Government vs. Private Control, Political Loans, and the Privatization of Korean Banks

Jaewook An\textsuperscript{a}, Sang Kun Bae\textsuperscript{b}, Ronald A. Ratti\textsuperscript{c}

\textsuperscript{a}Department of Economics, Kyung Hee University, Seoul, Korea 130-701
\textsuperscript{b}Korea Economic Research Institute, Seoul, Korea
\textsuperscript{c}Department of Economics, University of Missouri, Columbia, MO 65211, USA

ABSTRACT

This paper compares the performance of banks with and without effective government control in appointment of chief operating officers in Korea using panel data. A privatization program succeeded in spreading ownership of banks widely among the public. Government retention of an ownership stake in an institution meant \textit{de facto} control by government, decision-making subject to political objectives, and lack of government respect for investors' property rights following privatization. A model is presented in which political loans are a constraint on banks subject to government control. It is found that banks controlled by government, despite charging lower loan rates, experienced disproportionately bad loan performance, and were inefficient compared to privately controlled banks.

\textit{JEL classification:} G 21; G 28

\textit{Keywords:} Government control, bank privatization, political loans

\footnote{The authors wish to thank to J. Huston McCulloch, Paul Evans and Hyun Park for helpful comments. An earlier version of the paper has been presented at the Korea Law and Economics Association Monthly Meeting, the Korea Economics Association Annual Meeting in Seoul on February 15, 2001, and the Korea Econometric Society Annual Meeting in Seoul on June 15, 2001. We thank participants in these seminars for thoughtful comment.}

\footnote{Corresponding author. Tel.: 573-882-6474; fax: 573-882-2697. \textit{E-mail address:} rattir@missouri.edu}
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There has been a spread of privatization programs, whereby state owned enterprises are sold by government to agents in the private sector, in recent years. In their review of the growing literature on this issue, Megginson and Netter (2001) find that privatization has for the most part been successful. Kikeri et al. (1992), Galal et al. (1994), and Megginson et al. (1994) report that many newly privatized firms become more efficient. These and other authors carefully document the circumstances under which the sale of assets to private economic agents will result in firms becoming more efficient and profitable.

The objective in this paper is to present evidence on the performance in Korea of banks privatized, but controlled *de facto* by government, and on the performance of privately owned and managed banks using panel data from 1987 to 1997. Prior to 1980 commercial banks had been state owned in Korea, and bank lending was an instrument of industrial policy by directing scare funds to priority projects considered highly productive. Proponents of state ownership of banks could also argue that this helped overcome market failures due to information asymmetry.

Starting in the early 1980s a privatization program intended to bring market orientated

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1 Frydman et al. (1999) and Jones and Mygind (1999) show that privatizations have limited success (in transition economies) when there has been an overhang of worker and managerial ownership.
2 There has been recent interest on the issue of the relative efficiency of privately controlled and government controlled banks. La Porta et al. (2000) finds that government ownership of banks retards financial and economic development in an analysis of large banks in 92 countries. Barth et al. (2000) report that greater state ownership of banks across 60 countries tends to be associated with less developed banks and poorly functioning financial systems.
3 In Korea’s experience, the industrial policies of the 1960s that favored chemical and heavy industry seriously misallocated real and financial resources. These policies created overcapacity in those industries and denied resources to medium and small businesses.
4 Arguments about market failure are not firmly established. Rolnick and Weber (1984) found no evidence of any contagion effects from bank runs during the "free-banking" era (1837-1860) in the U.S. In a review of the national banking era (1863-1913), Kaufman (1988) demonstrated that evidence of contagions in the panics of 1878, 1893, and 1908 is weak except for 1893. Wicker (1980) found that the contagion effects had been limited regionally during the "Great Contraction" of 1930-1933, and that prior to 1932 runs were confined for the most part to banks suffering from pre-run insolvency or to banks affiliated with insolvent firms.
decision making to the financial sector succeeded in spreading ownership of banks widely among members of the public. The intent of the privatization program was undermined, however, by a restriction on ownership meant to prevent domination of banks by chaebol business groups, since those institutions in which government retained an ownership stake (with no major shareholders from the private sector) continued to be effectively controlled by government, in that government determined the appointment (and decisions regarding retention) of chief operating officers at these banks. This situation of overwhelming (but widely dispersed) private ownership and strong government influence raises potentially important issues about efficient decision making, since top managers at these institutions owe their positions and prospects for further advancement to the government. Government influence over decisions on loans and bank resources could result in outcomes adverse to the interests of bank shareholders, and ultimately the general public through implicit guarantee of security of deposits. Those institutions free of a government stake or with foreign investors as major shareholders (interestingly, ownership restrictions did not apply to foreigners) were controlled by the private sector.

The simultaneous existence of privately controlled banks and banks subject to government control of the appointment of chief operating officers allows us to directly compare their performance. It is argued that banks effectively controlled by government are more likely to make loans for political reasons or in line with broad public policy issues, and that this will raise costs. A model is presented in which political loans are a constraint on banks effectively controlled by government. The data suggest that despite higher loan rates at privately

5 Clark and Cull (2001) argue that the means whereby privatization is achieved is important in determining the outcome of privatization. They present a model of the incentives faced by government and private investors in setting the parameters for privatization.

6 Altunas et al. (2001) finds that state-owned banks are somewhat more efficient than private banks in Germany. Our results by type of control apply with regard to privatization in Korea and the way in which government operates in Korea. Laeven (1999) does not directly compare the efficiency of privately owned versus government owned banks, but shows that family owned and company-owned banks in East Asia took on more risk than foreign-owned banks. For banks in the U.S., Spong et al. (1995) and Sullivan and Spong (1998) find active involvement by major shareholders to be characteristic of efficient banks. The absence of major shareholders in some of the banks in Korea may have contributed to their relative inefficiency.
controlled banks, and the increased potential for greater adverse selection in the awarding of loans, the ratio of bad loans to total loans is much smaller at privately controlled banks than at government controlled banks. In empirical work we find that banks subject to government control in the appointment of chief operating officer have statistically significantly higher costs and lower profits than privately controlled banks.

The work in this paper is related to the literature on ownership issues, in that management at banks controlled by government is not subject to capital market discipline. This is not because of exclusive public ownership, but because following privatization government retained control of career paths of top management and performance was evaluated on criteria besides efficiency.\footnote{Public choice theory suggests that the public sector performs less efficiently than the private sector (see Buchanan and Tullock (1962), Niskanen (1975), and Shapiro (1975)). In contrast, Liebenstein (1966) argues that monopolies are likely to be X-inefficient, regardless of ownership. De Alessi (1983) criticizes Leibenstein’s X-inefficiency argument. Boardman and Vining (1989) provide comprehensive discussion of these issues and a summary of empirical evidence on relative efficiency of publicly owned and private owned firms. There has also been a wider debate on the public choice model and ownership issues (including contributions by Jensen and Meckling (1976), Fama (1980), and Fama and Jensen (1983)).}

Political interference forced banks subject to government control to make loans on bases other than profit and market orientated criteria, and may well have contributed to the severity of the Korean financial crisis at the end of 1997. The experience of Korea indicates that failure on the part of government to respect investors’ property rights following privatization was a major reason for the poor performance of banks subject to government control. Following the crisis of late 1997, a massive infusion of public money has been spent on restructuring the banking sector and effective recreation of government banks. The episode of privatization during the pre-crisis period provides lessons on what to avoid in setting up an efficient market orientated banking sector.

The paper is organized as follows. Section I provides an overview of Korea banking system. Section II presents a simple bank model for economic performance that introduces political loans that require real resources as a constraint on management behavior at banks.
subject to government control. Section III discusses the estimation methodology, the panel
data, and presents the empirical results. Conclusions appear in Section IV.

I. Overview of the Korean Banking System

A few large banks with extensive branch networks dominate the commercial banking
sector in Korea. There were only five commercial banks with nation wide operations at the
After financial liberalization and restructuring starting in 1980, eleven new ‘commercial’
banks entered the sector over time and there were sixteen commercial banks with nation wide
operations at the end of 1997. These banks are listed in Table I. The eleven new banks entered
the sector at the following dates: Shinhan Bank in 1982; Koram Bank in 1983; Dongwha
Bank, Dongnam Bank, Daedong Bank, and Korea Exchange Bank in 1989; Hana Bank and
Boram Bank in 1991; Peace Bank in 1992; Kookmin Bank in 1995; and Housing Bank in
1997. The total number of domestic branches of the nationwide commercial banks amounted
to over 4,100 and held approximately 85 percent of the total assets of commercial banks in
1997 (small regional commercial banks held the balance of assets).

Prior to 1980, government owned the large nationwide commercial banks and
directed them to provide priority to strategic sectors and industries with subsidized credit.
Government appointed top bank managers, supervised the bank budget, and organized the
business activities of banks. In an attempt to move toward private sector-oriented
management of economy, financial institutions, including commercial banks, were privatized
over the period from 1981 to 1983 by selling equity to the general public. Partial privatization,
the laws governing ownership, and the gradual granting of commercial bank charters to
institutions with very different histories resulted, as we will see, in a dual system in the

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8 In the last few years the number of banks has been reduced from sixteen to ten in order to create
larger and hence more viable economic units. Boram bank has merged with Hana Bank, Commercial
bank and Hanil Bank have been merged into Hanvit Bank, and Dongwha Bank, Daedong Bank, and
Dongnam Bank have been acquired by Shinhan Bank, Kookmin Bank, and Housing Bank, respectively.
commercial banking sector in that some institutions were effectively subject to strong
government influence and some were effectively privately controlled.9

To prevent the large business groups, the *chaebols*, from owning and controlling
banks, the privatization package included a restriction on the size of a minority stake in banks.10
Thus, the large nationwide commercial banks became widely owned, with some government
entity retaining a major ownership share in many cases. Exceptions that were not owned in
part by the government or agencies of government were Hana Bank and Boram Bank, which
prior to being chartered as commercial banks had been successful investment banks.

Interestingly, ownership restrictions did not apply to foreigners. During the period of
privatization foreigners were allowed entry into the banking system, and two new nationwide
banks, Shinhan Bank and Koram Bank, were established in each of which a foreign individual
or firm was the major shareholder.11 These two banks together with Hana Bank and Boram
bank, as indicated in Table I, were effectively subject to private sector control with regard to
the selection of chief operating officers. Table I also shows the major shareholders of Korean
nationwide commercial banks as of the end of 1996. Those banks with the government or a
government agency (such as the Bank of Korea, Industrial Bank, or the Securities Market
Stabilization Fund) as a major shareholder remained subject to government control of
selection and appointment of chief operating officers.

A potential bank president is recommended by a board of non-standing directors and

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9 Unlike the finding by Clarke and Cull (1997) for privatization of banks in Argentina, economic and
fiscal crisis did not occasion steps in the privatization process, nor were the weakest banks the most
likely to be privatized.

10 In a follow up to the *Banking Act* (the privatization act) of 1980, an amendment in 1982 states that
“One stockholder and a person in a special relationship with him as determined by Presidential Decree
shall not hold or actually control more than 8/100 of the total number of the issued voting stocks of
financial institutions” (paragraph 3, Article 17). This restriction was further tightened to 4% on new
prompted the 1982 amendment.

11 An interesting additional point was that ownership by “juristic persons” of the Republic of Korea
could rise above the 8% level to a maximum given by the share owned by any foreigner. Thus, the
Daewoo and Samsung groups were allowed to match the 18.56% ownership share of Bank of America
in Koram Bank (see Table I).
approved by Financial Supervisory Commission. A board of non-standing directors is composed of those recommended by stockholder representatives (70%) and those recommended by the board of directors (30%). On the surface, the influence of the government in the selection of bank presidents would seem to be restricted. However, when government is the major shareholder, government influence is paramount in the selection:

"On June 3, the selection of presidents of banks was announced in major daily newspapers as if the reshuffling of the cabinet is announced. .... Such an announcement of the government, which stated that it wants to respect the autonomy of banks to the maximum degree, provoked a skeptical view in the banking industries that 'the will of the government to financial autonomy is doubtful.' The resistance from the banking industry was unexpectedly strong. .... Though the selection of president was a hot issue during the month of June, the intentions of the government were implemented except in Koram Bank, whatever the repercussions of the president selection were in June. This is because, among the commercial banks concerned, i.e., Seoul Bank, Foreign Exchange Bank and Koram Bank, only the Koram Bank had major shareholders as members of non-standing directors" (The Bank World, July 1997, pp. 40-41).

In summary, two types of banks, privately controlled banks (PCBs) and banks subject to government control of the appointment of chief operating officers, that we will refer to as government controlled banks (GCBs), have operated in the Korean banking system. The four banks with major shareholders from the private sector, Shinhan Bank, Koram Bank, Hana Bank, and Boram Bank, have been relatively free of government influence with regard to appointment of chief operating officers and loan decisions and will be referred to PCBs. The other twelve banks, although having substantial fractions of equity owned by the private sector as far back as 1983, continued to have government or government agencies as the largest shareholders. Since these banks have been subjected to government determination of choice of chief operating officers and thus government influence over loan decisions and

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12 Previously, instead of the board of non-standing directors, a commission for the recommendation of
other bank business, we will refer to them as GCBs. It is the contention in this paper that the difference in effective government influence between the GCBs and the PCBs has resulted in statistically significant differences in economic performance of the two groups of banks.

All commercial banks operate in the same regulatory environment and are subject to the same reserve requirements, interest rate policies, and overall restrictions on lending and asset holdings. A bank cannot lend more than 15 percent of net worth to a single person or a single corporation. Nor can it possess more than 15 percent of another company's shares. A bank cannot invest more than 10 percent of net worth in debenture or other securities and bonds with more than three years' maturity. It cannot possess real estate other than that required for business. In addition, all banks have access to the discount window of the Bank of Korea, Korea’s central bank. They are also provided with deposit insurance through the Korea Deposit Insurance Corporation. Thus, privately controlled banks and banks subject to strong government influence appear on the surface to be very similar and to be engaged in the same sorts of regular commercial bank activity.

II. The Model

We will assume that managers at PCBs maximize bank profit. Managers at GCBs in contrast, are constrained by the requirement that some loans be made to further public policy objectives of the government. This will be the source of the inefficiency of GCBs compared to PCBs.

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13 In Table 1, Dongwha Bank would seem to be an exception in that quasi government ownership is limited. Dongwha Bank was however always a government controlled bank. Unlike Hana and Boram Banks that had previously been investment banks, Dongwha was established from scratch as a commercial bank. Given the lack of background in the financial sector, Dongwha Bank relied heavily on government patronage and was always heavily influenced by government. The decisive influence of the government in appointing leadership at Dongwha was confirmed in an unfortunate episode in 1993 when the incumbent president of the bank tried to bribe a top government official to secure his reappointment as bank president. Those involved in the scandal were arrested.

14 Before the Corporation was in place in 1997, government implicitly served as deposit insurer.

15 In Laffont and Tirole (1991), public ownership allows government to pursue social goals (not just profit maximization). Here, government control of management allows the pursuit of social goals.
Privately controlled banks

Banks are assumed to invest in illiquid loans, L, and in non-interest earning cash assets, R. Loans yield a return, \( r_L \). The balance sheet is given by \( D = R + L \). It is assumed that both loans and deposits require labor inputs, but reserves do not. Reserves will be assumed to be equal to the required reserve ratio times \( D \).

We assume both labor and deposit markets are competitive, while loan market is oligopoly. Let \( w \) and \( r_D \) be the price per unit of labor, N, and the interest rate on deposit, D, respectively. Suppose that there are n banks. Then the loan market demand is given by

\[
\frac{d_i}{L_i} = a - bL, \quad a, b > 0, \quad L = L_1 + L_2 + \ldots + L_n
\]

For analytical convenience, each bank technology is assumed to exhibit constant returns with

\[
L_i = g N_i, \quad g > 0, \quad i = 1, 2, \ldots, n, \quad (2)
\]

\[
D_i = hN_i \quad h > 0, \quad i = 1, 2, \ldots, n, \quad (3)
\]

where \( N_i \) is the labor employed by \( i \) bank.

A Cournot equilibrium of the banking industry is an n-tuple of vectors \((D^*_i, L^*_i)\) such that for every \( i \), \((D^*_i, L^*_i)\) maximizes the profit of bank \( i \) (taking the volume of deposits and loans of other banks as given). In other words, for every \( i \), \((D^*_i, L^*_i)\) solves

\[
\max_{D_i, L_i} \pi_i = r_L L_i - r_D D_i - w N_i
\]

16 In Korea, there are about 5,800 nonbank depository institutions. Thus, the deposit market of Korea can be defined as competitive.
\[ \text{s.t. } L_i = g N_i \]

\[ D_i = h N_i \]

\[ r_L = a - bL, \ L = L_1 + L_2 + \ldots + L_n \]

Since both \( D_i \) and \( L_i \) are determined by the amount of labor, the maximization problem becomes one of choosing the optimal amount of labor. The first-order condition is given by:

\[
\frac{d\pi_i}{dN_i} = ag - 2bg^2 N_i - b^2 \sum_{i \neq j}^n N_j - r_D h - w = 0
\]

(5)

Solving (5) yields the optimal amount of labor

\[ N_i^* = \frac{ag - b^2 \sum_{i \neq j}^n N_j - r_D h - w}{2bg^2} \]

(6)

If firms are identical the equilibrium level of employment will be given by

\[ N_i^* = \frac{ag - r_D h - w}{(n+1)bg^2}. \]

(6')

Corresponding to employment, optimal cost and profit will be:

\[ C_i^* = r_D h N_i^* + wN_i^* \]

(7)

\[ \pi_i^* = r_L g N_i^* - r_D h N_i^* - wN_i^* \]

(8)

Equations (6'), (7), and (8) represent the employment, cost, and profit functions at
PCBs, respectively.

**Government controlled banks**

We will now modify the model to consider manager’s behavior in GCB. We will assume that managers in GCBs have to respond to government pressure to make loans for political and/or public policy reasons. It will be assumed that the level of political loans, \( L_p \), is imposed on the GCB and require labor input given by:

\[
L_p = s N_i
\]  

(9)

The objective function for a manager at a GCB reflects not only concern with profits, but also the intentions of government as follows:

\[
V_i = (1 - \mu)\pi_i + \mu L^p_i,
\]  

(10)

where \( \mu \) is the weight assigned to the provision of political loans. The managers of GCBs have a strong relationship with politically influential people and can survive and prosper even in the presence of persistent economic losses.\(^{17}\) It is assumed that under PCBs \( \mu = 0 \) and \( s = 0 \).

The maximization problem of GCB can be set out as:

\[
\max_{N_i} V_i^G = (1 - \mu)(r_L L_i - r_D D_i - w N_i) + \mu L^p_i
\]  

s.t  \( L_i = g N_i, \quad g > 0 \)

(11)

\(^{17}\) A notable example of political influence in the provision of unsound loans concerns Hanbo Steel Company. Hanbo Steel served as a harbinger of Korean financial crisis in late 1997 by defaulting on loans in early 1997. Loans to Hanbo Steel by First Bank of Korea, Chohung Bank, and Industrial Bank increased by leaps and bounds beginning in 1993. Loans by Industrial Bank showed annual rates of increase of 416.7 %, 167 %, and 176.5 % in 1994, 1995, and 1996, respectively. The amount loaned increased enormously in a short period. In the case of Chohung Bank, the loans to Hanbo Steel Company increased 700 times, from 700 million won in 1993 to 496.1 billion won at the end of 1996. Loans by First Bank of Korea showed an increase of 43 fold between the end of 1993 and the end of 1996 at which time they reached one trillion won (exceeding net worth of 820 billion won in December, 1996).
\[ L_i^n = sN_i, \quad s \geq 0 \]
\[ D_i = hN_i, \quad h > 0 \]
\[ r_L = a - bL, \quad a, b > 0, L = L_1 + L_2 + \ldots + L_n. \]

The first-order condition is:

\[
\frac{dV_G}{dN_i} = (1 - \mu)(ag - 2bg^2 N_i - bg^2 \sum_{i \neq j} N_j - r_D h - w) + \mu s = 0 \quad (12)
\]

The first three terms in the brace represent the marginal revenue from additional loans when employment is expanded. The fourth and fifth terms in the brace represent the marginal interest cost of additional deposits and the marginal cost of additional labor inputs, respectively. The last term of (12) represents the marginal benefit from politically imposed loan. The second order condition is satisfied.

Solving (12) yields employment at the GCB given by,

\[
N_i^G = \frac{ag - bg^2 \sum_{i \neq j} N_j - r_D h - w + \left( \frac{\mu}{1 - \mu} \right) s}{2bg^2} \quad (13)
\]

If firms are identical the equilibrium level of employment will be given by

\[
N_i^G = \frac{ag - r_D h - w + s}{(n + 1)bg^2} \quad (13')
\]

Corresponding to employment, the cost and profit of GCBs will be:

\[
C_i^G = r_D hN_i^G + wN_i^G \quad (14)
\]
\[
\pi_i^G = r_L g N_i^G - r_D h N_i^G - w N_i^G
\]  

(15)

To get the effect of the political loans on the cost and the profit of GCB, we take the partial derivatives of the cost and profit with respect to \( s \), respectively. This yields

\[
\frac{\partial C_i^G}{\partial s} = (r_D h + w) \frac{\partial N_i^G}{\partial s} > 0
\]

(16)

\[
\frac{\partial \pi_i^G}{\partial s} = (r_L g - r_D h - w) \frac{\partial N_i^G}{\partial s} < 0
\]

(17)

where \( r_L^* = \frac{d(r_L N_i^G)}{dN_i^G} < 0 \).

Equations (16) and (17) imply that loans made for political reasons serve to increase cost and reduce profit at GCBs.

To compare the levels of employment between GCBs and PCBs, we subtract (6) from (13), yielding

\[
N_i^G - N^* = \frac{1}{2bg^2} \left( \frac{\mu}{1 - \mu} s \right) > 0
\]

(18)

The expression on the right hand side of equation (18) is always positive. Thus, we infer that there is overemployment in GCBs.\(^\text{18}\) This overemployment in GCBs has a source: the politically imposed loans. The higher the degree of political imposition, the more labor inputs are hired. Managers in GCBs may allocate a part of labor employed in pursuing government’s objectives with maximizing the shareholders’ wealth. A comparison of cost between GCBs and PCBs is obtained by subtracting equation (7) from equation (14):

\(^\text{18}\) It is very similar to the Averch and Johnson (1962) effect such that there is overcapitalization in the firms subject to a rate of return regulation.
\[ C_i^G - C_i^* = \frac{1}{2bg^2} (r_p h + w)(\frac{\mu}{1 - \mu} s) > 0 \]  \hspace{1cm} (19)

From (19), we see that the operating costs of GCBs are larger than those of the PCBs. The profit of GCB, \( \pi_i^G \), is not the maximized profit, and thus \( \pi_i^G \) is not greater than \( \pi_i^* \).

Using general employment, cost, and profit functions, we can express this relative efficiency of PCBs over GCB, as follows:

\[ N_{PCB} (w, y, z) < N_G (w, y, z) \]  \hspace{1cm} (20)

\[ C_{PCB} (w, y, z) < C_G (w, y, z) \]  \hspace{1cm} (21)

\[ \pi_{PCB} (w, y, z) > \pi_G (w, y, z) \]  \hspace{1cm} (22)

where \( N \) is employment of each bank, \( C \) measures variable costs of each bank, \( \pi \) is the profits of each bank, \( w \) is the vector of prices of variable inputs, \( y \) is the vector of quantities of variable outputs, and \( z \) indicates a set of other variables that may affect performance. The results in equations (20), (21), and (22) that there is overemployment in GCBs and that PCBs are more efficiently operated than GCBs in terms of costs and profits follow because political loans cause deleterious effects on the bank performance.

III. Empirical Implementation

A. Data and Variables Used

Our data consist of a panel of fourteen nationwide commercial banks of different ownership types over the period 1987-97. Various issues of Bank of Korea's *Bank Management Statistics* provide annual data that extend back to 1987. The study ends with 1997 since there were mergers of a number of banks following the Asian crisis. The dual nature of the commercial bank sector as between government controlled and privately
controlled banks has also changed since 1997. Data on Kookmin Bank and Housing Bank are excluded from the study because these banks only entered into the commercial banking sector in 1995 and 1997, respectively. Several other banks entered into the commercial banking sector after 1987, but data on these banks are available from either 1989 or 1991, and for these banks the unobservable years are treated as missing observations. Thus, in the empirical work there are four privately controlled banks and ten banks subject to government control in the appointment of chief operating officer that will be referred to as government-controlled banks. These banks are identified, together with information on the availability of data, in Table I.

The variables used in the empirical work are listed and defined in Table II. The variable outputs, \( y \), include consumer loans, business loans, and securities. The variable input prices, \( w \), include the interest rates on borrowed funds (deposits) and the average wage. Interest rate costs are the average interest rate of various deposits. Summary statistics on government controlled and privately controlled banks appear in Table III. Total cost relative to assets and employees relative to assets are higher for GCBs than for PCBs. Returns on assets either including or excluding trust accounts and returns on equity of GCBs are much lower than those of PCBs.\(^{19}\)

It is particularly interesting to note that while the loan rate at PCBs, \( p_1 \), is higher than that at GCBs, the ratio of bad loans to total loans, \( B_2 \), is much smaller at PCBs than at GCBs. These differences are statistically significant at the one percent level of confidence.\(^{20}\) Thus, it seems that PCBs are able to overcome and more than eliminate the potential for increased adverse selection when charging interest on loans that are higher than loan rates at GCBs. We believe that this reflects government direction of GCBs to lend for public policy

\(^{19}\) Variables are defined in line with OECD guidelines on Financial Statements for Banks. Total cost is the summation of all costs on the statement of profit and loss. Net Profit is given by summation of all revenues minus summation of all costs on the statement of profit and loss. Thus, net profits are profits after tax, loan loss reserves, retiring allowance reserves, dividends, and internal reserves.

\(^{20}\) Sample sizes are 99 and 36 for GCBs and PCBs, respectively. A test of the null hypothesis that loan rates are equal yields a t-statistic of 3.324. A test for equality of bad loan rates at GCBs and PCBs
objectives at the expense of profit maximization. The interest rate cost of deposits is lower at PCBs than at GCBs. The narrower gap between loan and deposit rates at GCBs is undoubtedly a source of lower net profits observed at GCBs compared to PCBs.

The primary means of determining whether there are statistically significant differences in costs and profits between GCBs and PCBs will be a dummy variable, S, for type of control ($S = 1$ if GCB and $S = 0$ otherwise). The effect of political influence on bank costs, employment, and profits will also be considered. We hypothesized that at government controlled banks bad loans are greater because political influence is greater. We will use two proxy variables for the political influence variable B; the ratio of bad loans to loan loss reserves and the ratio of bad loans to total loans.\(^{21}\) We argue that loans made for political reasons are more likely to result in loan losses than loans made in line with market determination of risk and profitability. Also, if banks are involved in political loans, they may attempt to make loan loss reserves small, since they expect regulatory forbearance and benefits or some protection from government to accrue to the recipient of the political loan should there be economic difficulties. Accordingly, we assume that the ratio of bad loans to loan loss reserves is positively related to politically imposed loans.\(^{22}\)

We also use the ratio of bad loans to total loans as an auxiliary proxy for B since this ratio can be assumed to rise as loans made for political reasons increase as a fraction of total loans. It is apparent from Table III that levels of political influence indices at GCBs are much higher than those of PCBs. Estimates of cost and profit functions of banks are presented in the next section. Results will be reported for each of the proxy measures of political influence and for regressions that exclude these variables.

\(^{21}\) The ownership percentage of large shareholders would be a possible alternative proxy for B, but these data are only available from 1996.

\(^{22}\) Bad loans may result from ordinary loans as well as politically imposed loans. It would be better to identify the category of political loans directly, but it is not possible to do this with the available data.
B. Estimation Methodology

B. 1. Cost Function Estimation

To estimate the bank cost function, we employ a standard translog functional form, which is a second-order approximation of any general cost function, given by

\[
\ln C = \alpha_0 + \sum_{k=1}^{2} \alpha_k \ln y_k + \sum_{l=1}^{2} \beta_l \ln w_l + \eta_b \ln B \\
+ \frac{1}{2} \sum_{k=1}^{2} \sum_{j=1}^{2} \gamma_{kj} \ln y_k \ln y_j + \frac{1}{2} \sum_{l=1}^{2} \sum_{h=1}^{2} \delta_{lh} \ln w_l \ln w_h + \frac{1}{2} \eta_{bb} (\ln B)^2 \\
+ \sum_{k=1}^{2} \sum_{l=1}^{2} f_{kl} \ln y_k \ln w_l + \sum_{k=1}^{2} g_{kb} \ln y_k \ln B + \sum_{l=1}^{2} h_{lb} \ln w_l \ln B + dS + e,
\]

(23)

where \( S = 1 \) if GCB and \( S = 0 \) otherwise, \( e \) is an error term, and the time and bank subscripts are deleted for simplicity. Homogeneity of degree one in input prices and symmetry require that

\[
\sum_{i} \beta_i = 1, \gamma_{ij} = \gamma_{ji} (\forall k, j), \delta_{ih} = \delta_{hi} (\forall l, h), \\
\sum_{i} \delta_{ih} = 0 (\forall l), \sum_{i} f_{kl} = 0 (\forall l), \sum_{i} h_{lb} = 0 (\forall l).
\]

(24)

The cost share equations are obtained from the cost function using Shephard’s lemma as follows:

\[
C_i = \frac{\partial \ln C}{\partial \ln w_i} = \beta_i + \sum_{h=1}^{2} \delta_{ih} \ln w_h + \sum_{k=1}^{2} f_{kl} \ln y_k + h_{lb} \ln B + u_i
\]

(25)
where $u_i$ is an error term and $C_i$ is the cost share of $i$th factor of total cost. Thus, we estimate the cost function jointly with the cost share equations by the method of seemingly unrelated regressions (SUR).

The joint estimates of the cost function with the cost share equation are presented in Table IV. An estimate of equation (23) that excludes political influence variables is shown in the last column. The estimate of $d$, the coefficient of the dummy variable indicating type of control, is positive and statistically significant at five-percent level, indicating that given bank output and prices, PCBs have lower cost relative to (total assets) than GCBs. Centered $R^2$ for the estimated SUR equation is 0.37.

Estimates of equation (23) that includes the political influence variables $B_1$, bad loans/loan loss provision, and $B_2$, bad loans/total loans, are shown in the first and second columns of Table IV, respectively. Centered $R^2$ s for the estimated SUR equations with $B_1$ and $B_2$ are 0.39 and 0.51, respectively. A test of the joint hypothesis $\eta_h = \eta_{hh} = g_{1b} = g_{2b} = h_{1b} = 0$, that all terms containing either $B_1$ or $B_2$ are not jointly statistically significant in explaining cost, is rejected at the one-percent level. The test statistics for this hypothesis are $\chi^2(5) = 18.720$ and $\chi^2(5) = 47.618$ for the equations with $B_1$ and $B_2$, respectively, and the critical value at the one-percent confidence level is 15.086.

Estimates of $\eta_h$, showing the relationship between total costs and political influence indices, are positive and statistically significant at the one-percent level, implying that political influence indices significantly increase total costs of banks. The estimates of $\eta_{hh}$, the coefficient on the square of the political influence variables are also statistically significant at the one-percent level, indicating that political influence in some sense raises costs at an increasing rate.

The estimates of $d$, the coefficient of the zero or unity dummy variable indicating type of control, are positive and statistically significant at five-percent level and at one-percent level in the equations with $B_1$ and $B_2$, respectively. This implies that even allowing
for bad loans as an explanation for cost, GCBs have higher costs than PCBs.

B. 2. Bank Profit Function

To estimate the bank profit function of bank, we employ a standard translog functional form given by

\[
\ln \pi = \alpha_0 + \sum_{k=1}^{2} \alpha_k \ln p_k + \sum_{j=1}^{2} \beta_j \ln w_j + \eta_k \ln B
\]

\[
+ \frac{1}{2} \sum_{k=1}^{2} \sum_{j=1}^{2} \gamma_{kj} \ln p_k \ln p_j + \frac{1}{2} \sum_{j=1}^{2} \sum_{h=1}^{2} \delta_{kh} \ln w_i \ln w_h + \frac{1}{2} \eta_{kb} (\ln B)^2
\]

\[
+ \sum_{k=1}^{2} \sum_{l=1}^{2} g_{kl} \ln p_k \ln w_l + \sum_{k=1}^{2} h_{k} \ln p_k \ln B + \sum_{l=1}^{2} h_{l} \ln w_l \ln B + dS + e ,
\]

where \( p \) is output prices, \( S \) is a dummy variable for type of control (\( S = 1 \) if GCB and \( S = 0 \) otherwise), \( e \) is an error term, and the time and bank subscripts are deleted for simplicity. Homogeneity of degree one in input prices and symmetry require that

\[
\sum_j \beta_j = -1, \gamma_{kj} = \gamma_{jk}, \delta_{kh} = \delta_{hk}.
\]

\[
\sum_k f_{kl} + \sum_h \delta_{lh} = 0 (\forall l), \sum_k g_{kl} + \sum_l h_{lb} = 0 (\forall b).
\]

Profit share equations are obtained from the profit function using Hotelling’s lemma and Shephard’s lemma as follows:

\[
S_k = \frac{\partial \ln \pi}{\partial \ln p_k} = \alpha_k + \sum_{j=1}^{2} \gamma_{kj} \ln p_j + \sum_{l=1}^{2} f_{kl} \ln w_l + h_b \ln B + u_i ,
\]

\[
S_l = -\frac{\partial \ln \pi}{\partial \ln w_l} = \beta_l + \sum_{k=1}^{2} f_{kl} \ln p_k + \sum_{h=1}^{2} \delta_{lh} \ln w_h + h_b \ln B + u_i ,
\]

where \( u_i \) is an error term, \( S_k \) is the profit share of \( k \)th output of net profit and \( S_l \) is the profit share of \( l \)th input of net profit. Thus, we can estimate the profit function jointly with a set of input-output share equations by the method of seemingly unrelated regressions (SUR).
Joint estimates of the profit function with the profit share equations are presented in Table V. An estimate of equation (26) that excludes political influence variables is shown in the last column. The estimate of $d$ is negative and statistically significant at the one-percent level, indicating that PCBs have higher net profit than GCBs.

Estimates of equation (26) that includes the political influence variables $B_1$, bad loans/loan loss provision, and $B_2$, bad loans/total loans, are shown in the first and second columns of Table V, respectively. The estimated SUR equations with either $B_1$ and $B_2$ have centered $R^2$s of 0.25. The political influence variables are statistically significant in explaining net profit. The estimates of $\eta_b$, the coefficient of the political influence indices, are negative and statistically significant at the one-percent level, as are the estimates of $\eta_{bb}$, the coefficient of the square of political influence indices. Thus, political influence reduces profit at an increasing rate. Estimates of $d$, are negative and statistically significant at the one-percent level in both regressions including terms in $B_1$ and $B_2$. Thus, GCBs have significantly lower profit than the PCBs even after controlling for loan loses (or political influence). This implies that profit difficulties at banks controlled by government go beyond those captured by loan losses.23

IV. Conclusion

In this paper we compared the cost and profit efficiencies of privatized banks controlled by government with that of privately controlled banks in Korea using panel data for 1987-1997. Despite substantial privatization, government or government agency as a shareholder subjected most Korean banks to de facto government control, since at these banks government controlled the appointment (and decisions about retention) of the chief operating officer. This made management decision-making at these banks, referred to as government-

23 These results are robust to elimination of the 1997 observation. Thus, even prior to the Asian crisis, agency problems existed at banks controlled by government, in that profit was significantly higher at privately controlled banks.
controlled banks, subject to political objectives. On the other hand, banks owned and controlled privately were less subject to government influence. Banks subject to government control in the appointment of chief operating officer experienced disproportionately bad loan performance. The implication is that privately controlled banks dealt more effectively with adverse selection in the loan market than did government controlled banks, despite the fact that the former charged higher loan rates than the latter. Government-controlled banks cost levels are significantly higher than those at privately controlled banks. Profits at government controlled banks are statistically significantly lower than profits at privately controlled banks. It is likely that politically imposed loans resulted in a weak and unstable banking system that was a major factor in deepening the Korean financial crisis in 1997.

The evidence suggests failure by government to respect investors’ property rights following privatization was a major reason for the relatively poor performance of banks subject to government control. The allocation of loans on the basis of political considerations rather than on the basis of market determined considerations of profitability at banks subject to government control and the reluctance of government to let the market work, has roots in the Korean system of centralized political control and in restrictions on ownership of commercial banks. The results in this paper suggest that for privatization to work as intended, it is necessary for government to respect investor property rights. To this end, appointment of top management at banks should be freed from government domination. Second, regulations that shield domestic institutions from foreign competition should be eliminated. These changes would subject bank management to competition and assign them full responsibility for meeting obligations to customers and owners, and provide the best chance of ensuring that the public resources committed to restructuring the banking sector following the crisis in Korea in late 1997 lay the foundation for an efficient and market orientated banking sector.
REFERENCES


Frydman, Roman, Cheryl Gray, Mark Hessel, and Andrzej Rapaczinski, 1999, When does


Table I  
Major Share-Holders of Korean banks and Management Type

<table>
<thead>
<tr>
<th>Banks (end 1997)</th>
<th>Largest Share-Holder (%)</th>
<th>Management Type**</th>
<th>Data starts***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chohung</td>
<td>SMSF(6.65),* Taekwang Group (5.47), Korea Life Insurance (4.48)</td>
<td>GCB</td>
<td>1987</td>
</tr>
<tr>
<td>Commercial</td>
<td>SMSF(7.25),* Samsung Group (7.03), Korea Investment Trust (5.01)</td>
<td>GCB</td>
<td>1987</td>
</tr>
<tr>
<td>First</td>
<td>SMSF(7.0),* Korea Life Insurance (5.48), Samsung Group (3.96)</td>
<td>GCB</td>
<td>1987</td>
</tr>
<tr>
<td>Hanil</td>
<td>SMSF(6.96),* Korea Investment Trust (4.86), Samsung Group (4.76)</td>
<td>GCB</td>
<td>1987</td>
</tr>
<tr>
<td>Seoul</td>
<td>SMSF(7.47),* Shin Dong-A Group (4.77), Kyobo Life Insurance (2.4)</td>
<td>GCB</td>
<td>1987</td>
</tr>
<tr>
<td>Foreign Exchange</td>
<td>Bank of Korea (47.88), Korea Investment Trust (2.02), QE INT, LTD (1.94)</td>
<td>GCB</td>
<td>1989</td>
</tr>
<tr>
<td>Dongnam</td>
<td>Industrial Bank (7.60), Kookmin Bank (6.22), Korea Investment Trust (1.58)</td>
<td>GCB</td>
<td>1989</td>
</tr>
<tr>
<td>Daedong</td>
<td>Kookmin Bank (7.60), Industrial Bank (7.60), Gabul Group (1.87)</td>
<td>GCB</td>
<td>1989</td>
</tr>
<tr>
<td>Dongwha</td>
<td>Koksangun Civilian Union in Seoul (1.99), Hwanghaedo Civilian Union in Incheon (1.80), Gaesung Civilian Union in Seoul (1.69)</td>
<td>GCB</td>
<td>1989</td>
</tr>
<tr>
<td>Peace</td>
<td>Korea Harbor Transportation Service Association (7.69), Industrial Bank (7.33), Pohang Steel (7.39)</td>
<td>GCB</td>
<td>1992</td>
</tr>
<tr>
<td>Kookmin</td>
<td>Government (17.08), Korea Inestment Trust (6.24), Daehan Investment Trust (3.80)</td>
<td>GCB</td>
<td>1995</td>
</tr>
<tr>
<td>Housing</td>
<td>Government (26.32), Daehan Investment Trust (1.97), Korea Investment Trust (1.81)</td>
<td>GCB</td>
<td>1997</td>
</tr>
<tr>
<td>Shinhan</td>
<td>Japanese Korean (26.25), Daehan Investment Trust (3.92), Korea Investment Trust (3.58)</td>
<td>PCB</td>
<td>1987</td>
</tr>
<tr>
<td>Koram</td>
<td>Bank of America (18.56), Daewoo Group (18.56), Samsung Group (18.56)</td>
<td>PCB</td>
<td>1987</td>
</tr>
<tr>
<td>Hana</td>
<td>Kyobo Group (6.79), Long Term Credit Bank (6.57), Dongwon Group (5.80)</td>
<td>PCB</td>
<td>1991</td>
</tr>
<tr>
<td>Boram</td>
<td>LG Group (7.58), Doosan Group (7.46), Korong Group (5.80)</td>
<td>PCB</td>
<td>1991</td>
</tr>
</tbody>
</table>

* SMSF, Securities Market Stabilization Fund, was organized by the government in 1990 in order to stabilize the securities markets.
** GCB (PCB) indicates government (private) control in appointment of chief operating officer and hence government (privately) controlled bank.
*** The empirical study is over 1987 to 1997. Unavailable years are treated as missing observations. Kookmin and Housing Banks will be excluded because of their late establishment.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variables</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Total costs</td>
</tr>
<tr>
<td>L</td>
<td>Number of employee (excluding CEOs)</td>
</tr>
<tr>
<td>( \pi )</td>
<td>Net profit (total revenue minus total cost)</td>
</tr>
<tr>
<td>Outputs</td>
<td></td>
</tr>
<tr>
<td>( y_1 )</td>
<td>All forms of loans to customers</td>
</tr>
<tr>
<td>( y_2 )</td>
<td>Securities</td>
</tr>
<tr>
<td>Output prices</td>
<td></td>
</tr>
<tr>
<td>( p_1 )</td>
<td>Price of loans (interest revenue divided by total loan)</td>
</tr>
<tr>
<td>( p_2 )</td>
<td>Price of securities (securities revenue divided by securities)</td>
</tr>
<tr>
<td>Input prices</td>
<td></td>
</tr>
<tr>
<td>( w_1 )</td>
<td>Price of deposit (interest costs divided by total deposit)</td>
</tr>
<tr>
<td>( w_2 )</td>
<td>Price of labor (average wage to employee except CEOs)</td>
</tr>
<tr>
<td>Environment variables</td>
<td></td>
</tr>
<tr>
<td>( B_1 )</td>
<td>Ratio of bad loans to loan loss reserves as political influence index</td>
</tr>
<tr>
<td>( B_2 )</td>
<td>Ratio of bad loans to total loans as political influence index</td>
</tr>
<tr>
<td>( S )</td>
<td>Dummy for ownership type</td>
</tr>
<tr>
<td>( S = 1 )</td>
<td>if GCB</td>
</tr>
<tr>
<td>( S = 0 )</td>
<td>otherwise</td>
</tr>
</tbody>
</table>
Table III  
Statistics of Data and Major Bank Performance Indices by Ownership Type:  
1987-1997

<table>
<thead>
<tr>
<th></th>
<th>ALL Banks</th>
<th>GCB</th>
<th>PCB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. dev.</td>
<td>Mean</td>
</tr>
<tr>
<td>$C$</td>
<td>-2.725</td>
<td>0.265</td>
<td>-2.707</td>
</tr>
<tr>
<td>$L$</td>
<td>-3.154</td>
<td>0.679</td>
<td>-3.038</td>
</tr>
<tr>
<td>$\pi$</td>
<td>-5.801</td>
<td>1.050</td>
<td>-6.083</td>
</tr>
<tr>
<td>$y_1$</td>
<td>-0.241</td>
<td>0.307</td>
<td>-0.294</td>
</tr>
<tr>
<td>$y_2$</td>
<td>-1.266</td>
<td>0.331</td>
<td>-1.320</td>
</tr>
<tr>
<td>$p_1$</td>
<td>-2.606</td>
<td>0.288</td>
<td>-2.645</td>
</tr>
<tr>
<td>$p_2$</td>
<td>-3.324</td>
<td>0.549</td>
<td>-3.168</td>
</tr>
<tr>
<td>$w_1$</td>
<td>-3.303</td>
<td>0.356</td>
<td>-3.280</td>
</tr>
<tr>
<td>$w_2$</td>
<td>-1.754</td>
<td>0.317</td>
<td>-1.799</td>
</tr>
<tr>
<td>$B_1$</td>
<td>0.716</td>
<td>1.303</td>
<td>1.043</td>
</tr>
<tr>
<td>$B_2$</td>
<td>-0.057</td>
<td>1.394</td>
<td>0.429</td>
</tr>
<tr>
<td>ROAIT</td>
<td>0.319</td>
<td>0.841</td>
<td>0.116</td>
</tr>
<tr>
<td>ROAET</td>
<td>0.479</td>
<td>1.111</td>
<td>0.164</td>
</tr>
<tr>
<td>ROE</td>
<td>2.992</td>
<td>10.974</td>
<td>0.892</td>
</tr>
</tbody>
</table>

$C$ denotes log of total costs divided by total asset. $L$ denotes log of number of employee divided by total asset. $\pi$ denotes log of net profit divided by total asset. Output quantities are $y_1$, log of total loans divided by total asset, and $y_2$, log of securities divided by total asset. Output prices are $p_1$, log of interest revenue divided by total loan, and $p_2$, log of securities revenue divided by securities. Input prices are $w_1$, the log of interest costs divided by deposit, and $w_2$, the log of price of labor. Political influence indices are $B_1$, the log of ratio of bad credits to loan loss reserves, and $B_2$, log of bad credits divided by total credits. ROAIT is returns on assets including trust accounts, ROAET is returns on assets excluding trust accounts, and ROE is returns on equity.
**Table IV**

**Estimation of Bank Cost Function using Seemingly Unrelated Regressions**

Dependent Variable: Total Cost/Total Asset

* denotes significant at 10% level, ** denotes significant at 5% level, and *** denotes significant at 1% level. *t*-statistics are in parenthesis.

<table>
<thead>
<tr>
<th></th>
<th>$B_1$: Bad Loan/Loan Loss Reserve</th>
<th>$B_2$: Bad Loan/Total Credit</th>
<th>Without $B_1$ &amp; $B_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_0$</td>
<td>1.477 (2.882)**</td>
<td>2.878 (4.359)***</td>
<td>0.156 (1.239)</td>
</tr>
<tr>
<td>$\alpha_1$</td>
<td>1.275 (2.569)**</td>
<td>1.839 (2.982)***</td>
<td>0.598 (2.810)***</td>
</tr>
<tr>
<td>$\alpha_2$</td>
<td>1.494 (3.288)***</td>
<td>2.512 (4.332)***</td>
<td>0.565 (3.236)***</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>1.027 (16.260)***</td>
<td>0.916 (11.700)***</td>
<td>0.927 (26.635)***</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-0.027 (-0.432)</td>
<td>0.084 (1.074)</td>
<td>0.073 (2.112)***</td>
</tr>
<tr>
<td>$\eta_b$</td>
<td>0.335 (3.148)***</td>
<td>0.593 (5.275)***</td>
<td></td>
</tr>
<tr>
<td>$\gamma_{11}$</td>
<td>0.204 (1.196)</td>
<td>0.234 (1.258)</td>
<td>0.192 (1.314)</td>
</tr>
<tr>
<td>$\gamma_{12}$</td>
<td>0.662 (2.624)***</td>
<td>0.819 (2.815)***</td>
<td>0.336 (1.940)*</td>
</tr>
<tr>
<td>$\gamma_{22}$</td>
<td>0.394 (3.600)***</td>
<td>0.587 (4.453)***</td>
<td>0.248 (4.210)***</td>
</tr>
<tr>
<td>$\delta_{11}$</td>
<td>0.093 (16.377)***</td>
<td>0.089 (12.820)***</td>
<td>0.093 (18.557)***</td>
</tr>
<tr>
<td>$\eta_{bb}$</td>
<td>0.020 (3.506)***</td>
<td>0.030 (6.073)***</td>
<td></td>
</tr>
<tr>
<td>$f_{11}$</td>
<td>-0.019 (-0.595)</td>
<td>-0.044 (-1.282)</td>
<td>-0.064 (-2.204)**</td>
</tr>
<tr>
<td>$f_{21}$</td>
<td>0.237 (8.728)</td>
<td>0.197 (6.231)***</td>
<td>0.204 (10.989)***</td>
</tr>
<tr>
<td>$g_{lb}$</td>
<td>0.066 (1.435)</td>
<td>0.122 (2.407)***</td>
<td></td>
</tr>
<tr>
<td>$g_{2b}$</td>
<td>0.126 (2.823)***</td>
<td>0.216 (4.540)***</td>
<td></td>
</tr>
<tr>
<td>$h_{lb}$</td>
<td>0.013 (2.525)***</td>
<td>0.002 (0.328)</td>
<td></td>
</tr>
<tr>
<td>$d$</td>
<td>0.041 (2.266)***</td>
<td>0.057 (3.071)***</td>
<td>0.039 (2.288)**</td>
</tr>
<tr>
<td>Centered $R^2$</td>
<td>0.39</td>
<td>0.51</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Joint Hypothesis: $\eta_b = \eta_{bb} = g_{lb} = g_{2b} = h_{lb} = 0$

$$\chi^2(5) = 18.720*** \quad \chi^2(5) = 47.618***$$

* denotes significant at 10% level, ** denotes significant at 5% level, and *** denotes significant at 1% level. *t*-statistics are in parenthesis.
Table V
Estimation of Bank Profit Function using Seemingly Unrelated Regressions

Dependent Variable: Net Profit normalized by Total Assets.

<table>
<thead>
<tr>
<th></th>
<th>$B_1$: Bad Loan/Loan Loss Reserve</th>
<th>$B_2$: Bad Loan/Total Credit</th>
<th>Without $B_1$ &amp; $B_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_0$</td>
<td>-7.805 (-17.033)***</td>
<td>-8.683 (-13.497)***</td>
<td>-5.988 (-25.871)***</td>
</tr>
<tr>
<td>$\alpha_1$</td>
<td>0.157 (0.902)</td>
<td>0.135 (0.765)</td>
<td>0.281 (2.458)***</td>
</tr>
<tr>
<td>$\alpha_2$</td>
<td>0.065 (0.606)</td>
<td>0.001 (0.013)</td>
<td>0.263 (3.097)***</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>-0.183 (-2.402)**</td>
<td>-0.146 (-1.903)*</td>
<td>-0.344 (-7.852)***</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-0.817 (-10.711)***</td>
<td>-0.854 (-11.110)***</td>
<td>-0.656 (-14.980)***</td>
</tr>
<tr>
<td>$\eta_b$</td>
<td>-0.542 (-4.053)***</td>
<td>-0.694 (-3.899)***</td>
<td></td>
</tr>
<tr>
<td>$\gamma_{11}$</td>
<td>-0.042 (-0.666)</td>
<td>-0.043 (-0.636)</td>
<td>-0.050 (-0.892)</td>
</tr>
<tr>
<td>$\gamma_{12}$</td>
<td>0.014 (0.335)</td>
<td>-0.024 (-0.534)</td>
<td>0.059 (1.605)</td>
</tr>
<tr>
<td>$\gamma_{22}$</td>
<td>0.027 (2.287)**</td>
<td>0.024 (2.136)**</td>
<td>0.034 (3.220)***</td>
</tr>
<tr>
<td>$\delta_{11}$</td>
<td>-0.089 (-2.748)***</td>
<td>-0.094 (-2.710)***</td>
<td>-0.070 (-2.464)**</td>
</tr>
<tr>
<td>$\delta_{12}$</td>
<td>0.044 (0.895)</td>
<td>0.019 (0.368)</td>
<td>0.065 (1.460)</td>
</tr>
<tr>
<td>$\delta_{22}$</td>
<td>0.053 (1.737)*</td>
<td>0.041 (1.317)</td>
<td>0.062 (2.197)**</td>
</tr>
<tr>
<td>$\eta_{bb}$</td>
<td>-0.055 (-3.498)***</td>
<td>-0.057 (-3.520)***</td>
<td></td>
</tr>
<tr>
<td>$f_{11}$</td>
<td>0.136 (1.646)*</td>
<td>0.150 (1.672)*</td>
<td>0.110 (1.531)</td>
</tr>
<tr>
<td>$f_{12}$</td>
<td>-0.099 (-1.290)</td>
<td>-0.066 (-0.813)</td>
<td>-0.144 (-2.045)**</td>
</tr>
<tr>
<td>$f_{31}$</td>
<td>-0.002 (-0.076)</td>
<td>0.019 (0.584)</td>
<td>-0.035 (-1.289)</td>
</tr>
<tr>
<td>$f_{22}$</td>
<td>-0.051 (-1.408)</td>
<td>-0.036 (-0.995)</td>
<td>-0.045 (-1.327)</td>
</tr>
<tr>
<td>$g_{1b}$</td>
<td>-0.041 (-1.765)*</td>
<td>-0.034 (-1.660)*</td>
<td></td>
</tr>
<tr>
<td>$g_{2b}$</td>
<td>-0.031 (-3.272)***</td>
<td>-0.035 (-4.330)***</td>
<td></td>
</tr>
<tr>
<td>$h_{1b}$</td>
<td>0.035 (2.176)**</td>
<td>0.031 (2.229)**</td>
<td></td>
</tr>
<tr>
<td>$h_{2b}$</td>
<td>0.038 (2.291)**</td>
<td>0.038 (2.719)**</td>
<td></td>
</tr>
<tr>
<td>$d$</td>
<td>-0.687 (-6.400)***</td>
<td>-0.674 (-5.801)***</td>
<td>-0.775 (-7.969)***</td>
</tr>
<tr>
<td>Centered $R^2$</td>
<td>0.25</td>
<td>0.25</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Joint Hypothesis: $\eta_b = \eta_{bb} = g_{1b} = g_{2b} = h_{1b} = 0$

$\chi^2(5) = 33.066*** \quad \chi^2(5) = 39.771***$

* denotes significant at 10% level, ** denotes significant at 5% level, and *** denotes significant at 1% level. t-statistics are in parenthesis.