (14) leads to the following proposition:

Proposition 1: Given condition A, $(r_0 - r^{opt}) > 0$ if and only if

$$n < 2 + \frac{x^{*n}p''}{p'}. \tag{15}$$

[8]The weakness of neglecting any possible domestic consumption will be discussed later.

In general the sign of $(r_0 - r^{opt})$ is ambiguous. If $n = 1$, i.e., there is only one home firm competing with the foreign firm, $(r_0 - r^{opt})$ is positive.[9] This justifies the use of an interest rate subsidy. If the number of home firms is greater, then $(r_0 - r^{opt})$ may be negative, meaning that the appropriate policy is an interest rate tax.

The intuition behind the use of either an interest rate subsidy or an interest rate tax is straightforward. If there is only one home firm, the home government would want to help the home firm to produce more and to induce the foreign firm to produce less, leading to a shift of part of foreign firm's profit to the home firm.[10] When the subsidy is appropriately chosen, the increase in the home firm's profit will be more than the subsidy payment, enabling the home economy to achieve a higher welfare in terms of efficiency. However, if there are two home firms or more, then they compete not just with respect to the foreign firm but also with each other. Under Cournot competition, the home firms will produce more than what they would do if they cooperate. In this case, there are two opposing forces affecting the action of the government. On the one hand, the government would want to help the home firms produce more in order to induce the foreign firm to produce less. For this, an interest rate subsidy will do. On the other hand, the government would want the home firm to produce less in order to exploit more the external monopoly power. To do that, an interest rate tax is needed. Whether a subsidy or a tax should be imposed depends on the relative strength of these two forces.

4 Production with Uncertainty

So far we assume that at the time of choosing the scale of production in period 1, the firms knows with certainty the demand in period 2. In general, this is not the case as production nearly always involves uncertainty. We now examine how uncertainty can be included in the analysis and how it may be one reason for the financial crisis in South Korea.

For simplicity, assume that there are two states in period 2: the good state and the bad state. If the good state occurs, the market demand is described by $p = p^g(q)$ while if the bad state occurs, the market demand is

[9] Recall that p'' is small or is negative.

[10] A policy like the present one is sometimes called a profit-shifting policy.

$p = p^b(q)$. This uncertainty is faced by both home firms and foreign firms. We do not consider any uncertainty in the production process.

Condition B: For all possible market demand $q > 0$, (a) $p^g(q)$ and $p^b(q)$ satisfy condition A; (b) $p^g(q) > p^b(q)$; (c) $p^{g\prime}(q) - p^{b\prime}(q) > \tilde{\sigma}$, where $\tilde{\sigma}$ is a sufficiently small, positive number.

Interpreting parts (a) and (b) of condition B is straightforward. To interpret part (c), note that the marginal revenue in state j, $j = g, b$ is defined as $MR^j(q) \equiv p^j + p^{j\prime}q$. Therefore, for $q > 0$,

$$\begin{aligned} MR^g(q) - MR^b(q) &= [p^g(q) - p^b(q)] + [p^{g\prime}(q) - p^{b\prime}(q)]q \\ &> 0, \end{aligned} \tag{16}$$

where parts (b) and (c) of condition B have been used.

Suppose that the firms believe that the probability of good state is ρ and that of bad state is $(1-\rho)$. The perceived expected profit function of home firm i is

$$\begin{aligned} \tilde{\pi}_i &= [\rho p^g(q)x_i + (1-\rho)p^b(q)x_i] - w\ell_i(1+r) - f \\ &= \tilde{p}(q)x_i - w\ell_i(1+r) - f, \end{aligned} \tag{17}$$

where $\tilde{p}(q) \equiv \rho p^g(q) + (1-\rho)p^b(q)$ is the expected price. The first-order condition for a maximum profit is

$$\frac{\partial \tilde{\pi}}{\partial x_i} = \tilde{p}' x_i + \tilde{p} - w\beta(1+r) = 0, \tag{18}$$

where $\tilde{p}' \equiv \rho p^{g\prime}(q) + (1-\rho)p^{b\prime}(q)$. Based on the first-order condition (18) and a similar one for the foreign firm, and if all the firms have the same belief about the probability of the good state, the analysis in the previous section can be applied here, with the price function $p(q)$ replaced with the expected price function $\tilde{p}(q)$.

The firms will make their production decision in period 1 based on the expected price. Denote the output of a representative home firm by $\tilde{x}_i$ (and the corresponding labor input by $\tilde{\ell}_i$) and that of the foreign firm by $\tilde{x}^*$. Note that both outputs are functions of parameters such as the probability of the good state. The total supply is equal to

$$\tilde{X} = \sum_{i=1}^{n} \tilde{x}_i + \tilde{x}^*,$$

which in equilibrium is equal to the demand, $\tilde{q}$. Substituting the output and input levels into (17), we get the expected profit of home firm i:

$$\tilde{\pi}_i = \tilde{p}(\tilde{q})\tilde{x}_i - w\tilde{\ell}_i(1+r) - f. \tag{19}$$

In period 2, the production process is completed. At the same time, the state of nature is revealed. Depending on which state occurs, the market price in period 2 is equal to

$$p = \begin{cases} p^g(\tilde{q}) & \text{if the good state occurs} \\ p^b(\tilde{q}) & \text{if the bad state occurs.} \end{cases}$$

The resulting profit of home firm i in state j, $j = g$, b, is equal to

$$\pi_i^j = p^j(\tilde{q})\tilde{x}_i - w\tilde{\ell}_i(1+r) - f. \tag{20}$$

Because $p^g(\tilde{q}) > p^b(\tilde{q})$, we have $\pi_i^g > \pi_i^b$. In fact, by comparing (19) and (20), we can see that since $1 \geq \rho \geq 0$, $\tilde{\pi}_i$ is a weighted average of the profits in the two states:

$$\tilde{\pi}_i = \rho\pi_i^g + (1-\rho)\pi_i^b.$$

If the fixed cost is not a sunk cost yet, home firm i will choose to produce nothing if the expected profit is negative. Thus we assume that in a Nash equilibrium $\tilde{\pi}_i \geq 0$. This implies that $\pi_i^g > 0$. However, π_i^b may be positive, negative, or zero.

What happens if the bad state occurs in period 2 and if $\pi_i^b < 0$? The firm will have a loss. How can it cover the loss? We assume that the firm can borrow either at home or abroad to cover the loss. If the model is extended to a multi-period model, the firm can continue to produce, hoping that in the next cycle (period 2-period 3), it will make a profit if a good state occurs in period 3. If there is no liquidity problem for the firms, if the market prices in the two states grow at a rate equal to the interest rate with constant (over time) probabilities of the states, and if the firms's belief is close enough to the true probability of the good state, then in the long run the firm will have a net positive profit.

5 Criticism of the Industrial Policy

The above model is a simple model analogous to the one in Brander and Spencer (1986). Both their model and the present one explain how a government can encourage the local firms to produce more and induce the foreign

competitor to produce less. Such shifts in the output levels of the firms thus raise the profits of the local firms at the expense of the foreign firm.

There are, however, some differences between the present model and the Brander-Spencer model. First, we concentrate on interest rate subsidies while they focus on export subsidies. In the real world, direct subsidy to encourage export is not common as it is not allowed under the rules of GATT and WTO. Policies to promote export do exist, usually in some disguised form. Interest rate subsidy could be a disguised export promotion policy. Furthermore, our model has the key feature that production is carried out in two periods and the market condition in the second period is not known in the first period. To ease the liquidity constraint faced by firms, the government provides low-interest loans. Firms could make a loss in the second period if the bad state occurs, but if low-interest loans are always available from the government, firms can continue to borrow and could make a net profit over time. The subsidy in the form of lower interest rates can encourage local firms to produce more, allowing the local industry to improve its welfare. At the same time, the policy causes a decrease in the profit of the foreign firm.

Some shortcomings of the Brander-Spencer model has been suggested in the literature. For example, it is argued that in some cases, a production/export subsidy can in fact lower the welfare.[11] Some of the more common reasons can be provided here: (a) the presence of domestic consumption, (b) existence of imperfect information, (c) Cournot competition versus Bertrand competition, (d) the costs of raising government revenue, and so on.

Since both the present model and the Brander-Spencer model are based on the profit-shifting argument for promoting export and local production, economists who are familiar with the strategic trade policy literature can easily see that the present interest-rate subsidy policy could possibly be harmful, instead of beneficial, to the economy. Since the criticism of profit-shifting policies is well known in the literature, there is no need to repeat them here. This paper would instead point out some of those shortcomings of interest-subsidizing policies that are less obvious but more relevant to the case of South Korea, in particular those that are more responsible for the 1997 crisis.

[11] For a recent survey of some of the criticism, see Wong (1995, Chapter 12).

5.1 Rising Number of Firms

Proposition 1 shows the dependence of the sign of the interest subsidy, $(r_0 - r)$, on the number of firms. In the present model, if the government has perfect information about technologies of all firms and about the market demand, the government would have no problem in calculating the optimal interest subsidy, including its magnitude and sign. The correct policy can then be imposed.

One problem of this policy is that the number of home firms may change over time, and that the rise in the number of home firms could be the direct result of the interest subsidy policy. To see this point, suppose that initially there is a small number of home firms in the industry. Taking this number as given, the government then decides that the optimal policy is an interest-subsidy policy, as described above.

However, it is quite likely that the government provides interest rate subsidies not only to one industry but to many industries at the same time. The reason is that for an economy to grow fast and for a long time, many industries should grow, and the government may see the need to target more than one industry. With more than one industry being targeted for interest rate subsidization, cross-sector investment is very possible.

A firm that is initially producing in an industry has at least three reasons to expand to other industries. First, the interest rate subsidies that it can obtain from the government is a source of cheap capital for investing in other industries. Second, the firm may want to invest in other industries to diversify and reduce risks. In fact, the more different the new industries in which it plans to invest from the prevailing industry in which it is producing, the less correlated the risks associated with the industries are.[12] Third, the fact that there is initially a limited number of firms in the targeted industry means that the existing firms are very likely earning positive profits. These profits are like magnets, attracting oligopolistic firms in other industries to enter.

One of the more important example of cross-sector investment was that of Daewoo. This company began as a successful textile trading company. Founded in 1967, Daewoo expanded quickly to become one of the most profitable company in Korea in the seventies and eighties. In 1975, it was asked by the government to take over an ailing state-owned machinery plant. It

[12]Of course it will be easier for a firm to expand into another industry that is of a similar nature because some of the assets, including technologies, can be transferred.

soon changed its name to Daewoo Heavy Industries. Shortly thereafter, Daewoo expanded into other industries with its take over of first a shipbuilding company and then a motor company. Daewoo even teamed up with many foreign companies to produce other products; for example, it formed joint ventures with General Motors, General Dynamics, Boeing, Caterpiller, Northern Telecom, General Electric, and JCB Participation (French), among others. Just before it went into troubles before the crisis, the group had production and business in industries like trading and construction, machinery, electric and electronics, automotive and automotive parts, shipbuilding, chemicals, finance, and others.[13] Samsung and Hyundai are two other examples although they did much better before and during the financial crisis.[14]

There is no evidence that the Korean government was aware of the danger of cross-sector investment. As a matter of fact, the government seemed to welcome such investment in a targeted industry because an increase in the number of firms could help develop the industry faster. In some cases, the government did encourage such cross-sector investment.

Such cross-sector investment creates two problems. First, firms in targeted industries will tend to over-borrow. Some of the money a firm in a targeted industry borrows will be used in investing in other industries, instead of raising its production in that industry. Second, cross-sector investment increases the number of firms. By Proposition 1 and condition (14), the optimal policy is dependent on the number of firms. This means that when there is an increase in the number of firms in an industry due to cross-sector investment, sticking to a predetermined subsidy policy could instead hurt the economy.

The possibility of cross-sector investment distinguishes the present interest-rate subsidy policy from other industrial promotion policies. Under the present policy, it is difficult to control how firms spend the money borrowed from the government. Even if firms state how the money is spent and the approval is made based on how firms state, it is costly to monitor exactly whether the firms follow.[15] Some other promotion policies are more firm

[13]See Steers, et al (1989: 64–70).

[14]See Hattori (1997: 464–465).

[15]Even if a firm states that the money will be used to build a new plant and eventually a plant is built, it is possible that the firm uses the money to freeze up some of the money it saves and it would use to build the new plant should no subsidy be available. In this case, the firm can spend the frozen-up saving on investing in another sector. In fact, there are many types of expenditures that can hardly be monitored.

or sector specific; for example export subsidy or production subsidy. In this case, a firm has really exported or produced so many units of the good before it can receive the stated amount of subsidy. This shows the "danger" of the present interest-rate policy.

5.2 Rising Optimism of Success

Another problem of the interest-subsidy policy is that there are cases in which home firms tend to get more and more optimistic about future successes. The reason is that the probability of the good state is unknown and unobservable. Firms have to make an estimate of the probability based on several factors including the history.

There are factors that could contribute to rising optimism among home firms about future successes. First, the economy of South Korea had experienced a long period of impressive growth before 1997. There are many reasons why the economy grew so fast. Some of them are internal that are due to certain characteristics of the economy such as the workers' rising skills plus hardworking and firms' investment in physical capital plus R&D, and government policies such as investment in infrastructure and education. There are some external factors; for example, expanding world markets for Korean products. Above all, there could just be a chance that a series of good states occurred. No matter what caused the long period of high growth before the crisis, if the home firms estimated the probability of good state based on past successes, the estimated probability could well be above the true probability.

Second, there is the herd behavior among the home firms.[16] This behavior could arise when there is more than one firm producing in one sector. In the presence of herd behavior, firms could make a production decision based on a perceived probability of the good state greater than what they think it may be. In other words, firms become over-optimistic.

There can be many reasons for herd behavior among firms. One reason is that the existing system seems to impose asymmetric penalties on people who make wrong production decisions in the presence of uncertainty. For example, the manager of a firm could be severely punished if the production decision turns out to be a sour one while many of other firms are getting

[16]See Saxena and Wong (1999) for a recent survey of herd behavior and Wong (1999) for an application of herd behavior in explainging the real estate bubbles in Thailand.

successes, but the manager could be much less punished if many other firms are also facing failure. On the other hand, such asymmetry may not exist when giving out rewards. For example, if a production decision is successful while many other firms are not, the manager may be regarded as lucky and may not be well rewarded, and if the firm and many other firms are successful, the manager is supposed to have done the right thing, and he may not receive any big reward either. As a result, firms tend to behave in the same way as what other firms are behaving.

With herd behavior, firms can get over-optimistic about the future and can make a production decision based on a perceived probability of the good state higher than what it could do when acting alone without herd behavior. To see this point, suppose that a few firms make some successes in the industry. Other firms in the same industry or in other industries may become more aggressive in investment as if their perceived probability of the good state has become higher. As explained, it is logical and rational for managers to make such a decision, even if they would not choose to do so based on what they truly believe about the probability of success. The reason is that they can get punished heavily if they do not invest so aggressively while other firms are reporting successes, but they may not receive heavy punishment if they invest but lose together with other firms.

Suppose now that all home firms behave in such a way that they believe that there is a rise in ρ. To see the effects, let us differentiate the first-order condition (18), keeping the outputs of all firms except that of home firm i constant, and rearrange terms to give

$$\left.\frac{\mathrm{d}\tilde{x}_i}{\mathrm{d}\rho}\right|_{\mathrm{R}} = -\frac{MR^g - MR^b}{\rho[p^{g\prime\prime}\tilde{x}_i + 2p^{g\prime}] + (1-\rho)[p^{b\prime\prime}\tilde{x}_i + 2p^{b\prime}]} > 0, \tag{21}$$

where conditions A and B have been used. The subscript on the LHS of condition (21) means that the outputs of all other firms are held constant. This condition implies that when taking the outputs of all other firms as given, home firm i will produce more when getting more optimistic.

To see the effects of herd behavior, assume that all home firms get more optimistic while the foreign firm is not affected by the herd behavior. Since all the home firms remain symmetric, they will have the same output, x. Differentiate the first-order condition of a home firm (18) to give

$$[n\tilde{p}''x + (n+1)\tilde{p}']\mathrm{d}x + [\tilde{p}''x + \tilde{p}']\mathrm{d}x^* + (MR^g - MR^b)\mathrm{d}\rho = 0. \tag{22}$$

Following the above procedure, we can derive the first-order condition of the foreign firm, which can then be differentiated, under the condition that its perceived probability does not change, to give[17]

$$n(\tilde{p}''x^* + \tilde{p}')\mathrm{d}x + (\tilde{p}''x^* + 2\tilde{p}')\mathrm{d}x^* = 0. \tag{23}$$

Conditions (22) and (23) can be combined together to yield:

$$\begin{bmatrix} n\tilde{p}''x + (n+1)\tilde{p}' & \tilde{p}''x + \tilde{p}' \\ n(\tilde{p}''x^* + \tilde{p}') & \tilde{p}''x^* + 2\tilde{p}' \end{bmatrix} \begin{bmatrix} \mathrm{d}x \\ \mathrm{d}x^* \end{bmatrix} = - \begin{bmatrix} MR^g - MR^b \\ 0 \end{bmatrix} \mathrm{d}\rho. \tag{24}$$

Denote the determinant of the matrix in (24) by $\tilde{D}$

$$\tilde{D} \equiv \tilde{p}'\tilde{p}''(nx + x^*) + (n+2)(\tilde{p}')^2 > 0,$$

where the sign comes from condition A. Using Cramer's rule, the output effects of a change in ρ are

$$\frac{\mathrm{d}x}{\mathrm{d}\rho} = -\frac{(MR^g - MR^b)(\tilde{p}''x^* + 2\tilde{p}')}{\tilde{D}} > 0 \tag{25}$$

$$\frac{\mathrm{d}x^*}{\mathrm{d}\rho} = \frac{n(MR^g - MR^b)(\tilde{p}''x^* + \tilde{p}')}{\tilde{D}} < 0. \tag{26}$$

Conditions (25) and (26) imply that a rise in the degree of optimism of the home firms would cause an increase in their outputs but a decrease in that of the foreign firm. The effect on the total supply to the market is

$$n\frac{\mathrm{d}x}{\mathrm{d}\rho} + \frac{\mathrm{d}x^*}{\mathrm{d}\rho} = -\frac{n\tilde{p}'(MR^g - MR^b)}{\tilde{D}} > 0. \tag{27}$$

Condition (27) means that the rise in the home firms' optimism leads to more output, and thus a lower market price of the commodity.

How would that affect the home firms' profit? We first consider home firm i's profit if the good state occurs:

$$\frac{\mathrm{d}\pi_i^g}{\mathrm{d}\rho} = \frac{\partial \pi_i^g}{\partial x_i}\frac{\mathrm{d}x_i}{\mathrm{d}\rho} + \sum_{k \neq i} \frac{\partial \pi_i^g}{\partial x_k}\frac{\mathrm{d}x_k}{\mathrm{d}\rho} + \frac{\partial \pi_i^g}{\partial x^*}\frac{\mathrm{d}x^*}{\mathrm{d}\rho}. \tag{28}$$

[17] The results here are in general valid when all the firms initially have the same probability belief.

Note that the effect of a change in optimism on the good-state profit comes entirely from changes in output. The three terms on the RHS of (28) measure the direct effect of a rise in the home firms' optimism, home-firm output effect, and foreign-firm output effect, respectively. Let us first consider the first term on the RHS of (28). Recall the first-order condition (18), which can be rewritten as

$$\begin{aligned} & \rho\left(\frac{\partial \pi_i^g}{\partial x_i}\right) + (1-\rho)\left(\frac{\partial \pi_i^b}{\partial x_i}\right) \\ = \; & \rho[MR^g - w\beta(1+r)] + (1-\rho)[MR^b - w\beta(1+r)] \\ = \; & 0. \end{aligned} \tag{29}$$

By condition B, $MR^g > MR^b$. So (29) implies that

$$\frac{\partial \pi_i^g}{\partial x_i} > 0 > \frac{\partial \pi_i^b}{\partial x_i}. \tag{30}$$

Since a firm's profit is hurt by an increase in other firms' outputs, conditions (25), (26) and (30) imply that the direct effect on the good-state profit of a rise in home firm's optimism is positive, the home-firm output effect negative, and the foreign-firm output effect positive, (the first term, second term, and third term on the RHS of (28), respectively). The total effect is in general ambiguous, but if the number of home firm is small, the total effect tends to be positive.

We now consider the effect on the bad-state profit, which can be derived in a similar way:

$$\frac{\mathrm{d}\pi_i^b}{\mathrm{d}\rho} = \frac{\partial \pi_i^b}{\partial x_i}\frac{\mathrm{d}x_i}{\mathrm{d}\rho} + \sum_{k \neq i} \frac{\partial \pi_i^b}{\partial x_k}\frac{\mathrm{d}x_k}{\mathrm{d}\rho} + \frac{\partial \pi_i^b}{\partial x^*}\frac{\mathrm{d}x^*}{\mathrm{d}\rho}. \tag{31}$$

The three terms on the RHS of (31) can be called the direct effect, home-firm output effect, and foreign-firm output effect of an increase in optimism. As explained, the home-firm output effect is negative while the foreign-firm output is positive. Condition (30) implies that the direct effect is negative. Therefore, unless the rise in optimism of the home firm can induce a sufficient drop in foreign firm's output, it will cause a drop in the bad-state profit. The results are summarized in the following proposition:

Proposition 2: A rise in optimism of the home firms about future successes will (a) raise the good-state profit of a home firm if the number of home firms

is sufficiently small; and (b) lower the bad-state profit of a home firm if the change in foreign firm's output has little effect on the home firm's profit.

5.3 Possibility of Government Bailout

When the South Korean government promoted the development of certain industries, it provided not only various incentive schemes, but also the implicit and explicit assurance that government assistance will be given when firms meet troubles in their investment and production.[18] Such assurance of bailout will no doubt encourage firms to develop the industry, but because of such assurance, firms could easily take too much risk and overproduce. This problem is usually called moral hazard.

To see the effect of such assurance, recall that the profit of a home firm in period 2 depends on which state occurs. In particular, profit of home firm i when state j occurs is π_i^j. To make the present point, suppose that $\pi_i^b < 0$, i.e., the firm will face a loss if the bad state occurs. If the firm knows that part of this loss will be covered by the government in a rescue effort, the firm will over-expand.

To see this point further, suppose that any loss in period 2 will be covered completely by the government, i.e., a lumpsum transfer of the amount of $-\pi_i^b$ will be given to home firm i by the government should the bad state occur. As a result, the firm will receive zero net profit in a bad state. This means that the expected profit of home firm i is

$$\tilde{\pi}_i = \rho[p^g(q)x_i - w\ell_i(1+r) - f]. \tag{32}$$

Condition (32) means that maximizing the expected profit is the same as maximizing the profit the home firm can get when the good state occurs. The first-order condition is

$$p^{g\prime}\hat{x}_i + p^g - w\beta(1+r) = 0,$$

or

$$MR^g(\hat{x}_i) = w\beta(1+r), \tag{33}$$

where the "hat" is used to denote the output reaction with bailout possibility. To see the effect of the bailout, rewrite the first-order condition (18) as

$$\rho MR^g(\tilde{x}_i) + (1-\rho)MR^b(\tilde{x}_i) = w\beta(1+r), \tag{34}$$

[18] See, for example, Hattori (1997: 462–464).

where the "tilde" denotes the variables in the equilibrium without bailouts. Condition (34) can be combined with (33) to give

$$MR^g(\hat{x}_i) = \rho MR^g(\tilde{x}_i) + (1-\rho)MR^b(\tilde{x}_i). \tag{35}$$

Since by condition B $MR^g(x) > MR^b(x)$ for $x > 0$ and $MR^g > 0$, condition (35) implies that $\hat{x}_i > \tilde{x}_i$ for any given outputs of all other firms. In other words, the bailout assurance shifts the reaction curve of a home firm to the right. Since the assurance is given to all the home firms in the industry, we have a case similar to the one with a rise in optimism analyzed in the previous subsection: the reaction curves of all home firms shift out while that of the foreign firm remains unchanged. At the new Nash equilibrium, all home firms produce more while the foreign firm produces less.

The effect of the bailout assurance on home firm i's profit is also given by (28) and (31). In particular, the change in the good-state profit is in general ambiguous, while the bad-state profit will fall as long as the decrease in the foreign firm's output does not benefit the home firm's profit much. There is of course a difference. In the case of rising optimism, the home firms will pay the price in the form of a loss in the bad state, but with the bailout assurance, the government will shoulder at least part of the loss. For the economy, however, there is always a cost whether the firms pay it directly or the government bails out the firms.

6 The Financial Crisis

How could the above industrial policy contribute to the current crisis? The previous section describes three shortcomings of the policy, which have different implications on the current crisis. The first one, which is caused by cross-sector investment and a rise in the number of home firms in an industry, is more about the correct magnitude and sign of the interest subsidy. Its direct effect on a financial crisis is generally small. In other words, this criticism, like those based on the presence of domestic consumption, imperfect information, and the actual form of competition between the firms, is about the size or sign of the optimal policy. It does not imply the occurrence of a financial crisis. The other two shortcomings are more direct in leading to a financial crisis, but they have different implications.

When the home firms get more optimistic about the success in the future, they produce more, and obviously the interest rate policy allows them to

borrow more to support their bigger production plans. If a bad state occurs, then the home firm could get bigger losses.

When a firm gets a loss due to a temporary downturn of the economy or deterioration of the conditions in the rest of the world, in normal cases, the firm can borrow from a financial intermediary such as a bank for a loan to cover the loss so that it can continue to produce. If the probability of good state is known, and if the firm invest and calculate the expected profit based on this probability, then after a large number of periods of production, the firm could expect to get a (discounted) net profit equal to the expected profit in each period.[19]

However, the last conclusion depends on one important assumption: the firm can continue to borrow money to cover bad-state loans. There are cases in which the firm could not get additional loans from the banks. For example, the firm has borrowed a lot and is asking for a big loan. Alternatively, the banks may be under their own liquidity problems.

We explained in the previous section that home firms can have bigger losses in bad states if they get more optimistic over time and are increasing their production. From the seventies to the early nineties, the economy of South Korea has been growing nearly without interruption. This unprecedented long periods of high growth has caused local firms to become higher optimistic. On top of this, herd behavior could lead to even more optimism, encouraging firms to expand faster and produce more than what they should have. When bad states came, many of them got into big troubles. In particular, when the losses became too big, and the losses accumulated, the firms could have difficulty in getting additional loans from the banks.

The liquidity problems do have spillover effects. When firms in one industry get into trouble and borrow heavily from banks, or if some of them fail and cannot pay back the debts, this lowers the availability of funds to the firms in other industries. If the good states for different industries have zero correlation, then the liquidity pressure on local banks will be less. However, in the nineties, many of the targeted industries in South Korea were facing hardship at the same time: overvalued exchange rate, declining foreign demand, rise of competitors in other Asian countries, and so on. Thus the losses in one industry were translated into troubles for firms in other industries. To put it in an alternative way, we can then say that if a firm fails, it

[19] We assume that either the home firm does not discount future profits or the good-state and bad-state market prices increase at a rate equal to the interest rate.

is its own problem, but if a large number of firms fail at the same time, it is the economy's problem — it is everyone's problem.[20]

Could this problem disappear if the government chooses to bailout the failing firms? The answer is no. We explained earlier that availability of government bailout will encourage local firms to over-borrow, over-invest, and over-produce. This will make the problem much bigger should one arise. Moreover, bailouts are only transfer of funds from the government (or other parts of economy) to the failing firms, i.e., losses of these firms shift to other parts of the economy. The economy as a whole still experience losses; the trouble does not go away.

7 Concluding Remarks

The industrial policy analyzed in this paper has widely been regarded as a positive factor of the rapid growth of the South Korean economy. However, we argued that it has the often neglected effect that it encourages local firms to be over-optimistic, and to over-borrow and over-invest. Coupled with the implicit and explicit assurance of the government for bailing out troubled firms on the one hand, and the presence of herd behavior among many firms, managers tend to be too willing to take too risky projects. Such aggressiveness can enhance the growth of the economy if good times occur. However, the policy unavoidably enlarges the troubles the firms would face should bad times come. The trouble is that the profits of many of the firms depend on many common factors so that they are highly correlated, and with high concentration in most of the pretigious industries in South Korea, many firms did face problems in the second half of the nineties. When the problems of these firms accumulated and multiplied, they became the problems of other sectors, such as banks, and eventually those of the economy.

It is of course true that the recent financial crisis in South Korea is due to many factors. Therefore one can hardly find a single, simple theory that can be used to fully explain various causes and effects of the crisis. It is not the purpose of this paper to develop such a theory. Rather, the purpose of this

[20]The recent collapse of the Daewoo Group caused lots of damage to local banks. It was reported that South Korea's banks posted a combined loss of 4.99 trillion won ($4.43 billion) for 1999. This is already down from the figure posted one year earlier, when the 16 commercial banks posted losses of 11.06 trillion won. (*Wall Street Journal*, March 3, 2000)

paper is to analyze the interest-rate subsidy policy that has been imposed from the sixties and try to explain how it may be a factor in the recent financial crisis. At the same time, we do not deny that there exists many other factors, some internal and some external, that may have contributed to the financial crisis. For example, while we argued that local firms may have the herd behavior and tend to borrow too much, foreign banks and financial intermediaries may also have herd behavior and lend too much to the Korean banks and firms.

Should the government abolish these industrial policies? This is a question too broad and too complicated to be answered in the present paper. We recognize the contribution of these policies to the recent growth and development of the Korean economy. It is in fact difficult to imagine what the economy might become should there be no such policies in the past decades. What we tried to do in this paper is to bring out some of the often neglected shortcomings of these policies and point out that these policies could be some of the factors of the financial crisis. To evaluate these policies, one has to consider both their contributions and their shortcomings.

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