Comparison of Performance of Korean Regional and National Banks: 1992-2004

Kang H. Park*

Southeast Missouri State University, 1 University Plz, Cape Girardeau, MO 63701-4799, USA

Abstract: This paper compares the performance of regional banks and national banks in Korea for the period of 1992-2004 by examining how the profitability of these two groups differs, identifying major determinants of profitability for each group, and explaining their similarities and differences. Two competing hypotheses, the market power hypothesis and the efficient structure hypothesis, are tested in an integrated model. The results obtained from the panel data indicate that economic growth, efficiency, and non-performing loans are significant variables in explaining profitability for both regional and national banks. On the other hand, the exchange rate and capital ratio affect bank profitability significantly for national banks, but not for regional banks, while the inflation rate and the net interest margin are important variables only for regional banks. Market concentration has no influence on bank profitability, and the market share is a significant variable for national banks, but it shows inconclusive results for regional banks.

Keywords: Determinants of bank profitability, Korean regional and national banks.

1. INTRODUCTION

Growth of the Korean banking sector since the 1960s has coincided with rapid growth in the Korean economy. In fact, for the last twenty years the banking sector grew faster than the overall economy, as the ratio of total Korean bank assets to nominal GDP more than doubled to 13%. During this period the Korean banking sector underwent many changes including financial liberalization, financial crisis, and, most recently, restructuring. In this process, market concentration decreased as the number of banks increased due to financial deregulation prior to the Asian financial crisis of 1997. However, the concentration indices increased as the number of banks was drastically reduced after the crisis due to consolidation of banks. The Herfindahl-Hirschman index of total bank assets was 876.06 in 1992, continuously declined to 664.23 at the onset of the Asian financial crisis and then increased to 1441.16 in 2001 and then stayed at 1407.32 in 2003. This change in concentration in Korea is different from the US experience with bank consolidation. While much of the bank consolidation in the US is typically characterized by market-extension mergers which are acquisitions involving two banks in different geographical markets, bank consolidation in Korea resulted from horizontal mergers among banks with overlapping geographical markets.

Korean banks recorded positive rates of return on both assets and equity prior to the financial crisis even though financial deregulation increased competition among banks. However, the performance of Korean banks deteriorated for the first three years after the crisis, with negative rates of return on both assets and equity. Since 2001, profitability of Korean banks has turned positive after successful restructuring of the banking industry. Recent record-high earnings by two mega banks, Kookmin Bank and Woori Bank, raise a question in regard to whether such high profits are due to monopolistic market power or efficient management through consolidation. The structural reform after the crisis introduced the financial holding company system and allowed mergers among larger banks, resulting in a few mega banks. Now, the largest bank, Kookmin Bank, holds over 30% of total industry assets.

There are two types of commercial banks in Korea: national banks and regional banks. In addition to these commercial banks, several special banks funded by the government were established in the early 1960s to be operated outside of the central bank's authority and to finance government-targeted industries. Several national banks were established since Korea's independence. Regional banks were introduced in the late 1960s to stimulate regional economic development and are allowed to operate only within their own provinces, while there is no geographical restriction for national banks. Regional banks can also operate a branch in Seoul. Until the Korean government introduced a series of financial reforms in 1982, there were just five national banks due to strict regulation on entry requirements, while ten much smaller regional banks were allowed to operate. However, entry requirements were eased with bank deregulation implemented by revisions to the General Banking Act in 1982. In 1997, just before the crisis, there were sixteen national banks and ten regional banks in operation. In the course of financial restructuring in the wake of the crisis, five national banks and four regional banks were either liquidated or merged. One more national bank was merged in 2002, and there were eight national banks and six regional banks as of 2003. See Appendix 1 for the list of banks and their closures and mergers.

The purpose of this paper is to compare the performance of regional banks and national banks in Korea for the period of 1992-2004, by examining how the profitability of these

*Address correspondence to this author at the Southeast Missouri State University, 1 University Plz, Cape Girardeau, MO 63701-4799, USA; Tel: 573-651-2942; Fax: 573-651-2947;
E-mails: khpark@semo.edu, khpark46@gmail.com

1874-9151/09

two groups differs, identifying major determinants of profitability for each group, and explaining their similarities and differences. Why Korean regional banks? Although there are many studies on either regional banks or Korean banks, no study has been done on Korean regional banks to our knowledge. Furthermore, this study on performance of the Korean banking industry is worthwhile because no other countries experienced both a major financial crisis and a drastic restructuring after the crisis in such a short time period.

Why do we distinguish regional banks from national banks? It is necessary to evaluate regional banks and national banks separately because they are different in size, in their permitted markets, and in their client bases. We will also consider how the financial crisis and consolidation binge after the crisis affected bank performance of both types of banks. Section 2 reviews previous studies on Korean banks. Section 3 presents a brief discussion of a structural model and an integrated equation in the reduced form to test competing hypotheses. The data, the variables, and descriptive statistics are also described in this section. Section 4 presents estimated results and their interpretation. In the last section we offer a summary of our work and draw conclusions.

2. REVIEW OF PREVIOUS STUDIES ON KOREAN BANKS AND REGIONAL BANKS

There are many studies on productivity and efficiency of Korean banks, but only a few studies on profitability of Korean banks. Gilbert and Wilson [1] investigated the effects of privatization and deregulation on the productivity of Korean banks over the period 1980-1994. Using Malmquist indexes, they decomposed productivity change into changes in technical efficiency and changes in technology. They found that Korean banks dramatically changed their mix of inputs and outputs while they were privatized and deregulated during the 1980s and early 1990s. They also concluded that privatization and deregulation enhanced potential output, as well as productivity, among Korean banks by measuring technological change from the perspective of the new mix of inputs and outputs.

Hao, Hunter, and Yang [2] extended the analysis of Gilbert and Wilson [1] in order to identify the key determinants of the efficiency gains. Using the stochastic cost frontier approach, they computed efficiency scores for a sample of nine national banks and 10 regional banks for the period 1985-1995. These efficiency scores were then regressed on several independent variables in order to identify the key determinants of the efficiency gains. Banks with higher rates of asset growth, fewer employees per million won of assets, larger amounts of core deposits, lower expense ratios, and classification as a national bank were found to be more efficient. However, they found that financial deregulation in 1991 had little or no significant effect on the level of the sample banks' efficiency.

Park and Weber [3] estimated Korean bank inefficiency and productivity change for the period from 1992 to 2002, using a directional technology distance function. They controlled for loan losses that are an undesirable by-product that arises from producing loans, and their method allowed the aggregation of individual bank inefficiency and productivity growth to the industry level. They showed that technical progress during the period was more than enough to offset efficiency declines so that the banking industry experienced productivity growth.

Jeon and Miller [4] analyzed the effect of the Asian financial crisis on the performance of Korean national banks for the period of 1991-1999, by regressing returns on assets and equity on the balance sheet and income statement information and macroeconomic variables. They found the equity ratio correlated positively with bank performance, even when the government recapitalized a number of banks that performed poorly. However, their study of the effect of the crisis on bank performance is limited to the first two years after the crisis. In this study, we extend the period to 2004 to include the recovery period and we also distinguish performance of regional banks from that of national banks. Park and Weber [5] studied profitability of Korean commercial banks for the period of 1992-2002. They found that bank efficiency has a significant effect on bank profitability while the effect of market power on profitability is insignificant. They also found that the major determinants of bank profitability in Korea changed between pre- and post-Asian financial crisis periods. Their study included both regional and national banks, but did not differentiate between them.

There have been several studies on regional banks in the U.S; Dunham [6], Amos [7], Bias [8], Chu [9], Chakravarty [10], Kwan [11], Coccorese [12], Hahn [13], Feinberg [14] and Gonzalez [15]. More recently, studies on regional banks have been extended to Europe, Australia, and Japan. Williams and Gardener [16] estimated efficiency of European regional banking, and Neal [17] found that regional banks in Australia were less efficient than other bank types. Koeppl and MacGee [18] found that compared to regional banks that are linked through well-functioning interbank markets, broad banks lead to higher levels of aggregate investment, higher output, and less fluctuations within regions. Japanese regional banks have been analyzed in terms of their efficiency, geographical segmentation, and level of competition. Drake and Hall [19] found that larger (city) banks have limited opportunity to gain from eliminating X-inefficiencies because they operate above the minimum efficient scale while that is not the case for regional banks. Kano and Tsutsui [20] concluded that the markets for regional banks are not segregated by examining whether the demand and supply factors of each region have an effect on the interest rates of that region. Uchida and Tsutsui [21] reported that competition among city (national) banks was stronger than among regional banks. Choe [22] explained how the political economy of financing small and medium enterprises contributed to Japan's regional bank problems. Hahn [13] compared efficiency of regional banks in Europe, Japan and USA to find a best-practice method. However, there have been no studies comparing regional and national banks in Korea to our knowledge, and the purpose of this paper is to shed light on their similarities and differences in performance.

3. MODEL, DATA AND VARIABLES

According to the market power hypothesis, profits are mainly determined by market power. There are two variants under the market power model. The collusion hypothesis states that the degree of market concentration is an important

exogenous variable in determining profits while market share is the major determinant of profits according to the relative market power hypothesis. Shepherd [23] and Kurtz and Rhoades [24] argued that the significance of market share supports the relative market power hypothesis. This model does not exclude the effects of X-efficiency or scale-efficiency on profitability through their inclusion as a control variable. However, supporters of the market power hypothesis argue that market structure or market power has greater influence on profitability than efficiency. The theory of contestable markets proposed by Baumol, *et al.* [25] indicates that the performance of firms does not depend on market concentration.

The proponents of the efficient structure hypothesis also used market share as an intermediary variable between efficiency and profit because of the difficulty of measuring efficiency, and argued that the significance of market share supports their hypothesis; Smirlock [26], Evanoff and Fortier [27], and Molyneux and Forbes [28]. According to the efficient structure model, a positive relationship between market share and profit is a spurious effect because both market share and profit are affected by efficiency. In the past, market share was used to support both the market power hypothesis and the efficient structure hypothesis. To resolve this issue, more recent studies have applied several direct measures of efficiency in determining bank profitability; Berger [29], Maudos [30], Park and Weber [5].

In order to test these different hypotheses, it is necessary to develop a model that nests these two hypotheses. Berger [29] constructed a structural model that can be tested for the above two hypotheses. Park and Weber [5] used a similar model to estimate profitability of Korean commercial banks without distinguishing between national and regional banks. The reduced-form equation for profits can be derived from either the structural models of Berger [29] or Park and Weber [5] as

$$\pi_{it} = f(P_{it}, EFF_{it,} MS_{it,} HHI_t, Z_{it}) + \varepsilon_{it} \quad (1)$$

where π_{it} is a measure of profitability of bank $_i$ at time $_t$, P is a vector of output prices, and EFF is a measure of efficiency, either X-efficiency or scale efficiency depending on the version of the efficient structure hypothesis used. MS represents market share while HHI (Herfindahl-Hirschman index) represents market concentration ratio. Z is a vector of control variables and ε is a random error term.

One specific variable is important while the other explanatory variables are irrelevant, depending on the hypothesis adopted. Under the collusion version of the market power hypothesis, HHI is expected to be statistically significant and have a positive sign. Under the relative market power hypothesis, MS is expected to have a statistically significant and positive effect on profitability. Under the efficient structure hypothesis, EFF, whether X-efficiency or scale efficiency, should be statistically significant while the other variables are irrelevant. Under this hypothesis, MS, in the absence of EFF, may have a spurious effect on profitability because MS is a mediating variable through which effects of EFF are transmitted to profitability. However, MS should be statistically insignificant when EFF is included in the model. This reduced-form equation allows for the validity of more than one hypothesis.

The data in this study are from *Bank Management Statistics* and *Economic Statistics* by the Bank of Korea, and financial statements of individual banks. We use panel data including all national banks and regional banks in operation in any year from 1992 to 2003. As the Korean banking sector went through financial liberalization in the early 1990s, the number of Korean banks rose during this period. At the beginning of the sample period, there were fourteen national banks and ten regional banks. Just before the crisis, twenty-six commercial banks were in existence with the addition of two more national banks. However, the number has continuously declined since the financial crisis of 1997-1998 due to bank closures and consolidation of existing banks through mergers and acquisitions. The number of commercial banks declined from its peak of 26 just prior to the crisis to 17 in 1999 and further down to 14 in 2002. There are now only six regional banks and eight national banks of which two are mega banks emerging from the consolidation of several existing banks.

As a dependent variable representing profits, two variables are used: ROA, the ratio of net after-tax income to assets, and ROE, the ratio of net after-tax income to equity. Explanatory variables are categorized into four different types: market power variables, efficiency variables, bank-specific control variables, and macroeconomic control variables. Two variables are used to represent the market power variable. Market share, MS, is the bank's share of total industry assets. The degree of market concentration (HHI) is measured by the sum of the squares of each bank's market share in total industry assets ($HHI = \Sigma MS_i^2$).

Both parametric and non-parametric approaches have been used in the literature to measure efficiency or inefficiency. In this study we use Data Envelope Analysis (DEA) to estimate the directional technology distance function and use technical inefficiency (T-INEFF) derived from the distance function as X-inefficiency. T-INEFF is used in the regression models to explain bank profitability. See Appendix 2 for a description of the directional technology distance function used in this study and the T-INEFF estimates derived from this distance function. Alternatively, a simple, though rudimentary, approach is to approximate cost inefficiency directly from the financial statements of each bank. We use three alternative proxies for operating inefficiency: EXP/A equals the operating expenses relative to total assets, EXP/W equals the operating expenses per worker, and EXP/B equals the operating expenses per branch.

The following three variables are used as bank-specific control variables. First, the equity ratio is used to capture the impact of capital ratio on banking performance. According to the signal theory (See Berger [29]), banks that expect to have better performance credibly transmit this information through a higher equity ratio. Thus, a positive relation of equity to profitability is expected. Instead of using a simple ratio of equity capital to total assets, we use BIS capital ratio (BIS), the risk-adjusted capital ratio calculated according to the Bank of International Settlements guideline, which assigns varying risk weights to different types of assets. Second, the variable P (output price) in the model is measured by MARGIN, the net interest margin, which is the difference between the interest rates on loans and securities and the interest rates on deposits

and borrowings. This variable is estimated by the average earnings on assets minus the average interest expenses on assets. Third, NPLSHARE, which represents non-performing loans as a percentage of total loans, is used to capture the impact of the quality of assets resulting from the deficiency in credit risk management. This variable is included because loans are the major type of earning asset, even though their significance diminished over time with weakening financial intermediary function of banks.

In order to see the effects of overall economic conditions on bank performance, we include several macroeconomic control variables in the model. They are the rate of real GDP growth (DGDP), the rate of inflation (INFLA) which is measured by the rate of change in the consumer price index, the rate of unemployment (UNEMP), and the rate of depreciation of the Korean currency, Won (EX). For regional banks, the rate of real regional GDP growth (DRGDP) is used instead of DGDP. The last macroeconomic control variable is a dummy variable, CRISIS, defined as 1 for the

Table 1. Descriptive Statistics

Group	Variable	N	Minimum	Maximum	Mean	Std. Deviation
National	ROA	155	-9.59	1.89	-.223	1.758
	ROE	155	-567.64	33.03	-8.264	55.212
	ASSETS	156	6537	2148219	400056.96	372256.301
	WORKERS	156	573	19185	5521.18	3807.036
	BRANCHES	156	14	1185	308.96	218.838
	BIS	154	-2.70	26.12	9.7532	3.346
	NPLSHARE	156	0.100	20.400	4.794	3.848
	MARGIN	156	-1.880	2.350	1.241	.618
	MS	156	0.033	29.478	7.476	5.086
	LOANAST	156	.088	.655	.444	.079
	DEPOAST	156	.521	.839	.687	.061
	EXP/W	156	.298	14.754	5.529	3.881
	EXP/B	156	12.214	237.509	90.339	54.748
	EXP/A	156	.026	.221	.074	.036
	T-INEFF	156	.00	1.21	.077	.159
Regional	ROA	104	-10.19	1.48	-.365	2.283
	ROE	104	-595.79	34.20	-12.363	72.078
	ASSETS	104	7100	197021	62890.04	47168.555
	WORKERS	104	246	3385	1566.88	842.287
	BRANCHES	104	29	207	111.24	54.254
	BIS	104	-10.65	32.16	12.435	5.460
	NPLSHARE	104	1.100	24.600	5.242	4.654
	MARGIN	104	-0.44	3.540	2.216	0.562
	MS	104	.225	2.61	1.287	.742
	LOANAST	104	.334	.691	.456	.073
	DEPOAST	104	.543	.820	.736	.050
	EXP/W	104	.861	10.394	3.479	2.347
	EXP/B	104	14.143	114.794	42.728	21.592
	EXP/A	104	.0232	.234	.084	.039
	T-INEFF	104	.00	.16	.016	.030

This data is for both banking and trust businesses. The data for banking business only are also available and are used for regression results in Table **4**. The average mean value of ROA and ROE excluding the crisis period of 1997-2000 are 0.578% and 9.1% respectively.
ROA: ratio of net after-tax income to total assets (in %).
ROE: ratio of net after-tax income to equity capital (in %).
ASSETS: total assets in 100 million Korean Won.
BIS: the risk-adjusted capital ratio calculated according to the BIS guideline (in %).
NPLSHARE: non-performing loans as a percentage of total loans (in %).
MARGIN: net interest margin, the average interest earning on assets minus the average interest expenses on assets (in %).
MS: share of a bank in total industry assets (in %).
LOANAST: the ratio of total loans to total assets.
DEPOAST: the ratio of total deposits to total assets.
EXP/W: operating expenses per employee in 100 million Korean Won.
EXP/B: operating expenses per branch in 100 million Korean Won.
EXP/A: the ratio of operating expenses relative to total assets.
T-INEFF: technical inefficiency derived from a directional technology distance function in Appendix 2.

crisis period of 1997-2000 and 0 otherwise. Most Korean banks had negative rates of return on both assets and equity during 1997-2000. Thus, this period is treated as a crisis period. When only two years of 1998-1999 with more serious financial trouble are used as a crisis period, the estimation results are similar.

This variable is used to capture the impact of disequilibrium during the crisis period.

Descriptive statistics for national banks and regional banks respectively are provided in Table **1**. National banks, on average, are 6.5 times larger than regional banks in their assets and 3-4 times larger in their number of workers and branches. On average, there is not much difference between national and regional banks in NPLSHARE, the ratios of total loans to total assets (LOANAST), the ratio of total deposits to total assets (DEPOAST), and the ratio of operating expenses to total assets (EXP/A). However, regional banks tend to maintain higher MARGIN and BIS than national banks. On the other hand, national banks tend to have higher operating expenses per worker or branch (EXP/W or EXP/B).

Table **2** shows the number of banks, ROA, ROE, and NPLSHARE for both national and regional banks over 1992-2004. Until 1997 both national and regional banks had positive rates of return, even though the rates had declined with increasing competition among banks, resulting from financial liberalization. However, the financial crisis of 1997-1998 negatively affected both ROA and ROE until 2000. With successful restructuring, both national and regional banks recovered and kept positive rates of return since 2001. A poor, though positive, rate of return for national banks in 2003 was mainly due to high default rates of consumer and credit-card loans exacerbated by excessive competition among national banks during the recovery period. Regional banks, being small, were not deeply involved in extensive credit-card loans and performed well in 2003. National banks as well as regional banks achieved record-high rates of return in 2004. Market concentration (HHI) decreased continuously until 1997 as financial liberalization in the early 1990s allowed easy entry of new banks. However, this index has increased since the crisis of 1997-1998 as consolidation through mergers and acquisitions occurred in response to the pro-merger policy of the Korean government, which is a part of its restructuring policy.

4. EMPIRICAL RESULTS

In the estimation of panel data, application of ordinary multiple regression techniques may result in omitted variable bias. Hsiao [31] demonstrated that pooled OLS results in biased and inconsistent coefficient estimates because omitted cross-section-specific variables may be correlated with the explanatory variables. Use of either a fixed-effects model or a random-effects model can solve this problem. A fixed-effects model is commonly used to control for omitted variables that differ between banks but are constant over time while a random-effects model is used to control for some bank-variant omitted variables and other time-variant omitted variables. In the absence of prior knowledge about omitted variables, we estimate both models and run the Hausman test comparing fixed effects *vs* random effects. Based on the Hausman test, we report the fixed-effects model only in the following tables. The Hausman test is done to check whether a more efficient random-effects model can also give results as consistent as the fixed-effects model. The test results indicate significant p-value, leading to the rejection of the null hypothesis for models 1-6 in Table **3**. The results support the claim by Hsiao [19] that the fixed effects model is usually regarded as more appropriate when population data are used. All Korean national banks as well as regional banks are included in our panel data. However, there is no qualitative difference between the estimates by the two models.

Tables **3** and **4** present the estimation results of Equation (1), using ROA from both banking and trust businesses as the dependent variable. While Table **3** reports the estimation results for national banks, Table **4** reports the estimation results for regional banks. The estimation results of Equation (1), using ROA from banking business only as the dependent variable, are shown in Appendix 3. The variables of four

Table 2. Average Rates of ROA, ROE and NPLSHARE (in %)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
# of Banks													
National	14	14	14	15	15	16	13	11	11	9	8	8	8
Regional	10	10	10	10	10	10	8	6	6	6	6	6	6
ROA													
National	0.54	0.41	0.40	0.28	0.23	-0.9	-2.99	-1.42	-0.53	0.79	0.56	0.07	0.89
Regional	0.68	0.67	0.53	0.56	0.47	-1.17	-5.83	-0.11	-1.07	0.41	0.90	0.75	0.8
ROE													
National	6.88	5.80	6.17	3.91	3.49	-14.09	-48.63	-24.73	-10.81	16.3	10.95	1.50	18.23
Regional	5.87	6.36	5.73	5.63	5.41	-14.77	-87.4	-2.28	-26.14	10.72	20.03	15.58	15.22
Non-Performing Loan Share													
National	6.6	6.4	6.2	5.3	4.1	5.5	7.2	8.4	6.6	2.9	2.0	2.2	1.7
Regional	3.7	3.9	3.7	4.0	4.0	10.1	9.1	7.1	6.5	2.7	1.7	1.7	1.6

Table 3. Panel Regression Results for Both Banking and Trust Businesses [Dependent Variable: ROA, Sample: National Banks (N=154)]

Category	Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Macro Variables	DGDP	0.160** (3.125)	0.210** (5.280)	0.231** (4.458)	0.133** (2.922)	0.154** (2.718)	0.181** (3.387)	0.282** (4.385)
	INFLA	-0.248 (-1.886)	-0.047 (-0.460)	0.011 (0.074)	0.052 (0.432)	-0.004 (-0.028)	0.005 (0.037)	-0.021 (-0.143)
	EX	0.054* (2.149)	0.056** (2.883)	0.056** (2.955)	0.033* (2.013)	0.037 (1.910)	0.044* (2.320)	0.080** (3.341)
	CRISIS	-2.069** (-6.229)	-0.759** (-2.700)	-0.558 (-1.451)	0.509 (1.447)	0.040 (0.095)	-0.103 (-0.254)	-0.441 (-1.113)
Bank Variables	BIS		0.147** (4.660)	0.159** (5.029)	0.151** (5.692)	0.149** (4.821)	0.155** (5.040)	0.169** (5.963)
	MARGIN		0.450** (2.712)	0.221 (1.213)	0.038 (0.247)	0.081 (0.441)	0.105 (0.577)	0.141 (0.686)
	NPLSHARE		-0.164** (-5.959)	-0.182** (-6.570)	-0.061* (-2.162)	-0.187** (-6.936)	-0.185** (-6.836)	-0.177** (-5.963)
Market Power	MS			0.056** (2.750)	0.041* (2.355)	0.059** (2.983)	0.075** (3.577)	0.088** (3.445)
	HHI			0.001 (0.066)	0.001 (1.946)	0.001 (1.543)	0.001 (0.928)	0.001 (0.034)
Efficiency	EXP/A				-29.790** (-7.767)			
	EXP/W					-0.136** (-3.037)		
	EXP/B						-0.007** (-2.872)	
	T-INEFF							-1.426* (2.000)
R^2		0.355	0.642	0.660	0.761	0.731	0.729	0.715
F		20.680	37.336	31.086	45.535	41.498	40.210	38.214

1. Estimation results of the fixed-effects model. The coefficients of the constant under the fixed-effects model are not reported here.
2. t values are shown in parentheses. * and ** indicate significance at the 5% and 1% levels respectively.

categories-- macroeconomic variables, bank-specific variables, market power variables, and efficiency variables-- are entered into the model. In order to see how much extra variance is explained by gradual addition of each category, we added the bank-specific control variables, the market power variables, and then the efficiency variables successively to a baseline specification with macro variables, moving from model (1) through model (7). In Appendix 3, only model (4) through model (7) are presented. Each of the inefficiency variables enters into the model one by one because of the presence of high correlations among the four inefficiency variables. When ROE instead of ROA is used as the dependent variable, similar results with less significance are obtained and are not reported here. Overall, there is a better fit of the model for regional banks than national banks.

Among the macroeconomic variables considered, the rate of unemployment (UNEMP) was deleted due to its high correlation with the rate of economic growth. DGDP (or DRGDP) has a statistically significant positive effect on ROA for both national and regional banks. While EX has a statistically significant effect for national banks, it has no influence on ROA of regional banks. Regional banks have a small amount of loans or deposits in dollars and are involved in the minimal level of foreign exchange transactions. INFLA is not significant for national banks, but affects profitability of regional banks negatively. The dummy variable, CRISIS, is statistically significant when macro and bank variables are present. However, with inclusion of the market power variables and particularly the efficiency variables in the model, it becomes insignificant.

Now we turn to the three bank-specific control variables included in the model. First, BIS exhibits a significant positive effect on profitability of national banks, but is insignificant for profitability of regional banks. A higher equity ratio might reduce the portfolio risk along with the expected costs of financial trouble, thereby increasing confidence among bank customers, leading to higher profitability. This empirical finding for national banks is consistent with the signaling theory. In regard to regional banks, implications of the signal theory are less important because these banks are small and locally connected, and most of the deposits are guaranteed through deposit insurance.

Second, MARGIN has a significant effect on regional banks' profitability, but it is less important in its magnitude

Table 4. Panel Regression Results for both Banking and Trust Businesses [Dependent Variable: ROA, Sample: Regional Banks (N=104)]

Category	Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Macro Variables	DRGDP	0.251** (5.170)	0.263** (7.765)	0.245** (5.449)	0.212** (5.314)	0.200** (4.687)	0.205** (4.723)	0.225** (5.570)
	INFLA	-0.326** (-2.676)	-0.309** (-3.543)	-0.367** (-3.023)	-0.231* (-2.105)	-0.351** (-3.140)	-0.341** (-2.995)	-0.385** (-3.033)
	EX	0.004 (0.165)	0.031 (1.886)	0.032 (1.974)	0.023 (1.617)	0.024 (1.656)	0.026 (1.703)	0.064 (1.952)
	CRISIS	-2.801** (-8.715)	-0.922** (-3.163)	-1.168** (-3.257)	-0.418 (-1.212)	-0.467 (-1.269)	-0.528 (-1.401)	-0.537 (-1.721)
Bank Variables	BIS		0.011 (0.541)	0.033 (1.526)	0.022 (1.181)	0.014 (0.682)	0.019 (0.934)	0.058 (1.404)
	MARGIN		0.929** (4.248)	0.806** (3.668)	0.597** (3.025)	0.657** (3.205)	0.631** (2.987)	0.400* (2.216)
	NPLSHARE		-0.177** (-6.626)	-0.154** (-5.369)	-0.139** (-5.504)	-0.169** (-6.367)	-0.162** (-6.008)	-0.152** (-4.872)
Market Power	MS			0.275* (2.442)	0.123 (1.191)	0.243* (2.345)	0.317** (2.994)	0.426 (1.908)
	HHI			0.001 (-0.236)	0.001 (0.393)	0.001 (1.700)	0.000 (0.945)	0.001 (0.017)
Efficiency	EXP/A				-16.526** (-5.342)			
	EXP/W					-0.247** (-4.274)		
	EXP/B						-0.023** (-3.757)	
	T-INEFF							-2.115* (-2.068)
R^2		0.774	0.901	0.907	0.929	0.922	0.919	0.915
F		84.662	124.736	101.787	121.303	110.264	105.800	101.436

1. Estimation results of the fixed-effects model. The coefficients of the constant under the fixed-effects model are not reported here.
2. t values are shown in parentheses. * and ** indicate significance at the 5% and 1% levels respectively.

and significance for national banks. National banks have diversified businesses and draw income from non-interest-bearing transactions such as fees. On average, the ratio of non-interest income to interest income is 22% higher for national banks than regional banks. Fig. (**1**) shows the trend of the average net interest margin and its standard deviation for regional banks and national banks. A similar trend in both variables is found for both types of banks. However, regional banks tend to have a little higher average net interest margin than national banks.

Third, NPLSHARE has a strong negative effect on profitability for both national and regional banks. Fig. (**2**) graphs the average percentage of non-performing loans in total loans and ROA for regional banks and national banks. Fig. (**2**) clearly shows the inverse relationship between NPLSHARE and ROA. Loans are the major income-earning asset of banks, and higher percentages of non-performing loans during 1997-2000 critically affected bank profitability, resulting in negative returns on assets. Why did national banks experience a continuous increase in NPLSHARE until 1999 while NPLSHARE of regional banks has continuously declined since the crisis? Two explanations can be provided. First, after the crisis, most of the troubled regional banks were closed and merged into a few national banks. This restructuring left relatively sound regional banks and caused the NPLSHARE of national banks to increase. Second, the Korean Financial Supervisory Commission introduced a strict "forward-looking criterion" in classifying loans with a grading system for evaluating credit risk. This new criterion led to a substantial increase in non-performing loans of national banks.

Two market power variables are used: MS and HHI. When the market share relative to total industry assets is used for regional banks, MS has a positive, but insignificant, effect on profitability of regional banks. By law, a regional bank is allowed to operate only in its own province so that its market share in the entire domestic market is not relevant to its performance and profits. So, for regional banks, MS is recalculated as each bank's share of total bank assets in its provincial market and the model was re-estimated with modified MS. MS has positive and significant influence on profitability in all models for national banks and in some models for regional banks. Overall, MS seems to be of less importance in terms of its magnitude and significance for regional banks. This might be because MS is more crucial for trust transactions than for banking transactions, and

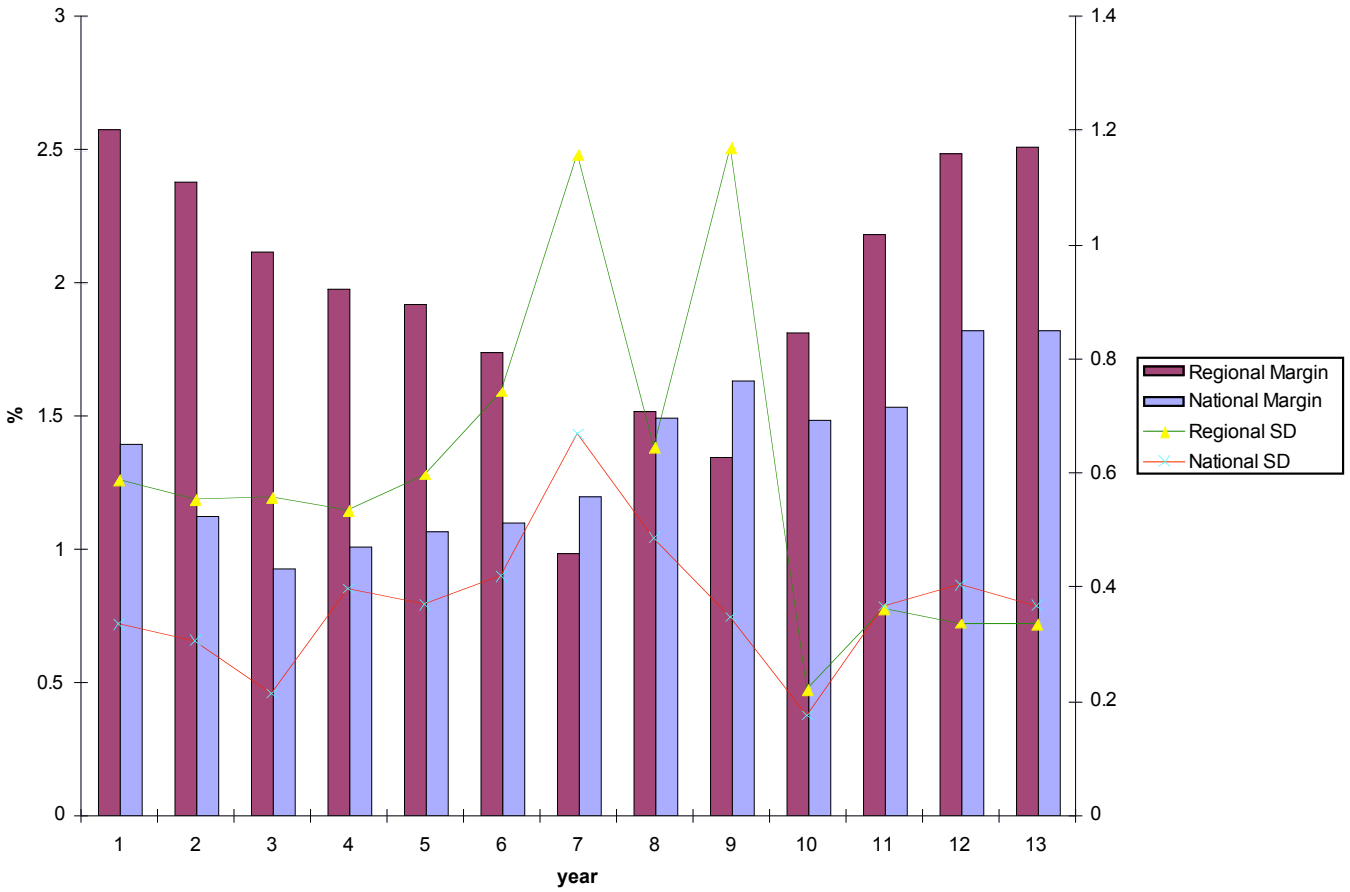

Fig. (1). Trend of net interest margin and standard deviation. Regional *vs* National Banks

regional banks have a smaller share of trust business than national banks. This is clearly confirmed by insignificant coefficients of MS for some models in Appendix 3 when ROA from banking business only is used as a dependent variable. Insignificant coefficients of HHI are obtained for both national and regional banks. The collusion hypothesis is not supported by this study.

In regard to efficiency, four variables are used in the model. T-INEFF measures technical inefficiency derived from the directional technology distance function explained in Appendix 2. EXP/A measures cost inefficiency associated with the use of assets while EXP/W or EXP/B measures cost inefficiency associated with utilization of workers or branches. Even though they represent inefficiency from different aspects, they are highly correlated. So, each variable enters into the model one by one. Each of these variables has the expected negative sign and is statistically significant.

In summary, there are three groups of significant variables: those significant for both national and regional banks, those significant only for national banks, and those significant only for regional banks. The results obtained from the panel data indicate that DGDP, all inefficiency variables (T-INEFF, EXP/A, EXP/W, EXP/B), and NPLSHARE are significant variables in explaining profitability for both national and regional banks. On the other hand, EX and BIS affect bank profitability significantly for national banks but not for regional banks, while INFLA and MARGIN are important variables only for regional banks. HHI explains profitability of neither national banks nor regional banks. MS is definitely a significant variable for national banks, but it shows mixed effects for regional banks—significant in some models and insignificant in other models.

5. CONCLUSIONS

This paper investigates the major determinants of profitability for regional and national banks in Korea during 1992-2004. The results obtained from the panel data indicate that economic growth, efficiency, are non-performing loans are significant variables in explaining profitability for both national and regional banks. On the other hand, the exchange rate and capital ratio affect bank profitability significantly for national banks but not for regional banks, while inflation rate and the net interest margin are important variables only for regional banks. The market concentration ratio has no influence on bank profitability regardless of whether the bank is national or regional. The efficient structure hypothesis is supported by this study for both national and regional banks. All four different measures of inefficiency are significant in explaining bank profitability. One unique feature of this paper is the estimation of technical inefficiency by the directional technology distance function and the use of this estimate in explaining bank profitability. The collusion hypothesis, one school of the market power hypothesis, is not empirically upheld in this study. The relative market power hypothesis is supported for national banks, but inconclusive results are obtained for regional banks.

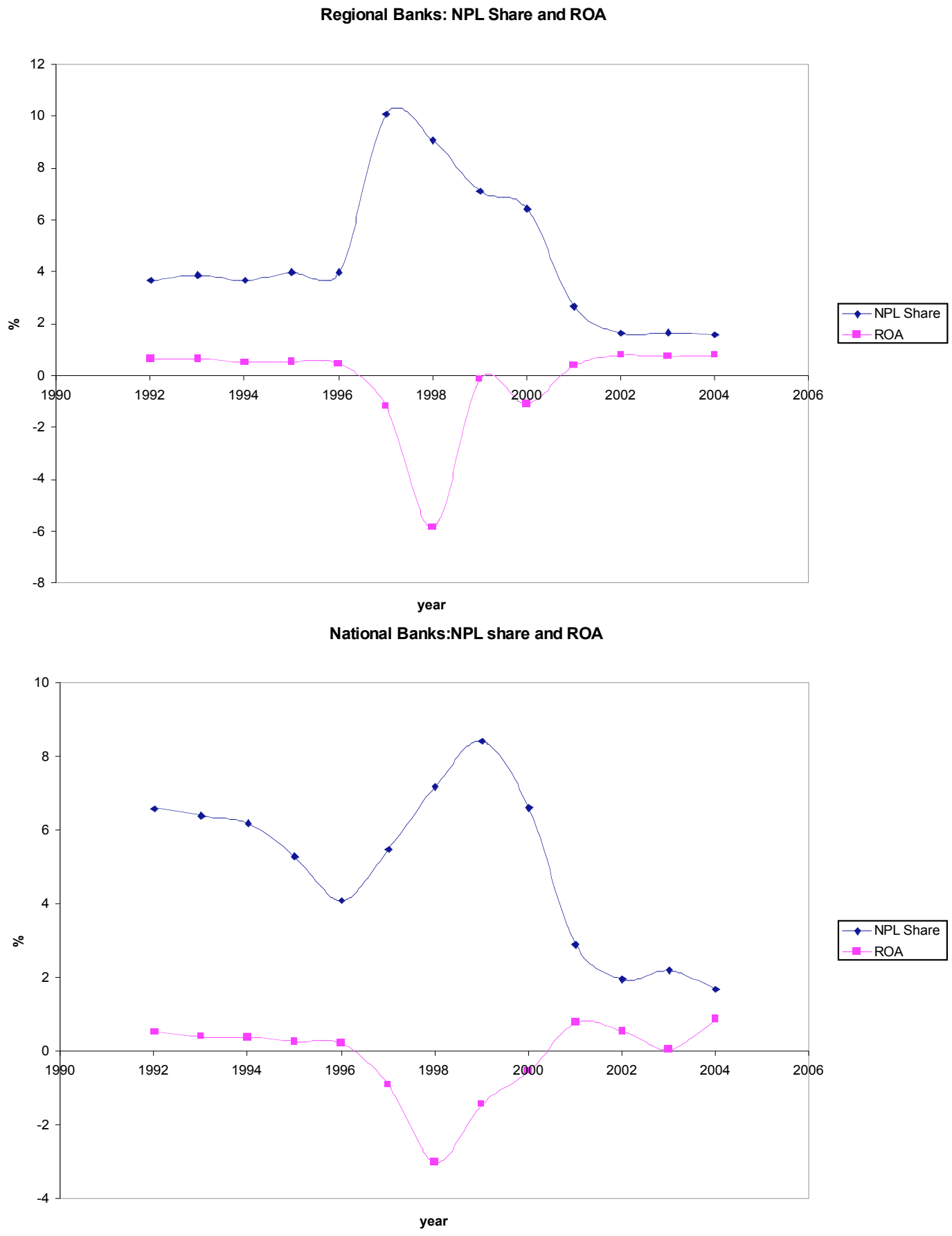

Fig. (2). NPLSHARE and ROA.

There are some differences between national and regional banks. First, national and regional banks have different significant determinants of profitability in addition to the common determinants as discussed above. Second, before the financial crisis of 1997-1998, regional banks, on average, had higher capital ratio, higher dependency on the net interest margin, and a lower non-performing loan rate than national banks, and thus were financially more sound and earning a higher rate of return on assets and equity. However, when the crisis occurred, they were more severely affected than national banks because of their small size and greater dependency on loans. Defaults by a few borrowers may not be critical for national banks because their loans and assets are diversified. On the other hand, defaults by one or a few big borrowers make a big impact on the performance of small regional banks. The percentage of non-performing loans in total loans increased gradually for national banks after the crisis, but this figure jumped from 4% in 1996 to 10.1% in 1997 and 9.1% in 1998 for regional banks.

There is a need for both regional and national banks to improve their credit analysis skills and risk management, as the crisis of 1997-1998 clearly demonstrated lack of expertise in this area. Because of asymmetric information between lenders and borrowers about investment opportunities and activities of borrowers, banks are engaged in two information-producing activities: screening and monitoring. In particular, the presence of adverse selection in loan markets requires that banks screen out the bad credit risks. Effective information collection and well-programmed screening are essential for credit risk management. It is welcome news that the Korean Financial Supervisory Commission introduced a forward-looking criterion to classify assets in place of a backward-looking criterion, along with more stringent procedures for valuation and provisioning of impaired assets. However, Korean banks need to improve their skills of information collection and analysis regarding credit and risk to further reduce the number of non-performing loans and the potential for bank crises in the future. Regional banks are in a better position than national banks to obtain information about borrowers which is not revealed in financial statements because of their closeness to local firms and relational banking.

Appendix 1. List of National and Regional Banks

National Banks	Regional Banks
1. Cho Hung Bank (grouped into Shinhan Financial Holding Co. in 2004)	1. Daegu Bank
2. Commercial Bank of Korea (merged with Hanil Bank to form Hanvit Bank in 1999, which was later transformed into Woori Financial Holding Co. in 2002)	2. Pusan Bank
3. Korea First Bank (nationalized in 1998 and sold to Newbridge Capital in 1999 and then to Standard Charter Bank and renamed as SC Korea First Bank in 2005)	3. Chung Chong Bank (acquired by Hana Bank in 1998)
4. Hanil Bank (merged with Commercial Bank of Korea to form Hanvit Bank in 1999, which was later transformed into Woori Financial Holding Co. in 2002)	4. Kwangju Bank (grouped into Woori Financial Holding Co. in 2001)
5. Bank of Seoul (nationalized in 1998 and acquired by Hana Bank in 2002)	5. Bank of Cheju (grouped into Shinhan Financial Holding Co. in 2002)
6. Korea Exchange Bank	6. Kyungki Bank (acquired by Hanmi Bank in 1998)
7. Shinhan Bank (renamed as Shinhan Financial Holding Co. in 2002)	7. Jeonbuk Bank
8. Hanmi Bank (acquired by Citi Bank in 2005 and renamed as Korea Citi Bank)	8. Kangwon Bank (merged into Cho Hung Bank in 1999)
9. Dongwha Bank (acquired by Shinhan Bank in 1998)	9. Kyungnam Bank (grouped into Woori Financial Holding Co. in 2001)
10. Dongnam Bank (acquired by Housing and Commercial Bank in 1998)	10. Choongbuk Bank (merged into Cho Hung Bank in 1999)
11. Daedong Bank (acquired by Kookmin Bank in 1998)	
12. Hana Bank	
13. Boram Bank (merged into Hana bank in 1999)	
14. Peace Bank (merged into Woori Holding Co. in 2001)	
15. Kookmin Bank (converted from a special bank in 1995)	
16. Housing and Commercial Bank (converted from a special bank in 1997 and merged into Kookmin Bank in 2002)	
17. Woori Holding Co. (former Hanvit Bank renamed in 2002 when it became a financial holding company)	

Appendix 2. Directional Technology Distance Function and Estimation of T-INEFF

A frontier cost function is typically used to estimate inefficiency as a parametric approach while data envelopment analysis (DEA) is frequently used as a typical non-parametric approach. The DEA approach assumes that any deviation from minimum cost is due entirely to inefficiency. On the other hand, a stochastic frontier approach based on parametric estimation decomposes the error term into an inefficiency component and a random component. There are two stochastic approaches: distribution-free and distribution-specific. If a distribution-free approach is to be used as in Berger [29], then the differences among banks are assumed to be stable over time. The distribution-free approach requires that banks be in existence for the entire sample period. It is difficult to apply this approach in the case of the Korean banking sector for the period of 1992-2004 because of frequent bank entry and exit during this period. If a distribution-specific approach is used as in Maudos [30], then it is necessary to know the distribution for both components of the error term. Without prior knowledge of the distribution, arbitrary assumptions about its shape are made in most studies. The DEA approach has the advantage of identifying best practices based upon observed costs rather than some hypothetical average derived from a given functional form.

In this study we use DEA to estimate the directional distance function and measure technical inefficiency (T-INEFF). Following Färe and Grosskopf [32], we assume that there are $k = 1, \ldots, K$ banks which employ x^k vector of inputs to produce y^k vector of outputs. The technology for each bank is written as $T^k = \{ (x^k, y^k) :$ inputs can produce outputs$\}$. The piecewise linear DEA technology is written as:

$$T = \{ (x,y) : \Sigma z_k x_{kn} \leq x_n, n = 1, \ldots, N, \Sigma z_k y_{km} \geq y_m, m = 1, \ldots, M,$$
$$\Sigma z_k = 1, k = 1, \ldots, K \text{ and } z_k \geq 0, k = 1,\ldots, K\} \quad \text{(A1)}$$

The intensity variables, z_k, $k = 1, \ldots, K$, serve to form linear combinations of all observed banks' inputs and outputs. The N+M inequality constraints restrict the technology in that for a particular bank no more output can be produced using no less input than a linear combination of all observed inputs and outputs. Requiring the intensity variables to sum to one allows variable returns to scale. We assume that the first N-1 inputs such as labor, capital, and deposits are variable inputs (x^v) and can be used in greater or lesser amounts at the bank manager's discretion, but that the Nth input, equity capital (e), is fixed exogenously by bank regulators and owners. Therefore, we partition bank k's input vector as $x^k = (x^{vk}; e^k)$.

We define the directional technology distance function for each bank as

$$D^k_T(x^{vk}, e^k, y^k; g_x, g_e, g_y) = \max \{\beta: (x^{vk} - \beta g_x, e^k - \beta g_e, y^k + \beta g_y) \in T^k\} \quad \text{(A2)}$$

where variable inputs are contracted in the direction g_x, equity capital is contracted in the direction g_e, and outputs are expanded in the direction of g_y . For $(x^{vk}, e^k, y^k) \in T^k$ a value of $D^k_T(x^{vk}, e^k, y^k; g_x, g_e, g_y) = 0$ indicates that the bank operates on the frontier of T^k and is efficient for the direction (g_x, g_e, g_y). A value of $D^k_T(x^{vk}, e^k, y^k; g_x, g_e, g_y) > 0$ indicates inefficiency. With the assumption that equity capital (e) is fixed exogenously by bank regulators and owners, $g_e = 0$. For the DEA technology, the directional technology distance function for bank ќ is estimated as

$$D^k_T(x^{vk}, e^k, y^k; g_x, 0, g_y) = \max \beta \text{ subject to}$$
$$\Sigma z_k x^v_{kn} \leq x^v_{ќn} - \beta g_x, n = 1, \ldots, N\text{-}1, \Sigma z_k e_k \leq e_ќ,$$
$$\Sigma z_k y_{km} \geq y_{ќm} + \beta g_y \; m = 1, \ldots, M$$
$$\Sigma z_k = 1, k = 1, \ldots, K \text{ and } z_k \geq 0, k = 1,\ldots, K \quad \text{(A3)}$$

Fig. (**A1**) shows how the production technology and inefficiency are estimated from the observed input and output with an example of four banks: A, B, C, and D. The piecewise linear technology, T, is bounded by the lines HB, BD, and DA, and the horizontal extension from A. Given a direction vector (g_x, g_e, g_y) where g_e is assumed to be zero, the directional function is defined as equation (A3). This function expands output in the direction g_y, contracts inputs in direction g_x, and is a measure of technical inefficiency (X-inefficiency). Banks A, B, and D produce on the frontier of T and are technically efficient. Bank C operates inside the frontier and is technically inefficient.

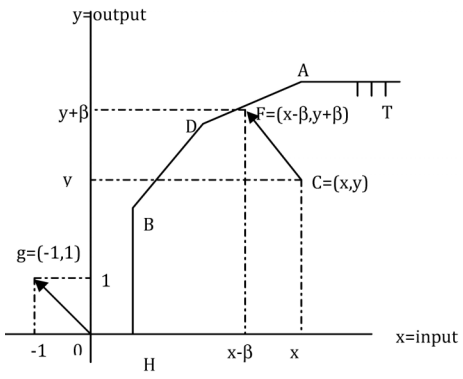

Fig. (A1). The Bank Production Technology (T) and the Directional Distance Function $\vec{D}(x, y; -1, 1) = \max\{\beta : (x - \beta, y + \beta) \in T\}$

In this study, we measure technical inefficiency (T-INEFF) by the directional distance between F and C in Fig. (**A1**). For estimation, we use three inputs, which are labor, capital, and deposits, and three outputs, which are commercial loans, consumer loans, and securities. We choose $g_y = (1,1,1)$ and $g_x = (1,1,1)$ so that the estimate of inefficiency from equation (A3) is the simultaneous unit expansion in the three outputs and unit contraction in the three inputs that is feasible, given the best-practice combinations of outputs and inputs of the banks in our sample. An inefficient bank earns less revenue and incurs higher costs than it would if it operated on the frontier. To examine the effect of inefficiency on ROA, we sum inefficiency over the outputs and inputs and divide by total assets. Thus, in this model T-inefficiency (T-INEFF) is:

$$\text{T-INEFF} = \beta\,(\Sigma\, g_{ym} + \Sigma\, g_{xn}) \,/\, \text{Assets} = \beta\,(1+1+1+1+1+1) \,/\, \text{Assets}. \qquad \text{(A4)}$$

The estimated results show that the average T-inefficiency increased somewhat in the early 1990s, but has gradually diminished since the financial crisis.

Appendix 3. Panel Regression Results for Banking Business only

Dependent Variable: ROA

Category	Variable	National Banks (n=154)				Regional Banks (n=104)			
		(4)	(5)	(6)	(7)	(4)	(5)	(6)	(7)
Macro Variables	DGDP	0.122* (1.986)	0.178** (2.471)	0.190** (2.692)	0.224** (4.208)	0.214** (4.129)	0.234** (4.407)	0.230** (4.273)	0.311** (5.868)
	INFLA	0.176 (1.383)	0.062 (0.423)	0.082 (0.554)	0.077 (0.440)	-0.262* (-2.309)	-0.385** (-3.376)	-0.367** (-3.178)	-0.391** (-2.844)
	EX	0.022* (2.189)	0.034* (2.251)	0.038 (1.762)	0.077** (2.707)	0.022 (1.425)	0.025 (1.551)	0.025 (1.506)	0.072 (1.892)
	CRISIS	-0.658 (-1.693)	-0.179 (-0.380)	-0.051 (-0.112)	-0.389 (-0.821)	-0.394 (-1.029)	-0.343 (-0.834)	-0.392 (-0.940)	-0.546 (-1.497)
Bank Variables	BIS	0.156** (4.979)	0.192** (5.370)	0.202** (5.688)	0.201** (4.968)	0.021 (0.898)	0.005 (0.181)	0.011 (0.458)	0.073 (1.489)
	MARGIN	0.210 (0.014)	1.235 (0.069)	1.407 (0.079)	0.069 (0.279)	0.621** (3.204)	0.699** (3.529)	0.657** (3.251)	0.460** (2.539)
	NPLSHARE	-0.137** (4.451)	-0.235** (-7.124)	-0.235** (-7.114)	-0.217** (-6.123)	-0.178** (-6.301)	-0.215** (-7.453)	-0.207** (-7.151)	-0.193** (-5.726)
Market Power	MS	0.024 (1.219)	0.066** (3.005)	0.086** (3.761)	0.096** (3.125)	0.094 (0.884)	0.173 (1.608)	0.24.3* (2.232)	0.313* (2.198)
	HHI	0.001 (0.501)	0.001 (1.318)	0.001 (0.678)	0.001 (0.134)	-0.001 (-0.132)	0.001 (1.790)	0.001 (1.169)	-0.001 (-0.009)
Efficiency	EXP/A	-28.902** (-7.787)				-14.324** (-4.530)			
	EXP/W		-0.155** (-2.994)				-0.235** (-3.704)		
	EXP/B			-0.009** (-2.986)				-0.023** (-3.346)	
	T-INEFF				-1.473* (2.012)				-2.959** (2.857)
R^2		0.767	0.737	0.727	0.719	0.929	0.925	0.923	0.920
F		46.723	41.189	39.175	37.547	121.774	113.923	111.012	108.634

1. Estimation results of the fixed-effects model. The coefficients of the constant under the fixed-effects model are not reported here.
2. t values are shown in parentheses. * and ** indicate significance at the 5% and 1% levels respectively.

REFERENCES

[1] Gilbert R, Wilson P. Effects of deregulation on the productivity of Korean banks. J Econ Bus 1998; 50: 133-55.

[2] Hao J, Hunter W, Yang W. Deregulation and efficiency: The case of private Korean banks. J Econ Bus 2001; 53: 237-54.

[3] Park K, Weber W. A note on efficiency and productivity growth in the Korean banking industry. 1992-2002. J Banking Finan 2006; 30: 2371-86.

[4] Jeon Y, Miller S. The effect of the Asian financial crisis on the performance of Korean national banks. App Finan Econ 2004; 14: 351-60.

[5] Park K, Weber W. Profitability of Korean banks: test of market structure versus efficient structure. J Econ Bus 2006; 58: 222-39.

[6] Dunham C. Regional banking competition. New England Econ Rev 1986: 3-19.

[7] Amos O. The regional distribution of bank closings in the United States from 1982 to 1988. Southern Econ J 1992; 58: 805-15.

[8] Bias P. Regional financial segmentation in the United States. J Regional Science 1992; 32: 321-34.

[9] Chu, K. Is free banking more prone to bank failures than regulated banking? Cato J 1996; 16: 47-61.

[10] Chakravarty S. Regional variation in banking services and social exclusion. Region Stud 2006; 40: 415-28.

[11] Kwan S, Eisenbeis R. An analysis of inefficiencies in banking: a stochastic cost frontier approach, Economic Review. Federal Reserve Bank of San Francisco: Working Papaers in Applied Economic Theory 1996; pp. 16-26.
[12] Coccorese P. Market power in local banking monopolies. J Banking Finan 2009; 33: 1196-210.
[13] Hahn F. Efficiency of Regional Banks in Europe, Japan and the USA. A Best-Practice Analysis. WIFO-Monatsberichte 2008; 81: 191-201.
[14] Feinberg R. Patterns and determinants of entry in rural county banking markets. J Ind Compet Trade 2009; 9: 101-15.
[15] Gonzalez F. Determinants of bank-market structure: efficiency and political economy variables. J Money Credit Banking 2009; 41: 735-49.
[16] Williams J, Gardener E. The efficiency of European regional banking. Region Stud 2003; 37: 321-30.
[17] Neal P. X-efficiency and productivity change in Australian banking. Aust Econ Papers 2004; 43: 174-91.
[18] Koeppl T, MacGee J. What broad banks do, and markets don't: cross-subsidization. European Econ Rev 2009; 53: 222-36.
[19] Drake L, Hall M. Efficiency in Japanese banking: an empirical analysis. J Bank Finan 2003; 27: 891-917.
[20] Kano M, Tsutsui Y. Geographical segmentation in Japanese bank loan markets. Reg Sci Urban Econ 2003; 33: 157-74.
[21] Uchida H, Tsutsui Y. Has competition in the Japanese banking sector improved? J Bank Finan 2005; 29: 419-39.
[22] Choe C. The political economy of SME financing and Japan's regional Bank problems. Pacific-Basin Finan J 2007: 15: 353-67.
[23] Shepherd W. Tobin's *q* and the structure performance relationship: Reply. Am Econ Rev 1986; 76: 1205-10.
[24] Kurtz R, Rhoades S. A note on the market share-profitability relationship. Working papers: Federal Reserve Board 1991.
[25] Baumol W, Panzar J, Willig R. Contestable markets and the theory of industry structure. San Diego: Harcourt Brace Jovanovich 1982.
[26] Smirlock M. Evidence on the (non-)relationship between concentration and profitability in banking. J Money Credit Banking 1985; 17: 69-83.
[27] Evanoff D, Fortier D. Reevaluation of the structure-conduct-performance paradigm in banking. J Finan Services Res 1988; 1: 277-94.
[28] Molyneux P, Forbes W. Market structure and performance in European banking. App Econ 1995; 27: 155-9.
[29] Berger A. The profit-relationship in banking - tests of market-power and efficient-structure hypotheses. J Money Credit Banking 1995; 27: 405-31.
[30] Maudos J. Market structure and performance in Spanish banking using a direct measure of efficiency. App Finan Econ 1998; 8: 191-200.
[31] Hsiao C. Analysis of panel data. Cambridge: Cambridge University Press 1986.
[32] Färe R, Grosskopf S. New direction: efficiency and productivity. Boston: Kluwer Academic Publishers 2004.

Received: March 24, 2009 Revised: August 13, 2009 Accepted: August 24, 2009