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Discussion Paper 02-09-Rev.

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Abstract

This paper investigates whether competition in the Japanese banking sector has improved in the last quarter of the 20th century. By estimating the first order condition of profit maximization, together with the cost function and the inverse demand function, we found that competition had improved, especially in the 1970s and in the first half of the 1980s. The results fail to reject a Cournot oligopoly for city banks for most of the period, while they do reject it for regional banks for the overall period. This suggests that competition among city banks was stronger than that among regional banks.

JEL Classification number: G21, L13

Keyword: Japanese banks, degree of competition, loan market.

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1. Introduction

The purpose of this paper is to investigate whether competition in the Japanese banking sector has improved in the last quarter of the 20th century. Over this period, a regulated system for the Japanese banking sector that had dominated in Japan over the high growth period has been substantially liberalized. This period includes the bubble period of the late 1980s, and the long stagnation in the 1990s in which private banks struggled with huge non-performing loans. As a result, we expect that the degree of competition in the Japanese banking sector has changed throughout this period.

There have been a few studies, to our knowledge, that have investigated the degree of competition in Japanese financial industries. Molyneux, Thornton, and Lloyd-Williams (1996) estimated the Panzar and Rosse (1987) H-statistic of Japanese banks in 1986 and 1988. They found that the Japanese banking sector was in monopoly equilibrium in 1986, whereas in 1988 it was in monopolistic competition equilibrium.[1] Following Clark and Davies (1982), Alley (1993) estimated a degree of collusion in the Japanese banking sector to find a high degree of collusion in 1986 and 1987. Souma and Tsutsui (2000) applied an approach similar to that of this paper to the Japanese life insurance industry from 1986 to 1997 to find that the degree of competition was low, but that the industry became more competitive after 1995 when the New Insurance Industry Law was promulgated. Kamesaka and Tsutsui (2002) estimated Panzar-Rosse's H-statistic for the Japanese

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[1] De Bandt and Davis (2000) argue that estimates of cross-section analysis often change sharply, so

securities industry to find that the industry was in monopoly equilibrium in the 1980s and was in monopolistic competition equilibrium in the 1990s.

We assess the degree of competition by direct estimation of the first order condition of profit maximization. This is essentially the method that is formalized by Bresnahan (1982) and Lau (1982), and has been applied to many studies.[2] For example, Shaffer (1989, 1993), Shaffer and DiSalvo (1994), and Zardkoohi and Fraser (1998) applied this method to the banking industries in the U.S. and Canada. The method uses time-series data, and therefore only elucidates a long-run average degree of competition. In contrast, we use panel data, which enable us to investigate short-run changes in the degree of competition.[3]

The next section reviews the history of the liberalization in the Japanese banking sector. In section 3, we present a model for an estimation of the degree of competition. In section 4, we explain our data and present the empirical results. Section 5 is devoted to checking the robustness of the results. In section 6, we investigate what elements had critically affected the degree of competition. Section 7 provides the conclusion.

2. Liberalization of the Japanese Banking Sector

The liberalization of the Japanese banking sector was caused, at least partially, by the enormous issuance of government bonds from the early 1970s. Initially all the newly

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that the results may suffer from some problems.

[2] See Bresnahan (1989, 1997) for the development of this method.

[3] Angelini and Cetoreli (1999) analyzed Italian banks with panel data for 1983-97 to estimate the Lerner index.

issued government bonds were bought by private banks, and one year later the Bank of Japan purchased all of them. Therefore, few bonds circulated outside the banking sector. After 1970, however, the issuance of government bonds became so large that the Bank of Japan could not purchase all of them. The government bonds were issued at a high price, and therefore the private banks that bought them suffered enormous losses. The banks demanded that the Ministry of Finance (MOF) deregulate the selling of bonds to the market, and the MOF began to relax the restriction in 1977. Consequently, a secondary market for government bonds rapidly emerged. The emergence of a large free financial market was a major event that significantly affected the Japanese banking sector in that the market enabled the securities companies to offer a mutual fund that could compete with deposits.[4] This situation might have promoted some dis-intermediation. A greater degree of disintermediation did not occur because the issuance amount of the mutual fund was regulated so that securities companies were prevented from meeting the potential demand such funds. Nevertheless, it is probable that the emergence of the secondary government bond market applied greater competitive pressure on the Japanese banking sector.[5]

The next important liberalization was that of deposit interest rates. Jumbo time-deposits and Money Market Certificates were introduced in 1985. The interest rates of the former were not regulated, and those of the latter were tied to market interest rates.

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[4] The medium-term government bond fund was the main brand of mutual fund.

[5] The threat of dis-intermediation was also created by the revision of the Foreign Exchange and Foreign Trade Control Act in 1980, which facilitated investors’ access to foreign markets. The internationalization of the financial markets was promoted over 1980–85.

However, with respect to these deposits, the minimum amount that could be deposited was restricted. For example, in 1985, each jumbo time deposit account was required to hold an amount of more than one billion yen. This restriction was gradually relaxed up until 1992. In 1994, all the deposit interest rates were deregulated. However, interest rates fell rapidly from 1991 to 1996, suggesting that banks might not have been under deposit interest rate competition.

On the other hand, loan interest rates seem to have moved more freely since 1973. In Figure 1, we show loan interest rates over the period 1956 to 2001. Loan interest rates apparently began to change more sharply from 1973. Table 1 shows that the coefficient of variation of loan interest rates jumped from 0.055 in the high growth period (1961–1972) to 0.20 in the low growth period (1973–1983). The correlation coefficient between loan interest rates and the call rate increased from 0.80 to 0.91 in the same period, while the coefficient of variation of the call market did not change substantially during this period. These facts suggest that the market environment for Japanese banks drastically changed in the late 1970s, which may have affected competition among them.

In 1993, regulation regarding the segregation of business lines in financial industries was relaxed. Banks and securities companies were allowed to enter each other’s businesses by establishing subsidiaries. Although banks established many securities company subsidiaries based on this deregulation, no securities companies established bank subsidiaries. This is probably because banks had stronger business power than securities companies in Japan. Therefore, this deregulation did not have a significant effect on the banking sector, contrary to the case for the securities industry.

3. Model

We assume that a bank i raises funds d_i from depositors and invests it to loans q_i and government bonds b_i. Thus, the profit of the bank i at time t is:

$$\pi_{i,t} = P_t(Q_t)q_{i,t} + r_{i,t}^b b_{i,t} - r_{i,t}^d d_{i,t} - C_{i,t}(q_{i,t}, d_{i,t}), \tag{1}$$

where $P_t(Q_t)$ is the inverse demand function for loans, $Q_t \equiv \sum_{i=1}^{n} q_{i,t}$, n is the number of banks, $r_{i,t}^b$ is the yields for bonds, $r_{i,t}^d$ is the deposit interest rate, and $C_{i,t}(q_{i,t}, d_{i,t})$ stands for the operating cost function. The bank's problem is:

$$\underset{\{b_{i,t}, q_{i,t}, d_{i,t}\}}{Max} \ \pi_{i,t} \quad s.t. \ b_{i,t} + q_{i,t} = d_{i,t} . \tag{2}$$

The first order conditions of the profit maximization are:

$$P_t(1 - \frac{1}{\eta_t}\theta_{i,t}) = r_{i,t}^b + \frac{\partial C_{i,t}}{\partial q_{i,t}}, \tag{3}$$

and

$$r_{i,t}^b - r_{i,t}^d - \frac{\partial C_{i,t}}{\partial d_{i,t}} = 0, \tag{4}$$

where $\eta_t \equiv -\frac{P_t}{Q_t}\frac{\partial Q_t}{\partial P_t}$ is the market demand elasticity for loans, $S_{i,t} \equiv \frac{q_{i,t}}{Q_t}$ is the market share of bank i in loans, and $\theta_{i,t} = \frac{\partial Q_t}{\partial q_{i,t}} S_{i,t}$. Note that $\theta_{i,t} = 0$ for perfect competition, whereas $\theta_{i,t} = S_{i,t}$ for Cournot competition. From (3) and (4), we obtain:[6]

$$P_t(1 - \frac{1}{\eta_t}\theta_{i,t}) = r^d_{i,t} + \frac{\partial C_{i,t}}{\partial d_{i,t}} + \frac{\partial C_{i,t}}{\partial q_{i,t}}. \tag{5}$$

On the other hand, if the banks are maximizing their joint profits, represented as $P_t(Q_t)Q_t + \sum_{i=1}^{n}(r^b_{i,t}b_{i,t} - r^d_{i,t}d_{i,t} - C_{i,t}(q_{i,t}, d_{i,t}))$, the first order condition can be expressed as equation (5) with $\theta_{i,t} = 1$. Furthermore, $S_{i,t} < \theta_{i,t} < 1$ represents an array of repeated game equilibria whose one-shot game is Cournot oligopoly.

Rearranging (5) and defining $R_{i,t} \equiv P_t q_{i,t}$ to represent the revenue of bank *i* generated by loans, we obtain the following equation:

$$R_{i,t} = \frac{\theta_t}{\eta_t}R_{i,t} + r^d_{i,t}q_{i,t} + q_{i,t}\frac{\partial C_{i,t}}{\partial d_{i,t}} + q_{i,t}\frac{\partial C_{i,t}}{\partial q_{i,t}}. \tag{6}$$

θ_t represents the *degree of competition*. Note that we have dropped out the subscript i for θ in order to capture the industry average degree of competition.[7]

Because the marginal cost is not observable, we assume the translog cost function:

$$\begin{aligned}\ln C_{i,t} &= a_0 + a_1\overline{\ln q_{i,t}} + \frac{1}{2}a_2(\overline{\ln q_{i,t}})^2 + a_3\overline{\ln d_{i,t}} + \frac{1}{2}a_4(\overline{\ln d_{i,t}})^2 + a_5\overline{\ln w_{i,t}} + \frac{1}{2}a_6(\overline{\ln w_{i,t}})^2 \\ &\quad + a_7(\overline{\ln q_{i,t}})(\overline{\ln w_{i,t}}) + a_8(\overline{\ln q_{i,t}})(\overline{\ln d_{i,t}}) + a_9(\overline{\ln d_{i,t}})(\overline{\ln w_{i,t}}) + \varepsilon^C_{i,t},\end{aligned} \tag{7}$$

where $w_{i,t}$ stands for the wage rate of bank i, $\varepsilon^C_{i,t}$ is an error term, and variables with upper bars are the deviations from their means. Given equation (7), our regression

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[6] Equation (3) can be estimated instead of equation (5). Estimation of equation (3), however, did not generate reasonable results. The reason for the poor results may be that, in the estimation, we should use as $r^b_{i,t}$ the data for securities including stocks, instead of the data for government bonds, because the revenues from government bonds are not reported. In Japan, however, considerable parts of stocks are held as the mutual holding, which is not determined based on the short-run incentives. In addition, although bond yields should include capital gains and losses, they are not incorporated in the reported data of r^b. Therefore, we present the results based on equation (5).

[7] See Bresnahan (1989) for this point.

equation is specified as:

$$R_{i,t} = \frac{\theta_t}{\eta_t} R_{i,t} + r_{i,t}^{d} q_{i,t} + C_{i,t}(a_1 + a_2 \overline{\ln q_{i,t}} + a_7 \overline{\ln w}_{i,t} + a_8 \overline{\ln d}_{i,t})$$

$$+ C_{i,t} \frac{q_{i,t}}{d_{i,t}} (a_3 + a_4 \overline{\ln d_{i,t}} + a_8 \overline{\ln q}_{i,t} + a_9 \overline{\ln w}_{i,t}) + \varepsilon_{i,t}^{S}, \qquad (8)$$

where $\varepsilon_{i,t}^{S}$ is the error term.

We identify θ_t from η_t using information from the loan demand function. The following inverse loan demand function is assumed:[8]

$$\ln P_{i,t} = b_0 - \frac{1}{\eta_t} \ln Q_t + \underset{(+)}{b_2} \ln IIP_t + \underset{(-)}{b_3} \ln ASL_{i,t} + \underset{(+)}{b_4} \ln SMSF_{i,t} + \underset{(-)}{b_5} \ln OPL_{i,t} + \varepsilon_{i,t}^{D}, \qquad (9)$$
$$\qquad\qquad (+)$$

where IIP_t is the index of industrial production, $ASL_{i,t}$ the average size of loans of bank i, $SMSF_{i,t}$ the ratio of the amount of loans to small- and medium-sized firms to total loans, $OPL_{i,t}$ the ratio of the amount of loans to operation funds to the total loans, and $\varepsilon_{i,t}^{D}$ is a disturbance term.[9] Simultaneous estimation of (7), (8), and (9) gives the estimates of θ_t and η_t.[10]

Expected signs are shown under the coefficients. The expected sign of b_3 is negative because increasing the loan size lowers average operation costs, resulting in lower

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[8] Here, we assume that loans are heterogeneous, so that their interest rates differ based on their size, riskiness, and maturity. This assumption contradicts the derivation of equation (3), which assumes homogeneity of loans. At the sacrifice of this theoretical disparity, we obtain an identification of θ from η.

[9] Total loans are divided into two parts: operation funds and equipment funds. While borrowers use the former for the short-term operation of their businesses, the latter are used for capital investment.

[10] We conducted the analysis using GDP instead of *IIP*. The results were quite similar.

interest rates. The sign of b_4 is expected to be negative, because loans to smaller firms are often riskier. Since operation funds are generally advanced by shorter loans than equipment funds, the sign of b_5 depends on the shape of the yield curve of the term structure of interest rates. As the yield curve is usually increasing, we expect that it is negative.

A merit of the estimation method of this paper is that by using panel data, it gives the estimates of the degree of competition every year, which enables us to investigate the short-term changes in the degree of competition. On the other hand, the method proposed by Bresnahan (1982) and Lau (1982) only reveals the average degree of competition for a long period, because it uses aggregated time series data.

4. Results

4.1 Data

We select regional banks and city banks as samples. Long-term credit banks, trust banks, and smaller cooperative institutions such as shinkin banks are excluded from the analysis for the following reasons. The former two types of banks are not ‘ordinary banks’ and their operations are substantially different from those of city and regional banks. The smaller cooperative institutions generally operate in small areas. Kano and Tsutsui (2003) found that loan markets of shinkin banks are segmented by prefecture, implying that they compete within each prefecture. Other cooperative institutions, credit cooperatives and agricultural and forestry cooperatives, are much smaller, so they probably compete within more limited areas. Therefore, the analysis of these institutions should require a somewhat different methodology than that applied in this paper, which should be interesting as a future study.

Regional banks, together with city banks, constitute ‘ordinary banks’. Legally, regional banks are not distinguished from city banks, but they form their own business organizations.[11] They differ from city banks in that they are much smaller and basically operate in restricted areas. However, Kano and Tsutsui (2003) found that the loan markets of regional banks are not segmented by prefecture. In 1996, their share of the loan market in Japan was 33.1%.[12]

City banks have nation-wide branch networks and operate diversified businesses, including international bank business, while regional banks tend to be specialized in traditional deposit-loan business. In 1996, city banks’ share of the loan market in Japan was 49.6%. Thus, by analyzing regional and city banks, we cover 82.7% of the total amount of loans of Japanese banks. We estimate the model with separate samples because city and regional banks have different production functions and their markets are somewhat segregated.

We used panel data of city banks and regional banks for the estimation. All the data were extracted from Nikkei NEEDS Company (Bank) Data File, except for those of IIP_t,

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[11] Regional banks consist of regional banks and second regional banks. The latter were converted from mutual banks during 1989–92, and had previously been specialized financial institutions for small- and medium-sized firms.

[12] The total loan outstanding in Japan is defined as the sum of city banks, long-term credit banks,

which were extracted from the Nikkei NEEDS Macro Data File. The list of the data used for each variable is:

$R_{i,t}$: loan interest revenue for bank i at time t,

$q_{i,t}$: outstanding balances of loan for bank i at time t,

Q_t: sum of $q_{i,t}$ over city banks or regional banks at time t,

$d_{i,t}$: outstanding balances of deposit for bank i at time t,

$C_{i,t}$: operating costs for bank i at time t,

$r_{i,t}^d$ = (interest paid for deposit) / (total amounts of deposit) for bank i at time t,

$w_{i,t}$ = (personnel expenses + welfare expenses) / (the number of employees) for bank i at time t,

$P_{i,t} \equiv \frac{R_{i,t}}{q_{i,t}}$: loan interest rates for bank i at time t,

$ASL_{i,t}$ = $q_{i,t}$ / (the number of loans for bank i at time t),

$SMSF_{i,t} \equiv$ (the amount of loans to small- and medium-sized firms) / $q_{i,t}$,

$OPL_{i,t} \equiv$ (the amount of loans for operation funds) / (the amount of loans for operation funds + that for equipment funds) for bank i at time t,

IIP_t: index of industrial production at time t.

The estimation period is from fiscal 1974 to fiscal 2000. After excluding observations that lack some data, the number of observations each year is 9–13 for city banks and 116–131 for regional banks. The total number of observations is 318 for city

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trust banks, regional banks, shinkin banks, and credit cooperatives.

banks and 3441 for regional banks.[13] Until 1980, banks reported financial statements twice a year, in September and March, so we constructed annual data of flow variables as the sum of the semi-annual data. Data at the end of each fiscal year, i.e., March, are used for the stock variables.

Descriptive statistics for these variables are shown in Table 2. The results reveal that city banks are much larger than regional banks. For example, city banks have outstanding loans and deposits that are 15 times larger, on average, than regional banks. City banks earn 15 times as much as regional banks and pay 1.3 times the salary to each employee, on average. Regional banks tend to lend smaller amounts to each borrower, and are more likely to lend to small- and medium-sized firms.

We use year dummy variables to estimate θ_t in equation (8). To estimate $\frac{1}{\eta_t}$ in equations (8) and (9), we use time dummy variables for every two years.[14] We cannot use time dummy variables for each year because they are linearly dependent with IIP_t.

Equations (7), (8), and (9) are simultaneously estimated by multivariate regression (MVR) and three-stage least squares (3SLS).[15] In 3SLS we use rank variables as instrumental variables for the terms including $q_{i,t}$, $d_{i,t}$, $R_{i,t}$, $r^d_{i,t}$, $P_{i,t}$, and $C_{i,t}$, the

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[13] For 1999 and/or 2000, there are some observations that lack data of *ASL* and/or *OPL*. Deletion of them results in only two observations for city banks in 2000. Therefore, for both city and regional banks, we complement these data by copying the latest available data to include these observations in the sample. To check the possible bias due to this expediential method, we conduct the estimation by deleting the two explanatory variables from the demand function. The estimation results are essentially unchanged.

[14] We use a one-year dummy for 1974.

[15] Since equation (7) is not necessary for identifying θ from η, we estimated only equations (8) and (9) jointly. The results were generally unreasonable, suggesting that equation (7) plays an

exogenous variables, $w_{i,t}$, $ASL_{i,t}$, $SMSF_{i,t}$, $OPL_{i,t}$, and Q_t, and year dummies.[16]

4.2 Estimation results of city banks

Results of the simultaneous estimation of equations (7), (8), and (9) for city banks are presented in Table 3. In the left columns, the estimates by MVR are shown. As for the cost function, four coefficients out of ten are significant at a 5% level of significance. As for the demand function, the coefficient of IIP_t is significantly positive and that of $\ln Q_t$ is significantly negative, confirming that the demand function (9) is identified from the supply relation (8). The estimates of $\frac{1}{\eta_t}$ took on a value of around 0.7 and were significant for all the years. However, the estimate of b_4 unexpectedly took on a negative value. This may be interpreted as meaning that the small- and medium-sized firms that could obtain loans from city banks were promising firms and not riskier than large firms.

In the right columns of Table 3, the estimates by 3SLS are shown. They are similar to those by MVR, but the results of the cost function are not convincing: the coefficient of $\ln d$ is non-positive, casting some doubt on the results.

The estimates of θ_t by MVR are depicted in Figure 2 together with their 95% confidence interval. The value of $1/n$ is also depicted as a proxy of Cournot oligopoly. The results from 3SLS are quite similar so they are not presented here. For the first two

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important role in identifying the marginal cost part in equation (8).

[16] The rank variable of X_i is the variable whose value is the order of X_i ranked in ascending order. (See Maddala, 1977, pp. 297-298.)

years, 1974 and 1975, the results reject $\theta = n$, $\theta = 1$, and $\theta = 0$, at a 5% significance level. θ_t generally had a downward trend, with a spike in 1981, until 1984. It stayed around zero for 1984–1989, and rose in the first half of the 1990s, rejecting perfect competition for these years. In the middle of the 1990s, θ_t again took on a value around zero, while it rose again in the final few years. In summary, competition improved until 1984, and the competitive environment obtained until 1997. Cournot oligopoly was not rejected for most of the period. Perfect competition was not rejected for about half of the period.

4.3 Estimation results of regional banks

Results of simultaneous estimation of equations (7), (8), and (9) for regional banks are presented in Table 4. The results by MVR are shown in the left columns. All the estimates of the cost function are significant except for that of the quadratic term of deposits. A problem is that the coefficients of $\ln w$ (and $(\ln w)^2$) are negative. We suspected that the wage rate might be an endogenous variable and conducted 3SLS estimation using a rank variable of $w_{i,t}$ as an instrumental variable. However, the signs of the coefficients did not change.

The estimates of the demand function significantly satisfy the expected signs except for that of operation funds. The estimates of $\frac{1}{\eta_t}$ took on a value around 0.43 and were significant for all the years. Fits are good for all the equations: the coefficient of determination exceeds 0.93.

Figure 3 shows the MVR estimates of θ_t together with their 95% confidence interval. During the entire sample period, $\theta = n$, $\theta = 1$, and $\theta = 0$ were all rejected. This implies that the degree of competition was less severe than Cournot oligopoly, although it was more severe than joint profit maximization. θ_t declined from 1974 to 1987, and the decline was especially rapid in the 1970s, implying that competition improved during this period. θ_t then rose to around 0.35 and did not change from 1988 to 1998. It rose again markedly after 1998.

In summary, the degree of competition improved from the 1970s to 1987, and was stable during the late 1980s and the first half of the 1990s. Competition has recently become laxer.

The 3SLS estimates shown in the right columns of Table 4 are not remarkably different from those generated by MVR. However, the 3SLS estimates of θ_t are smaller than the MVR estimates in the early period.

Comparing Figure 3 with Figure 2, we find that competition among city banks has been stronger than among regional banks. The result is plausible because the business areas of regional banks are limited, even though they overlap, so that they may possess monopolistic power in their areas.

The results of the basic estimations are summarized as follows: First, competition in the Japanese banking sector had improved in the 1970s and in the first half of the 1980s. Second, the degree of competition is higher for city banks than for regional banks. Third, the loan market for city banks has been perfectly competitive during the 1980s and the mid 1990s. Fourth, the loan market for regional banks has never been perfectly competitive or a Cournot oligopoly, while joint profit maximization is also rejected. Fifth, competition became laxer again after 1998.

5. Robustness Checks of the Basic Results

In this section, we provide a check on the robustness of the results in the previous section.

5.1 Cost of capital

Although the model in this paper indicates that the deposit interest rate is the relevant financial cost of the loan, this outcome depends on the assumption that the bank manipulates only the amount of deposit. If the bank manipulates all the liability side including capital, the deposit interest rate $r_{i,t}^{d}$ in equation (7) should be replaced with the cost of capital $\bar{r}$, which is defined as:

$$\frac{\text{debt}}{\text{debt}+\text{capital}}\frac{\text{interest paid for debt}}{\text{amount of debt}}+\frac{\text{capital}}{\text{debt}+\text{capital}}\frac{\text{current profit}}{\text{capital}},$$

where debt consists of deposits, certificate of deposits, call money, borrowing from other financial institutions, including the Bank of Japan, etc.

The estimates of θ_t using $\bar{r}$ are shown in Figure 4 (city banks) and Figure 5 (regional banks). Figure 4 is quite similar to Figure 2 except for the period after 1992. θ_t was significantly negative in the middle of the 1990s and in 1999. Figure 5 shows more variability after 1995 than does Figure 3. Together with the fact that the current profits of many banks were negative in these periods, these results may imply that it is inappropriate to use the cost of capital as calculated above. However, the conclusions in the previous section are confirmed with this analysis.

5.2 Bank reserves

The model in this paper disregards the existence of reserves for deposits. If we introduce bank reserve R and assume that it is a constant ratio of deposit, i.e., $R = \beta D$, equation (8) becomes:

$$\begin{aligned} R_{i,t} &= \frac{\theta_t}{\eta_t} R_{i,t} + \frac{r_{i,t}^d q_{i,t}}{1-\beta} + C_{i,t}(a_1 + 2a_2 \overline{\ln q_{i,t}} + a_7 \overline{\ln w}_{i,t} + a_8 \overline{\ln d}_{i,t}) \\ &\quad + C_{i,t} \frac{q_{i,t}}{(1-\beta) d_{i,t}} (a_3 + 2a_4 \overline{\ln d_{i,t}} + a_8 \overline{\ln q}_{i,t} + a_9 \overline{\ln w}_{i,t}) + \varepsilon_{i,t}^S. \end{aligned} \tag{8)'$$

Estimation of equations (7), (8)’, and (9), θ_t for regional banks is shown in Figure 6. Figure 6 resembles Figure 3, but close inspection reveals that the curve shifts downwards, so that θ_t took on a negative value in 1987. Estimates of θ_t for city banks are not reasonable and not presented: θ_t is negative for most of the period, and although it decreases until 1984, it rises after 1990 and takes almost the same value in the 1990’s as in the 1970s.

We construct the data of β as money plus reserves divided by deposits. The mean of β is about 0.1, which is much larger than the required reserve ratio. This implies that banks held large excess reserves. Our assumption of a constant reserve ratio is therefore irrelevant, which may be the reason we could not obtain reasonable results for city banks.

5.3 Adding a constant term

One might question why equation (8) has no constant term. Although the theory does not allow for a constant term, it is not unusual to include it in empirical analysis. The fact that there is no constant term may make θ critically dependent on the level of interest rates in equation (8).

The estimation with the addition of a constant term to equation (8) reveals that this speculation is wrong. The basic results, presented in Tables 3 and 4, and in Figures 2 and 3, are confirmed by the estimation with a constant term.

6. What Affects the Degree of Competition?

In this section, we investigate what factors relate to the degree of competition. In particular, clarifying which element of financial liberalization promoted competition in loan markets is an interesting agenda. As described in section 2, three important events are recognized in the financial liberalization in Japan, i.e., the emergence of a huge government bond market, the deregulation of deposit interest rates, and the deregulation of the segregation of business lines in the financial sector. We regress the degree of competition obtained in section 4 on variables representing these elements in order to find their influences. As a proxy for the first element, we employ the trading amount of government bonds (*BTRADE*). We adopt the ratio of time deposits with unregulated interest rates to the total time deposits (*FREEDEP*) as the data of the second element. The variable is calculated separately for city banks and regional banks.[17] As for the third element, we use a year dummy (*SEGDUM*), which takes the value of zero until 1993, and unity thereafter.

The degree of competition may be affected by various other factors, which should be added as explanatory variables in the regression equation. The first candidate for these factors is the effect of the business cycle. We use the composite index (*CIX*) to represent this factor. The real GDP growth rate (*GDP*) and inflation rates (*INFL*) are also examined as alternatives to *CIX*. The second element is the market structure of the loan market. The Structure-Conduct-Performance hypothesis predicts that the less concentrated the market, the more competitive it becomes. The efficiency structure hypothesis proposed by Demsetz (1973), however, predicts the opposite relationship. We use the Herfindahl index of city banks and regional banks (*HI*) as a measure of market concentration.

In view of these arguments, our regression equation is

$$\begin{aligned}\theta_{k,t} = \alpha_0 + \alpha_1 BTRADE_t + \alpha_2 FREEDEP_{k,t} + \alpha_3 SEGDUM_t \\ + \alpha_4 CIX_t (or\ GDP_t\ and\ INFL_t) + \alpha_5 HI_{k,t} + \alpha_6 REGDUM_k ,\end{aligned} \tag{10}$$

where k = city or regional banks, and *REGDUM* is the dummy variable representing regional banks.

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[17] For regional banks, only the data for the first regional banks are used, since the second regional banks were undergoing conversion from mutual banks, and the data was not available during 1989–1991.

The estimation results are shown in Table 5. The benchmark case using *CIX* is shown in the left columns. The coefficient of *BTRADE* is significantly negative at a 5% level, implying that the emergence of a government bond market promoted competition in loan markets. In contrast, the coefficients of *FREEDEP* and *SEGDUM* are not significant, suggesting that deregulation of deposit interest rates and the segregation of business lines did not promote competition in the loan markets.

The business condition, *CIX*, did not systematically affect the degree of competition. The coefficient of the Herfindahl index is not significant either. The coefficient of *REGDUM* is significantly positive, implying that competition among regional banks is laxer than that among city banks.

In the right columns, the results of the case where *GDP* and *INFL* substitute for *CIX* are shown. In this case, the coefficient of *INFL* is significantly positive at a 1% level, while that of *GDP* is insignificant. Thus, competition becomes laxer when the inflation rate is higher. The other results are the same as for the benchmark case.

In summary, the analysis of this section suggests the following. First, the emergence of the government bond markets promoted competition in loan markets, but the deregulation of deposit interest rates and the segregation of financial business lines did not have an impact on competition. Second, competition among regional banks is laxer than that among city banks. Third, the business conditions did not systematically affect the degree of competition except for the inflation rate. Nor did the market structure.

7. Conclusions

In this paper, we investigated whether competition in the Japanese banking sector has improved in the last quarter of the 20th century. By estimating the first order condition of profit maximization, together with the cost function and the inverse demand function, we estimated the degree of competition of city and regional banks. The results reveal that competition had improved during the 1970s and in the first half of the 1980s. This corresponds to the period where the secondary market for government bonds emerged. In support of this view, the follow-up analysis of the factors affecting the degree of competition demonstrates that the trading volume of the government bonds significantly affected the degree of competition.

The results also reveal that Cournot oligopoly cannot be rejected at a 5% significance level for city banks for most of the period, while the results do reject it for regional banks over the entire period. This suggests that competition among city banks was stronger than that among regional banks, which is consistent with our intuition.

The results are richer and more extensive than those obtained in earlier studies on the competitiveness of the Japanese banking sector, such as Molyneux, Thornton, and Lloyd-Williams (1996), and Alley (1993), which analyzed only a short period of time using different methods.

Souma and Tsutsui (2000) found that although competition in the Japanese life insurance industry became stronger after 1995, it was still close to perfect collusion in 1997. Kamesaka and Tsutsui (2002) found that the Japanese securities industry was in monopoly equilibrium in the 1980s and was in monopolistic competition equilibrium in the 1990s. In view of these results, the banking industry seems more competitive than the securities and life insurance industries in Japan.

Although most of the results were convincing, there is one question left unanswered: why did the degree of competition θ_t rise again after 1998? One possible interpretation is that Japanese banks suffered from huge non-performing loans in the 1990s, and that they have been faced with financial crisis since 1997.[18] Consequently, they do not have enough strength to compete with each other, and want to avoid severe competition, which often leads to a cut in their profits. The clarification of this speculation regarding laxer competition in the late 1990s should constitute an interesting study in the future.

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[18] Three large banks failed in 1997 and 1998.

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Table 1. Variation and Correlation of Loan Interest Rates and the Call Rate

	High growth period		Low growth period	
	Variation	Correlation	Variation	Correlation
Short term loan Interest rate	0.055	0.80	0.20	0.91
Call rate	0.21		0.25	

Note: The coefficient of variation is defined as the standard deviation over the mean. The high growth period is from December 1961 to December 1972, for which the number of observations is 133. The low growth period is from January 1973 to March 1983, for which the number of observations is 123.

Table 2. Descriptive Statistics

City banks

Variables	Mean	Standard Deviation	Minimum	Maximum
R	756262	542198	117803	2941256
P	0.059	0.020	0.020	0.105
C	205908	112701	38034	525323
q	14984300	11363200	1453931	43751900
d	17077500	11938000	1734864	46946000
r^d	0.041	0.017	0.001	0.101
w	8.404	2.738	3.135	15.126
ASL	111.432	354.046	8.224	2185.624
SMSF	0.478	0.133	0.040	0.785
OPL	0.740	0.086	0.190	0.945
Number of Observations		318		

Regional banks

Variables	Mean	Standard Deviation	Minimum	Maximum
R	47311	49299	2209	632901
P	0.058	0.019	0.005	0.094
C	20636	17365	817	128085
q	962380	1070126	25922	9040438
d	1229090	1340053	31388	9814217
r^d	0.031	0.015	0.002	0.060
w	6.278	1.951	1.167	11.899
ASL	12.079	5.389	3.384	51.748
SMSF	0.796	0.118	0.156	1.894
OPL	0.684	0.082	0.203	0.901
Number of Observations		3441		

Note: Refer to the main text for a definition of the variables. *R*, *C*, *q*, *d*, *w*, and *ASL* are measured in one million yen. *P*, r^d, *SMSF*, and *OPL* are ratios.

Table 3. Results of simultaneous estimation of eqs. (7), (8), and (9): city banks

Parameter	**MVR**		**3SLS**	
	Estimate	**P-value**	**Estimate**	**P-value**
θ **1974**	0.353	[.001]	0.297	[.006]
θ **1975**	0.348	[.001]	0.261	[.010]
θ **1976**	0.228	[.007]	0.178	[.046]
θ **1977**	0.208	[.013]	0.115	[.176]
θ **1978**	0.097	[.199]	0.016	[.850]
θ **1979**	0.125	[.047]	0.085	[.210]
θ **1980**	0.227	[.001]	0.157	[.011]
θ **1981**	0.245	[.000]	0.222	[.003]
θ **1982**	0.047	[.217]	0.001	[.985]
θ **1983**	0.094	[.026]	0.072	[.132]
θ **1984**	-0.025	[.446]	-0.045	[.262]
θ **1985**	0.041	[.208]	0.016	[.654]
θ **1986**	0.020	[.547]	0.002	[.951]
θ **1987**	-0.036	[.258]	-0.054	[.182]
θ **1988**	-0.002	[.941]	-0.026	[.458]
θ **1989**	-0.028	[.188]	-0.027	[.372]
θ **1990**	0.042	[.012]	0.023	[.223]
θ **1991**	0.108	[.000]	0.082	[.003]
θ **1992**	0.124	[.000]	0.101	[.004]
θ **1993**	0.184	[.000]	0.133	[.003]
θ **1994**	0.092	[.006]	0.057	[.117]
θ **1995**	-0.005	[.862]	-0.056	[.167]
θ **1996**	-0.024	[.475]	-0.050	[.296]
θ **1997**	-0.007	[.822]	-0.040	[.407]
θ **1998**	0.151	[.002]	0.136	[.044]
θ **1999**	0.262	[.000]	0.215	[.009]
θ **2000**	0.185	[.001]	0.152	[.024]
a_0	12.090	[.000]	12.094	[.000]
a_1	0.678	[.000]	0.947	[.000]
a_2	-0.677	[.326]	1.201	[.469]
a_3	0.110	[.166]	-0.113	[.629]
a_4	-1.928	[.007]	0.311	[.860]
a_5	-0.459	[.000]	-0.545	[.000]
a_6	-0.099	[.611]	-0.171	[.741]
a_7	0.412	[.148]	-0.893	[.255]
a_8	1.308	[.059]	-0.697	[.681]
a_9	-0.540	[.061]	0.687	[.396]
b_0	5.917	[.014]	5.995	[.032]
b_2	1.053	[.000]	1.063	[.000]
b_3	0.000	[.780]	0.000	[.633]
b_4	-0.291	[.000]	-0.294	[.000]
b_5	0.070	[.470]	0.109	[.262]
$1/\eta$ **1974**	0.707	[.000]	0.715	[.000]
$1/\eta$ **1975-76**	0.710	[.000]	0.718	[.000]
$1/\eta$ **1977-78**	0.723	[.000]	0.731	[.000]
$1/\eta$ **1979-80**	0.709	[.000]	0.717	[.000]
$1/\eta$ **1981-82**	0.700	[.000]	0.708	[.000]
$1/\eta$ **1983-84**	0.704	[.000]	0.712	[.000]
$1/\eta$ **1985-86**	0.709	[.000]	0.717	[.000]
$1/\eta$ **1987-88**	0.711	[.000]	0.719	[.000]
$1/\eta$ **1989-90**	0.691	[.000]	0.698	[.000]
$1/\eta$ **1991-92**	0.691	[.000]	0.699	[.000]
$1/\eta$ **1993-94**	0.712	[.000]	0.719	[.000]
$1/\eta$ **1995-96**	0.729	[.000]	0.737	[.000]
$1/\eta$ **1997-98**	0.736	[.000]	0.743	[.000]
$1/\eta$ **1999-00**	0.747	[.000]	0.755	[.000]
R^2 for (7)	0.961		0.951	
R^2 for (8)	0.843		0.852	
R^2 for (9)	0.949		0.950	

Table 4. Results of simultaneous estimation of eqs. (7), (8), and (9): regional banks

Parameter	**MVR**		**3SLS**	
	Estimate	**P-value**	**Estimate**	**P-value**
θ **1974**	0.624	[.000]	0.380	[.000]
θ **1975**	0.511	[.000]	0.274	[.000]
θ **1976**	0.473	[.000]	0.226	[.000]
θ **1977**	0.365	[.000]	0.137	[.000]
θ **1978**	0.407	[.000]	0.165	[.000]
θ **1979**	0.487	[.000]	0.261	[.000]
θ **1980**	0.389	[.000]	0.247	[.000]
θ **1981**	0.264	[.000]	0.135	[.000]
θ **1982**	0.334	[.000]	0.200	[.000]
θ **1983**	0.323	[.000]	0.193	[.000]
θ **1984**	0.239	[.000]	0.142	[.000]
θ **1985**	0.242	[.000]	0.160	[.000]
θ **1986**	0.259	[.000]	0.187	[.000]
θ **1987**	0.180	[.000]	0.148	[.000]
θ **1988**	0.337	[.000]	0.307	[.000]
θ **1989**	0.365	[.000]	0.335	[.000]
θ **1990**	0.282	[.000]	0.283	[.000]
θ **1991**	0.337	[.000]	0.314	[.000]
θ **1992**	0.338	[.000]	0.304	[.000]
θ **1993**	0.274	[.000]	0.246	[.000]
θ **1994**	0.392	[.000]	0.376	[.000]
θ **1995**	0.285	[.000]	0.316	[.000]
θ **1996**	0.391	[.000]	0.413	[.000]
θ **1997**	0.381	[.000]	0.417	[.000]
θ **1998**	0.563	[.000]	0.555	[.000]
θ **1999**	0.693	[.000]	0.698	[.000]
θ **2000**	0.720	[.000]	0.722	[.000]
a_0	9.637	[.000]	9.635	[.000]
a_1	0.178	[.000]	0.575	[.000]
a_2	0.316	[.000]	0.837	[.000]
a_3	0.698	[.000]	0.288	[.000]
a_4	0.146	[.102]	0.807	[.000]
a_5	-0.263	[.000]	-0.239	[.000]
a_6	-0.393	[.000]	-0.140	[.358]
a_7	0.226	[.000]	-0.672	[.000]
a_8	-0.251	[.004]	-0.809	[.000]
a_9	-0.180	[.007]	0.525	[.001]
b_0	3.331	[.000]	3.448	[.000]
b_2	0.360	[.000]	0.356	[.000]
b_3	-0.005	[.000]	-0.006	[.000]
b_4	0.353	[.000]	0.318	[.000]
b_5	-0.019	[.454]	-0.071	[.008]
$1/\eta$ **1974**	0.428	[.000]	0.430	[.000]
$1/\eta$ **1975-76**	0.427	[.000]	0.428	[.000]
$1/\eta$ **1977-78**	0.436	[.000]	0.437	[.000]
$1/\eta$ **1979-80**	0.429	[.000]	0.431	[.000]
$1/\eta$ **1981-82**	0.424	[.000]	0.425	[.000]
$1/\eta$ **1983-84**	0.425	[.000]	0.427	[.000]
$1/\eta$ **1985-86**	0.427	[.000]	0.428	[.000]
$1/\eta$ **1987-88**	0.433	[.000]	0.435	[.000]
$1/\eta$ **1989-90**	0.421	[.000]	0.423	[.000]
$1/\eta$ **1991-92**	0.417	[.000]	0.420	[.000]
$1/\eta$ **1993-94**	0.434	[.000]	0.437	[.000]
$1/\eta$ **1995-96**	0.453	[.000]	0.455	[.000]
$1/\eta$ **1997-98**	0.461	[.000]	0.463	[.000]
$1/\eta$ **1999-00**	0.466	[.000]	0.468	[.000]
R^2 for (7)	0.980		0.975	
R^2 for (8)	0.964		0.966	
R^2 for (9)	0.939		0.939	

Table 5. Effects on the Degree of Competition

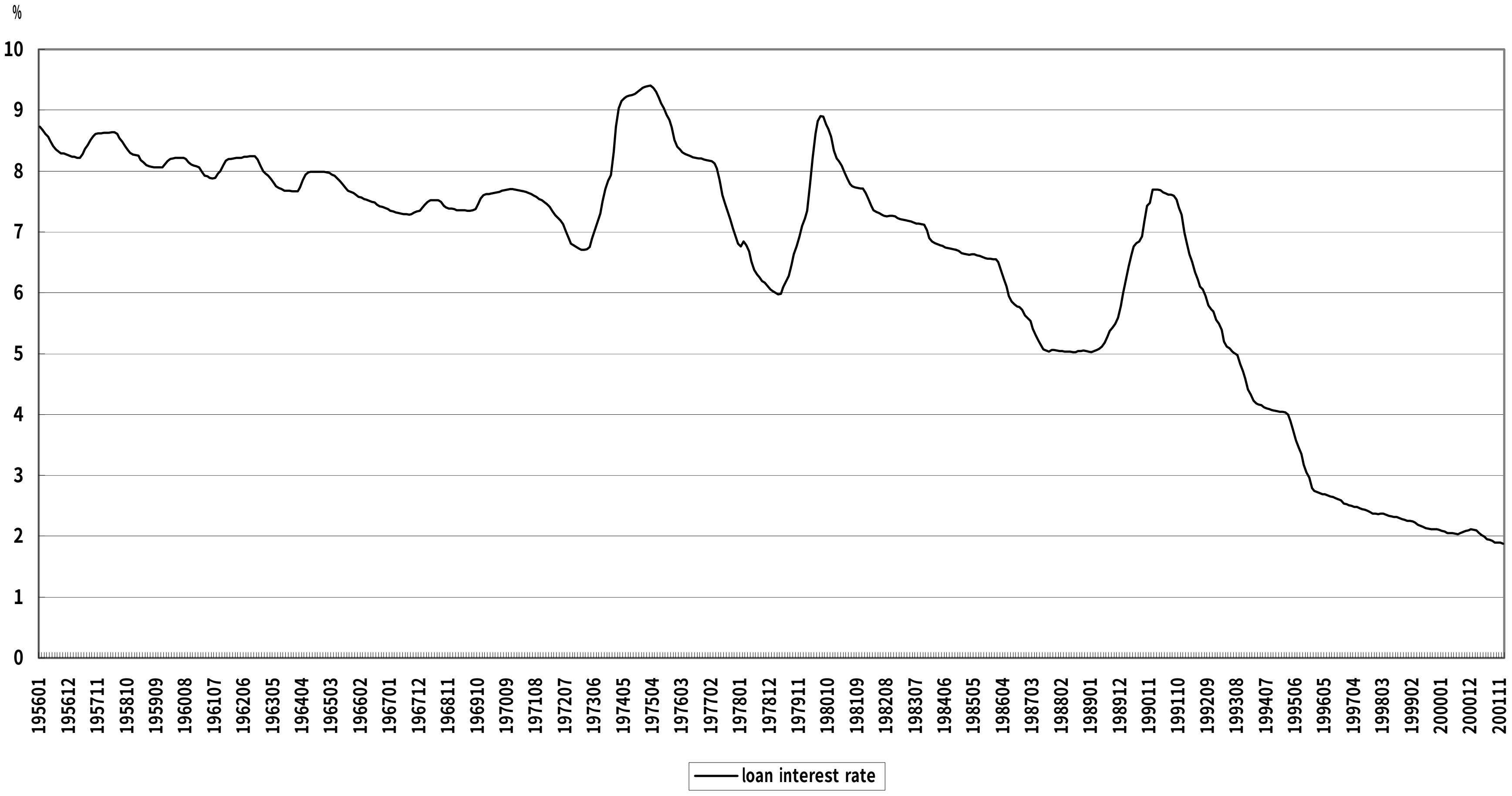
	Basic equation		GDP & INFLATION	
Variable	Coefficient	P-value	Coefficient	P-value
constant	0.426	[.015]	0.074	[.184]
BTRADE	$-1.87\text{x}10^{-9}$	[.021]	$-1.544\ \text{x}10^{-9}$	[.025]
FREEDEP	0.056	[.441]	0.012	[.832]
SEGDUM	-0.011	[.861]	0.063	[.261]
CIX	-0.003	[.108]		
GDP			-0.379	[.637]
INFL			1.294	[.003]
HI	0.161	[.419]	0.167	[.369]
REGDUM	0.294	[.000]	0.293	[.000]
Adjusted R^2	0.682		0.724	

Note: Equation (10),

$$\theta_{k,t} = \alpha_0 + \alpha_1 BTRADE_t + \alpha_2 FREEDEP_{k,t} + \alpha_3 SEGDUM_t + \alpha_4 CIX_t\,(or\,GDP_t\ and\ INFL_t) + \alpha_5 HI_{k,t} + \alpha_6 REGDUM_k\,,$$

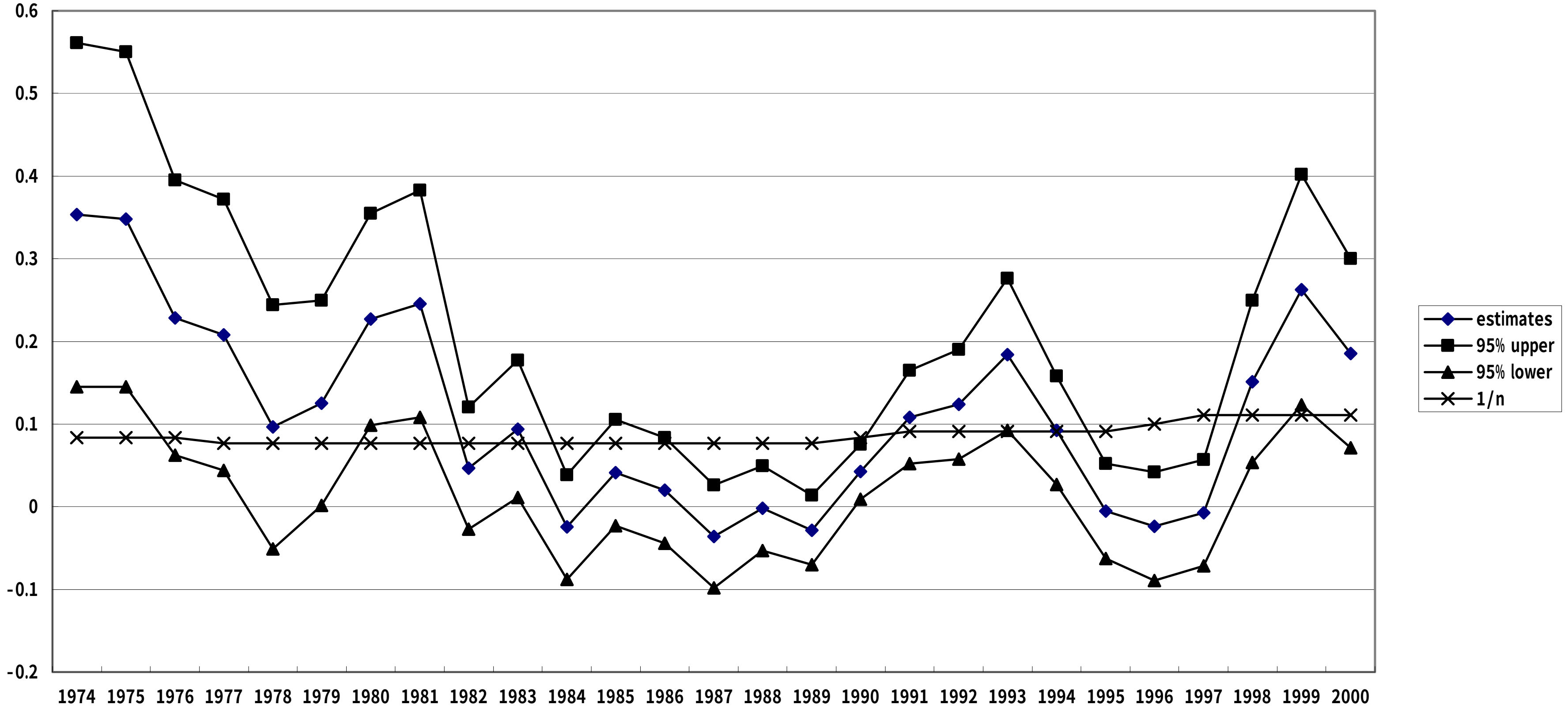
is run by Ordinary Least Squares to find the magnitude of the effects of the variables on the degree of competition. The number of observations is 54. For a definition of the explanatory variables, refer to the main text.

Figure 1. Loan Interest Rate



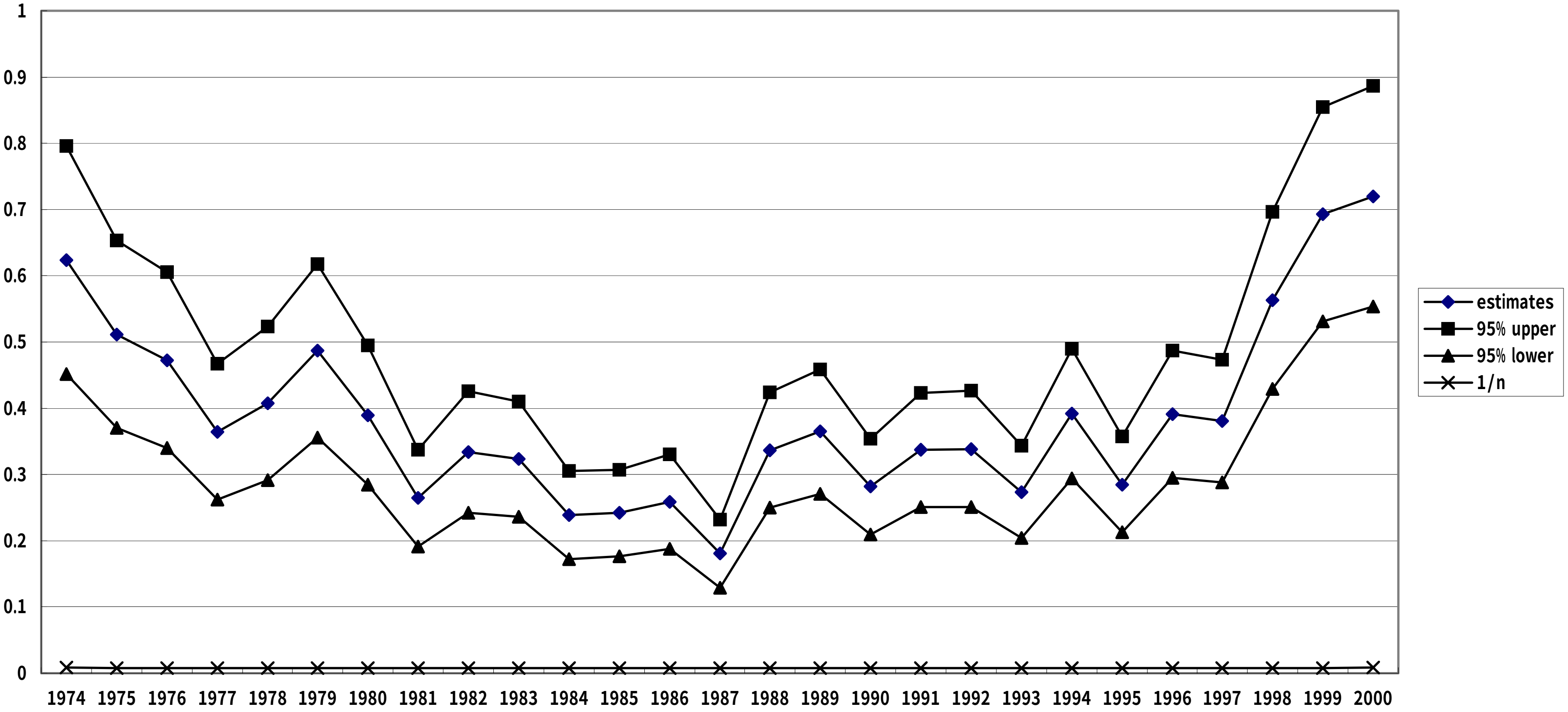
Note: Average contracted interest rates on loans of all banks are shown.

Figure 2. Estimates of θ_t for city banks



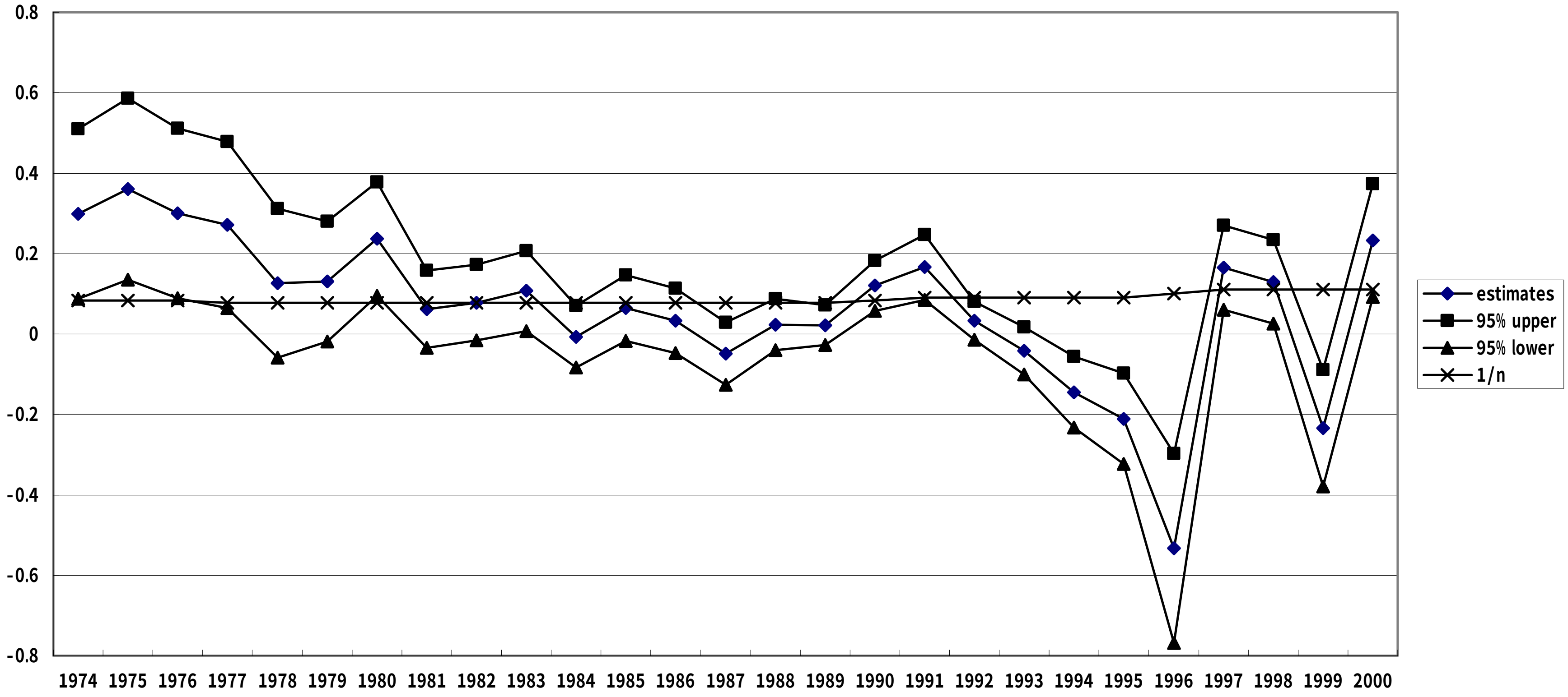
Note: MVR estimates of θ_t in Table 2 are shown with their 95% confidence interval. Line of 1/n corresponds to Cournot oligopoly, and line at zero to perfect competition.

Figure 3. Estimates of θ_t for regional banks



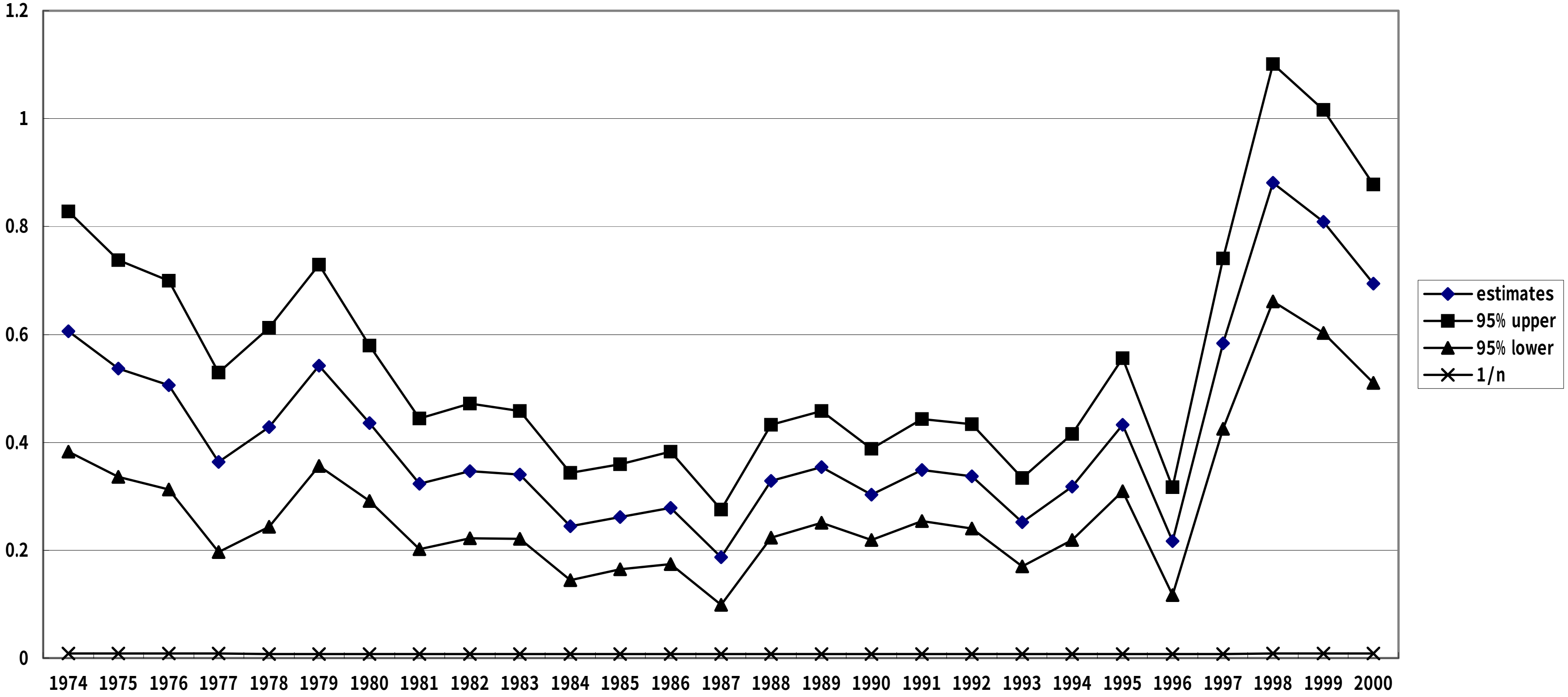
Note: MVR estimates of θ_t in Table 3 are shown with their 95% confidence interval. Line of 1/n corresponds to Cournot oligopoly, line at zero to perfect competition, and line at unity to joint profit maximization.

Figure 4. Estimates of θ_t for city banks, with r^d in eq. (8) being the cost of capital



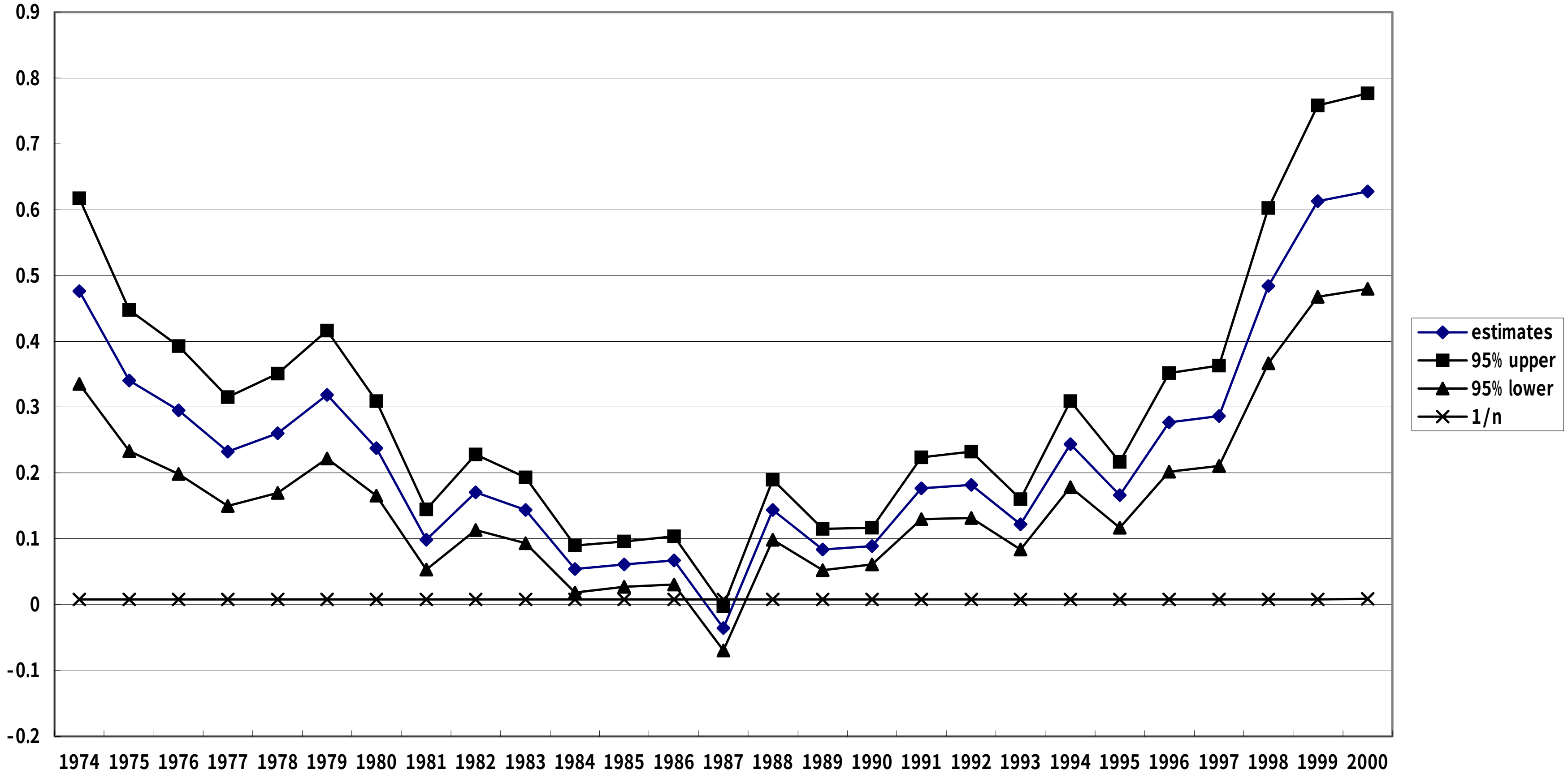
Note: MVR estimates of θ_t for city banks are shown with their 95% confidence interval. While r^d in eq. (8) is the deposit interest rate in Figures 2 and 3, the cost of capital is used for the data of r^d in the estimation of this Figure.

Figure 5. Estimates of θ_t for regional banks, with r^d in eq. (8) being the cost of capital



Note: MVR estimates of θ_t of regional banks are shown with their 95% confidence interval. While r^d in eq. (8) is the deposit interest rate in Figures 2 and 3, the cost of capital is used for the data of r^d in the estimation of this Figure.

Figure 6. Estimates of θ_t for regional banks: bank reserves are considered in eq. (8)'



Note: Results based on the simultaneous MVR estimation of eqs. (7), (8)', and (9) are shown.