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AN EMPIRICAL ANALYSIS OF JAPANESE BANKING BEHAVIOR IN A PERIOD OF FINANCIAL INSTABILITY

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Abstract: In this paper, we undertake to analyze the bank behavior in Japan during the period of financial instability between 1982 and 1995. We focus attention on empirically uncovering some factors which may have potentially initiated and sustained instability in the level of loans extended by the Japanese banking industry. The development in this paper revolves around the following items. First, (a) we document evidence against profit-maximization and in favor of the fact that the Japanese banks in fact tended to supply loans beyond profit-maximization levels, thus accentuating the excess loan problem. Second, (b) the Japanese banks have recognized—certainly during the instability period, existence of interdependence (externalities) among themselves with reference to loan supply decisions. We explore how the Cournot-type conjectural variation we consider, which engenders interdependence, has induced banks to indulge in aggressive loan expansion. Third, (c) we examine the bearing of the call lending rate on the financial instability. Fourth, (d) following the lead of several previous works, we investigate whether the capital requirement of the Basle Accord helped curtail loan levels. Finally, (e) we look at the impact of the land price on loan, both from the demand side and the supply side; study of the demand side is made possible by our use of an aggregate loan demand function, absent in most previous works.

Key words: Japanese banking behavior, Share maximization, Interdependence among banks.

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1. INTRODUCTION

In this paper, we undertake to analyze the bank behavior in Japan during the period of financial instability. We focus attention on empirically uncovering some factors which may have potentially initiated and sustained instability in the level of loans extended by the Japanese banking industry. We take the instability period to extend from 1982 to 1995.

Several studies have previously explored potential determinants of the banking instability phenomenon in Japan under alternative choices of the instability period, data sets, and model specifications—see, e.g., Noma (1986), Ito and Sasaki (2002), Rhodes and Yoshino (1999), Boone (2001), Horie (2001), Hanazaki and Horiuchi (2002), Honda (2002), Woo (2003) and Watanabe (2005); also see the relevant references therein. From our prospective, a main feature of the previous works is that they have invariably tended to carry out the analyses in regression frameworks. As recognized in some of these works, regression models cannot enable the researcher to distinguish between the 'supply-side factors' and the 'demand-side factors'; in studies of this sort, it is highly desirable to be able to isolate the two sets of factors. We remedy this by expressly opting for a two-equation structural system. The system is comprised of an aggregate loan demand equation and a disaggregated individual bank supply equation assumed to be common to all the banks. This permits us, for example, to separate out and quantify the impact of the land price on total loan emanating from the supply side and the demand side.

The development in this paper revolves around the following items. First, (a) it is allegedly contended in private circles that the banks may not have acted as profit-maximizers but rather may have aggressively sought to supply loans beyond the profit-maximizing levels. Acting to shed light on this possibility, we formulate the individual bank supply equation by assuming that banks follow a goal more general than profit-maximization. The supply function readily offers a test of profit-maximization as a test of whether a certain slope coefficient in it is zero. We document evidence against profit-maximization and in favor of the fact that banks in fact tended to supply loans beyond profit-maximization levels, thus accentuating the excess loan problem. Most previous works assume, at least implicitly, that the banks pursue maximum profits. A notable exception to this is Noma (1986) where profit-maximization is an item to be tested; the test details there however differ from ours. Second, (b) it is often contended, again in informal discussions among bankers and scholars, that the Japanese banks have long recognized—certainly during the instability period—existence of interdependence (externalities) among themselves with reference to loan supply decisions. [The phenomenon is often called "Yokonarabi" in Japanese.] This is a new item never before discussed in this literature. We offer a test of this contention in the context of the supply equation, again as a test of whether a specific coefficient in it is zero; the coefficient is of the rivals' previous period aggregate loan amount whose presence in the supply equation signals existence of interdependence. We also explore how this rivals' aggregate loan induced banks to indulge in aggressive loan expansion. Third, (c) we examine the bearing of the call lending rate on the financial instability, a theme explored earlier in some detail in Rhodes and Yoshino (1999). We find that this variable was a very promising instrument available for the monetary authority for purposes of reigning in the loan expansion but was not used effectively, thus exasperating the crisis. Fourth, (d) following the lead of several of the above-noted works, we investigate whether the capital requirement of the Basle Accord helped curtail loan levels. Finally, (e) we look at the impact of the land price on loan, both from the demand side and the supply side.

The sample period we consider in this study runs from 1982 to 1995 inclusive. The choice of this period is influenced, in most part, by the developments on both ends of the time span. First, the late 1970's were marked by strong government regulation of the banking industry, and the foreign capital controls were lifted in 1980. Also, with reference to the upper end of the chosen period, it was the case that 1997 and the period immediately thereafter witnessed a severe domestic financial crisis, and the accompanying currency crisis in South East Asia only made matters worse for the Japanese economy. Indeed, in 1998, some of the banks included in the present study filed for bankruptcy, and some others entered into mergers. This explains our choice of the sample period for consideration in this study. Furthermore, most experts agree that our chosen period consists of two sets of sub-periods marked by different sets of developments: 1982–1989 (Period I), and 1990–1995 (Period II). In Period I, for example, the land price and the Nikkei Stock price increased steadily—the former from 29.4 in 1982 to 104.1 in 1990, and the latter from 7,531Yen to 34,968Yen. Concurrently also, loans expanded very rapidly over this period. This is because the banks used land as collateral whose value had increased sharply. By contrast, the stock price started to decline precipitously over Period II, indeed from 26,872Yen to 19,868Yen, when the Bank of Japan raised its call lending rate in December 1989. As a result, the growth of the bank loan supply began to decrease. Figure 1A (in Appendix A) captures these phenomena.

Our empirical analysis will recognize this dichotomy, by allowing for different reaction coefficients over the two periods for select regressor variables in the loan supply and loan demand functions.

The plan of the paper is as follows. Section 2 formally develops the banks' loan supply function based on the aggregate loan demand function and a common individual bank's cost function. The precise formulation of the supply function is also of independent interest, as it suggests expedient ways of developing rich enough frameworks within which to test the profit-maximization hypothesis; see, in particular, footnote 3. Section 3 provides the list of the banks included in the analysis, their data and the data sources. Section 4 is empirical, which collects and discusses the empirical evidence relating to the bank behavior. Section 5 concludes the paper.

2. THE FRAMEWORK

A. *Formulation*

We work with a two-equation structural system consisting of a loan demand (DD) equation and a loan supply (SS) equation. First, we assume an aggregate DD equation given by

$$r = f(X) - d_2 Q\,, \quad d_2 > 0 \tag{2.1}$$

where r = loan rate, Q = total loan demanded, X denotes a set of predetermined variables (not including Q or individual bank loan supply, q_i) which are common to all borrowers and all lenders and $f(.)$ is linear in the argument. We spell out our choice of X shortly below.

Next, we deduce the individual bank's SS equation as follows. Let q_i be the ith bank's loan supply and $Q_i = Q - q_i$ be the amount supplied by its rival banks, $i = 1, 2, \ldots. N$. Then, given Q_i, the ith bank's (anticipated) marginal revenue function is [1]

$$\begin{aligned} MR_i &= \frac{d}{dq_i}[q_i(f(X) - d_2(q_1 + Q_1)] \\ &= f(X) - d_2 Q_i - 2d_2 q_i \\ &= r - d_2 q_i\,, \quad i = 1, \ldots, N\,. \end{aligned} \tag{2.2}$$

Further, we take the total cost function of the i-th bank as

$$TC_i = c_{0i} + c_{1i} q_i + (1/2) c_2 q_i^2$$

so that its marginal cost function is

$$MC_i = c_{1i} + c_2 q_i\,. \tag{2.3}$$

We assume that the intercept term of the MC function depends on some relevant variables other than q_i. In particular, since an important element of the marginal cost for a bank is the call rate (CR)[2], we take the intercept as[3]

$$c_{1i} = CR + F(Z_i, S) \tag{2.4}$$

where $F(\,,\,)$ is a function of Z_i, the predetermined variables specific to the i-th bank and of S, the predetermined variables common to all banks. We spell out our choice of Z_i and S shortly below, but point out for now that functional dependence of c_{1i} on predetermined variables makes for fairly flexible total cost functions.

[1] The result in (2.2) assumes that banks correctly anticipate rival banks' loan supply amount Q_i. This perfect foresight assumption, while not uncommon in microeconomic practice, is not entirely essential in our analysis but is convenient for expository purposes. Thus suppose the typical bank expects rivals' total supply to be Q^*. Given its own supply of q, its expectation of the current loan rate is $r^* = f(x) - d_2(Q^* + q)$, and hence its expectation of the marginal revenue is $MR^* = r^* - d_2 q$. In the text, we treat r as endogenous. Consequently, it is evident from (2.5) that the usual erros-in-variables formulation: $r = r^* + e$ (measurement error) will produce a version of the supply function (2.5) which, in particular, would lead to the same empirical results as obtained in the text. The formulation of r is of course equivalent to the formulation: $Q = Q^* + w$ (measurement error) in the usual errors-in-variables fashion.

[2] The CR is popularly known in the US as the federal funds rate.

[3] As will become clearer later, the specification in (2.4)—in particular, the dependence of c_1 on variables of the type Z_i and S—permits one to entertain a variety of patterns of interdependence/externalities among participating agents (banks) without unduly complicating the analysis. The device exemplified by (2.4) is reminiscent of the "tricks" used by Gorman (1976) in extending the consumer analysis through inclusion of variables other than commodities in the utility function.

Finally, we assume that the banks follow a goal which subsumes profit-maximization as a special case. Specifically, we assume that each operates by the rule: $MC = MR(1+\theta)$ where θ is a scalar; the rule signals profit-maximization when θ is zero. Under this rule, one can find from (2.2)–(2.4) that the loan supply function of the i-th bank is given by

$$q_i = \frac{1+\theta}{g}r - \frac{CR}{g} - \frac{F(Z_i, S)}{g} \tag{2.5a}$$

$$= \frac{1+\theta}{g}(r - CR) + \frac{\theta}{g}CR - \frac{F(Z_i, S)}{g} \tag{2.5b}$$

where $g = c_2 + d_2(1 + \theta)$. It is evident from (2.5b) that the profit-maximization hypothesis ($\theta = 0$) is equivalent to

$$H_0 : \theta/g = 0 \quad (g \neq 0)\,.$$

Accordingly, we will test the hypothesis by testing whether the coefficient of CR in (2.5b) is zero.[4]

B. Stochastic Specification

We implement the supply function as a two-way random effects error-component model with an additive disturbance term, which for the i-th bank at time t is given by

$$u_{it} = \mu_i + \lambda_t + v_{it}\,, \quad i = 1, \ldots, N; \;\; t = 1, \ldots, T\,,$$

where the μ's are bank-specific; the λ's are time-specific; and the v's are the white noise disturbances. Usual stochastic assumptions about the error components apply.[5]

We take the function F in (2.5b) to be linear in Z_i and S, assumed to be predetermined variables. The explanatory variable r is endogenous, assumed to be correlated with all the three error components. The supply function is thus treated as a structural error component model.

The predetermined variables at time t are Z_{it} and S_t. Z_{it} consists of variables which vary across individuals and S_t consists of variables which are specific to time t. We take Z_{it} as consisting of;

DEP_{it} = deposits of the i-th bank (including certificates of deposits)
MS_i = initial market share of the i-th bank in 1981 as a fraction of total loan of all the banks in the sample
= (q_i, 1981/$\sum q_i$,1981)
BIS_{it} = BIS capital ratio of i-th bank (=Capital/Risk Adjusted Capital)
$Q_{i(t-1)}$= total loan of the i-th bank's rivals in period $t - 1 = Q^*_{it}$

[4] Strictly speaking, the profit-maximization hypothesis asserts that the net coefficient of CR and the coefficient of r in (2.5b) are equal with opposite signs, or that coefficients of CR and r in (2.5a) are equal with opposite signs.

[5] We opted to employ a random effects (RE) model in preference to the fixed effects (FE) model in light of the empirical result in favor of the former specification. This is evident from Table 1 where the Hausman statistic, used to test the RE against the FE, strongly suggests acceptance of the RE in as much as the p-value is much larger than 0.05, the usual level of significance.

where Q^*_{it} is formally the i-th bank's expectation of its rivals' total loan for the current period t, which for simplicity is taken to be equal to $Q_{i(t-1)}$. Observe that the presence of the regressor Q^*_{it} in the SS function underscores interdependence among banks,[6] and also signals Cournot type behavior on the part of the banks. Further, we take S_t as consisting of;

LP_t = Land price

CR_t = call lending rate (which is the short term interest rate controlled by the Bank of Japan).

We allow for the possibility that some of these variables may have different coefficients in Period I (1982–1989) and Period II (1990–1995). Specifically, we estimate the model in the form

$$\begin{aligned} q_{it} &= a_0 + a_1 DEP_{it} + a_2 MS_i + a_3 BIS_{it} + a_4 Q^*_{it} + a_5 CR_t \\ &\quad + a_6(r - CR)_t + a_7 LP_t + u_{it} \end{aligned} \tag{2.6a}$$

in Period I, and

$$\begin{aligned} q_{it} &= a_0 + a_1 DEP_{it} + a_2 MS_i + a_3 BIS_{it} + b_4 Q^*_{it} + b_5 CR_t \\ &\quad + b_6(r - CR)_t + b_7 LP_t + u_{it} \end{aligned} \tag{2.6b}$$

in Period II, assuming different coefficients on Q^*_{it}, CR_t, $(r - CR)_t$ and LP_t over the two periods. The subscripts 'i', 't'and 'it' indicate that the variables in question vary over the corresponding domains. Thus the supply function (2.6a–2.6b) we implement exhibits interdependence among the banks through inclusion of Q^*_{it} and also signals potential structural change from Period I to Period II. Note that—see (2.5b)—the coefficients a_5 and b_5 are of the form: θ/g , and a_6 and $b_6$are of the form: $(1+\theta)/g$.

Finally as regards the aggregate demand function (DD) in (2.1), we take $f(.)$ as linear in the land price variable (LP) to obtain the empirical version of the DD as

$$r_t = d_0 + d_1 LP_t - d_2 Q_t + v_t$$

Again allowing two different coefficients on LP in the two subperiods we finally take this empirical version as:

$$r_t = d_0 + h_1 LP_t - d_2 Q_t + v_{1t} \quad \text{in Period I} \tag{2.7a}$$

$$r_t = d_0 + h_2 LP_t - d_2 Q_t + v_{2t} \quad \text{in Period II} \tag{2.7b}$$

where v_{1t}, v_{2t} are zero mean, constant variance disturbances distributed independently overtime.

Thus the framework employed here consists of the SS function in (2.6a)–(2.6b) and the DD function in (2.7a)–(2.7b).

[6] Revankar and Rupert (1992) have previously considered interdependence of this sort in a "returns to schooling" regression model implemented in a panel data context.

3. DATA AND DATA SOURCES

The present study analyzes the SS and DD functions using a panel data set on N=14 banks in Japan, for T=14 years from 1982 to 1995; we also have occasion to use data on the banks' loan shares in the initial period 1981. We focus attention on the city banks and the long-term credit banks; in particular, we abstain from the trust banks as these are behaviorally different. Banks included here are;

Daiichi Kangyo Bank,
Sakura Bank,
Fuji Bank,
Mitsubishi Bank,
Asahi Bank,
Sanwa Bank,
Sumitomo Bank,
Daiwa Bank,
Tokai Bank,
Hokkaido Takushoku Bank,
Bank of Tokyo,
Industrial Bank of Japan,
Long term Credit Bank,
Nippon Credit Bank.

Data on q_{it}, DEP_{it}, MS_i, BIS_{it} are obtained from Zenkoku Ginko Zaimu Shohyo Bunseki (Financial Statement of All banks), Federation of Bankers Association of Japan. Also data on LP_t, CR_t and r_t are taken from Economic Statistics Annual, Bank of Japan, and Economic Statistics Monthly, Bank of Japan, 1982 January–1996 March.

4. EMPIRICAL EVIDENCE

We now turn to implement the SS-DD framework to the panel data set noted in the previous section. We point out at the outset, however, that the interpretations of the results offered here are at best only suggestive as the sample size at hand is rather small. Following convention we assume that the data are arranged first by banks and then overtime.

We estimate the SS in (2.6a) and (2.6b) by generalized 2SLS which takes into account the covariance structure of the component disturbances. The instrument set used for the purpose is an NT-rowed matrix whose columns feature observations on all the predetermined variables appearing in the SS, augmented by an $NT \times 1$ column of observations on Q_{t-1} which is omitted from the SS; it is assumed that the SS is identified through exclusion of Q_{t-1} from it. Specifically, the IV matrix used is

$$IV_{ss} = \{(DEP)_{it}, (MS)_i, (BIS)_{it}, \{(Q)_{i(t-1)}\}I, \{(Q)_{i(t-1)}\}II, \{(CR)_t\}I, \{(CR)_t\}II, \{(LP)_t\}I, \{(LP)_t\}II; (Q)_{t-1}\}$$

where the subscripts indicate that the variables in question vary only over the corresponding domains; columns with the additional subscript 'I' ('II') permit this variation

Table 1. Estimated loan supply function (SS equation)*

Dependent Variable q_{it} (bankloan)	Period I (1982–1989)		Period II (1990–1995)
DEP_{it} (Bank deposit)		0.658	
		(19.69)	
MS_i (Market Share)		0.426	
		(1.48)	
$r_t - CR_t$ (Loan Rate –Call Rate)	16.298		21.351
	(2.611)		(3.028)
CR_t (Call Rate)	8.564		6.755
	(2.568)		(2.904)
BIS_{it} (BIS-ratio)		8.658	
		(2.353)	
$Q^*_{it} = Q_{i(t-1)}$	0.066		0.038
(Rival Bank's Previous Period Loan)	(3.675)		(2.333)
LP_t (Land Price)	0.123		−1.760
	(2.546)		(−1.449)
Constant		−36.302	
		(−0.874)	
Adjusted-R^2 0.892, Hausman Statistic, CHI-SQUARE=0.923, P-Value=0.820			

* Figures in parentheses are t-values.

only over subperiod I (II), and contain zero elements in subpoeriod II (I). We use the TSP version 4.5 in executing the generalized 2SLS after replacing the endogenous variable r by its LS estimate obtained from its regression on IV_{ss}. Further, we estimate the DD in (2.7a)–(2.7b) by simple 2SLS using the T-rowed instruments matrix;

$$IV_{dd} = \{[(LP)_t]I, (LP)_t II, (Q)_{t-1}\}$$

where the notation used is by now obvious.[7]

Table 1 presents estimates of the supply function (2.6a–2.6b). In discussing these results, we focus attention primarily on the issues of: (a) interdependence among banks, (b) effectiveness of the call lending rate (*CR*) as a monetary policy instrument, (c) the role of the land price (*LP*) both from the demand side and the supply side, (d) whether the banks pursued the goal of profit-maximization and (e) the effectiveness of the *BIS* capital requirement ratio—issues highlighted in Section 1.

We begin by first noting that the coefficient estimates are for the most part significant, and have expected signs. There is also evidence that the loan supply function underwent

[7] We have of course deemed IV_{dd} to be a natural choice. One might consider using additional instruments obtainable by resorting to aggregation over banks in the SS context. One may thus wish to use the extended *IV* set given by (in obvious notation): $IV^*_{dd} = (IV_{dd}; \sum DEP_{it}, \sum BIS_{it}, CR_t)$. We have in fact exercised this option, but were lead to results almost identical to those reported in Table 2: Indeed, the coefficient on Q was 0.028, on *LP* in Period I was 0.055 and on *LP* in Period II was 0.087. Compare Table 2.

a structural change from Period I to Period II. Indeed, the coefficients of Q^*_{it} and $(r_t - CR_t)$ have been different between the two periods: We have in fact separately verified that the t-values for testing $a_4 - b_4 = 0$ (relating to Q^*_{it}) and $a_6 - b_6 = 0$ (relating to $(r_t - CR_t)$) are (respectively) -4.298 and 4.451 which are significant even at the 1% level of significance. Further, the t-value for testing $a_5 - b_5 = 0$ (relating to CR_t) is -1.706 which is significant at the 10% level of significance.[8] It seems safe to conclude that the *LP* variable too has different coefficients in the two periods in as much as the estimate of a_7 is , while that of b_7 is not, significantly different from zero; we have not computed the relevant t-value.

(a) Interdependence

The possible existence of interdependence/externalites in our model is signaled by the presence of the Q^*_{it} variable, which is what the ith bank thinks the rivals will supply in period t; following a version of the so-called Cournot oligopoly model discussed extensively in the literature, we have set $Q^*_{it} = Q_{i(t-1)}$ = rivals' previous period supply of loan. Table 1 above shows that individual bank behavior is subject to interdependence, in as much as the coefficients of this variable are significant in both periods, the respective t-values, being 3.675 and 2.333. Some additional features of these coefficients are also worth noting. First, the coefficients in both periods are positive. This indicates that a bank's current period loan expansion was fueled by the previous period expansion by its rivals, thus making for a spirited expansion of total supply. Second, the coefficient in Period I is larger than in Period II, being 0.066 and 0.038, respectively. This supports the accepted view that the expansion in Period I proceeded at a higher rate than in Period II. Third, the significant Period-II coefficient indicates that the aggregate loan did proceed to expand even after the burst of the bubble in 1990. Figure 1A (in Appendix A) confirms this expansion phenomenon over Period II at the aggregate level, though expansion is more gradual over the period.

In all this, one gets the impression that the banks were more concerned with loan expansion, and not necessarily with profit-maximization. Indeed, it will be seen shortly below that evidence supports the view that the banks in fact abandoned maximum profits goal.

(b) Influence of the Call Lending Rate

In Period I, the coefficient of $(r - CR)$ is 16.298 and that of *CR* is 8.564, so the net coefficient on *CR* is -7.736. Likewise we find the net coefficient of *CR* in Period II to be -14.595. Both of these net coefficients are also significantly different from zero, the corresponding t-values being -2.654 and -3.087, respectively.

It is evident therefore that the *CR* was available as an effective policy instrument over the two periods. The monetary authority indeed exploited this fact to control the loan supply. However, in order to encourage domestic demand, it is known that the monetary authority lowered the *CR* too much in Period I, which inevitably prompted

[8] Here and elsewhere, the t-values which are not exhibited in the tables of the text, were computed separately by making them as part of the computer printout under suitably modified but equivalent versions of the SS equation. Details can be obtained from the authors.

Table 2. Estimate of aggregate loan demand equation (DD equation)*

Dependent Variable= r	
Const	8.777
	(10.14)
Q_t	−0.029
	(−4.55)
LP_t (in Period I)	0.056
	(3.85)
LP_t (in Period II)	0.088
	(3.87)
$R^2 = 0.695$, $Q_t = \sum q_{it}$	LP_t =Land Price

* Figures in parentheses are t-values.

the rapid growth of the loan supply over this period. On the other hand, the authority raised the *CR* considerably in the first part of Period II, which again explains why loan supply dried up beyond some point over this period.

(c) Influence of the Land Price (LP)

Consider first Period I, and also consult Table 2 which presents 2SLS estimates of DD coefficients. The coefficient of *LP* in the DD is positive and significant—0.056 (t=3.854) and the coefficient of *LP* in the SS equation is also positive and significant—0.124 (t= 2.546). It is conspicuously evident, therefore, that this period experienced a rapid growth in total loans in the face of rising *LP* levels, the growth being fueled by both the upward shifts in the DD (in the (r, Q) plane) and the downward shifts in the SS (in the (r, q) plane). In a way, the borrowers were on the side of the lenders, both relying on land as the collateral because of the rising *LP*.

Next consider Period II. The coefficient of *LP* in the DD in Table 2 is again positive and significant—0.88 (t=3.87), which shows that borrowers began contracting loan demand in the face of falling *LP* levels, the downward movement in *LP* having set in 1990—see Fig. 2A (Appendix). The coefficient in the SS in Table 1is now negative but is insignificant—1.76 (t= -1.449), which shows that the SS shifted up [in the (r,q) plane], but not by much, i.e., banks were not particularly active participants in reigning in loans. The net result has been that total loans continued to rise until 1993, though at a slower pace, even though *LP* started dropping in 1990—see Fig. 2A (Appendix A).

(d) Profit Maximization?

The issue of whether the banks in Japan pursued the goal of maximum profits over the two sub-periods in question has been debated frequently in some quarters, but has not been previously subjected to rigorous scrutiny through a quantitative analysis. We gather here some convincing evidence on the issue: Table 1 shows, in fact, that the banks did not pursue the maximum profit goal over either of the two subperiods. It is readily seen from the table that the coefficient of the *CR* variable, θ/g, is estimated as 8.564 in Period I and 6.755 in Period II, the respective t-values being 2.568 and 2.904. The estimates are significantly different from zero even at the 1% level of significance. The evidence therefore is overwhelmingly against the hypothesis of profit-maximization ($\theta = 0$) in both periods. Furthermore, the coefficient on $(r - CR)$ is $(1+\theta)/g$, and is estimated at 16.298 and 21.351 in Period I and Period II, respectively. Consequently, the respective θ-values are 1.1072 and 0.4628—both positive and significantly different from zero. Two implications of this: First, it follows from the general rule of $MC = MR(1+\theta)$ that the banks operated throughout the sample period at points where MC exceeded MR, i.e., where the loan amounts supplied were well beyond the profit-maximizing levels. It is also apparent from the θ-values that the loan amounts in Period I outstripped profit-maximizing levels by a much larger margin on average than in Period II. This is entirely consistent with what we observed while assessing the impact of *LP* immediately above.

Figure 1 depicts the situation for a typical bank where $q^* =$ profit-maximizing loan amount, $q^a_{II} =$ actual loan amount supplied in period II and $q^a_I =$ actual loan amount supplied in period I. Figure 2 is merely a restatement, in which a bank is seen to sacrifice maximum profits in favor of increased total loans–profits are obviously lower at q^a_I or q^a_{II} than at q^*. One is reminded here of the Baumol hypothesis (BH) which would posit that each bank maximizes total revenue subject to satisfactory profit-constraint:

$$\pi^a_I \quad \text{or} \quad \pi^a_{II}\,.$$

Unlike in the BH, however, the profit-constraint here will not be extraneously set but will be determined within the system.

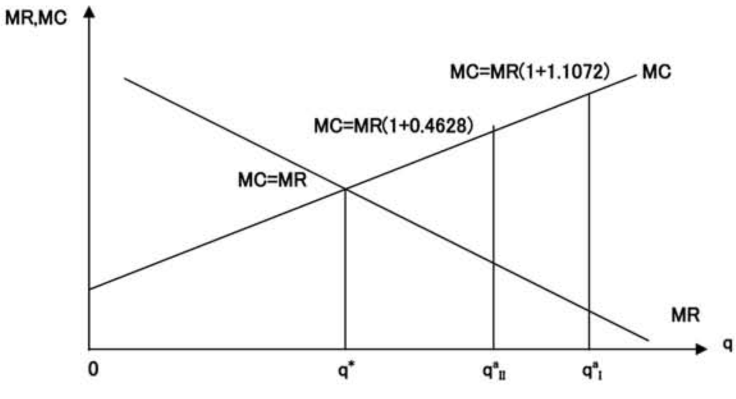

Figure 1. Typical profit-maximizing and actual loan amounts.
$q^* =$ profit-maximizing loan
$q^a_I =$Actual loan supply in Period I
$q^a_{II} =$ Actual loan supply in Period II

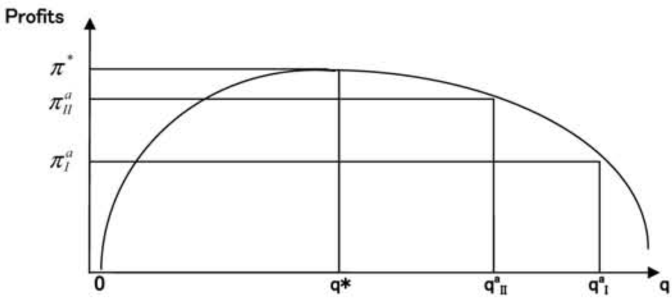

Figure 2. Actual profits (π^a_I, π^a_{II}) and maximum profits (π^*).

Table 3. Actual loan relative to profit-maximizing loan: Select banks

Bank	Period I	Period II
Hokkaido Takushoku Bank	13.1% (1982–1989)	8.5% (1990–1995)
Nippon Credit Bank	13.7% (1982–1989)	9.1% (1990–1995)

Finally, we provide in Table 3 some feel for the extent of over-supply of loan beyond the profit maximizing levels, based on the experience with a couple of banks. We computed profit-maximizing output (q^*) as the point of the intersection between the estimated *MR* and *MC* functions at any given point in time and arrived at the value of

$$\text{EXCESS} = ((\text{actual loan} - q^*)/q^*) \cdot 100$$

for each t. The figures reported in Table 3 are the averages of the EXCESS entity for the subperiods. As is seen, the overall extent of over-supply is about 13.5% in Period I and is about 8.75% in Period II. Evidently, abandonment of the profit-maximization goal has been a contributing factor in the expansion of loan supply—to a lesser extent in Period II than in Period I.

(e) BIS Capital Requirement

BIS (Bank for International Settlement) imposed capital requirement of 8% for all banks which operate international lending business. We have used the *BIS* capital ratios publicly available for the banks in our study for the years 1990 to 1995; in every instance, the ratio has been above the required minimum of 8%. For prior years in the sample, we have set *BIS*=0 in the belief that the regulation did not have a measurable impact over that time span. One objective of the *BIS* regulation is to make sure that when banks are faced with a non-performing loan problem they hold sufficient capital to cope with the problem.

Table 1 shows that the *BIS* capital ratio has a positive and significant coefficient in the SS equation. This indicates that the regulation was effective since bank loan tended to contract for smaller values of the *BIS* ; or alternatively, the banks felt comfortable to expand loan only when actual *BIS* capital ratio was larger (above the 8% mark) and hence when banks had sufficient amount of secure capital. The effectiveness of the regulation was also documented in some previous works—see, e.g., Honda (2002) and Watanabe (2005).

5. CONCLUSION

The present paper analyzes the bank behavior in Japan over the financial instability period: 1982–1995, partitioning the period into two subperiods: Period I—1982 to 1989, and Period II—1990 to 1995. We employ a structural framework in our analysis, in preference to regression frameworks commonly used in previous works. It is comprised of an aggregate demand for loan equation (DD), and an individual bank loan supply equation (SS). A main advantage of a DD-SS system is that it permits quantitative assessment of the roles played by several potential factors (variables) in the financial instability, both from the demand side and from the supply side, though we have carried out this exercise only with respect to the impact of the land price (*LP*) variable. The DD was estimated by 2SLS using aggregate data, and the SS was estimated by generalized 2SLS using the panel data on $N = 14$ banks, treating it as a structural error component model; the data details are provided in Section 3. The SS features potential interdependence among banks, and incorporates a goal which encompasses profit-maximization as a special case; it also leads to a very simple test of profit maximization.

It was found there is significant evidence which supports the fact that the banks did not pursue the goal of maximum profits in either of the two subperiods, but instead went for market shares larger than those warranted by profit-maximization. The extent of this over supply (beyond the profit–maximizing levels) was also much larger in Period I than in Period II. A particularly noteworthy aspect is that, even in Period II when total loan supply was contracting, individual banks were nonetheless operating beyond profit-maximizing levels. In sum, abandonment of the goal of profit-maximization had its own hand in loan expansion throughout the sample period. Further, land price (*LP*) played a very influential role during the instability period, exerting its impact both from the demand side and from the supply side. In Period I, when *LP* was rising, borrowers and lenders acted in concert in driving up loan supply using land as a collateral. In Period II, whose start coincides with a downward trend in the *LP*, banks continued for a while a weak expansion of loan; however, the borrowers began cutting down on their loan demand, which explains why the total loan amount continued to (weakly) rise for a while before eventually declining. We also documented evidence that the *BIS* capital requirement regulation in fact was effective in reigning in expansion of loan supply in period II, a phenomenon also noted in previous works.

We presented some evidence of interdependence/externalities among banks, treating this phenomenon as signaled by the presence of a certain regressor in the supply function. The regressor in question is the total loan supply by rivals in the previous year. In the first subperiod, the coefficient on the regressor is significant (even at the five percent level), which constitutes convincing evidence that the banks experienced strong interdependence. Furthermore, the fact that this coefficient is positive indicates that banks aggressively expanded the loan amounts in the current year in response to loan increases by rivals in the previous year, which is in agreement with the rapid rise in the total loan supply experienced in the first subperiod. Intriguingly, however, there is no evidence of such interdependence in the second subperiod. Finally, the call lending rate was in fact available for the Bank of Japan in controlling the loan supply throughout the sample period. Indeed the net coefficient on this variable is significant and negative in both subperiods. For some extraneous reasons, this policy variable was set at rather low levels, which obviously contributed to the large amounts of loans witnessed in the first subperiod. The Bank also raised the level of this variable in the early part of the second subperiod, which apparently has been a contributing factor in the rapid reduction of loans over the years in question.

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APPENDIX A: SOME SELECT GRAPHS

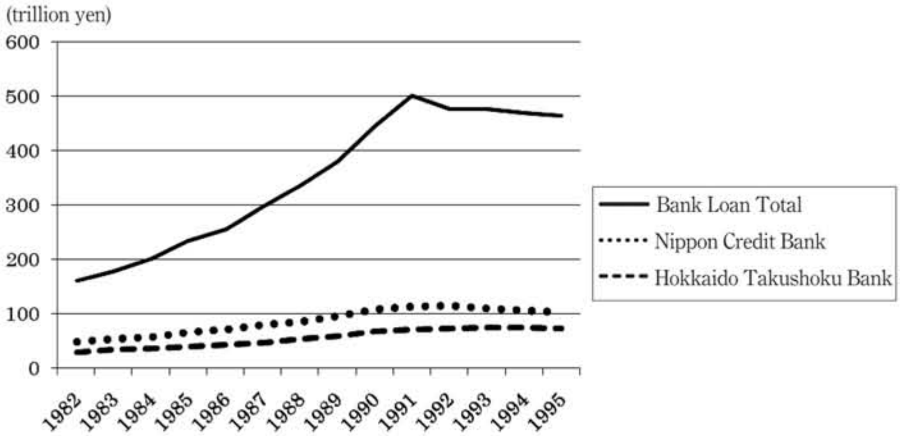

Figure 1A. Loans of Two Select Banks and Aggregate Loans.

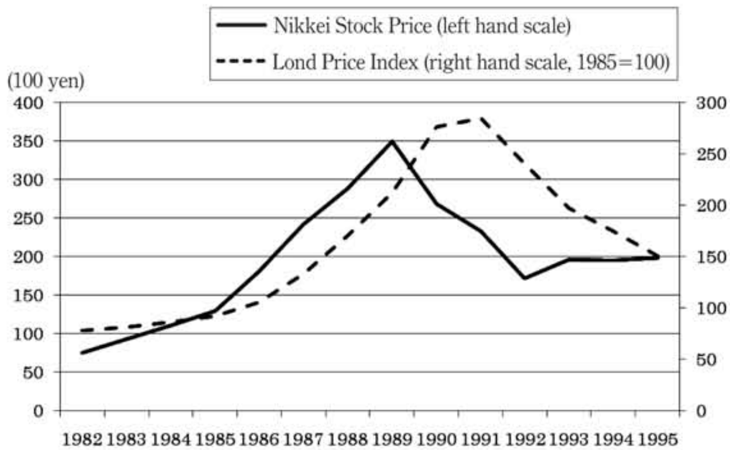

Figure 2A. Land Price and Nikkei Stock Price.