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A Generalized User-Revenue Model of Financial Firms under Dynamic Uncertainty : An Interdisciplinary Analysis of Producer Theory, Industrial Organization, and Finance

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Abstract

In the present paper, we apply the generalized user-revenue model (GURM) presented by Homma (2009) to Japan's banking industry and perform an analysis fusing producer theory and industrial organization theory (applied microeconomics) and finance (asset pricing theory). Basically, while basing the approach on the GURM, we derived the generalized user-revenue prices (GURPs) and the extended generalized Lerner indices (EGLIs), organized their theoretical characteristics from an interdisciplinary analytical perspective, applied the GURM to Japanese city banks, and estimated the GURPs and the EGLIs. These efforts provided material for thinking about the necessity of risk-adjustment policies as part of the industrial organization policy in the banking industry. Based on the EGLI estimation results, regarding the components of the EGLIs (in terms of absolute value), the risk-adjustment effects are the largest, followed by the equity capital effects, and the market structure and conduct effects are the smallest. This is the same as the results for the GURPs, so there is pressure to review conventional competition policy, which considers primarily the market structure and conduct effects. It has been pointed out that switching from a competition policy to a risk-adjustment policy is necessary, so specific measures in risk-adjustment policy that have not yet been considered must be taken into account. Furthermore, the injection of public funds dramatically improved (decreased) the risk-adjustment effects of the EGLI for long-term loans and dramatically increased the degree of competition in the long-term loan market.

Keywords: Generalized user-revenue price; Risk-adjustment effects; Extended generalized Lerner index; Empirical generalized user-revenue model; Japanese city banks

JEL classification: C33; C51; C61; D24; G21; L13

1 Introduction

The objective of the present study is to apply the generalized user-revenue model (GURM) presented by Homma (2009) to Japan's banking industry and perform an analysis fusing producer theory and industrial organization theory (applied microeconomics) and finance (asset pricing theory). Basically, while basing the approach on the GURM, we derived the generalized user-revenue prices (GURPs) and the extended generalized Lerner indices (EGLIs), organized their theoretical characteristics from an interdisciplinary analytical perspective, applied the GURM to Japanese city banks, and estimated the GURPs and the EGLI. These efforts provided material for thinking about the necessity of risk-adjustment policies as part of the industrial organization policy in the banking industry.

The GURM of Homma (2009) directly incorporates the essence of the consumption-based capital asset pricing model (CCAPM) into the conjectural user-revenue model (CURM) presented by Homma and Souma (2005), developing the CURM so that it can clearly take into account the impact of the fluctuation risk of short-run profit, which takes into account the balance fluctuation of financial assets and liabilities (quasi-short-run profit) and the impact of equity capital reflecting the risk of the burden of financial distress costs. However, since the CURM was developed from the user-cost model (UCM) for financial firms presented by Hancock (1985, 1987, 1991), we can conclude that the GURM was indirectly developed from the UCM.

If we compare the UCM and the GURM in order to bring out the characteristics of the GURM, the GURM is a more general model that relaxes the following five assumptions that are implicitly assumed by the UCM. First, financial firms are risk-neutral. Second, no strategic interdependence exists between financial firms. Third, no asymmetric information exists in the market for financial assets and liabilities. Fourth, no uncertainty exists in holding revenues and holding costs. Fifth, the utility function of financial firms does not depend on equity capital.

By relaxing these assumptions, the following outcomes are obtained by the GURM. First, by relaxing the first assumption (so that the impact of risk attitudes other than risk-neutral attitudes can also be taken into account), the user-cost prices (UCPs) presented by Hancock (1985, 1987, 1991) are extended to stochastic user-revenue prices (SURPs). More specifically, the subjective discount rate is extended to a stochastic discount rate. As a result, in the case that financial firms have risk attitudes other than risk-neutral (risk-averse or risk-loving) the discount rate depends on the quasi-short-run profit in the current period and the next period through the inter-temporal marginal rate of substitution, and we are able to take these impacts into account. Moreover, by relaxing the second and third assumptions (so that the impact of strategic interdependence and asymmetric information can be taken into account), the SURPs are extended to conjectural user-revenue prices (CURPs). Furthermore, the Lerner index is extended to the generalized Lerner index (GLI). More specifically, the market structure and conduct effects expressed by market share, the price elasticity of demand, and the conjectural derivative are added. As a result, we are able to take into account the impact of market structure and market conduct from the perspective of industrial organization theory. In addition, by relaxing the fourth and fifth assumptions (introducing uncertainty to holding revenues and holding costs and making the utility functions of financial firms depend on equity capital as well), the CURPs are extended to GURPs. Furthermore, the GLI is extended to the EGLI. More specifically, the risk-adjustment effects expressed by the covariance of the uncertain or unpredictable components of the stochastic endogenous holding-revenue rate (SEHRR) or the stochastic endogenous holding-cost rate (SEHCR) and stochastic discount factors, and the equity capital effects expressed by the marginal rate of substitution of the equity capital and the quasi-short-run profit are added. As a result of these steps, we are able to take into account the impact of the fluctuation risk of quasi-short-run profits from the asset pricing theory perspective and (although indirectly) the risk of the burden of financial distress costs from the banking theory perspective. From an academic perspective, it can be said that this has opened up a path to interdisciplinary analysis of industrial organization theory and finance (asset pricing theory).

In addition to Hancock (1985, 1987, 1991), outstanding studies that have performed an analysis based on the UCM of financial firms or a model similar to the UCM include Barnett (1987), Fixler and Zieschang (1991, 1992a, 1992b, 1993, 1999), Fixler (1993), Barnett and Zhou (1994), Barnett and Hahm (1994), and Barnett et al. (1995). Among these studies, Fixler and Zieschang (1991, 1992a, 1992b, 1993, 1999) and Fixler (1993) examined the measurement of financial services in national economic accounting and the measurement of productivity in the banking sector, and Barnett (1987), Barnett and Zhou (1994), Barnett and Hahm (1994), and Barnett et al. (1995) examined monetary aggregation, which has provided a number of insights into the GURM. In Japan, Homma et al. (1996), Ōmori and Nakajima (2000), and Nagano (2002) performed analyses based on the UCM of financial firms. Homma et al. (1996) was the first analysis in Japan that applied the UCM of financial firms, and they used the panel data of private banks in the high-growth era to estimate the stochastic profit frontier function and analyze the relationship between profit efficiency in Japan's banking industry and interventions in the financial system, such as the manipulation of the deposit interest rate and branch regulation. Based on the same model, Ōmori and Nakajima (2000) used data from 1987-1995 to measure the economies of scope and total factor productivity (TFP) of 20 randomly selected private banks. Taking into consideration the analysis of Fixler and Zieschang (1991), Nagano (2002) used UCP in measurements of the financial services in national economic accounting.

Thus, although there have been few analyses based on the UCM of financial firms, such analyses have been performed in Japan. However, no analyses have yet been performed, either inside or outside of Japan, from an interdisciplinary perspective combining producer theory, industrial organization theory, and finance and based on the GURM, which is a development of the UCM. The importance from an interdisciplinary analytical perspective of the GURM, for which there have not yet been any examples of analysis, is the derivation of the EGLI, an index of market performance. The traditional index of market performance from the perspective of conventional industrial organization theory comprises only factors that affect the market structure and conduct, whereas the EGLI was developed so that we could consider not only these factors, but also the impact of the risk-averse attitude of financial firms from a financial perspective, the fluctuation risk of quasi-short-run profits, and equity capital (which reflects the risk of the burden of financial distress costs). The magnitude of these impacts on an index of market performance has not yet been ascertained, and revealing these impacts empirically may provide important insights into the industrial organization policies of the banking industry going forward. The present paper attempts to reveal these impacts through the EGLIs of Japanese city banks and is expected to provide material for thinking about the necessity of risk-adjustment policies as part of the industrial organization policy in Japan's banking industry.

If we focus on other approaches from broader perspectives in order to meet this expectation, we notice that attempts to estimate an index of market performance (degree of competition) in Japan's financial industry have been gaining pace in recent years. Outstanding examples include Tsutsui and Kamesaka (2005), Uchida and Tsutsui (2005), and Souma and Tsutsui (2010), with Tsutsui and Kamesaka (2005) estimating the degree of competition in the securities industry, Uchida and Tsutsui (2005) estimating the degree of competition in the banking industry, and Souma and Tsutsui (2010) estimating the degree of competition in the insurance industry. Although these studies were based on the asset approach,[1] they provided useful references when examining the empirical results of the present study.

The remainder of the present paper is organized as follows. Section 2 explains the theoretical model of the GURM on which the present study is based, and the empirical model is discussed in Section 3. Section 3 explains the endogenous state variables and their creation, the specifications of the utility function and the stochastic Euler equations, and the estimation method and test method. A discussion of the SEHRR and SEHCR and their creation, the specifications of the endogenous components, the exogenous state variables and their creation, and the specifications of the variable cost function and cost share equation are presented in the Appendix. Section 4 presents an investigation of the empirical results, which examines the estimation results for the stochastic Euler equations, the degree of relative

[1] For further details of the asset approach, see Berger and Humphrey (1992, pp.247-248).

risk-aversion, the reference rate (risk-free rate), the GURPs and their components, a factor analysis of the risk-adjustment effects, and the EGLIs and their components. A discussion of the estimation results for the endogenous components of the SEHRR and SEHCR and the variable cost function is presented in the Appendix. Finally, Section 5 summarizes the findings and presents the conclusions of the present study.

2 Theoretical Specification

The present study basically adopts the GURM of Homma (2009) as its theoretical model. However, we assume that the endogenous state variables comprise only financial goods (financial assets and liabilities) and real resource fixed inputs (physical capital or human capital) are not included. Furthermore, it is assumed that real resource fixed inputs comprise physical capital only, and they are treated as variable inputs that have been optimized within a single period, in the same manner as labor and current goods. This step was taken because the main focus of the analysis is financial goods rather than real resource fixed inputs, and we wanted to narrow the analysis to financial goods. For this reason, it was necessary to treat real resource fixed inputs as simply as possible. Moreover, liabilities other than deposits (certificates of deposit and other liabilities[2]) are treated as variable inputs. This is because it was confirmed that this approach would obtain more credible estimation results in the *ex ante* estimate of the variable cost function.

Before presenting an explanation, in this section, the following preliminary assumptions are made. (i) Time is divided into discrete periods. (ii) These periods are sufficiently short that variations in exogenous (state) variables within the period can be neglected. In other words, exogenous variables are constant within each period but can change discretely at the boundaries between periods. (iii) The process of adjustment is essentially instantaneous, allowing stock adjustment problems to be ignored. These assumptions are

[2] Other liabilities include bonds, bills sold, payables under repurchase agreements, commercial paper, due to foreign banks, due from foreign banks, corporate bonds, and convertible bonds.

made in order to facilitate empirical research, similar to Hancock (1985, 1987, 1991), Homma and Souma (2005), and Homma (2009), with the expectation that the GURM may provide a consistent basis for such research.

2.1 Dynamic-Uncertainty Behavior and Stochastic Euler Equations

The formulation of the decisions of a financial firm as a stochastic dynamic programming (SDP) problem is derived based on the same considerations as in Homma (2009). Two specifications of the problem exist, for which the primary difference is in the relative timing of decision-making periods and the realization of uncertainty. In the first specification, the decision is made after the uncertainty is resolved, such that, in each period, the decision maker chooses the state variable of the next period directly. In the second specification, the decision is made before the uncertainty is resolved, in which case, the decision maker chooses the control variable of the current period, and the state variable of the next period then becomes a function of the chosen control variable and the state variable of the current period. The adjustment cost of stock variables is assumed to be zero, as mentioned above, and more reliable information on the decision leads to a rise in the value of the firm. The first specification is therefore assumed to be similar to that in Homma (2009), i.e., the financial firm chooses the state variable of the next period directly.

In the case of SDP, the state variables are classified as endogenous and exogenous state variables. The endogenous state variable vectors $\mathbf{q}_{i,t}$ $(t \geq 0)$ are the vectors of real balances of financial goods,[3] i.e.,

$$\mathbf{q}_{i,t} = \left(q_{i,1,t}, \cdots, q_{i,N_A+N_L,t}\right)' (t \geq 0) \, .$$

The exogenous state variable vectors $\mathbf{z}_{i,t}$ $(t \geq 0)$ are similarly defined as

$$\mathbf{z}_{i,t} = \left(\mathbf{z}^{H\prime}_{i,t-1}, \boldsymbol{\zeta}'_{i,t}, p_{G,t}, \mathbf{p}'_{i,t}, \tau_{i,t}\right)' (t \geq 0) \, ,$$

[3] As stated above, some liabilities other than deposits (certificates of deposit and other liabilities) are not included. These are treated as one real resource variable input.

where $\mathbf{z}^{H}_{i,t-1} = \left(\mathbf{z}^{H\prime}_{i,1,t-1}, \cdots, \mathbf{z}^{H\prime}_{i,N_A+N_L,t-1}\right)'$ $(t \geq 0)$ are the exogenous variable vectors, which consist of the certain or predictable components of the SEHRR and the SEHCR in the period $t-1$ (≥ -1). At $t = 0$, $\mathbf{z}^{H}_{i,-1} = \mathbf{z}^{H}_{i,0} = \left(\mathbf{z}^{H\prime}_{i,1,0}, \cdots, \mathbf{z}^{H\prime}_{i,N_A+N_L,0}\right)'$. $\boldsymbol{\zeta}_{i,t} = \left(\zeta_{i,1,t}, \cdots, \zeta_{i,N_A+N_L,t}\right)'$ $(t \geq 0)$ are vectors of the uncertain or unpredictable components of the SEHRR and the SEHCR, and $p_{G,t}$ $(t \geq 0)$ are the general price indices.[4] $\mathbf{p}_{i,t} = (p_{i,1,t}, \cdots, p_{i,M,t})'$ $(t \geq 0)$ are the vectors of factor prices,[5] and $\tau_{i,t}$ $(t \geq 0)$ are the indices of exogenous technical change. Among these exogenous state variables, the vectors of the exogenous state variables with respect to the variable cost function are defined as $\mathbf{z}^{C}_{i,t} = \left(\mathbf{p}'_{i,t}, \mathbf{z}^{Q\prime}_{i,t}, \tau_{i,t}\right)'$ $(t \geq 0)$, where $\mathbf{z}^{Q}_{i,t} = \left(\mathbf{z}^{Q\prime}_{i,1,t}, \cdots, \mathbf{z}^{Q\prime}_{i,N_A+N_L,t}\right)'$ $(t \geq 0)$ are the corresponding vectors that affect the quality of financial goods.[6] The vectors with respect to the quasi-short-run profit in period t (≥ 0) are defined as $\mathbf{z}^{\pi}_{i,t} = \left(\mathbf{z}^{H\prime}_{i,t-1}, \boldsymbol{\zeta}'_{i,t}, p_{G,t-1}, p_{G,t}, \mathbf{z}^{C\prime}_{i,t}\right)'$ $(t \geq 0)$, and in the case of $t = 0$, $\mathbf{z}^{\pi}_{i,0} = \left(\mathbf{z}^{H\prime}_{i,0}, \boldsymbol{\zeta}'_{i,0}, p_{G,0}, \mathbf{p}'_{i,0}, \tau_{i,0}\right)'$. The vectors with respect to equity capital are defined as $\mathbf{z}^{e}_{i,t} = \left(p_{G,t}, \mathbf{z}^{C\prime}_{i,t}\right)'$ $(t \geq 0)$.

As in Homma (2009), in considering the uncertainties faced by the financial firm, it is assumed that the stochastic process $\{\mathbf{z}_{i,t}\}_{t\geq 0}$ follows a stationary Markov process. Let $(Z, \boldsymbol{B}_Z)$ be a measurable space, where Z is a set of $\mathbf{z}_{i,t}$, and $\boldsymbol{B}_Z$ is a σ-algebra of its subsets. In this case, the stochastic properties of the exogenous state variables can be expressed as a stationary transition function: $Q : Z \times \boldsymbol{B}_Z \to [0, 1]$.[7] The interpretation of this definition is that $Q\left(\mathbf{z}_{i,t}, A_{i,t+1}\right)$ is the probability that the state of the next period lies in the set $A_{i,t+1}$, given that the current state is $\mathbf{z}_{i,t}$. The product space of $(Z, \boldsymbol{B}_Z)$ is expressed as $\left(Z^t, \boldsymbol{B}^t_Z\right) = (Z \times \cdots \times Z, \boldsymbol{B}_Z \times \cdots \times \boldsymbol{B}_Z)$, and $\mathbf{z}_{i,0}$ $(\in Z)$ is given.

Definition 1 *The probability measures on* $(Z, \boldsymbol{B}_Z)$*,* $\mu^t\left(\mathbf{z}_{i,0}, \cdot\right) : \boldsymbol{B}^t_Z \to [0, 1]$

[4] For details regarding $\mathbf{z}^{H}_{i,j,t}$ and $\zeta_{i,j,t}$, see Homma (2009, pp.6-9).

[5] Including the interest rate of certificates of deposit and other liabilities. However, these are treated collectively as one interest rate.

[6] $\mathbf{z}^{Q}_{i,j,t}$ is an element of $\mathbf{z}^{H}_{i,j,t}$. For details regarding $\mathbf{z}^{Q}_{i,j,t}$, see Homma (2009, pp.6-10).

[7] For further details regarding the stationary transition function, see Stokey and Lucas (1989, p.212).

$(t \geq 1)$, are defined as follows.[8] *For any rectangle $A_i^t = A_{i,1} \times \cdots \times A_{i,t} \in \boldsymbol{B}_Z^t$:*

$$\mu^t \left(\mathbf{z}_{i,0}, A_i^t\right) = \int_{A_{i,1}} \cdots \int_{A_{i,t-1}} \int_{A_{i,t}} Q\left(\mathbf{z}_{i,t-1}, \mathbf{dz}_{i,t}\right) Q\left(\mathbf{z}_{i,t-2}, \mathbf{dz}_{i,t-1}\right) \cdots Q\left(\mathbf{z}_{i,0}, \mathbf{dz}_{i,1}\right). \tag{1}$$

The probability measure $\mu^t \left(\mathbf{z}_{i,0}, \cdot\right)$ satisfies the properties of measures and $\mu^t \left(\mathbf{z}_{i,0}, Z^t\right) = 1$.

As described in Homma (2009), the decision to be carried out in period t can depend on the information that will be available at that time. This information can be expressed as a sequence of vectors of the exogenous state variables. Let $\mathbf{z}_i^t = \left(\mathbf{z}_{i,1}, \cdots, \mathbf{z}_{i,t}\right)$ $(\in Z^t)$ denote the partial history in periods 1 through t, and let $(Y, \boldsymbol{B}_Y)$ be a measurable space, where Y is a set of vectors of the endogenous state variables $\mathbf{q}_{i,t}$, and $\boldsymbol{B}_Y$ is a σ-algebra of its subsets. A plan $\mathbf{q}_i^p$ is then defined as the set of a value $\mathbf{q}_{i,0}^p$ $(\in Y)$ and a sequence of functions $\mathbf{q}_{i,t}^p : Z^t \to Y$ $(t \geq 1)$, where $\mathbf{q}_{i,t}^p \left(\mathbf{z}_i^t\right)$ is the value of $\mathbf{q}_{i,t+1}$ that will be chosen in period t if the partial history of the exogenous state variables in periods 1 through t is $\mathbf{z}_i^t$.

In the remainder of the present paper, as in Homma (2009), the financial firm is assumed to choose a plan that maximizes the expected value of the discounted intertemporal utility of its profits stream. The intertemporal utility function is also assumed to be additively separable.[9] In this case, the optimization problem of the i-th financial firm is given by

$$\begin{aligned} \max_{\mathbf{q}_i^p} u_i &\left[\pi_i^{QS}\left(\mathbf{q}_{i,0}, \mathbf{q}_{i,0}^p\left(\mathbf{z}_{i,0}\right), \mathbf{z}_{i,0}^{\pi}\right), q_{e,i}^p\left(\mathbf{q}_{i,0}^p\left(\mathbf{z}_{i,0}\right), \mathbf{z}_{i,0}^e\right)\right] \\ &+ \lim_{T\to\infty} \sum_{t=1}^{T} \int_{Z^t} \beta_i^t \cdot u_i \left[\pi_i^{QS}\left(\mathbf{q}_{i,t-1}^p\left(\mathbf{z}_i^{t-1}\right), \mathbf{q}_{i,t}^p\left(\mathbf{z}_i^t\right), \mathbf{z}_{i,t}^{\pi}\right),\right. \\ &\left. q_{e,i}^p\left(\mathbf{q}_{i,t}^p\left(\mathbf{z}_i^t\right), \mathbf{z}_{i,t}^e\right)\right] \mu^t\left(\mathbf{z}_{i,0}, \mathbf{dz}_i^t\right), \end{aligned} \tag{2}$$

where $u_i(\cdot, \cdot)$ is the utility function, $\beta_i^t = \prod_{s=0}^{t-1} \beta_{i,s} = \prod_{s=0}^{t-1} \frac{1}{1+r_{i,s}^D}$ is the

[8] For a full account of the probability measures, see Stokey and Lucas (1989, pp.220-225).

[9] For details regarding the utility function, see Homma (2009, pp.11-15).

cumulative discount factor, and $r^D_{i,s}$ is the subjective rate of time preference.[10] Here, $\pi^{QS}_i\left(\mathbf{q}^p_{i,t-1}\left(\mathbf{z}^{t-1}_i\right), \mathbf{q}^p_{i,t}\left(\mathbf{z}^t_i\right), \mathbf{z}^{\pi}_{i,t}\right)$ $(t \geq 1)$ and $\pi^{QS}_i\left(\mathbf{q}_{i,0}, \mathbf{q}^p_{i,0}\left(\mathbf{z}_{i,0}\right), \mathbf{z}^{\pi}_{i,0}\right)$ are the planned quasi-short-run profits, which are as follows:[11]

$$\begin{aligned}
&\pi^{QS}_i\left(\mathbf{q}^p_{i,t-1}\left(\mathbf{z}^{t-1}_i\right), \mathbf{q}^p_{i,t}\left(\mathbf{z}^t_i\right), \mathbf{z}^{\pi}_{i,t}\right) \\
&= \sum_{j=1}^{N_A+N_L} b_j \cdot \left[\left\{1 + b_C \cdot h^R_{i,j}\left(Q^p_{j,t-1}, \mathbf{z}^H_{i,j,t-1}\right) + \zeta_{i,j,t}\right\} \cdot p_{G,t-1} \cdot q^p_{i,j,t-1}\left(\mathbf{z}^{t-1}_i\right)\right. \\
&\qquad \left. - p_{G,t} \cdot q^p_{i,j,t}\left(\mathbf{z}^t_i\right)\right] - C^V_i\left(\mathbf{q}^p_{i,t}\left(\mathbf{z}^t_i\right), \mathbf{z}^C_{i,t}\right) \ (t \geq 1), \quad (3)
\end{aligned}$$

$$\begin{aligned}
&\pi^{QS}_i\left(\mathbf{q}_{i,0}, \mathbf{q}^p_{i,0}\left(\mathbf{z}_{i,0}\right), \mathbf{z}^{\pi}_{i,0}\right) \\
&\quad = \sum_{j=1}^{N_A+N_L} b_j \cdot \left[\left\{1 + b_C \cdot h^R_{i,j}\left(Q_{j,0}, \mathbf{z}^H_{i,j,0}\right) + \zeta_{i,j,0}\right\} \cdot p_{G,0} \cdot q_{i,j,0}\right. \\
&\qquad \left. - p_{G,0} \cdot q^p_{i,j,0}\left(\mathbf{z}_{i,0}\right)\right] - C^V_i\left(\mathbf{q}^p_{i,0}\left(\mathbf{z}_{i,0}\right), \mathbf{z}^C_{i,0}\right). \quad (4)
\end{aligned}$$

The parameters and functions in Eqs.(3) and (4) are defined as follows.

- b_j: Parameter used to distinguish between financial assets and liabilities: $b_j = 1$ for assets (i.e., $j = 1, \ldots, N_A$), and $b_j = -1$ for liabilities (i.e., $j = N_A + 1, \ldots, N_A + N_L$).
- b_C: Parameter used to distinguish cash from other financial assets. In other words, if $q^p_{i,j,t}$ represents cash (i.e., $j = 1$), then $b_C = 0$, whereas if the financial good is another type of financial asset (i.e., $j \neq 1$), then $b_C = 1$.
- $h^R_{i,j}\left(Q^p_{j,t-1}, \mathbf{z}^H_{i,j,t-1}\right)$: Planned certain or predictable component of the SEHRR or the SEHCR.[12]

[10] For details regarding this optimization problem, see Stokey and Lucas (1989, pp.241-254).

[11] For details regarding the quasi-short-run profit, see Homma (2009, pp.11-13). The difference from Homma (2009, pp.11-13) is that it is assumed here that real resource fixed inputs comprise physical capital only and are treated as a variable input that is optimized within a single period, in the same manner as labor and current goods. Therefore, it is assumed that real resource fixed costs are zero.

[12] For details regarding this component, see Homma (2009, pp.6-9).

- $Q^{p}_{j,t}$: Planned total assets or liabilities in the market.
- $C_i^V\left(\mathbf{q}^p_{i,t}\left(\mathbf{z}_i^t\right), \mathbf{z}^C_{i,t}\right)$: Planned variable cost function.[13]

In addition, $q^p_{e,i}\left(\mathbf{q}^p_{i,t}\left(\mathbf{z}_i^t\right), \mathbf{z}^e_{i,t}\right)$ $(t \geq 0)$ is the planned equity capital, which is given by

$$q^p_{e,i}\left(\mathbf{q}^p_{i,t}\left(\mathbf{z}_i^t\right), \mathbf{z}^e_{i,t}\right) = \sum_{j=1}^{N_A} p_{G,t} \cdot q^p_{i,j,t}\left(\mathbf{z}_i^t\right) + \sum_{j=1}^{M_F} p^F_{i,j,t} \cdot x^p_{F,i,j,t}\left(\mathbf{q}^p_{i,t}\left(\mathbf{z}_i^t\right), \mathbf{z}^C_{i,t}\right) - \sum_{j=N_A+1}^{N_A+N_L} p_{G,t} \cdot q^p_{i,j,t}\left(\mathbf{z}_i^t\right) \quad (t \geq 0), \quad (5)$$

where $p^F_{i,j,t}$ is the j-th real resource fixed factor price, and $x^p_{F,i,j,t}\left(\mathbf{q}^p_{i,t}\left(\mathbf{z}_i^t\right), \mathbf{z}^C_{i,t}\right)$ is the conditional factor demand function for the j-th planned real resource fixed input.

As described in Homma (2009), the necessary conditions for stochastic optimization problems in sequence form can be found by adopting a variational approach. Such conditions are represented by stochastic Euler equations, which for the above optimization problem (2) are expressed as

$$-\frac{\partial u^*_{i,t}}{\partial \pi^{QS*}_{i,t}} \cdot \left(b_j \cdot p_{G,t} + \frac{\partial C^{V*}_{i,t}}{\partial q^{p*}_{i,j,t}}\right) + b_j \cdot p_{G,t} \cdot \frac{\partial u^*_{i,t}}{\partial q^{p*}_{e,i,t}} + \beta_{i,t} \cdot b_j \cdot p_{G,t} \cdot \int_Z \left\{1 + b_C \cdot \left(h^{R*}_{i,j,t} + \frac{\partial h^{R*}_{i,j,t}}{\partial \ln q^{p*}_{i,j,t}}\right) + \zeta_{i,j,t+1}\right\} \cdot \frac{\partial u^*_{i,t+1}}{\partial \pi^{QS*}_{i,t+1}} Q\left(\mathbf{z}_{i,t}, \mathbf{dz}_{i,t+1}\right) = 0;\ j = 1, \cdots, N_A + N_L, \quad (6)$$

where $q^{p*}_{i,j,t} = q^{p*}_{i,j,t}\left(\mathbf{z}_i^t\right)$, $\pi^{QS*}_{i,t} = \pi^{QS}_i\left(\mathbf{q}^{p*}_{i,t-1}\left(\mathbf{z}_i^{t-1}\right), \mathbf{q}^{p*}_{i,t}\left(\mathbf{z}_i^t\right), \mathbf{z}^\pi_{i,t}\right)$, $q^{p*}_{e,i,t} = q^p_{e,i}\left(\mathbf{q}^{p*}_{i,t}\left(\mathbf{z}_i^t\right), \mathbf{z}^e_{i,t}\right)$, $u^*_{i,t} = u_i\left(\pi^{QS*}_{i,t}, q^{p*}_{e,i,t}\right)$, $C^{V*}_{i,t} = C^V_i\left(\mathbf{q}^{p*}_{i,t}\left(\mathbf{z}_i^t\right), \mathbf{z}^C_{i,t}\right)$, and $h^{R*}_{i,j,t} = h^R_{i,j}\left(Q^{p*}_{j,t}, \mathbf{z}^H_{i,j,t}\right)$.

As in Homma (2009), if the utility function $u^*_{i,t}$ is concave and continu-

[13] For details regarding this function, see Homma (2009, pp.9-11).

ously differentiable in $\mathbf{q}_{i,t-1}^{p*}$ and $\mathbf{q}_{i,t}^{p*}$ and is integrable,[14] then if each of the partial derivatives of $u_{i,t}^{*}$ with respect to $\mathbf{q}_{i,t-1}^{p*}$ are absolutely integrable,[15] then the stochastic Euler equations (6) with the transversality conditions

$$\lim_{t\to\infty} \beta_i^t \cdot \int_Z \frac{\partial u_{i,t+1}^{*}}{\partial \pi_{i,t+1}^{QS*}} \cdot \frac{\partial \pi_{i,t+1}^{QS*}}{\partial q_{i,j,t}^{p*}} \cdot q_{i,j,t}^{p*} \, Q\left(\mathbf{z}_{i,t}, \mathbf{dz}_{i,t+1}\right) = 0;\ j = 1, \cdots, N_A + N_L \quad (7)$$

are sufficient conditions for an optimal plan $\mathbf{q}_i^{p*} = \left\{ \mathbf{q}_{i,0}^{p*}, \left\{ \mathbf{q}_{i,t}^{p*} \right\}_{t=1}^{\infty} \right\}$.

2.2 Risk Corrections and Generalized User-Revenue Prices

The influence of uncertainties in the SEHRR and the SEHCR is resolved explicitly by transforming Eq.(6) into the form of an expression of risk correction. This is similar to the treatment in the CCAPM.

Theorem 1 *Under the assumption that* $\partial u_{i,t}^{*} \Big/ \partial \pi_{i,t}^{QS*} \neq 0$ *and* $E\left[\zeta_{i,j,t+1} \middle| \mathbf{z}_{i,t} \right] = 0$*, Eq.(6) can be transformed into the form of an expression of risk correction as follows:*

$$\begin{aligned} & - b_j \cdot p_{G,t} - MC_{i,j,t}^{V*} + b_j \cdot p_{G,t} \cdot MRS_{e,i,t}^{\pi*} \\ & \qquad + \beta_{i,t} \cdot b_j \cdot p_{G,t} \cdot \left\{ 1 + b_C \cdot \left(h_{i,j,t}^{R*} + \eta_{i,j,t}^{*} \right) \right\} \cdot E\left[IMRS_{\pi,i,t+1}^{*} \left| \mathbf{z}_{i,t} \right. \right] \\ & \qquad\qquad + \beta_{i,t} \cdot b_j \cdot p_{G,t} \cdot \frac{cov\left(\zeta_{i,j,t+1}, \partial u_{i,t+1}^{*} \Big/ \partial \pi_{i,t+1}^{QS*} \middle| \mathbf{z}_{i,t} \right)}{\partial u_{i,t}^{*} \Big/ \partial \pi_{i,t}^{QS*}} = 0; \\ & \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad j = 1, \cdots, N_A + N_L, \quad (8) \end{aligned}$$

where $MC_{i,j,t}^{V*} = \partial C_{i,t}^{V*} \big/ \partial q_{i,j,t}^{p*}$, $MRS_{e,i,t}^{\pi*} = \left(\partial u_{i,t}^{*} \big/ \partial q_{e,i,t}^{p*} \right) \Big/ \left(\partial u_{i,t}^{*} \Big/ \partial \pi_{i,t}^{QS*} \right)$ [16],

[14] The integrability of $u_{i,t}^{*}$ means that $\int_Z u_{i,t}^{*} \, Q\left(\mathbf{z}_{i,t-1}, \mathbf{dz}_{i,t}\right) < \infty$.

[15] The absolute integrability of $\frac{\partial u_{i,t}^{*}}{\partial q_{i,j,t-1}^{p*}}$ is defined as $\int_Z \left| \frac{\partial u_{i,t}^{*}}{\partial q_{i,j,t-1}^{p*}} \right| Q\left(\mathbf{z}_{i,t-1}, \mathbf{dz}_{i,t}\right) < \infty$.

[16] This term is the marginal rate of substitution (MRS) of quasi short-run profits for equity capital. This MRS is a measure of the rate at which the financial firm is just willing

$\eta^*_{i,j,t} = \partial h^{R*}_{i,j,t} \big/ \partial \ln q^{p*}_{i,j,t}$, $IMRS^*_{\pi,i,t+1} = \left(\partial u^*_{i,t+1} \big/ \partial \pi^{QS*}_{i,t+1} \right) \big/ \left(\partial u^*_{i,t} \big/ \partial \pi^{QS*}_{i,t} \right)$ [17], *and* $E[\,\cdot\, | \mathbf{z}_{i,t}] = \int_Z \cdot\, Q(\mathbf{z}_{i,t}, \mathbf{dz}_{i,t+1})$.

Proof. See Homma (2009, pp.23-24). ■

The fraction in the fifth term on the left-hand side of Eq.(8),

$$\mathrm{cov}\left(\zeta_{i,j,t+1}, \partial u^*_{i,t+1} \big/ \partial \pi^{QS*}_{i,t+1} \Big| \, \mathbf{z}_{i,t} \right) \big/ \left(\partial u^*_{i,t} \big/ \partial \pi^{QS*}_{i,t} \right),$$

i.e., the ratio of the covariance of uncertain components of the SEHRR and the SEHCR with respect to the marginal utility of quasi-short-run profits in period $t+1$ to the same marginal utility in period t, is a risk-adjustment term. In the case that the risk attitude of financial firms is averse, the marginal utility of quasi-short-run profits is a decreasing function of its profits. Therefore, $\mathrm{cov}\left(\zeta_{i,j,t+1}, \pi^{QS*}_{i,t+1} \Big| \, \mathbf{z}_{i,t} \right)$ is positive if $\mathrm{cov}\left(\zeta_{i,j,t+1}, \partial u^*_{i,t+1} \big/ \partial \pi^{QS*}_{i,t+1} \Big| \, \mathbf{z}_{i,t} \right)$ is negative, and vice versa. In this case, the variance of quasi-short-run profits in the next period increases if a financial asset in the current period increases, while the same variance decreases if a liability in the current period increases, and vice versa. For example, if ξ $(0 < \xi < 1)$ of the j-th financial good in period t increases, then from Eq.(3), the quasi-short-run profit in the next period becomes $\pi^{QS}_{i,t+1} + b_j \cdot \left\{ 1 + b_C \cdot h^R_{i,j} \left(Q_{j,t}, \mathbf{z}^H_{i,j,t} \right) + \zeta_{i,j,t+1} \right\} \cdot p_{G,t} \cdot \xi$. In this case, its variance can be expressed as

$$\begin{aligned} &\mathrm{var}\left(\pi^{QS}_{i,t+1} + b_j \cdot \left\{ 1 + b_C \cdot h^R_{i,j} \left(Q_{j,t}, \mathbf{z}^H_{i,j,t} \right) + \zeta_{i,j,t+1} \right\} \cdot p_{G,t} \cdot \xi \Big| \, \mathbf{z}_{i,t} \right) \\ &= \mathrm{var}\left(\pi^{QS}_{i,t+1} \Big| \, \mathbf{z}_{i,t} \right) + 2 \cdot b_j \cdot p_{G,t} \cdot \xi \cdot \mathrm{cov}\left(\zeta_{i,j,t+1}, \pi^{QS}_{i,t+1} \Big| \, \mathbf{z}_{i,t} \right) \\ &\quad + \left(b_j \cdot p_{G,t} \cdot \xi \right)^2 \cdot \mathrm{var}\left(\zeta_{i,j,t+1} \big| \, \mathbf{z}_{i,t} \right). \end{aligned} \tag{9}$$

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to substitute quasi short-run profits for equity capital, or in other words, a measure of the opportunity costs of equity capital.

[17] This term represents the intertemporal marginal rate of substitution (IMRS) with respect to quasi short-run profits, and is a measure of the rate at which the financial firm is just willing to substitute quasi short-run profits in period t for profits in period $t+1$. In the case that the financial firm is risk-averse, the marginal utility of quasi short-run profits is a decreasing function of quasi short-run profits. The IMRS therefore declines if quasi short-run profits increase from the current period to the next period and rises if profits decrease.

Thus, if ξ is sufficiently small, then the third term on the right-hand side of this equation is much smaller than the second term. The sign of the second term, $\operatorname{cov}\left(\zeta_{i,j,t+1}, \pi_{i,t+1}^{QS} \middle| \mathbf{z}_{i,t}\right)$, determines whether this variance is greater than $\operatorname{var}\left(\pi_{i,t+1}^{QS} \middle| \mathbf{z}_{i,t}\right)$. Thus, in the case that the j-th financial good is a financial asset (i.e., $b_j = 1$), the variance is greater than $\operatorname{var}\left(\pi_{i,t+1}^{QS} \middle| \mathbf{z}_{i,t}\right)$ if the sign of $\operatorname{cov}\left(\zeta_{i,j,t+1}, \pi_{i,t+1}^{QS} \middle| \mathbf{z}_{i,t}\right)$ is positive. Similarly, in the case that the j-th financial good is a liability (i.e., $b_j = -1$), this variance is greater than $\operatorname{var}\left(\pi_{i,t+1}^{QS} \middle| \mathbf{z}_{i,t}\right)$ if the sign of $\operatorname{cov}\left(\zeta_{i,j,t+1}, \pi_{i,t+1}^{QS} \middle| \mathbf{z}_{i,t}\right)$ is negative.

Equation (8) represents a stochastic Euler equation with respect to financial goods, extended from that in the original CURM to incorporate consideration of the effects of equity capital and the volatility risk of quasi-short-run profits. By transforming these equations, the GURP is derived as an extension of the SURP and the CURP.

Corollary 1 *Equation (8) can be expressed as follows:*

$$MC_{i,j,t}^{V*} = b_j \cdot p_{G,t} \cdot \left[\left(b_C \cdot h_{i,j,t}^{R*} - r_{i,t}^{F*}\right) \big/ \left(1 + r_{i,t}^{F*}\right) + b_C \cdot \eta_{i,j,t}^{*} \big/ \left(1 + r_{i,t}^{F*}\right) \right.$$
$$\left. + MRS_{e,i,t}^{\pi*} + \varpi_{i,j,t}^{*}\right] ; \; j = 1, \cdot \cdot \cdot, N_A + N_L, \quad (10)$$

where $r_{i,t}^{F*} = 1 \big/ E\left[\beta_{i,t} \cdot IMRS_{\pi,i,t+1}^{*} \left| \mathbf{z}_{i,t}\right.\right] - 1$ *and*

$$\varpi_{i,j,t}^{*} = \beta_{i,t} \cdot \frac{cov\left(\zeta_{i,j,t+1}, \partial u_{i,t+1}^{*} \big/ \partial \pi_{i,t+1}^{QS*} \middle| \mathbf{z}_{i,t}\right)}{\partial u_{i,t}^{*} \big/ \partial \pi_{i,t}^{QS*}}.$$

Proof. See Homma (2009, p.32). ■

The right-hand side of Eq.(10) is then the price of the j-th financial good, i.e., is equivalent to $MC_{i,j,t}^{V*}$. From the perspective of producer theory, this corrollary is thus used as the definition for the GURP.

Definition 2 *The generalized user-revenue price of the i-th financial firm* *during period t, denoted by* $p^{GUR}_{i,j,t}$*, is defined as*

$$p^{GUR}_{i,j,t} = b_j \cdot p_{G,t} \cdot \left[\left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}\right) / \left(1 + r^{F*}_{i,t}\right) + b_C \cdot \eta^*_{i,j,t} / \left(1 + r^{F*}_{i,t}\right)\right.$$
$$\left. + MRS^{\pi *}_{e,i,t} + \varpi^*_{i,j,t}\right] ; j = 1, \cdots, N_A + N_L. \quad (11)$$

As described in Homma (2009), the four terms on the right-hand side of Eq.(11) represent the SURP, the market structure and conduct effects, the equity capital effects, and the risk-adjustment effects respectively.[18]

From Corollary 1 and Definition 2, the following remark follows immediately.

Remark 1 *From Corollary 1 and Definition 2,*

$$MC^{V*}_{i,j,t} = p^{GUR}_{i,j,t} ; j = 1, \cdots, N_A + N_L \quad (12)$$

holds, and thus the classification of financial goods into inputs and outputs based on the sign of each GURP is consistent with the classification based on the sign of each partial derivative of the variable cost function with respect to financial goods. The sign of the partial derivative of the variable cost function is the same as the sign of the GURP, indicating that a financial good is an output if positive and a fixed input if negative.

As defined in the CURM, the SURP and the CURP are expressed as the following definitions.

Definition 3 *The stochastic user-revenue price of the i-th financial firm during period t, denoted by* $p^{SUR}_{i,j,t}$*, is defined as*

$$p^{SUR}_{i,j,t} = b_j \cdot p_{G,t} \cdot \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}\right) / \left(1 + r^{F*}_{i,t}\right) ; j = 1, \cdots, N_A + N_L. \quad (13)$$

Definition 4 *The conjectural user-revenue price of the i-th financial firm*

[18] For details regarding the GURP, see Homma (2009, pp.32-36).

during period t, denoted by $p^{CUR}_{i,j,t}$, is defined as

$$\begin{aligned} p^{CUR}_{i,j,t} &= b_j \cdot p_{G,t} \cdot \left[\left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t} \right) / \left(1 + r^{F*}_{i,t} \right) + b_C \cdot \eta^{*}_{i,j,t} / \left(1 + r^{F*}_{i,t} \right) \right] \\ &= p^{SUR}_{i,j,t} + b_j \cdot p_{G,t} \cdot b_C \cdot \eta^{*}_{i,j,t} / \left(1 + r^{F*}_{i,t} \right) \; ; \; j = 1, \cdots, N_A + N_L. \quad (14) \end{aligned}$$

From Definition 2, 3, and 4, the following remark follows immediately.

Remark 2 *Using the SURP or the CURP, the GURP can be then expressed as*

$$\begin{aligned} p^{GUR}_{i,j,t} &= p^{SUR}_{i,j,t} + b_j \cdot p_{G,t} \cdot \left[b_C \cdot \eta^{*}_{i,j,t} / \left(1 + r^{F*}_{i,t} \right) + MRS^{\pi*}_{e,i,t} + \varpi^{*}_{i,j,t} \right] \\ &= p^{CUR}_{i,j,t} + b_j \cdot p_{G,t} \cdot \left[MRS^{\pi*}_{e,i,t} + \varpi^{*}_{i,j,t} \right] \; ; \; j = 1, \cdots, N_A + N_L. \quad (15) \end{aligned}$$

This equation shows that the GURP takes into account the SURP, as well as market structure and conduct effects, equity capital effects, and risk-adjustment effects. The GURP is therefore equivalent to the CURP with the addition of equity capital effects and risk-adjustment effects, i.e., the extension SURP includes explicit consideration of market structure and conduct effects, equity capital effects, and risk-adjustment effects. If the equity capital effects and risk-adjustment effects are zero, i.e., if the effects cancel or are both zero, then the GURP is fully equivalent to the CURP. If the market structure and conduct effects are zero, then the GURP is fully equivalent to the SURP. As described in the CURM, if the financial firm is risk-neutral, then the GURP corresponds to the UCP of the UCM.

2.3 Extended Generalized Lerner Indices

The EGLI, an extension of the GLI in the CURM, can be derived using Eqs.(10) and (12), which represent the relationship between the GURP and marginal variable costs, and Eq.(15), which gives the relationships between the SURP, the CURP, and the GURP. In concrete terms, as in the CURM, dividing the discrepancy between the SURP and the marginal variable costs by the SURP of Eq.(13) gives the EGLI. The SURP is a price in which market structure and conduct effects, equity capital effects, and risk-adjustment effects are assumed to be zero. The discrepancy between the SURP and marginal variable costs therefore takes these effects into account. In this section, the case of a positive SURP and positive marginal variable costs is considered with respect to the j-th financial good as an output.

Remark 3 *From Eqs.(12) and (15), the discrepancy between the SURP and marginal variable costs can be expressed as*

$$p^{SUR}_{i,j,t} - MC^{V*}_{i,j,t} = -b_j \cdot p_{G,t} \cdot \left(\gamma^*_{i,j,t} + MRS^{\pi*}_{e,i,t} + \varpi^*_{i,j,t}\right) \; ; \; j = 1, \cdots, N_A + N_L, \quad (16)$$

where

$$\gamma^*_{i,j,t} = b_C \cdot \eta^*_{i,j,t} \big/ \left(1 + r^{F*}_{i,t}\right) \; ; \; j = 1, \cdots, N_A + N_L. \quad (17)$$

The EGLI is defined by dividing both sides of Eq.(16) by the SURP given by Eq.(13).

Definition 5 *The extended generalized Lerner index of the j-th financial good of the i-th firm in period t, denoted by $EGLI_{i,j,t}$, is defined as*

$$\begin{aligned} EGLI_{i,j,t} &= \frac{p^{SUR}_{i,j,t} - MC^{V*}_{i,j,t}}{p^{SUR}_{i,j,t}} \\ &= -\frac{b_C \cdot \eta^*_{i,j,t} + \left(MRS^{\pi*}_{e,i,t} + \varpi^*_{i,j,t}\right) \cdot \left(1 + r^{F*}_{i,t}\right)}{b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}}; \\ & \qquad j = 1, \cdots, N_A + N_L. \end{aligned} \quad (18)$$

Under the assumption that the j-th financial good is an output, the sign of $b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}$ is positive if the j-th financial good is a financial asset other than cash, and negative if the j-th financial good is a liability. If the sign of $\eta^*_{i,j,t}$ is determined by the sign of the elasticity of the collected or paid interest rate of the SEHRR or the SEHCR with respect to the total balance in the market, then the sign of $\eta^*_{i,j,t}$ is negative if the j-th financial good is a financial asset and positive if the j-th financial good is a liability.[19] From Eq.(8), the sign of $MRS^{\pi*}_{e,i,t}$ is positive, and from Eq.(10),

[19] For details regarding $\eta^*_{i,j,t}$, see Homma (2009, pp.33-34).

the sign of $\varpi^*_{i,j,t}$ can be either positive or negative. From the definitional identity of $\varpi^*_{i,j,t}$ in Eqs.(9) and (10), if the j-th financial good is a financial asset and the risk (variance) of the quasi-short-run profit increases due to its increase, then ($\mathrm{cov}\left(\zeta_{i,j,t+1}, \pi^{QS}_{i,t+1} \middle| \mathbf{z}_{i,t} \right) > 0$), and if the financial firm is risk-averse, the sign of $\varpi^*_{i,j,t}$ is negative, whereas if the risk (variance) of the quasi-short-run profit decreases, then ($\mathrm{cov}\left(\zeta_{i,j,t+1}, \pi^{QS}_{i,t+1} \middle| \mathbf{z}_{i,t} \right) < 0$), and if the financial firm is still risk-averse, the sign of $\varpi^*_{i,j,t}$ is positive. On the other hand, if the j-th financial good is a liability and the risk (variance) of the quasi-short-run profit increases due to its increase, then ($\mathrm{cov}\left(\zeta_{i,j,t+1}, \pi^{QS}_{i,t+1} \middle| \mathbf{z}_{i,t} \right) < 0$), and if the financial firm is risk-averse, the sign of $\varpi^*_{i,j,t}$ is positive, whereas if the risk (variance) of the quasi-short-run profit decreases, then ($\mathrm{cov}\left(\zeta_{i,j,t+1}, \pi^{QS}_{i,t+1} \middle| \mathbf{z}_{i,t} \right) > 0$), and if the financial firm is still risk-averse, the sign of $\varpi^*_{i,j,t}$ is negative.

From Definition 5, we can see that the factors that have an impact on the degree of competition are not only the factors that affect the market structure and conduct ($\eta^*_{i,j,t}$) from the perspective of conventional industrial organization theory. From a financial perspective, the risk-averse attitude of financial firms ($r^{F*}_{i,t}$), the fluctuation risk of quasi-short-run profits ($\varpi^*_{i,j,t}$), and equity capital (which reflects the risk of the burden of financial distress costs) ($MRS^{\pi*}_{e,i,t}$) also have an impact. According to Homma (2009), these impacts can be organized into the following three effects: market structure and conduct effects ($-b_C \cdot \eta^*_{i,j,t} \big/ \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t} \right)$), equity capital effects ($-MRS^{\pi*}_{e,i,t} \cdot \left(1 + r^{F*}_{i,t} \right) \big/ \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t} \right)$), and risk-adjustment effects ($-\varpi^*_{i,j,t} \cdot \left(1 + r^{F*}_{i,t} \right) \big/ \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t} \right)$). Consequently, the following two propositions can be derived.

Proposition 1 *In the case that financial firms are risk-averse, an increase in equity capital increases the EGLI of financial assets other than cash (decreases the degree of competition) and decreases the EGLI of liabilities (raises the degree of competition).*

Proof. From Eq.(8), $MRS^{\pi*}_{e,i,t} = \left(\partial u^*_{i,t} \big/ \partial q^{p*}_{e,i,t} \right) \Big/ \left(\partial u^*_{i,t} \Big/ \partial \pi^{QS*}_{i,t} \right) > 0$. Furthermore, if the j-th financial good is an output and a financial asset other than cash, then $b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t} > 0$, and, in the same manner, if the j-th financial good is a liability $b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t} < 0$. Therefore, if the j-th financial good is an output and a financial asset other than cash, then the equity capital effects $\left(-MRS^{\pi*}_{e,i,t} \cdot \left(1 + r^{F*}_{i,t}\right) \middle/ \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}\right)\right)$ are negative, and if the j-th financial good is a liability, then these effects are positive. Here, we can show that $MRS^{\pi*}_{e,i,t}$ is a decreasing function of equity capital ($q^{p*}_{e,i,t}$) as follows. In other words, from Eq.(5), equity capital in the current period (time t) increases (decreases) due to the increase (reduction) of financial assets or the reduction (increase) of liabilities in the current period. From Eq.(3), at this time the quasi-short-run profit for the current period decreases (increases). Furthermore, if the financial firm is risk-averse, then the marginal utility of the equity capital in the current period $\left(\partial u^*_{i,t} \middle/ \partial q^{p*}_{e,i,t}\right)$ is a decreasing function of the equity capital and the marginal utility of the quasi-short-run profit in the current period $\left(\partial u^*_{i,t} \middle/ \partial \pi^{QS*}_{i,t}\right)$ is a decreasing function of the quasi-short-run profit. Therefore, as the equity capital in the current period grows larger (smaller), the denominator of $MRS^{\pi*}_{e,i,t}$ grows larger (smaller) and the numerator grows smaller (larger), and as a result $MRS^{\pi*}_{e,i,t}$ grows smaller (larger). Thus, $MRS^{\pi*}_{e,i,t}$ is a decreasing function of equity capital, so that if the j-th financial good is an output and a financial asset other than cash, then when the equity capital grows larger, the equity capital effects $\left(-MRS^{\pi*}_{e,i,t} \cdot \left(1 + r^{F*}_{i,t}\right) \middle/ \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}\right)\right)$ grow larger, and the EGLI of the j-th financial good increases (the degree of competition decreases). On the other hand, if the j-th financial good is an output and a liability, then the equity capital effects grow smaller and the EGLI of the j-th financial good decreases (the degree of competition increases). ■

Proposition 2 *Under the assumption that the risk (variance) of quasi-short-run profit increases due to an increase in financial assets other than cash and liabilities, if the financial firm is risk-averse, then the EGLI increases (the degree of competition decreases), whereas if it is assumed that the risk (variance) decreases, then the EGLI decreases (the degree of competition increases) if the financial firm is risk-averse.*

Proof. As stated above, under the assumption that the risk (variance) of quasi-short-run profit increases due to increases in financial assets, if the financial firm is risk-averse, then the sign of $\varpi_{i,j,t}^{*}$ is negative, whereas if we assume that the risk (variance) decreases, then the sign is positive if the financial firm is risk-averse. On the other hand, under the assumption that the risk (variance) of quasi-short-run profit increases due to increases in liabilities, if the financial firm is risk-averse, then the sign of $\varpi_{i,j,t}^{*}$ is positive, whereas if we assume that the risk (variance) decreases, then the sign is negative if the financial firm is risk-averse. Furthermore, under the assumption that the j-th financial good is an output and a financial asset other than cash, $b_C \cdot h_{i,j,t}^{R*} - r_{i,t}^{F*} > 0$, and, in the same way, if the j-th financial good is a liability, then $b_C \cdot h_{i,j,t}^{R*} - r_{i,t}^{F*} < 0$. Therefore, under the assumption that the risk (variance) of quasi-short-run profit increases due to an increase in financial assets other than cash and liabilities, if the financial firm is risk-averse, then the sign of the risk-adjustment effects $\left(-\varpi_{i,j,t}^{*} \cdot \left(1 + r_{i,t}^{F*}\right) / \left(b_C \cdot h_{i,j,t}^{R*} - r_{i,t}^{F*}\right)\right)$ is positive and the EGLI increases (the degree of competition decreases). On the other hand, if we assume that the risk (variance) decreases, then the sign of the risk-adjustment effects is negative if the financial firm is risk-averse and the EGLI decreases (the degree of competition increases). ■

In this way, the EGLI comprises market structure and conduct effects, equity capital effects, and risk-adjustment effects, but the market structure and conduct effects are the same as the GLI defined in the CURM. For the subsequent empirical analysis, the definition of the GLI is given below.

Definition 6 *The generalized Lerner index of the j-th financial good of the i-th firm in period t, denoted by $GLI_{i,j,t}$, is defined as*

$$GLI_{i,j,t} = -\frac{b_C \cdot \eta_{i,j,t}^{*}}{b_C \cdot h_{i,j,t}^{R*} - r_{i,t}^{F*}};\ j = 1, \cdots, N_A + N_L. \tag{19}$$

Consequently, the following remark is established.

Remark 4 *Using the GLI, the EGLI can be expressed as*

$$EGLI_{i,j,t} = GLI_{i,j,t} - \frac{\left(MRS_{e,i,t}^{\pi*} + \varpi_{i,j,t}^{*}\right) \cdot \left(1 + r_{i,t}^{F*}\right)}{b_C \cdot h_{i,j,t}^{R*} - r_{i,t}^{F*}};\ j = 1, \cdots, N_A + N_L. \tag{20}$$

The EGLI thus represents an extension of the GLI to include the consideration of equity capital effects and risk-adjustment effects in the discrepancy between the SURP and marginal variable costs. If these effects cancel or are both zero, then the EGLI is fully equivalent to the GLI.

From Remark 4, the following two propositions are established.

Proposition 3 *Under the assumption that the j-th financial good is a financial asset other than cash, the risk (variance) of quasi-short-run profit increases due to an increase in financial assets and at the same time the financial firm is risk-averse (as a result of both of these factors, $\varpi^*_{i,j,t} < 0$), and if the risk-adjustment effects ($-\varpi^*_{i,j,t} \cdot \left(1 + r^{F*}_{i,t}\right) / \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}\right)$) are larger than the absolute value of the equity capital effects ($-MRS^{\pi*}_{e,i,t} \cdot \left(1 + r^{F*}_{i,t}\right) / \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}\right)$) (i.e., $MRS^{\pi*}_{e,i,t} + \varpi^*_{i,j,t} < 0$), then the EGLI is higher than the GLI. On the other hand, even under the assumption that the risk (variance) of quasi-short-run profit decreases due to the increase in financial assets other than cash and either the financial firm is risk-averse (as a result of both of these factors, $\varpi^*_{i,j,t} > 0$) or the risk (variance) increases and the financial firm is risk-averse (as a result of both of these factors, $\varpi^*_{i,j,t} < 0$), if the risk-adjustment effects are smaller than the absolute value of the equity capital effects (i.e., $MRS^{\pi*}_{e,i,t} + \varpi^*_{i,j,t} > 0$), then the EGLI is lower than the GLI.*

Proposition 4 *Under the assumption that the j-th financial good is a liability, the risk (variance) of quasi-short-run profit increases due to an increase in liabilities and, at the same time, the financial firm is risk-averse (case in which $\varpi^*_{i,j,t} > 0$ as a result of both of these factors) or even if the risk (variance) decreases and the financial firm is risk-averse (case in which $\varpi^*_{i,j,t} < 0$ as a result of both of these factors), if the absolute value of the risk-adjustment effects ($-\varpi^*_{i,j,t} \cdot \left(1 + r^{F*}_{i,t}\right) / \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}\right)$) is smaller than the equity capital effects ($-MRS^{\pi*}_{e,i,t} \cdot \left(1 + r^{F*}_{i,t}\right) / \left(b_C \cdot h^{R*}_{i,j,t} - r^{F*}_{i,t}\right)$) (i.e., $MRS^{\pi*}_{e,i,t} + \varpi^*_{i,j,t} > 0$), then the EGLI is higher than the GLI. On the other hand, if the risk (variance) of quasi-short-run profit decreases due to an increase in liabilities and, at the same time, the financial firm is risk-averse, and the absolute value* *of the risk-adjustment effects is larger than the equity capital effects (i.e., $MRS^{\pi *}_{e,i,t} + \varpi^{*}_{i,j,t} < 0$), then the EGLI is lower than the GLI.*

Based on Remark 4 and Propositions 3 and 4, we understand that, as long as $MRS^{\pi *}_{e,i,t} + \varpi^{*}_{i,j,t} = 0$ is not true, when estimating the degree of competition while considering only market structure and conduct effects from the perspective of traditional industrial organization theory (GLI), we will arrive at an overestimation or an underestimation of the more realistic degree of competition (EGLI) that takes into account the equity capital effects and the risk-adjustment effects. The problem is the extent of the difference that emerges, or, in other words, the magnitude of the absolute values of the equity capital effects and the risk-adjustment effects, but this is an extremely empirical problem, and must be clarified by estimating the GLI and EGLI.

3 Empirical Application

In order to apply the GURM described in Section 2 to Japanese city banks and estimate the GURM, we must specify the model and create the data, and, at the same time, we must consider the estimation method and the test method for that specified model (the empirical generalized user-revenue model, EGURM). These points are discussed in this section.

The EGURM is created according to the following procedure. First, the endogenous state variable is specified, and its data are created. Second, the exogenous state variable excluding the uncertain or unpredictable components of the SEHRR and SEHCR is specified, and its data are created. Third, the components of the SEHRR and SEHCR are specified and estimated, and their data are created. Fourth, the variable cost function is specified and estimated, and the data for the marginal variable costs are created. Fifth, the utility function and the stochastic Euler equations are specified. Unfortunately, due to space restrictions, only the most important points, namely, the first and fifth points, are discussed in this section. The other points are discussed in the Appendix.

The 15 city banks considered in the analysis are as follows: Shinsei Bank, Aozora Bank, Mizuho Bank, Sakura Bank, Mizuho Corporate Bank, Bank of Tokyo-Mitsubishi UFJ, Asahi Bank, UFJ Bank, Sumitomo Mitsui Banking Corporation, Resona Bank, Tokai Bank, Hokkaido Takushoku Bank, Taiyo Kobe Bank, Bank of Tokyo, and Saitama Bank. (The three long-term credit banks, Industrial Bank of Japan, Long-Term Credit Bank of Japan, and Nippon Credit Bank, are not included.) The period covered by the analysis is from fiscal year 1975 to fiscal year 2007. However, as stated below, the EGURM includes lag variables for the previous period and the next period, so the data period in the estimate is from fiscal year 1974 to fiscal year 2008.

3.1 Empirical Model Specification

3.1.1 Endogenous State Variables

According to Homma (2009, p.16), the endogenous state variables comprise financial goods and real resource fixed inputs (physical capital or human capital). However, as stated at the beginning of Section 2, the focus of the analysis is narrowed to financial goods, and it is assumed that the real resource fixed inputs comprise physical capital only. These inputs are treated as variable inputs, which have been optimized within a single period, in the same manner as labor and current goods. In other words, only the endogenous state variables are assumed to be financial goods.

Financial goods are classified into financial assets and liabilities. Cash is different from other financial assets, and its SEHRR comprises only uncertain or unpredictable components ($\zeta_{i,j,t+1}$).[20] Therefore, financial assets are divided into cash and financial assets other than cash. Ideally, financial assets other than cash should be classified while considering the basic functions of banks (the settlement of accounts function, credit creation function, financial intermediation function, and information production function). However, due to data restrictions and gaps in the data creation theory, such classifications cannot be made easily. Here, the classification is made with reference to Ōmori and Nakajima (2000, pp.242-244), which broadly categorized the inherent operations of the banking industry into settlement services

[20] See Homma (2009, pp.7-8).

and financial intermediation services. First, loans are divided into short-term loans (loans for a period of one year or less, or with no loan period stipulated) and long-term loans (loans for a period in excess of one year). Furthermore, financial assets other than these loans and cash are divided into three categories: securities, due from banks and call loans, and other financial assets (financial assets other than the first two types) (= money held in trust + foreign exchange-debit + other assets). According to Ōmori and Nakajima (2000, pp.242-244), long-term loans provide a financial intermediation service, whereas short-term loans provide primarily a settlement service. Furthermore, they stated that other financial assets, such as money held in trust and foreign exchange-debit, provide a financial intermediation service, whereas due from banks and call loans provide primarily a settlement service. In particular, the following explanation is given regarding the fact that short-term loans provide a settlement service. They reported, for example, that in the case in which the balance is insufficient in the account of a party with an overdraft contract, the overdraft is used, and in the same way, short-term loans are used when an economic unit such as a corporation, which holds a deposit account, has insufficient daily working funds (particularly, in the case that there are no problems with the business condition of the economic unit). Furthermore, with regard to individuals, in the case that their ordinary deposit balance is insufficient due to a "combined bank account," for example, short-term loans with financial assets, such as time deposits, as the collateral are provided.

Although the above discussion is related to the classification of financial assets other than cash, here, liabilities are also classified with reference to Ōmori and Nakajima (2000, pp.242-244). First, deposits are divided into demand deposits (= current deposits + ordinary deposits + other deposits) and time deposits.[21] Furthermore, the liabilities other than these deposits are divided into the two categories of call money and borrowed money, and

[21] In Ōmori and Nakajima (2000, pp. 242-244), time deposits with a period of less than six months for which the depositor is not an individual are considered to be the management of funds used for the settlement of accounts within a comparatively short term and are distinguished from other time deposits. Unfortunately, this type of distinction cannot be made in the present paper due to restrictions on the available data.

certificates of deposit and other liabilities. According to Ōmori and Nakajima (2000, pp.242-244), demand deposits provide a settlement service, whereas time deposits (excluding time deposits with a period of less than six months for which the depositor is not an individual) provide a financial intermediation service.[22] Furthermore, they stated that call money and borrowed money provide a settlement service, whereas certificates of deposit and other liabilities provide a financial intermediation service. However, as stated at the beginning of Section 2, certificates of deposit and other liabilities are treated as the fourth (variable) input, in the same manner as labor, current goods, and physical capital. The reason for this is stated at the beginning of Section 2.

From the above discussion, it is assumed that the endogenous state variable vector of $\mathbf{q}_{i,t+1}$ the i-th bank at the end of fiscal year t (= the beginning of fiscal year $t+1$) comprises short-term loans $q_{SL,i,t+1}$, long-term loans $q_{LL,i,t+1}$, securities $q_{S,i,t+1}$, cash $q_{C,i,t+1}$, due from banks and call loans $q_{CL,i,t+1}$, other financial assets $q_{A,i,t+1}$, demand deposits $q_{DD,i,t+1}$, time deposits $q_{TD,i,t+1}$, and call money and borrowed money $q_{CM,i,t+1}$.

Consequently, $\mathbf{q}_{i,t+1}$ is expressed as follows:

$$\begin{aligned} \mathbf{q}_{i,t+1} \quad = \quad & (q_{SL,i,t+1}, q_{LL,i,t+1}, q_{S,i,t+1}, q_{C,i,t+1}, q_{CL,i,t+1}, q_{A,i,t+1}, \\ & q_{DD,i,t+1}, q_{TD,i,t+1}, q_{CM,i,t+1})' . \end{aligned} \tag{21}$$

The data for financial goods that is used, as well as the creation of that data and the sources of the data, are described in Table 3.1.

<<Insert Table 3.1 about here>>

3.1.2 Utility Function and Stochastic Euler Equations

It is necessary to specify the utility function that appeared in Eq.(2) and Eq.(6) to Eq.(8), as described in Section 2, while taking into account the

[22] Ōmori and Nakajima (2000) stated that time deposits with a period of less than six months for which the depositor is not an individual provide a settlement of accounts service.

problems related to estimation. In the case of a static model assuming temporal optimization, it is possible to apply duality theory to estimate the indirect utility function and the minimum expenditure function.[23] However, with the establishment of the dynamic-uncertainty model discussed in Section 2, it is difficult to derive the same types of functions. For this reason, we estimate the parameter indirectly through a stochastic Euler equation, clearly stating the risk-adjustment term in Eq.(8). As shown in the macroeconometric model and the calibration approach, estimation of the stochastic Euler equation is not difficult if a quadratic form or logarithm form is assumed for the utility function, or a variety of linearization processing is applied. However, in most cases, a significant degree of theoretical flexibility is lost. Here, we consider parameterizing the utility function without taking these types of approaches.

Unlike with specification of a variable cost function, assuming that a direct estimate will be made, the specification of a utility function that does not have a direct estimation equation cannot go beyond the necessary minimum parameterization. For this reason, we specify this utility function as a Box-Cox form:

$$u\left(\pi_{i,t}^{QS}, q_{e,i,t}\right) = \frac{\left(\pi_{i,t}^{QS} + \phi_\pi\right)^\gamma - 1}{\gamma} + \alpha_e \cdot \frac{(q_{e,i,t} + \phi_e)^\gamma - 1}{\gamma}, \tag{22}$$

where ϕ_π and ϕ_e (> 0) are parameters established taking into account the possibility that the quasi-short-run profit and the equity capital become negative. Here, α_e indicates the degree of relative influence of equity capital based on the impact of the quasi-short-run profit. If α_e is larger (smaller) than 1, then the impact is larger (smaller) on utility than quasi-short-run profit. Taking into account the possibility that α_e varies depending on the period, we specify α_e as follows:

$$\alpha_e = \sum_s \alpha_{e,s} \cdot D_s^{YB}, \tag{23}$$

[23] See Hughes, Lang, Mester, and Moon (1995).

where D_s^{YB} is the period dummy variable in the case that the period covered by the analysis is split into several sub-periods (the dummy variable equals 1 in period s and 0 in other periods). Furthermore, γ is the risk attitude parameter, and taking into account the possibility that γ varies depending on the period, just as we did for α_e, we specify γ as follows:

$$\gamma = \sum_s \gamma_s \cdot D_s^{YB}. \tag{24}$$

In this case, $1 - \gamma_s$ indicates the degree of relative risk-aversion, which is expressed as follows:

$$1 - \gamma_s = -\pi_{i,t}^{QS} \cdot \frac{\partial^2 u}{\partial \pi_{i,t}^{QS2}} \bigg/ \frac{\partial u}{\partial \pi_{i,t}^{QS}} = -q_{e,i,t} \cdot \frac{\partial^2 u}{\partial q_{e,i,t}^{\;2}} \bigg/ \frac{\partial u}{\partial q_{e,i,t}} . \tag{25}$$

Here, $0 \leq \gamma_s < 1$ $(= 1, > 1)$, $1 - \gamma_s > 0$ $(= 0, < 0)$ indicates risk-averse (risk-neutral or risk-loving).

For the subjective rate of time preference (SRTP) $r_{i,t}^D$, which appears directly in Eq.(2) and indirectly in Eq.(8), rather than using the existing interest rate data *a priori*, we consider estimating the SRTP indirectly through the stochastic Euler equation in Eq.(8), just as we did with the utility function. The reason for this is that, as we can see from Eqs.(10) through (12), the SRTP plays an important role in classifying financial goods as outputs or inputs, so that estimating the SRTP that is most suitable for the GURM is more desirable than trying to forcibly relate the existing interest rate data to our purposes. Here, we specify the SRTP as follows, assuming that it is identical for all of the city banks:

$$r_t^D = \delta^S \cdot r_t^{CR}, \tag{26}$$

where δ^S is the parameter to be estimated, and r_t^{CR} is the uncollateralized overnight call rate.

The stochastic Euler equation in Eq.(8) of Theorem 1 is expressed with an expectation operator or integral sign, so that it is extremely difficult to estimate this equation as is. For this reason, we consider deriving an estimation equation in a form that does not depend on an expectation operator or integral sign. First, transform Eq.(8) in Theorem 1 as follows:

$$1 = \frac{1 + b_C \cdot \left(h^{R*}_{i,j,t} + \eta^*_{i,j,t} \right)}{1 + \left(b_j \cdot p_{G,t} \right)^{-1} \cdot MC^{V*}_{i,j,t} - MRS^{\pi*}_{e,i,t}} \cdot \beta_{i,t} \cdot \frac{E\left[\partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} \Big| \mathbf{z}_{i,t} \right]}{\partial u^*_{i,t} \Big/ \partial \pi^{QS*}_{i,t}}$$
$$+ \beta_{i,t} \cdot \frac{\operatorname{cov}\left(\zeta_{i,j,t+1}, \partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} \Big| \mathbf{z}_{i,t} \right)}{\left(\partial u^*_{i,t} \Big/ \partial \pi^{QS*}_{i,t} \right) \cdot \left[1 + \left(b_j \cdot p_{G,t} \right)^{-1} \cdot MC^{V*}_{i,j,t} - MRS^{\pi*}_{e,i,t} \right]}$$
$$\left(j = 1, \cdots, N_A + N_L \right). \quad (27)$$

Here, $E\left[\partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} \Big| \mathbf{z}_{i,t} \right] = \int_Z \partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} \, Q\left(\mathbf{z}_{i,t}, \mathbf{dz}_{i,t+1} \right)$ and

$$\operatorname{cov}\left(\zeta_{i,j,t+1}, \partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} \Big| \mathbf{z}_{i,t} \right) = \int_Z \left(\zeta_{i,j,t+1} - E\left[\zeta_{i,j,t+1} \middle| \mathbf{z}_{i,t} \right] \right)$$
$$\cdot \left(\partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} - E\left[\partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} \Big| \mathbf{z}_{i,t} \right] \right) Q\left(\mathbf{z}_{i,t}, \mathbf{dz}_{i,t+1} \right),$$

so Eq.(27) is expressed as follows:

$$\int_Z \left[\frac{1 + b_C \cdot \left(h^{R*}_{i,j,t} + \eta^*_{i,j,t} \right)}{1 + \left(b_j \cdot p_{G,t} \right)^{-1} \cdot MC^{V*}_{i,j,t} - MRS^{\pi*}_{e,i,t}} \cdot \beta_{i,t} \cdot \frac{\partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1}}{\partial u^*_{i,t} \Big/ \partial \pi^{QS*}_{i,t}} + \beta_{i,t} \right.$$
$$\left. \cdot \frac{\left(\zeta_{i,j,t+1} - E\left[\zeta_{i,j,t+1} \middle| \mathbf{z}_{i,t} \right] \right) \cdot \left(\partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} - E\left[\partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} \Big| \mathbf{z}_{i,t} \right] \right)}{\left(\partial u^*_{i,t} \Big/ \partial \pi^{QS*}_{i,t} \right) \cdot \left[1 + \left(b_j \cdot p_{G,t} \right)^{-1} \cdot MC^{V*}_{i,j,t} - MRS^{\pi*}_{e,i,t} \right]} \right]$$
$$Q\left(\mathbf{z}_{i,t}, \mathbf{dz}_{i,t+1} \right) = 0 \;\; \left(j = 1, \cdots, N_A + N_L \right). \quad (28)$$

Consequently, we consider making the expression inside the brackets the estimation equation. In this case, the problem is the treatment of $E\left[\zeta_{i,j,t+1} \middle| \mathbf{z}_{i,t} \right]$ and $E\left[\partial u^*_{i,t+1} \Big/ \partial \pi^{QS*}_{i,t+1} \Big| \mathbf{z}_{i,t} \right]$. Based on Theorem 1 in Section 2, we assume that $E\left[\zeta_{i,j,t+1}\middle|\,\mathbf{z}_{i,t}\right]$ is zero. Regarding $E\left[\partial u^*_{i,t+1}\middle/\partial\pi^{QS*}_{i,t+1}\middle|\,\mathbf{z}_{i,t}\right]$, we assume

$$E\left[\partial u^*_{i,t+1}\middle/\partial\pi^{QS*}_{i,t+1}\middle|\,\mathbf{z}_{i,t}\right]=\left(\sum_i a_i^{MU}\cdot D_i^B+\mathbf{b}^{MU\prime}\cdot\mathbf{z}_{i,t}\right)\cdot\left(\partial u^*_{i,t}\middle/\partial\pi^{QS*}_{i,t}\right), \tag{29a}$$

$$\partial u^*_{i,t+1}\middle/\partial\pi^{QS*}_{i,t+1}-\left(\sum_i a_i^{MU}\cdot D_i^B+\mathbf{b}^{MU\prime}\cdot\mathbf{z}_{i,t}\right)\cdot\left(\partial u^*_{i,t}\middle/\partial\pi^{QS*}_{i,t}\right)=\varepsilon^{MU}_{i,t+1}, \tag{29b}$$

where $\varepsilon^{MU}_{i,t+1}$ is an ordinary error term, D_i^B is a dummy variable for an individual bank (bank-fixed effect), $\mathbf{z}_{i,t}$ is the exogenous state variable vector, and $\mathbf{b}^{MU}$ is the corresponding coefficient vector.[24]

Taking into account the above considerations, the estimation equation inside the brackets is expressed as follows:

$$\frac{1+b_C\cdot\left(h^R_{j,i,t}+\eta_{j,i,t}\right)}{1+\left(b_j\cdot p_{G,t}\right)^{-1}\cdot MC^V_{j,i,t}-MRS^{\pi}_{e,i,t}}\cdot\beta_{i,t}\cdot\frac{\partial u_{i,t+1}\middle/\partial\pi^{QS}_{i,t+1}}{\partial u_{i,t}\middle/\partial\pi^{QS}_{i,t}}+\beta_{i,t}$$

$$\cdot\frac{\zeta_{j,i,t+1}\cdot\left[\partial u_{i,t+1}\middle/\partial\pi^{QS}_{i,t+1}-\left(\sum_i a_i^{MU}\cdot D_i^B+\mathbf{b}^{MU\prime}\cdot\mathbf{z}_{i,t}\right)\cdot\left(\partial u_{i,t}\middle/\partial\pi^{QS}_{i,t}\right)\right]}{\left(\partial u_{i,t}\middle/\partial\pi^{QS}_{i,t}\right)\cdot\left[1+\left(b_j\cdot p_{G,t}\right)^{-1}\cdot MC^V_{j,i,t}-MRS^{\pi}_{e,i,t}\right]}$$

$$-1=\varepsilon^{EU}_{j,i,t+1}\ \left(j=SL,LL,S,C,CL,A,DD,TD,CM\right), \tag{30a}$$

where $\varepsilon^{EU}_{j,i,t+1}$ is the error term. In order to simplify the notation, the $*$ symbols have been omitted. Moreover, in accordance with the notation in the present section, the order of subscripts i and j has been reversed. Further-

[24] For more details about the specific exogenous state variables see Section 4.1.

more, from Appendix 6.2, $h^R_{j,i,t}$ is

$$h^R_{j,i,t} = \begin{cases} r^R_{j,i}\left(Q_{j,t}, \mathbf{z}^{RQ}_{L,i,t}\right) + r^Q_{j,i}\left(\mathbf{z}^{RQ}_{L,i,t}\right) + h^S_{j,i,t} - h^D_{j,i}\left(\mathbf{z}^D_{L,i,t}\right) & (j = SL, LL) \\ r_{j,i,t} + h^S_{j,i,t} + h^C_{j,i,t} - h^D_{j,i,t} & (j = S, A) \\ 0 & (j = C) \\ r_{j,i,t} & (j = CL, CM) \\ r^R_{j,i}\left(Q_{j,t}, \mathbf{z}^{RQ}_{D,i,t}\right) + r^Q_{j,t}\left(\mathbf{z}^{RQ}_{D,i,t}\right) + h^I_{j,i,t} + r^D_{i,t} \cdot \kappa_{j,i,t} - h^S_{j,i,t} & (j = DD, TD) \end{cases} . \tag{30b}$$

Moreover, from Appendix 6.2, $\eta_{j,i,t}$ is

$$\begin{aligned} \eta_{j,i,t} &= \frac{\partial h^R_{j,i,t}}{\partial \ln q_{j,i,t}} = \frac{q_{j,i,t}}{Q_{j,t}} \cdot \frac{\partial h^R_{j,i,t}}{\partial \ln Q_{j,t}} \cdot \left(1 + \sum\nolimits_{k \neq i}^{N_F} \frac{\partial q_{j,k,t}}{\partial q_{j,i,t}}\right) \\ &= \begin{cases} \frac{q_{j,i,t}}{Q_{j,t}} \cdot \left(\sum\nolimits_s \beta^R_{j,s} \cdot D^{YA}_s\right) \cdot \left(1 + \sum\nolimits_s \rho_{j,s} \cdot D^{YB}_s\right) & (j = SL, LL, DD, TD) \\ 0 & (j = S, A, C, CL, CM) \end{cases} \end{aligned} \tag{30c}$$

Here, $\sum_s \rho_{j,s} \cdot D^{YB}_s$ is the parameterization of the conjectural derivative $(\sum_{k \neq i}^{N_F} \frac{\partial q_{j,k,t}}{\partial q_{j,i,t}})$. Furthermore, we impose the restriction that $-1 \leq \rho_{j,s} \leq 2.95$, so that $\rho_{j,s}$ does not take on a value smaller than -1, which means perfect competition, or a dramatically large value (in this case, a value of 2.95 or greater)[25]. Basically, we assume that

$$\rho_{j,s} = -1 + 3.95 \cdot \Phi\left(\rho^*_{j,s}\right), \tag{30d}$$

where $\Phi(\cdot)$ is the standard normal distribution function, and $\rho^*_{j,s}$ is the parameter to be estimated. Essentially, the conjectural derivative differs for each individual bank and for each fiscal year. However, with a simple parameterization, making this type of estimate is impossible. For this reason, we assume that the conjectural derivative is identical for all of the banks and that it is identical in each of the several sub-periods split from the period covered by the analysis. In the case that these types of assumptions are made, the number of parameters to be estimated $\rho_{j,s}$ is limited to the number of

[25] In the nonlinear estimation, among the values that successfully converged, 2.95 is the value for which the estimation results for the overall model were the best.

sub-periods. Moreover, from Eq.(22), we have

$$\frac{\partial u_{i,t}}{\partial \pi_{i,t}^{QS}} = \left(\pi_{i,t}^{QS} + \phi_\pi\right)^{\gamma-1}, \tag{30e}$$

$$\frac{\partial u_{i,t+1}}{\partial \pi_{i,t+1}^{QS}} = \left(\pi_{i,t+1}^{QS} + \phi_\pi\right)^{\gamma-1} \tag{30f}$$

and

$$MRS_{e,i,t}^{\pi} = \frac{\partial u_{i,t} / \partial q_{e,i,t}}{\partial u_{i,t} \Big/ \partial \pi_{i,t}^{QS}} = \alpha_e \cdot \left(\frac{q_{e,i,t} + \phi_e}{\pi_{i,t}^{QS} + \phi_\pi}\right)^{\gamma-1}. \tag{30g}$$

In addition, from Eq.(6.3.1a) in Appendix 6.3, we have

$$MC_{j,i,t}^{V} = \frac{\partial C_{i,t}^{V}}{\partial q_{j,i,t}} = \frac{\hat{C}_{i,t}^{V}}{q_{j,i,t}} \cdot \frac{\partial \ln\left(C_{i,t}^{V} / p_{V,i,t}^{*}\right)}{\partial \ln q_{j,i,t}^{*}} = \frac{\hat{C}_{i,t}^{V}}{q_{j,i,t}} \cdot \sigma_{j,i,t}^{Q}. \tag{30h}$$

Here, the estimates $\hat{C}_{i,t}^{V}$ of the variable cost function and the elasticity of the variable cost function with respect to the financial good $\sigma_{j,i,t}^{Q}$ are as follows:

$$\begin{aligned}
\hat{C}_{i,t}^{V} = \exp\Bigg[& \sum_i a_i\left(D_i^{MA}, \tau_t^*\right) \cdot D_i^B + \sum_{j\in\{SL,LL\}} a_j\left(\mathbf{z}_{GL,i,t}^{RQ}\right) \cdot \ln q_{j,i,t}^{*} \\
& + \sum_{j\in\{DD,TD\}} a_j\left(\mathbf{z}_{GD,t}^{RQ}\right) \cdot \ln q_{j,i,t}^{*} + \sum_{j\in\{S,C,CL,A,CM\}} a_j \cdot \ln q_{j,i,t}^{*} \\
& + \sum_{j\in\{L,K,B\}} a_j\left(\mathbf{z}_{G,i,t}^{RQ}\right) \cdot \ln\left(p_{j,i,t}^{*} / p_{V,i,t}^{*} + \theta_j\right) \\
& + \frac{1}{2} \cdot \sum\sum_{j,h\in\{SL,LL,S,C,CL,A,DD,TD,CM\}} b_{jh} \cdot \ln q_{j,i,t}^{*} \cdot \ln q_{h,i,t}^{*} \\
& + \frac{1}{2} \cdot \sum\sum_{j,h\in\{L,K,B\}} b_{jh} \cdot \ln\left(p_{j,i,t}^{*} / p_{V,i,t}^{*} + \theta_j\right) \cdot \ln\left(p_{h,i,t}^{*} / p_{V,i,t}^{*} + \theta_h\right) \\
& + \sum\sum_{j\in\{SL,LL,S,C,CL,A,DD,TD,CM\}, h\in\{L,K,B\}} b_{jh} \cdot \ln q_{j,i,t}^{*} \cdot \ln\left(p_{h,i,t}^{*} / p_{V,i,t}^{*} + \theta_h\right) \\
& + \sum_{j\in\{SL,LL,S,C,CL,A,DD,TD,CM\}} b_{jT} \cdot \ln q_{j,i,t}^{*} \cdot \tau_t^{*} + \sum_{j\in\{L,K,B\}} b_{jT} \cdot \ln\left(p_{j,i,t}^{*} / p_{V,i,t}^{*} + \theta_j\right) \cdot \tau_t^{*} \\
& + \ln p_{V,i,t}^{*} \Bigg],
\end{aligned} \tag{30i}$$

$$\sigma^{Q}_{j,i,t} = a_j\left(\mathbf{z}^{RQ}_{GL,i,t}\right) + \sum_{h\in\{SL,LL,S,C,CL,A,DD,TD,CM\}} b_{jh}\cdot \ln q^{*}_{h,i,t} + \sum_{h\in\{L,K,B\}} b_{jh}\cdot \ln\left(p^{*}_{h,i,t}/p^{*}_{V,i,t}+\theta_h\right) + b_{jT}\cdot\tau^{*}_{t} \quad (j = SL, LL)\,, \tag{30j}$$

$$\sigma^{Q}_{j,i,t} = a_j + \sum_{h\in\{SL,LL,S,C,CL,A,DD,TD,CM\}} b_{jh}\cdot \ln q^{*}_{h,i,t} + \sum_{h\in\{L,K,B\}} b_{jh}\cdot \ln\left(p^{*}_{h,i,t}/p^{*}_{V,i,t}+\theta_h\right) + b_{jT}\cdot\tau^{*}_{t} \quad (j = S, C, CL, A, CM)\,, \tag{30k}$$

$$\sigma^{Q}_{j,i,t} = a_j\left(\mathbf{z}^{RQ}_{GD,t}\right) + \sum_{h\in\{SL,LL,S,C,CL,A,DD,TD,CM\}} b_{jh}\cdot \ln q^{*}_{h,i,t} + \sum_{h\in\{L,K,B\}} b_{jh}\cdot \ln\left(p^{*}_{h,i,t}/p^{*}_{V,i,t}+\theta_h\right) + b_{jT}\cdot\tau^{*}_{t} \quad (j = DD, TD)\,. \tag{30l}$$

Furthermore, from Eq.(26), the subjective discount factor $\beta_{i,t}$ is obtained as follows:

$$\beta_{i,t} = \beta_t = \frac{1}{1+r^{D}_{t}} = \frac{1}{1+\delta^{S}\cdot r^{CR}_{t}}. \tag{30m}$$

Finally, from Appendix 6.2, the uncertainty factor $\zeta_{j,i,t+1}$ is obtained as follows:

$$\zeta_{j,i,t+1} = \begin{cases} \zeta^{R}_{j,i,t+1} + \zeta^{Q}_{j,i,t+1} + \zeta^{S}_{j,i,t+1} - \zeta^{D}_{j,i,t+1} & (j = SL, LL) \\ \zeta^{S}_{j,i,t+1} + \zeta^{C}_{j,i,t+1} - \zeta^{D}_{j,i,t+1} & (j = S, A) \\ 0 & (j = C, CL, CM) \\ \zeta^{R}_{j,i,t+1} + \zeta^{Q}_{j,i,t+1} + \zeta^{I}_{j,i,t+1} - \zeta^{S}_{j,i,t+1} & (j = DD, TD) \end{cases}. \tag{30n}$$

3.2 Estimation and Test Procedure

The estimate is made in three stages. In the first stage, as in Eq.(6.2.1.1) in the Appendix, the actual holding-revenue rate or holding-cost rate ($H_{j,i,t+1}$) at the end of fiscal year t (= the beginning of fiscal year $t+1$) is broken down into the certain or predictable components at the beginning of fiscal year t ($h^{R}_{j,i,t}$) and the uncertain or unpredictable components at the end of fiscal year t ($\zeta_{j,i,t+1}$). Basically, $H^{k}_{j,i,t+1}$ ($k = R, Q$; $j = SL, LL, DD, TD$) and $H^{D}_{j,i,t+1}$ ($j = SL, LL$) are respectively estimated using multivariate regression analyses of Eqs.(6.2.3.1.6a) and (6.2.3.1.6b), Eqs.(6.2.3.1.7a) and

(6.2.3.1.7b), and Eq.(6.2.3.2.3) in the Appendix,[26] and broken down into the certain or predictable components of the independent variable and the uncertain or unpredictable components of the error term. The other components of $H_{j,i,t+1}$ are broken down into $h^R_{j,i,t}$ and $\zeta_{j,i,t+1}$, as shown in Section 6.2.1 of the Appendix.

In the second stage, we estimate the marginal variable cost ($MC^V_{j,i,t}$) in Eq.(30h). For this reason, we perform a nonlinear simultaneous estimation of Eqs.(6.3.1a) and (6.3.2) in the Appendix using the generalized method of moments (GMM).[27] The GMM estimates take into account the conditional heteroskedasticity and autocorrelation of the error term. In particular, regarding the autocorrelation of the error term, when including the moving average of the error term in the estimate of the covariance matrix of the orthogonality conditions, we use Bartrett's spectral density kernel proposed by Newey and West (1987) in order to guarantee that the estimate of the covariance matrix is a positive definite matrix. Furthermore, it is assumed that the degree of the moving average is three. When making a nonlinear estimation, we use the Gauss-Newton method to approximate the Hessian matrix required in the iterative computation of the parameter estimation.

In the third stage, we use the $h^R_{j,i,t}$ term and the $\zeta_{j,i,t+1}$ term estimated in the first stage and the $MC^V_{j,i,t}$ term estimated in the second stage to obtain a nonlinear simultaneous estimation of Eqs.(29b) and (30a) using the GMM. The estimate of the GMM is made taking into account the conditional heteroskedasticity and autocorrelation of the error term, just as in the second stage. However, due to the small sample size and large number of instrumental variables, if a simultaneous estimation of Eq.(30a) is obtained for all of the financial goods ($j = SL, LL, S, C, CL, A, DD, TD, CM$), then an estimate incorporating the conditional heteroskedasticity of the error term is impossible. Therefore, we obtain a simultaneous estimate of Eqs.(29b) and (30a) regarding short-term and long-term loans ($j = SL, LL$), demand deposits ($j = DD$), and time deposits ($j = TD$).

[26] For the equation for short-term loans, i.e., Eq.(6.2.3.1.6a), and Eq.(6.2.3.2.3), since the sample is the same, simultaneous estimation is used. For the other equations, the sample differs so single-equation estimation is used.

[27] For details regarding the GMM see Hansen (1982) and Hansen and Singleton (1982).

Generally, with the GMM, the multiple of the minimum value of the value function (which is the covariance of the orthogonality conditions) and the sample size (amount of data) yield the test statistic of the overidentifying restriction.[28] The test statistic is expressed as TJ. If the model is correctly specified and the instrumental variables are appropriate, then TJ asymptotically follows a χ^2 distribution. Therefore, given appropriate instrumental variables, this test is useful for investigating misspecification of the model. Furthermore, TJ is also used when testing the parameter restrictions. In other words, the test uses the same approach as the likelihood ratio test and is based on the fact that the TJ obtained by subtracting the TJ of the unrestricted model from the TJ of the restricted model follows a χ^2 distribution with the number of restrictions being the same as its number of degrees of freedom. Based on this concept, we perform a test of the overidentifying restriction in order to investigate misspecification of the model. If the null hypothesis of overidentifying is rejected, then (under the assumption that the instrumental variables are appropriate) there is a high likelihood that there is an error in the specification of the model.

4 Estimation Results

In this section, while examining the estimation results of the stochastic Euler equations, we prioritize the following issues based on the estimation results of the EGURM. First, we verify the risk attitudes of bank managers. As stated in Homma and Souma (2005), risk attitudes other than risk-neutral are the most fundamental causes of the difference between conventional UCPs and SURPs (constituting GURPs) and the difference between the conventional Lerner index and the GLI (constituting the EGLI). Therefore, clarifying these attitudes is the highest-priority issue. The questions examined when verifying these attitudes are whether the risk attitudes of bank managers are averse, rather than neutral, and whether the extent of their risk-aversion differs depending on the period, and, in particular, whether the extent of their

[28] Regarding this point see Davidson and MacKinnon (1993, pp.232-237, 614-621, 665).

risk-aversion varies greatly between bubble periods and other periods. For the specific analysis, we estimate the degree of relative risk-aversion in each period and determine whether there is a significant difference from zero (null hypothesis: bank managers are risk neutral).

Second, we compare the reference rate (risk-free rate) and the call rate. The reference rate is the risk-free rate ($r_{i,t}^{F*}$) of Corollary 1 in Section 2, and based on Definition 3, the reference rate is an important factor that impacts the determination of the sign of the SURPs. If bank managers have risk-neutral attitudes, then $r_{i,t}^{F*} = 1 \big/ \beta_{i,t} - 1$ and, as defined, in Hancock (1985, 1987, 1991) the reference rate is an important factor having that impacts the determination of the sign of the UCPs. Ōmori and Nakajima (2000) used the call rate as a proxy variable for the reference rate, and clarifying the validity of this technique had a lower priority. The question is whether the reference rate and the call rate differ greatly and thus whether it is appropriate to use the latter as the former. For the specific analysis, we compare the two rates for the entire period and for each sub-period to reveal their differences. Furthermore, by comparing the magnitudes of the two rates, we reveal the direction of the bias in the UCPs and SURPs in the case that the call rate is used as the reference rate.

Third, we estimate the SURPs, CURPs, and GURPs (= marginal variable costs) and compare them and quantitatively reveal the magnitude of each constituent element of the GURPs. In particular, the important step from the perspective of industrial organization theory is the comparison of the conventional market structure and conduct effects with the equity capital effects and risk-adjustment effects, and, in the case that the equity capital effects and risk-adjustment effects are larger than the market structure and conduct effects, there may be pressure to review conventional industrial organization policy, which considers primarily the market structure and conduct effects. These points are important from an analytical perspective. For the specific analysis, by comparing the SURPs, CURPs, and GURPs (= marginal variable costs) for short-term loans, long-term loans, demand deposits, and time deposits, we quantitatively reveal the size of the market structure and conduct effects, equity capital effects, and risk-adjustment effects for the entire period and for each sub-period.

Fourth, we reveal the important factors having an impact on the risk-adjustment effects as the most important components of the GURPs that are not SURPs. As stated below, the risk-adjustment effects are the largest components of the GURPs that are not SURPs, and they have a large impact on the GURPs and the EGLIs. Therefore, revealing the factors that have an impact on the GURPs and the EGLIs is important from a policy perspective. In particular, the impacts of the interest rate, injection of public funds, the reserve requirement ratio, and the deposit insurance rate are extremely important when ascertaining the impact of conventional monetary policy. The impact of cost efficiency cannot be ignored either. This is because it is thought that screening and monitoring of borrower firms and finely tuned responses to depositors have an impact on the risk-adjustment effects through cost efficiency. The above points are important analytical perspectives. For the specific analysis, we use the GMM to simultaneously estimate a regression equation with the risk-adjustment effects of short-term loans, long-term loans, demand deposits, and time deposits as the dependent variables and the interest rate, a proxy variable for public funds, the reserve requirement ratio, the deposit insurance rate, and cost efficiency, for example, as the independent variables.

Fifth, we estimate the EGLI to quantitatively reveal the market structure and conduct effects, equity capital effects, and risk-adjustment effects that it comprises. In the same manner as with the estimate of the SURPs, CURPs, and GURPs (= marginal variable costs), the important step from the perspective of industrial organization theory is the comparison of the conventional market structure and conduct effects with the equity capital effects and risk-adjustment effects. In the case that the equity capital effects and risk-adjustment effects are larger than the market structure and conduct effects, there may be pressure to review conventional competition policy, which considers primarily the market structure and conduct effects. Furthermore, this situation hints at the need for risk-adjustment policies that have not been considered before, and there may be pressure to switch from a competition policy to a risk-adjustment policy. These points are important analytical perspectives. For the specific analysis, based on the signs of the GURPs, we reveal the magnitudes of the EGLI and the market structure and conduct effects, equity capital effects, and risk-adjustment effects that it comprises for short-term loans, long-term loans, and demand deposits, which are judged to be outputs, over the entire period and for each sub-period.

As stated at the beginning of the preceding section, the period covered by the analysis is from fiscal year 1975 to fiscal year 2007, but this period is divided into five sub-periods for the purposes of the analysis: Period I (before the bubble period: fiscal year 1975 to fiscal year 1986), Period II (bubble period: fiscal year 1987 to fiscal year 1989), Period III (from after the bubble period to before the financial crisis and financial big bang period: fiscal year 1990 to fiscal year 1995), Period IV (financial crisis and financial big bang period: fiscal year 1996 to fiscal year 2001), and Period V (after the financial crisis and financial big bang period: fiscal year 2002 to fiscal year 2007). Note that, with the exception of the stochastic Euler equations, the estimation results of the EGURM are given in Appendix 7.

4.1 Stochastic Euler Equations

In order to estimate Eqs.(29b) and (30a) simultaneously using the GMM, we must specify the elements of the exogenous state variable vector ($\mathbf{z}_{i,t}$) and the instrumental variables. We assume that the exogenous state variable vector ($\mathbf{z}_{i,t}$) comprises the long-term prime rate ($z^{RQ}_{L,1,i,t}$), the capital ratio of borrower firms ($z^{RQ}_{L,2,i,t}$), the loan loss provision rate ($z^{RQ}_{L,4,i,t}$), the logarithm of loans per case ($\ln z^{RQ}_{L,5,i,t}$), the proportion of loans for small and medium firms ($z^{RQ}_{L,6,i,t}$), the Herfindahl index of loan proportions classified by industry ($z^{RQ}_{L,7,i,t}$), the Herfindahl index of loan proportions classified by mortgage ($z^{RQ}_{L,8,i,t}$), the proportion of loans for real estate business ($z^{RQ}_{L,9,i,t}$), the proportion of loans secured by real estate ($z^{RQ}_{L,10,i,t}$), the proportion of loans without collateral and without warranty ($z^{RQ}_{L,11,i,t}$), the logarithm of depositor's income ($\ln z^{RQ}_{D,1,t}$), the yield on government bonds ($z^{RQ}_{D,2,t}$), the interest rate of postal savings certificates ($z^{RQ}_{D,3,t}$), the benchmark index of Japanese stock investment trust (TOPIX, $z^{RQ}_{D,4,t}$), the interest rate of securities ($r_{S,i,t}$), the interest rate of due from banks and call loans ($r_{CL,i,t}$), the interest rate of other financial assets ($r_{A,i,t}$), the interest rate of call money and borrowed money ($r_{CM,i,t}$), the interest rate of certificates of deposit and other liabilities ($p_{B,i,t}$), the insurance rate of time deposits ($h^I_{TD,t-1}$), and the reserve requirement ratio for time deposits ($\kappa_{TD,t-1}$).

Consequently, $\mathbf{z}_{i,t}$ and $\mathbf{b}^{MU}$ are expressed as follows:

$$\begin{aligned}
\mathbf{z}_{i,t} &= \Big(z^{RQ}_{L,1,i,t}, z^{RQ}_{L,2,i,t}, z^{RQ}_{L,4,i,t}, \ln z^{RQ}_{L,5,i,t}, z^{RQ}_{L,6,i,t}, z^{RQ}_{L,7,i,t}, z^{RQ}_{L,8,i,t}, z^{RQ}_{L,9,i,t}, z^{RQ}_{L,10,i,t}, \\
&\quad z^{RQ}_{L,11,i,t}, \ln z^{RQ}_{D,1,t}, z^{RQ}_{D,2,t}, z^{RQ}_{D,3,t}, z^{RQ}_{D,4,t}, r_{S,i,t}, r_{CL,i,t}, r_{A,i,t}, r_{CM,i,t}, \\
&\quad p_{B,i,t}, h^I_{TD,t-1}, \kappa_{TD,t-1}\Big)', \qquad (31a) \\
\mathbf{b}^{MU} &= \big(b^{MU}_{L,1}, b^{MU}_{L,2}, b^{MU}_{L,4}, b^{MU}_{L,5}, b^{MU}_{L,6}, b^{MU}_{L,7}, b^{MU}_{L,8}, b^{MU}_{L,9}, b^{MU}_{L,10}, b^{MU}_{L,11}, b^{MU}_{D,1}, b^{MU}_{D,2}, \\
&\quad b^{MU}_{D,3}, b^{MU}_{D,4}, b^{MU}_{S}, b^{MU}_{CL}, b^{MU}_{A}, b^{MU}_{CM}, b^{MU}_{CD}, b^{MU}_{I}, b^{MU}_{\kappa}\big)'. \qquad (31b)
\end{aligned}$$

To improve the precision of estimation, we use different instrumental variables for each equation. More specifically, the instrumental variables that we use are as follows:

- Instruments for all the equations: D^B_i, D^{YB}_s ($s = 7586, 8789, 9095, 9601, 0207$), $r_{CL,i,t}$, $h^I_{TD,t}$, $\kappa_{TD,t}$, $r_{CM,i,t}$, $p_{B,i,t}$, $z^{RQ}_{L,1,i,t}$, $z^{RQ}_{L,2,i,t}$, $\ln z^{RQ}_{L,5,i,t-1}$, $z^{RQ}_{L,j,i,t-1}$ ($j = 4, 6, 7, 8, 9, 10, 11$), $\ln z^{RQ}_{D,1,t}$, $z^{RQ}_{D,j,t}$ ($j = 2, 3, 4$), $r_{S,i,t}$, $r_{A,i,t}$, r^{CR}_t, and r^{CR}_{t-1}, and
- Instruments for the (respective) stochastic Euler equations: $MC^V_{j,i,t}$ ($j = SL, LL, DD, TD$), $q_{j,i,t-1}/Q_{j,t-1}$ ($j = SL, LL, DD, TD$), $\beta D^{RYA}_{j,t}$ ($j = SL, LL, DD, TD$), $h^R_{j,i,t}$ ($j = SL, LL$), $\zeta_{j,i,t}$ ($j = SL, LL$), $r^R_{j,i}\left(Q_{j,t}, \mathbf{z}^{RQ}_{D,t}\right)$ ($j = DD, TD$), $\zeta^R_{j,i,t}$ ($j = DD, TD$), $r^Q_{j,i}\left(\mathbf{z}^{RQ}_{D,t}\right)$ ($j = DD, TD$), $\zeta^Q_{j,i,t}$ ($j = DD, TD$), $h^S_{j,i,t}$ ($j = DD, TD$), $\zeta^S_{j,i,t}$ ($j = DD, TD$), $h^I_{DD,t}$, and $\kappa_{DD,t}$,

where $q_{j,i,t-1}/Q_{j,t-1}$ is the market share of the j-th financial good in the period $t-1$, $\beta D^{RYA}_{j,t-1} = \sum_s \beta^R_{j,s} \cdot D^{YA}_s$,[29] $r^R_{j,i}\left(Q_{j,t}, \mathbf{z}^{RQ}_{D,t}\right)$ is the certain or

[29] For details regarding this equation, see Eqs.(6.2.3.1.4a) and (6.2.3.1.5a) in Section 6.2.3.1 of the Appendix.

predictable component of the paid interest rate for demand or time deposits,[30] $\zeta^R_{j,i,t}$ is the uncertain or unpredictable component of the paid interest rate for demand or time deposits,[31] $r^Q_{j,i}\left(\mathbf{z}^{RQ}_{D,t}\right)$ is the certain or predictable component of the unpaid interest rate for demand or time deposits,[32] $\zeta^Q_{j,i,t}$ is the uncertain or unpredictable component of the unpaid interest rate for demand or time deposits,[33] $h^S_{j,i,t}$ is the certain or predictable component of the service charge rate for demand or time deposits,[34] $\zeta^S_{j,i,t}$ is the uncertain or unpredictable component of the service charge rate for demand or time deposits,[35] $h^I_{DD,t}$ is the insurance rate of demand deposits, and $\kappa_{DD,t}$ is the reserve requirement ratio for demand deposits.

The estimation results of Eqs.(29b) and (30a) are shown in Table 4.1. From this table, the following five points can be inferred. First, the test statistic of the overidentifying restriction is not significant at the 99% level. Therefore, the null hypothesis of overidentifying is not rejected. This means that there is a very low likelihood that there is an error in the specification of Eqs.(29b) and (30a). Second, parameter γ_s, which shows the risk attitude parameter in period s, is positive, significant at the 1% level, and less than 1 in all of the periods, so we know that there is a high likelihood that the managers of the city banks were risk-averse for the entire period. However, more exactly, $1-\gamma_s$, which shows the degree of relative risk-aversion in period s, needs to be examined. Details will be presented in the following section. Furthermore, parameter $\alpha_{e,s}$, which shows the degree of relative influence of equity capital on utility based on the impact of the quasi-short-run profit, is positive and significant at the 1% level in all periods except Period II (bubble

[30] For details regarding this function, see Eq.(6.2.3.1.5a) in Section 6.2.3.1 of the Appendix.

[31] For details regarding this instrumental variable, see Eq.(6.2.1.3) in Section 6.2.1 of the Appendix.

[32] For details regarding this function, see Eq.(6.2.3.1.5b) in Section 6.2.3.1 of the Appendix.

[33] For details regarding this instrumental variable, see Eq.(6.2.1.5) in Section 6.2.1 of the Appendix.

[34] For details regarding this instrumental variable, see Eqs.(6.2.1.6) and (6.2.1.7) in Section 6.2.1 of the Appendix.

[35] For details regarding this instrumental variable, see Eqs.(6.2.1.6) and (6.2.1.10) in Section 6.2.1 of the Appendix.

period: fiscal year 1987 to fiscal year 1989) and Period IV (financial crisis and financial big bang period: fiscal year 1996 to fiscal year 2001). During Period II, city banks had sufficient equity capital, and during Period IV, public funds were injected. If we exclude these periods, during which there were special circumstances, city bank managers placed importance on the role of equity capital. Third, parameter δ^S, which shows the ratio of the subjective rate of time preference to the uncollateralized overnight call rate, is positive, significant at the 1% level, and much less than 1, so the subjective rate of time preference is much smaller than the call rate. Therefore, if we use the call rate as a proxy variable for the subjective rate of time preference instead of estimating it, we will end up overestimating the subjective rate of time preference. Fourth, parameters $b^{MU}_{L,7}$, $b^{MU}_{L,8}$, $b^{MU}_{L,9}$, $b^{MU}_{D,3}$, and b^{MU}_{A} are positive and significant at the 10% level,[36] so the Herfindahl index of loan proportions classified by industry, the Herfindahl index of loan proportions classified by mortgage, the proportion of loans for real estate business, the interest rate of postal savings certificates, and the interest rate of other financial assets had the effect of increasing the conditional expected value of the intertemporal marginal rate of substitution (IMRS) with respect to quasi-short-run profits. On the other hand, parameters $b^{MU}_{L,6}$, $b^{MU}_{D,1}$, b^{MU}_{CD}, and b^{MU}_{κ} are negative and significant at the 5% level,[37] so the proportion of loans for small and medium firms, the logarithm of depositor's income, the interest rate of certificates of deposit and other liabilities, and the reserve requirement ratio for time deposits in period $t-1$ had the effect of decreasing the conditional expected value of the IMRS. Furthermore, parameter a^{MU}_{i}, which shows the dummy coefficient for individual banks, is positive and significant at the 1% level for all Japanese city banks, so that the conditional expected value of the IMRS has the individual constant terms. Fifth, parameter $\rho_{j,s}$, which shows the conjectural derivative of the j-th financial good in period s, is not significant, except for the conjectural derivative of time deposits in the period 1985-1989,

[36]More specifically, parameters $b^{MU}_{L,8}$ and $b^{MU}_{L,9}$ are significant at the 1% level and parameters $b^{MU}_{L,7}$, $b^{MU}_{D,3}$, and b^{MU}_{A} are significant at the 10% level.

[37]More specifically, parameters $b^{MU}_{L,6}$, $b^{MU}_{D,1}$, and b^{MU}_{κ} are significant at the 5% level and parameter b^{MU}_{CD} is significant at the 1% level.

so that the null hypothesis that Japanese city banks are Cournot firms in the market for the short-term loans, long-term loans, demand deposits, and time deposits is not rejected.

<<Insert Table 4.1 about here>>

4.2 Risk Attitude and Reference Rate (Risk-Free Rate)

As stated in the explanation of Eq.(25), $1-\gamma_s$ shows the degree of relative risk-aversion. A value of $1-\gamma_s$ of greater than zero indicates a risk-averse attitude. A value of $1-\gamma_s$ of zero indicates a risk-neutral attitude. Finally, a value of $1-\gamma_s$ of less than zero indicates a risk-loving attitude. Table 4.2.1 shows the results for the estimates of the degree of relative risk-aversion for each sub-period. From this table, the following three points can be inferred. First, the estimate for degree of relative risk-aversion for the entire period is positive and significant, so that the managers of the city banks were risk-averse for the entire period. Second, however, in Period II (bubble period: fiscal year 1987 to fiscal year 1989), $1-\gamma_s$ was small, so that, compared to the other periods, managers were in a state closer to the risk-neutral attitude. Third, the degree of relative risk-aversion was greatest in the recent Period V (after the financial crisis and financial big bang period: fiscal year 2002 to fiscal year 2007), so that the tendency toward risk-averseness is strengthening. These results show the limits of the conventional UCM, which is implicitly based on a risk-neutral attitude, and reveal the necessity of using the GURM, which develops the UCM further so that risk attitudes other than the risk-neutral attitude can be treated.

<<Insert Table 4.2.1 about here>>

As stated at the beginning of this section, the reference rate (risk-free rate) is an important factor having an impact on the determination of the sign of the SURPs, and if bank managers have a risk-neutral attitude then the reference rate is one of the important factors having an impact on the determination of the sign of the UCPs. Table 4.2.2 shows the results for the estimates of this rate for each sub-period, and, for the purposes of comparison, the values of the call rate are also shown. Based on this table, the following three points can be inferred. First, the reference rate is smaller than the call rate in all periods except Period IV (financial crisis and financial big bang period: fiscal year 1996 to fiscal year 2001). Therefore, if we use the call rate as a proxy variable for the reference rate instead of estimating the reference rate, as was done by Ōmori and Nakajima (2000), we end up underestimating the UCPs, SURPs, CURPs, and GURPs of the financial assets and overestimating the UCPs, SURPs, CURPs, and GURPs of the liabilities. Second, Period IV (financial crisis and financial big bang period: fiscal year 1996 to fiscal year 2001) includes a period of zero interest rate policy (fiscal year 1999 to fiscal year 2001), so that the call rate is even smaller than the reference rate. Third, the reference rate in the recent Period V (after the financial crisis and financial big bang period: fiscal year 2002 to fiscal year 2007) is negative but not significantly different from zero, and can be regarded as approximately zero. These results show the necessity of estimating the reference rate and also indicate that there is a high likelihood that monetary policy in recent years (the zero interest rate policy and quantitative easing policy) has dramatically lowered the reference rate.

<<Insert Table 4.2.2 about here>>

4.3 SURPs, CURPs, and GURPs

Table 4.3.1 shows the results for the estimates of the SURPs (Eq.(13)), CURPs (Eq.(14)), and GURPs (Eq.(11)) of the short-term loans, long-term loans, demand deposits, and time deposits over the entire period. Consequently, the following five points can be inferred. First, the signs of the GURPs are all positive, except for the GURP for time deposits, so that short-term and long-term loans and demand deposits are considered to be outputs, whereas time deposits are considered to be a fixed factor. In most conventional studies, deposits are assumed to be input factors, but if deposits are divided into demand deposits and time deposits, then demand deposits tend to provide a settlement service more strongly and are considered to be an output. Second, the effects that account for the largest share (in terms of absolute value) with regard to the components of the GURPs that are not SURPs are the risk-adjustment effects, and compared to this share, the share of the market structure and conduct effects is smaller except for time deposits. These results are important from the perspective of industrial organization theory, and there may be pressure to review conventional industrial organization policy, which considers primarily the market structure and conduct effects. Third, as a consequence of the second result, the differences between the SURPs and CURPs are small for all of the financial goods, whereas the differences between the CURPs and GURPs are large for the long-term loans and the time deposits. Regarding the short-term loans and the demand deposits, the risk-adjustment effects and the equity capital effects are cancelled out, so the differences are not as large as for the long-term loans and time deposits. This indicates the necessity of using the GURM rather than the CURM when placing more importance on long-term financial goods than short-term financial goods. Fourth, the sign of the risk-adjustment effects of short-term and long-term loans is significantly negative, so increases in these financial goods increase the risk (variance) of quasi-short-run profit. In contrast, the sign of the risk-adjustment effects of demand and time deposits is significantly positive, so increases in these financial goods decrease the risk (variance) of quasi-short-run profit. This indicates that, for city bank management, loans are risky assets whereas deposits are safe liabilities. Furthermore, the results indicate that a decline in the ratio of loans to deposits may lower profitability while reducing risk. Fifth, the equity capital effects are significant at the 1% level, so that city bank managers place importance on the role of equity capital. These results indicate that the burden of the financial-distress cost may be large and that equity capital, which plays a role in alleviating that burden, has an impact on the utility of city bank managers.

<<Insert Table 4.3.1 about here>>

Tables 4.3.2 through 4.3.5 show the estimation results by period of the SURPs, CURPs, and GURPs for short-term loans, long-term loans, demand

deposits, and time deposits, respectively. Based on these tables, the following five points can be inferred. First, looking at the sign of the GURPs, the sign is identical in all of the periods except in the case of demand deposits. Namely, the GURPs are always positive for short-term and long-term loans and are always negative for time deposits. Short-term and long-term loans are consistently considered to be outputs, whereas time deposits are consistently considered to be an input (fixed factor). For demand deposits the sign of the GURP is positive in all periods except Period I (before the bubble period: fiscal year 1975 to fiscal year 1986) and Period V (after the financial crisis and financial big bang period: fiscal year 2002 to fiscal year 2007), and the demand deposits are therefore considered to be an output in these periods. However, in Periods I and V, the sign is negative and demand deposits are considered to be a fixed factor. A particularly important point is that in the recent Period V, the sign changed to negative after being positive in Period IV (financial crisis and financial big bang period: fiscal year 1996 to fiscal year 2001). As shown in Table 4.2.2, the main reason for this is that the reference rate became negative (or almost zero) in Period V. This indicates the high likelihood that the low-interest policy and quantitative easing policy in recent years has changed demand deposits from an output to a fixed factor. Second, except for short-term loans in Period I and time deposits in Periods IV and V, the effects that account for the largest share of the GURPs (in terms of absolute value) with regard to the components of the GURPs that are not SURPs were the risk-adjustment effects for all of the financial goods and periods, and compared to this share, the share of market structure and conduct effects is smaller. This reinforces the results obtained in Table 4.3.1, and it is necessary to rethink conventional industrial organization policy, which considers primarily market structure and conduct effects. However, for time deposits in Periods IV and V (in terms of absolute value), the market structure and conduct effects were greater than the risk-adjustment effects, which hints at the possibility that, in recent years, conventional industrial organization policy has gained importance in the time deposits market. Third, as a consequence of the second result, except for time deposits in Periods IV and V, the differences between the

SURPs and the CURPs were small for all of the financial goods and periods, whereas the differences between the CURPs and the GURPs were large, except for demand deposits and time deposits in Periods IV and V. Except for the demand deposits and time deposits for recent years, this indicates the necessity of using the GURM rather than the CURM. Regarding demand deposits and time deposits in Periods IV and V, the risk-adjustment effects are dramatically smaller (in terms of absolute value), so the differences between the CURPs and the GURPs were not as large as for short-term and long-term loans. Fourth, the risk-adjustment effects of short-term loans were significantly negative, except in Periods I and IV, and in Periods I and IV they were significantly positive. In the valuation for the entire period in Table 4.3.1, the risk-adjustment effects of short-term loans were significantly negative. However, looking at each sub-period, we can see that periods in which the risk-adjustment effects of short-term loans were significantly positive also exist. Of particular importance is that Period IV is positive, which raises the question as to why the risk-adjustment effects of short-term loans became positive during this period, which includes the time of the financial crisis. We perform a detailed study in the following section, but the high likelihood that public funds injection had an impact is shown in the analysis below (Section 4.4). The risk-adjustment effects of long-term loans were significantly negative, except in Periods IV and V, and in Periods IV and V they were significantly positive. In the same manner as in the case of short-term loans, the valuation for the entire period in Table 4.3.1 was significantly negative, but looking at each sub-period reveals that, in recent years, the valuation has become significantly positive. In particular, the positive value in Period IV is large compared to Period V, and in the same manner as in the case of short-term loans, the high likelihood that public funds injection had an impact is shown in the analysis below (Section 4.4). Note that, in Period V, the value was small but positive and significant, which is different from short-term loans. This means that, triggered by the injection of public funds, the increase in long-term loans in recent years has decreased the risk (variance) of quasi-short-run profit and indicates that long-term loans have changed from risky assets to safe assets. The risk-adjustment effects of demand deposits were significantly positive except in Period I, during which they were significantly negative. The sign of the risk-adjustment effects was consistently positive, except in Period I. In other words, this means that the increase in demand deposits decreased the risk (variance) of quasi-short-run profit and indicates that demand deposits are safe liabilities. However, in Periods IV and V the value was dramatically smaller, so we know that the quasi-short-run profit stabilization effects of the demand deposits declined substantially. The risk-adjustment effects of time deposits were significantly positive, except in Period IV, during which they were significantly negative. In all but Period IV, there was a quasi-short-run profit stabilization effect in time deposits in the same manner as for demand deposits, which shows that time deposits are safe liabilities. Considering the risk-adjustment effects of time deposits were significantly negative in Period IV and significantly positive in Period V, although having a small value, the high likelihood that public funds injection had an impact is indicated in the analysis below (Section 4.4), just as for short-term and long-term loans. Fifth, the equity capital effects were significant at the 1% level for all of the financial goods, except in Periods II and IV, which reinforces the results obtained in Table 4.3.1. Period II was a bubble period, during which city banks had sufficient equity capital, and public funds were injected during Period IV. If we exclude these times, which are considered to be special circumstances, we can see that city bank managers placed importance on the role of equity capital. As stated in Table 4.3.1, these results indicate that equity capital, which plays a role in alleviating financial-distress cost, has an impact on the utility of city bank managers.

<<Insert Table 4.3.2 about here>>
<<Insert Table 4.3.3 about here>>
<<Insert Table 4.3.4 about here>>
<<Insert Table 4.3.5 about here>>

4.4 Factors in the Risk-Adjustment Effects

As indicated by the second result for Table 4.3.1 and Tables 4.3.2 through 4.3.5, the effects that account for the largest share (in terms of absolute value) with regard to the components of the GURPs that are not SURPs are the risk-adjustment effects, and exploring these factors is important not only from the perspective of industrial organization policy but also from the perspective of monetary policy. In particular, the fact that from Period III (from after the bubble period to before the financial crisis and financial big bang period: fiscal year 1990 to fiscal year 1995) to Period IV (financial crisis and financial big bang period: fiscal year 1996 to fiscal year 2001) the risk-adjustment effects dramatically increased for short-term and long-term loans, while decreasing dramatically for time deposits, suggests the high likelihood that public funds injections carried out from 1998 to 2000 had an impact. This is revealed by the first priority issue of this section. Furthermore, in addition to this injection of public funds, the impacts of the interest rate, the reserve requirement ratio, and the deposit insurance rate are also extremely important when ascertaining the impact of conventional monetary policy. The impact of cost efficiency cannot be ignored either. As stated at the beginning of Section 4, this is because screening and monitoring of borrower firms and finely tuned responses to depositors is thought to have an impact on the risk-adjustment effects through cost efficiency. From this perspective, in this section, we use the GMM to simultaneously estimate a regression equation with the risk-adjustment effects of short-term loans, long-term loans, demand deposits, and time deposits as the dependent variables and the interest rate, a proxy variable for public funds, the reserve requirement ratio, the deposit insurance rate, and cost efficiency, for example, as the independent variables.[38]

[38] In the same manner as in Eqs.(6.3.1a) and (6.3.2) in the Appendix and Eqs.(29b) and (30a) in the present paper, the GMM estimate takes into account the conditional heteroskedasticity and autocorrelation of the error term. The instrumental variables are as follows: the individual dummy, the short-term prime rate, the long-term prime rate, the borrower firm equity capital ratio, the rank variable for the loan loss provision rate, the rank variable for the loan per case, the rank variable for the proportion of loans for small and medium firms, the rank variable for the Herfindahl index of loan proportions classified

The specific estimation equation is as follows:

$$
\begin{aligned}
RAE_{j,i,t} &= \alpha_j + \left(\sum\nolimits_s \beta_{j,s}^{CCRCB} \cdot D_s^Y\right) \cdot CCRCB_{i,t} + \beta_j^E \cdot EF_{i,t} + \beta_j^R \cdot r_{j,t} \\
&\quad + \varepsilon_{j,i,t}^A \qquad\qquad (j = SL, LL, DD, TD)\,, \qquad (32) \\
RAE_{j,i,t} &= \alpha_j + \left(\sum\nolimits_s \beta_{j,s}^{CCRCB} \cdot D_s^Y\right) \cdot CCRCB_{i,t} + \beta_j^E \cdot EF_{i,t} + \beta_j^X \cdot X_{j,t} \\
&\quad + \beta_j^Y \cdot Y_{j,t} + \varepsilon_{j,i,t}^B \qquad\qquad (j = SL, LL, DD, TD)\,, \qquad (33)
\end{aligned}
$$

where $\varepsilon_{j,i,t}^A$ and $\varepsilon_{j,i,t}^B$ are the error terms. The dependent variables and independent variables are as follows. $RAE_{j,i,t}$ is the risk-adjustment effect of the j-th financial good, and D_s^Y is a dummy variable that is equal to 1 in period s and 0 in other periods. As stated at the beginning of Section 4, there are five periods: $s = 1$ (Period I: fiscal year 1975 to fiscal year 1986), $s = 2$ (Period II: fiscal year 1987 to fiscal year 1989), $s = 3$ (Period III: fiscal year 1990 to fiscal year 1995), $s = 4$ (Period IV: fiscal year 1996 to fiscal year 2001), and $s = 5$ (Period V: fiscal year 2002 to fiscal year 2007). $CCRCB_{i,t}$ is the total of the capital stock, the capital surplus reserve, and the corporate bonds, and is a proxy variable for public funds injection. From 1998 to 2000, the injection of public funds was carried out in the form of purchases of preferred stock and subordinated debentures by the government. For city banks, purchases of preferred stock by the government have the effect of increasing their capital stock or capital surplus reserve, and purchases of subordinated debentures by the government lead to increases in corporate bonds. For this reason, we use the total of the capital stock, the capital surplus reserve, and the corporate bonds as the proxy variable for public funds injection. $EF_{i,t}$ is

by industry, the rank variable for the Herfindahl index of loan proportions classified by mortgage, the rank variable for the proportion of loans for real estate business, the rank variable for proportion of loans secured by real estate, the rank variable for the proportion of loans without collateral and without warranty, the yield on government bonds, TOPIX, the logarithm of depositor's income, the interest rate of ordinary savings, the insurance rate of demand deposits, the reserve requirement ratio for demand deposits, the interest rate of postal savings certificates, the insurance rate of time deposits, the reserve requirement ratio for time deposits, the rank variable for $EF_{i,t}$, the period dummy, and the product of the rank variable for $CCRCB_{i,t}$ and the period dummy. In order to improve the precision of the estimate, we do not use identical instrumental variables in all of the estimate equations. Instead, we use the set of instrumental variables suitable for each individual estimate equation.

cost efficiency, and its specific definition is as follows:

$$EF_{i,t} = \exp\left[\left\{\min_i a_i\left(D_i^{MA}, \tau_t^*\right)\right\} - a_i\left(D_i^{MA}, \tau_t^*\right)\right], \tag{34}$$

where $a_i\left(D_i^{MA}, \tau_t^*\right)$ is the individual dummy coefficient in equation (6.3.1b) in the Appendix, and $\min_i a_i\left(D_i^{MA}, \tau_t^*\right)$ is the minimum value of $a_i\left(D_i^{MA}, \tau_t^*\right)$ in fiscal year t. $EF_{i,t}$ is the ratio of the frontier cost with respect to the actual cost in the case that the factor prices, each type of financial good, and technical progress are identical in all of the samples. This definition is the same in Schmidt and Sickles (1984), Kumbhakar (1989), and Cornwell, Schmidt, and Sickles (1990), and is a definition method that enables us to handle the endogeneity problem or the simultaneous problem with an estimate using the GMM, while also estimating cost efficiency. Moreover, $r_{j,t}$ is the variable for each type of interest rate, $r_{SL,t}$ is the short-term prime rate, $r_{LL,t}$ is the long-term prime rate, $r_{DD,t}$ is the interest rate of ordinary savings, and $r_{TD,t}$ is the yield on government bonds (10-year bonds). These variables have a positive impact on the short-term loan interest rate, long-term loan interest rate, demand deposit interest rate, and time deposit interest rate, respectively, and are alternative interest rates for these interest rates. In the GURM, these interest rates are endogenous variables, so we use the interest rates of exogenous variables, which are in an alternative relationship with these interest rates for the independent variables. $X_{j,t}$ and $Y_{j,t}$ are the variables other than public funds, cost efficiency, and interest rates, which have an impact on the risk-adjustment effects, $X_{SL,t}$ and $X_{LL,t}$ are the loan loss provision rates, $Y_{SL,t}$ and $Y_{LL,t}$ are the proportions of loans for small and medium firms, $X_{DD,t}$ is the reserve requirement ratio for demand deposits, $X_{TD,t}$ is the reserve requirement ratio for time deposits, $Y_{DD,t}$ is the insurance rate of demand deposits, and $Y_{TD,t}$ is the insurance rate of time deposits.

Furthermore, for the interpretation of the impact of cost efficiency, we use the GMM to estimate a regression equation with cost efficiency as the dependent variable and the ratio of loans and discounts for small business to the number of small business borrowers and the ratio of the total number of employees at term-end to the number of offices as the independent variables.[39] The ratio of loans and discounts for small business to the number of small business borrowers is a proxy variable for the screening and monitoring of the borrower firm. If this variable is larger, then we can conclude that screening and monitoring are being carried out more vigorously. Furthermore, the ratio of the total number of employees at term-end to the number of offices is a proxy variable for whether finely tuned responses are being offered primarily in regard to deposit operations. If this variable is larger, then we can conclude that more finely tuned responses are being offered. The specific estimation equation is as follows:

$$\begin{aligned} EF_{i,t} &= \alpha^{LSMFC} + \beta^{LSMFC} \cdot LSMFC_{i,t} + \varepsilon_{i,t}^{LSMFC}, & (35) \\ EF_{i,t} &= \alpha^{EB} + \beta^{EB} \cdot EB_{i,t} + \varepsilon_{i,t}^{EB}, & (36) \\ EF_{i,t} &= \alpha^{LE} + \beta^{LE} \cdot LSMFC_{i,t} + \gamma^{LE} \cdot EB_{i,t} + \varepsilon_{i,t}^{LE}, & (37) \end{aligned}$$

where $\varepsilon_{i,t}^{LSMFC}$, $\varepsilon_{i,t}^{EB}$, and $\varepsilon_{i,t}^{LE}$ are the error terms, and the dependent variables and independent variables are $EF_{i,t}$, which is the cost efficiency in Eq.(34), $LSMFC_{i,t}$, which is the ratio of loans and discounts for small business to the number of small business borrowers (one million yen/case), and $EB_{i,t}$, which is the ratio of the total number of employees at term-end to the number of offices (employees/offices).

Table 4.4.1 shows the estimation results of Equations (35) through (37). Consequently, the following two points can be inferred. First, parameters β^{LSMFC} and β^{LE} are negative and significant at the 1% level, so we know that more cost efficient city banks give smaller loans per case to small and medium firms. This can be interpreted as indicating that when the loan per case to small and medium firms is smaller, the screening and monitoring costs are smaller, so that the banks become more cost efficient. Second, parameters

[39] In the same manner as in Eqs.(6.3.1a) and (6.3.2) in the Appendix and Eqs.(29b) and (30a) in the present paper, the GMM estimate takes into account the conditional heteroskedasticity and autocorrelation of the error term. The instrumental variables are as follows: the individual dummy, the rank variable for the ratio of loans and discounts for small business to the number of small business borrowers, and the rank variable for the ratio of the total number of employees at term-end to the number of offices.

β^{EB} and γ^{LE} are positive and significant at the 5% level, so we know that more cost efficient city banks have a higher ratio of the total number of employees to the number of offices. This can be interpreted as indicating that when the ratio of the total number of employees to the number of offices is larger, more finely tuned responses can be offered to the borrower firms and the depositors, so that the banks become more efficient. Below, we attempt to interpret the impact of cost efficiency based on the above results.

<<Insert Table 4.4.1 about here>>

Tables 4.4.2 and 4.4.3 are the estimation results for Eqs.(32) and (33), respectively. From these results, the following six points can be inferred. First, parameter $\beta_{j,4}^{CCRCB}$ $(j = SL, LL, DD)$, which indicates the impact of $CCRCB_{i,t}$ in Period IV on the risk-adjustment effects of short-term and long-term loans and demand deposits, is positive and significant at the 10% level,[40] so that the injections of public funds carried out from 1998 to 2000 had the effect of improving the risk-adjustment effects of short-term and long-term loans and demand deposits. The magnitude of $\beta_{j,4}^{CCRCB}$ $(j = SL, LL)$ is particularly noteworthy in that $\beta_{j,4}^{CCRCB}$ $(j = SL, LL)$ is the largest value for short-term loans, except in Period I, when it is not significant, and for long-term loans in all of the periods. This indicates the magnitude of the impact of the public funds injections. The risk-adjustment effects of short-term loans had a particularly large impact, inverting the sign from negative in Periods II and III to positive in Period IV. Thus, the injections of public funds changed the total impact on the risk-adjustment effects of the capital stock, the capital surplus reserve, and the corporate bonds from negative to positive. However, the magnitude of $\beta_{DD,4}^{CCRCB}$ is not necessarily the largest value for demand deposits. Compared with short-term and long-term loans, the impact of the injections of public funds on the risk-adjustment effects of demand deposits is very small. Second, on the other hand, parameter $\beta_{TD,4}^{CCRCB}$, which shows the impact of $CCRCB_{i,t}$ in Period IV on the risk-adjustment effects of time deposits, is negative and significant at the 1%

[40] More specifically, short-term and long-term loans are significant at the 1% level and demand deposits are significant at the 10% level.

level, so that the injections of public funds had the effect of worsening the risk-adjustment effects for the time deposits. As shown in Table 4.3.1, we can conclude from the sign of the GURPs that the fact that short-term and long-term loans and demand deposits are considered to be outputs, whereas time deposits are considered to be an input (fixed factor), is probably having an impact. Based on the first and second results, we can conclude that the injections of public funds improved the risk-adjustment effects of the outputs while worsening the risk-adjustment effects of the fixed factors. Third, the parameters β_j^E $(j = SL, LL)$, which indicate the impact of cost efficiency $(EF_{i,t})$ on the risk-adjustment effects of short-term and long-term loans, are both significant at the 1% level, and are positive for short-term loans and negative for long-term loans. As shown in Table 4.4.1, if the loan per case to small and medium firms is small, then screening and monitoring costs are small, so that the bank becomes more cost efficient. Furthermore, a risk reduction effect due to risk dispersion can be expected. However, risk may increase to the extent that screening and monitoring is not implemented sufficiently. As a result, we can interpret this to mean that 1) the impact of the improvement of cost efficiency on the risk-adjustment effects will be positive in the case that the effect of risk reduction due to risk dispersion is higher than the effect of the rise in risk due to the fact that screening and monitoring was not implemented sufficiently and 2) will be negative if the effect of risk reduction due to risk dispersion is lower than the effect of the rise in risk due to the fact that screening and monitoring was not implemented sufficiently. Consequently, it can be concluded that the case of short-term loans corresponds to the first case and the case of long-term loans corresponds to the second case. This indicates that for short-term loans, risk dispersion is more important than screening and monitoring, and for long-term loans screening, and monitoring is more important than risk dispersion. Fourth, the parameters β_j^E $(j = DD, TD)$, which indicate the impact of cost efficiency $(EF_{i,t})$ on the risk-adjustment effects of demand and time deposits, are both significant at the 1% level and are negative for demand deposits and positive for time deposits. As shown in Table 4.4.1, when the ratio of the total number of employees to the number of offices is higher, the bank is able to offer more finely tuned responses to (borrower firms and) depositors, and so is more cost efficient. However, it can be concluded that the impact of demand deposits and time deposits on the risks of these types of responses differs depending on whether the more finely tuned response can be offered for making a deposit or for direct debit and withdrawal. In the case of time deposits, liquidity is smaller than the demand deposits, so more finely tuned responses may be possible for making a deposit than for direct debit and withdrawal. Therefore, we can interpret this to mean that when the ratio of the total number of employees to the number of offices is higher, the risk declines. However, in the case of demand deposits, liquidity is larger than the time deposits, so more finely tuned responses are offered for direct debit and withdrawal as well as for making a deposit. We cannot state a definitive conclusion about which of these responses is more finely tuned. However, in terms of the results, we can conclude that the responses offered for direct debit and withdrawal are more finely tuned than the responses offered for making a deposit and the risk increased. Fifth, the estimates for the parameter β_j^R $(j = SL, LL, DD, TD)$, which indicates the impact of interest rate $(r_{j,t})$ on the risk-adjustment effects, indicates that it is positive and significant at the 10% level for short-term loans and demand deposits[41] and negative and significant at the 1% level for long-term loans and time deposits. Thus, a decline in the long-term interest rate improves the risk-adjustment effects, while a decline in the short-run interest rate worsens the risk-adjustment effects. This indicates that there is a high likelihood that a zero interest rate or low-interest policy improves the risk-adjustment effects of long-term financial goods (long-term loans and time deposits) and worsens the risk-adjustment effects of short-run financial goods (short-term loans and demand deposits). Sixth, the estimates for the parameter β_j^X $(j = DD, TD)$, which indicate the impact of the reserve rate $(X_{DD,t}, X_{TD,t})$ on the risk-adjustment effects of deposits, indicate that it is negative and significant at the 1% level for both demand and time deposits. Thus, a monetary easing policy based on a decline in the reserve requirement ratio for deposits improves the risk-adjustment effects of deposits. Furthermore,

[41] Demand deposits are significant at the 1% level.

the parameter β_j^Y ($j = DD, TD$), which indicates the impact of insurance rates ($Y_{DD,t}$, $Y_{TD,t}$) on the risk-adjustment effects of deposits, is negative and significant at the 1% level for demand deposits but negative and not significant for time deposits. Thus, we know that a decline in insurance rates improves the risk-adjustment effects of demand deposits.[42]

<<Insert Table 4.4.2 about here>>
<<Insert Table 4.4.3 about here>>

4.5 Extended Generalized Lerner Indices

As shown in Table 4.3.1, based on the sign of the GURPs, short-term and long-term loans and demand deposits are considered to be outputs, whereas time deposits are considered to be an input (fixed factor). Here, we narrow our focus to the output market, which is more important from the perspective of industrial organization theory, and show the estimation results regarding the EGLIs of the short-term and long-term loans and demand deposits (Eq.(18)). Table 4.5.1 shows the EGLIs of these financial goods for the entire period. Consequently, the following five points can be inferred. First, the EGLI of short-term loans is not significantly different from zero, so that the short-term loan market observed over the entire period is judged to be competitive. For demand deposits, the EGLI is negative and significant at the 10% level, so that the demand deposit market observed over the entire period (fiscal year 1992 onwards) is judged to be competitive.[43] In contrast, the EGLI of long-term loans is large, positive, and significant at the 1% level, so that the long-term loan market observed over the entire period is judged to be uncompetitive. This indicates that short-run financial goods (short-term loans and demand deposits) are competitive, while long-term financial goods (long-term loans) are uncompetitive. Second, regarding the components of the EGLIs (in terms of absolute value), the risk-adjustment effects are the

[42] Interpretation of the results regarding the impact of the loan loss provision rate and the proportion of loans for small and medium firms on the risk-adjustment effects of short-term and long-term loans should be a priority going forward.

[43] The liberalization of the demand deposits market began with the introduction of new savings deposits in June 1992.

largest, followed by the equity capital effects, and the market structure and conduct effects are the smallest. As shown in Table 4.3.1 and Tables 4.3.2 through 4.3.5, this is the same as the results for the GURPs, so there may be pressure to review conventional competition policy, which considers primarily the market structure and conduct effects. Going forward, a change from competition policy to risk-adjustment policy is necessary, so specific measures in risk-adjustment policy that have not been considered before must now be considered. Third, the risk-adjustment effects of short-term and long-term loans are positive and significant at the 1% level. From Eq.(18) in Section 2.3, this indicates that the risk (variance) of quasi-short-run profit increases due to the increase in these loans. Therefore, based on Proposition 2, the EGLIs of these loans increase (the degree of competition decreases) more in this case than when the risk (variance) of quasi-short-run profit is unchanged or decreases. In contrast, the risk-adjustment effects of demand deposits are large in terms of absolute value, are negative, and are significant at the 5% level. This is opposite the results for the case of short-term and long-term loans and indicates that the risk (variance) of quasi-short-run profit decreases due to an increase in demand deposits. Therefore, based on Proposition 2, this means that this reduction is dramatic, so the EGLI of demand deposits decreases (the degree of competition increases) more dramatically than when the risk (variance) of quasi-short-run profit is unchanged or increases. As shown in Table 4.3.1, short-term and long-term loans are risky assets, whereas demand deposits are safe liabilities. This indicates that, in the case of risky assets, the risk-adjustment effects work to lower the degree of competition, whereas, in the case of safe liabilities, the risk-adjustment effects work to raise the degree of competition. Fourth, the equity capital effects of short-term and long-term loans are negative and significant at the 1% level, whereas, for demand deposits, they are positive and significant at the 5% level. Based on Proposition 1 in Section 2.3, in this case, an increase in equity capital increases the EGLIs of short-term and long-term loans (decreases the degree of competition) and decreases the EGLI of demand deposits (raises the degree of competition), which indicates that an increase in equity capital makes the financial asset market uncompetitive, while making the liability market competitive. Fifth, based on Proposition 3 in Section 2.3, the risk (variance) of quasi-short-run profit increases due to an increase in financial assets, and if the financial firm is risk-averse and the risk-adjustment effects are larger than the absolute value of the equity capital effects, then the EGLI is higher than the GLI. We know that these facts apply to short-term and long-term loans, which indicates that there is a high likelihood that estimates of the degree of competition in the conventional loan market will overestimate the degree of competition. Furthermore, based on Proposition 4, the risk (variance) of quasi-short-run profit decreases due to an increase in liabilities, and if the financial firm is risk-averse and the absolute value of the risk-adjustment effects is larger than the equity capital effects, then the EGLI is lower than the GLI. These facts apply to demand deposits, which indicates that there is a high likelihood that estimates of the degree of competition in the conventional demand deposit market will underestimate the degree of competition.

<<Insert Table 4.5.1 about here>>

In Table 4.5.1, the EGLIs of short-term and long-term loans and demand deposits are shown for the entire period, and the EGLI of long-term loans is shown below for each sub-period. For short-term loans, the SURP in Period IV is negative, so there is a problem whereby the EGLI for this period cannot be determined. Furthermore, with respect to demand deposits, the liberalization of the interest rate was started from fiscal year 1992, so the period is limited. For these reasons, we do not calculate the EGLIs for short-term loans and demand deposits in each sub-period. Table 4.5.2 shows the EGLIs for long-term loans in each sub-period. Consequently, the following four points can be inferred. First, if we exclude Period IV, the EGLIs have gradually decreased, so that the degree of competition has been increasing in the long-term loan market. In particular, in the recent Periods IV and V, the EGLIs were negative and significant, which indicates that there were competitive conditions in these periods. Regarding Period IV, the EGLI is very large and negative because the risk-adjustment effects are very large and negative. Based on Eq.(11) in Section 2.2 and Eq.(18) in Section 2.3, the sign of the risk-adjustment effects of the GURPs and the sign of the risk-adjustment effects of the EGLI are in an inverse relationship. As such, as shown in Tables 4.4.2 and 4.4.3, we know that the very large negative risk-adjustment effects in Period IV are caused by the impact of the injections of public funds. Therefore, we can conclude that the injections of public funds dramatically improved (decreased) the risk-adjustment effects of the EGLI for long-term loans and dramatically increased the degree of competition in the long-term loan market. Second, as stated above, if we exclude Period IV, the risk-adjustment effects have had a tendency to decrease, which is significant at the 1% level in all of the periods. The risk-adjustment effects are the largest component of the EGLI in all of the periods, so that the tendency of the EGLIs to decrease discussed in the first result is due to the reduction of the risk-adjustment effects, which indicates that the risk-adjustment effects of the EGLI for long-term loans have a tendency to improve (decrease), which increases the degree of competition in the long-term loan market. Third, except for Periods II and IV, the equity capital effects are negative and significant at the 5% level. As shown in Table 4.5.1, based on Proposition 1 in Section 2.3, in this case, an increase in equity capital increases the EGLI of long-term loans (decreases the degree of competition), which indicates that the results in Table 4.5.1 apply, except in the periods with special circumstances (Period II, the bubble period, and Period IV, in which public funds were injected). Fourth, from Periods I through III, the EGLI is higher than the GLI, which reinforces the results in Table 4.5.1, but in Periods IV and V, the EGLI is dramatically lower than the GLI. Based on Proposition 3 in Section 2.3, this is because the risk (variance) of quasi-short-run profit greatly decreases due to an increase in long-term loans, and, as a result, the risk-adjustment effects are very large and negative, which indicates that there is a high likelihood that estimates of the degree of competition in the conventional long-term loan market will underestimate the degree of competition in the recent Periods IV and V.

<<Insert Table 4.5.2 about here>>

5 Conclusions

In the present study, we applied the GURM presented by Homma (2009) to Japan's banking industry and performed an analysis fusing producer theory and industrial organization theory (applied microeconomics) and finance (asset pricing theory). Basically, while basing the approach on the GURM, we derived the GURPs and the EGLIs, organized their theoretical characteristics from an interdisciplinary analytical perspective, applied the GURM to Japanese city banks, and estimated the GURPs and the EGLIs. These efforts provided material for thinking about the necessity of risk-adjustment policies as part of the industrial organization policy in the banking industry. In the following, we describe the major results and present the conclusion of the present study:

1. Under the assumption that the risk (variance) of quasi-short-run profit increases due to an increase in financial assets other than cash and liabilities, if the financial firm is risk-averse, then the EGLI increases (the degree of competition decreases), whereas if the risk (variance) is assumed to decrease, then the EGLI decreases (the degree of competition increases) if the financial firm is risk-averse. (Proposition 2 in Section 2.3).

2. The estimate for degree of relative risk-aversion for the entire period is positive and significant, so managers of city banks were risk-averse for the entire period. However, in Period II (bubble period: fiscal year 1987 to fiscal year 1990) the value was small, so compared to the other periods, the attitude of the managers was closer to risk-neutral.

3. The signs of the GURPs are all positive, except for the GURP for time deposits, so that short-term and long-term loans and demand deposits are considered to be outputs, whereas time deposits are considered to be a fixed factor. In most conventional studies, deposits are assumed to be input factors, but if deposits are divided into demand deposits and time deposits, demand deposits tend to provide a settlement service more strongly and are considered to be an output.

4. The effects that account for the largest share of the GURPs (in terms of absolute value) with regard to the components of the GURPs that are not SURPs are the risk-adjustment effects, and, compared to this share, the share of the market structure and conduct effects is smaller, except for time deposits. These results are important from the perspective of industrial organization theory, and there may be pressure to review conventional industrial organization policy, which considers primarily the market structure and conduct effects.

5. Based on the factor analysis of the risk-adjustment effects, the injections of public funds carried out from 1998 to 2000 improved the risk-adjustment effects of short-term and long-term loans and demand deposits, while worsening the risk-adjustment effects for the time deposits.

6. Based on the estimation results of the EGLIs, the short-term loan market and demand deposit market observed over the entire period are judged to be competitive, whereas the long-term loan market observed over the entire period is judged to be uncompetitive, which indicates that short-run financial goods (short-term loans and demand deposits) are competitive, whereas long-term financial goods (long-term loans) are uncompetitive.

7. Regarding the components of the EGLIs (in terms of absolute value), the risk-adjustment effects are the largest, followed by the equity capital effects, and the market structure and conduct effects are the smallest. This is identical to the results for the GURPs, so that there may be pressure to review conventional competition policy, which considers primarily the market structure and conduct effects. Going forward, a change from competition policy to risk-adjustment policy is necessary, so specific measures in risk-adjustment policy that have not been considered before must be considered.

8. If we exclude Period IV (financial crisis and financial big bang period: fiscal year 1996 to fiscal year 2001), the EGLIs of long-term loans have

gradually decreased, so that the degree of competition has been increasing in the long-term loan market. In particular, in the recent Periods IV and V (after the financial crisis and financial big bang period: fiscal year 2002 to fiscal year 2007), the EGLIs were negative and significant, which indicates that competitive conditions existed in these periods. Regarding Period IV, the EGLI was dramatically large and negative, but this is because the risk-adjustment effects were very large and negative. Based on the factor analysis of the risk-adjustment effects, we can conclude that the reason for this is the injections of public funds and that injections of public funds dramatically improved (decreased) the risk-adjustment effects of the EGLI for long-term loans and dramatically increased the degree of competition in the long-term loan market.

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6 Appendix: Empirical Model Specification

6.1 Exogenous State Variables other than the Components of the Stochastic Endogenous Holding-Revenue Rates and Holding-Cost Rates

As stated in Section 2, the exogenous state variable vector ($\mathbf{z}_{i,t}$) comprises the vector of exogenous variables ($\mathbf{z}^H_{i,t-1}$), which have an impact on the certain or predictable components of SEHRR and SEHCR, the vector ($\boldsymbol{\zeta}_{i,t}$) comprising the uncertain or unpredictable components of SEHRR and SEHCR, the general price index ($p_{G,t}$), the input price vector ($\mathbf{p}_{i,t}$), and the variable ($\tau_{i,t}$), which expresses exogenous technical progress. Among these components, $p_{G,t}$ uses a GDP deflator, as indicated in Table 3.1 in Section 3.1.1. Furthermore, for the data for $\tau_{i,t}$, time trend data is created, and the normalized version of this data is used. The specification of the components of SEHRR and SEHCR-related $\mathbf{z}^H_{i,t-1}$ and $\boldsymbol{\zeta}_{i,t}$ and their data creation is discussed in a later section on the specification of the components of SEHRR and SEHCR and the corresponding data creation. In this section, the remaining $\mathbf{p}_{i,t}$ is discussed, and, later, taking the estimation of the variable cost function into account, we discuss the cost of the inputs and creation of data for the inputs.

As stated in the beginning of Section 2 and in Section 3.1.1., we consider the inputs to be current goods, labor, physical capital, certificates of deposit, and other liabilities. Therefore, the input price vector $\mathbf{p}_{i,t}$ comprises the current goods price $p_{V,i,t}$, the wage $p_{L,i,t}$, the physical capital price $p_{K,i,t}$, and the interest rate of certificates of deposit, and other liabilities $p_{B,i,t}$. Namely,

$$\mathbf{p}_{i,t} = (p_{V,i,t}, p_{L,i,t}, p_{K,i,t}, p_{B,i,t})' . \tag{6.1}$$

Below, we discuss the costs related to the creation of data for these input prices and the creation of data for the inputs.

6.1.1 Current goods

The cost of current goods is determined by subtracting depreciation and rent of land, buildings, and machinery from non-personnel expenses [source: Nikkei NEEDS Company (Bank) Data File CD-ROM (Nikkei Media Marketing, Inc.), hereinafter referred to as source (a)]. For the current goods price, we divide the cost of current goods into the cost of advertisements, the cost of fringe benefits, and the cost of other current goods, individually create the price indices using the weighted average of the logarithm, use these indices to constitute the multilateral index, and create a bilateral index of the individual banks and the virtual representative bank. The ratio of any two of these indices is a multilateral index.[44] The amount (input) of current goods is found by dividing the cost of the current goods by the current goods price.

The appropriate proxy variable for the price of advertisements is the advertising service price of the corporate service price (source: Corporate Service Price Index of the Bank of Japan). For the price of fringe benefits, medical care and education costs are included in comsumer price index data (for the entire country) (source: Consumer Price Index of the Statistical Bureau of Director-General for Policy Planning & Statistical Research and Training Institute, Ministry of Internal Affairs and Communications). Nevertheless, the advertising service price can only be used from 1985 onward. For this reason, for 1984 and earlier, we assume that the advertising service price is identical to the price of other current goods. The appropriate proxy

[44] For details, see Caves and Diewert (1982). Furthermore, see Fixler and Zieschang (1993) regarding the application of this index to the banking industry.

variable for the price of other current goods is the group of items related to the corporate service price. However, these items can only be used from 1995 onwards, so for 1994 and earlier we use the items of the consumer price index. The formula used to calculate the price of advertisements is as follows:

$$p_{V,t}^{A} = \begin{cases} \text{The advertising service price of the corporate serviceprice} & \text{(1985 onward)} \\ \exp\left[\sum_{j=1}^{6} w_{P,j}^{VA} \cdot \ln p_{V,j,t}^{A}\right] & \text{(1984 and earlier)} \end{cases}, \tag{6.1.1a}$$

where $p_{V,j,t}^{A}$ $(j = 1, \ldots, 6)$ are the consumer price index items of personal service, public service, repairs and maintenance, transportation and communication, commodity (other manufacturing), and fuel, light, and water charges, respectively. Here, $w_{P,j}^{VA}$ is the proportion of the weight of $p_{V,j,t}^{A}$ with respect to the total weight of $p_{V,j,t}^{A}$ $(j = 1, \ldots, 6)$ in the base year.

The price of fringe benefits is found as follows:

$$p_{V,t}^{B} = \exp\left[\sum_{j=1}^{2} w_{P,j}^{VB} \cdot \ln p_{V,j,t}^{B}\right], \tag{6.1.1b}$$

where $p_{V,j,t}^{B}$ $(j = 1, 2)$ are the medical care and education components, respectively, from the consumer price index (for the entire country). In the same manner as in the case of the price of advertisements, $w_{P,j}^{VB}$ is the proportion of the weight of $p_{V,j,t}^{B}$ with respect to the total weight of $p_{V,j,t}^{B}$ $(j = 1, 2)$ in the base year.

The price of other current goods is given by the following formula:

$$p_{V,t}^{C} = \begin{cases} \exp\left[\sum_{j=2}^{6} w_{P,j}^{VA} \cdot \ln p_{V,j,t}^{A} + \sum_{j=1}^{12} w_{P,j}^{VC} \cdot \ln p_{V,j,t}^{C}\right] & \text{(1995 onward)} \\ \exp\left[\sum_{j=1}^{6} w_{P,j}^{VA} \cdot \ln p_{V,j,t}^{A}\right] & \text{(1994 and earlier)} \end{cases}, \tag{6.1.1c}$$

where $p_{V,j,t}^{A}$ and $w_{P,j}^{VA}$ $(j = 1, \ldots, 6)$ are the same as the price of advertisements in 1984 and earlier, and $p_{V,j,t}^{C}$ $(j = 1, \ldots, 12)$ are the building maintenance services, machinery repairment, transportation, communication, information services, rent paid for real estate (office), rent paid for real estate (store), rent paid for real estate (parking lots), leasing (computers), leasing (communications equipment), leasing (office equipment), and computer rental, respectively, of the corporate service price. Moreover, $w_{P,j}^{VC}$ is the proportion of the weight of $p_{V,j,t}^{C}$ with respect to the total weight of $p_{V,j,t}^{C}$ ($j = 1, \ldots, 12$) in the base year multiplied by the weight $w_{P,1}^{VA}$ of personal service in the consumer price index.

From Eqs.(6.1.1a) through (6.1.1c), the current goods price $p_{V,i,t}$ is found as the bilateral index of these prices, as follows:

$$p_{V,i,t} = \exp\left[\sum_{j \in \{A,B,C\}} \left(\frac{w_{j,i,t}^{VM} + \bar{w}_j^{VM}}{2}\right) \cdot \left(\ln p_{V,t}^{j} - \overline{\ln p_V^{j}}\right)\right], \qquad (6.1.1d)$$

where $w_{j,i,t}^{VM}$ ($j \in \{A, B, C\}$) are the respective proportions of the cost of advertisements, the cost of fringe benefits, and the cost of other current goods with respect to the cost of current goods. Here, $\bar{w}_j^{VM}$ is the sample mean of $w_{j,i,t}^{VM}$ ($j \in \{A, B, C\}$), and $\overline{\ln p_V^{j}}$ is the sample mean of $\ln p_{V,t}^{j}$.

6.1.2 Labor

Personnel expenses (source (a)) are assumed to be the cost of labor. The amount (input) of labor is created separately for men and women, and double these bilateral aggregations is assumed to be the overall amount (input) of labor $x_{L,i,t}$. We double the bilateral aggregations because the bilateral aggregates can only express the annual amount (input) of labor of the weighted geometric mean for gender, so we made the bilateral aggregates equivalent to the gender total by doubling them. However, since the proportions of men and women are not known from fiscal year 1999 onwards, we use the mean value of the proportions of men and women by firm up to that point (fiscal year 1998). Upon confirmation using the data, the differences in the proportions of men and women among firms in the same fiscal year were larger than the differences among fiscal years for the same firm. Furthermore, the wage $p_{L,i,t}$ is found by dividing the cost of labor by $x_{L,i,t}$.

(1) $x_{L,i,t}$ in fiscal year 1998 and earlier

The amount (input) of labor by gender ($x^j_{L,i,t}$)
= [number of employees of gender j (source (a))]
× [hours worked by gender (for gender j) in the finance and insurance industry (monthly) (source : Monthly Labour Survey of the Ministry of Health, Labour and Welfare, referred to hereinafter as source (b))]
×12/1000 ($j \in \{M\,(\text{Males})\,, F\,(\text{Females})\}$),

(6.1.2a)

$$x_{L,i,t} = 2 \cdot \exp\left[\sum_{j \in \{M,F\}} \left(\frac{w^{LM}_{j,i,t} + \bar{w}^{LM}_j}{2}\right) \cdot \ln x^j_{L,i,t}\right], \tag{6.1.2b}$$

where $w^{LM}_{j,i,t}$ ($j \in \{M, F\}$) is given by the following equation:

$$w^{LM}_{j,i,t} = \frac{p^j_{L,i,t} \cdot x^j_{L,i,t}}{p^M_{L,i,t} \cdot x^M_{L,i,t} + p^F_{L,i,t} \cdot x^F_{L,i,t}} \quad (j \in \{M, F\})\,, \tag{6.1.2c}$$

and $p^j_{L,i,t}$ ($j \in \{M, F\}$) is the amount of salary in cash by gender (for gender j) in the finance and insurance industry (monthly) (source (b)). Moreover, $\bar{w}^{LM}_j$ is the sample mean of $w^{LM}_{j,i,t}$. Taking into account the fact that $p_{L,i,t}$ is found by dividing the cost of labor by $x_{L,i,t}$, we have not standardized $p_{L,i,t}$ using $\overline{\ln x^j_L}$, the sample mean of $\ln x^j_{L,i,t}$.[45]

(2) $x_{L,i,t}$ in fiscal year 1999 and onwards The amount (input) of labor by gender $x^j_{L,i,t}$ is obtained using Eq.(6.1.2d) below, and the amount (input)

[45] In a strict sense, it is no longer the same type of bilateral index as the current goods price, but considering the facility of the interpretation of the wage, we have not normalized the geometric mean.

of labor $x_{L,i,t}$ is obtained in the same manner using Eq.(6.1.2b).

$$\begin{aligned}
&\text{The amount (input) of labor by gender } (x^j_{L,i,t})\\
&= [\text{number of total employees (source (a))}]\\
&\times [\text{mean value by bank for the proportions of men and women}\\
&\quad \text{among the number of employees at the end of each period}\\
&\quad \text{until fiscal year 1998 (source (a))}]\\
&\times [\text{hours worked by gender (for gender } j\text{) in the finance and}\\
&\quad \text{insurance industry (monthly) (source (d))}] \times 12/1000\\
&\qquad\qquad (j \in \{M\,(\text{Males})\,, F\,(\text{Females})\}).
\end{aligned} \tag{6.1.2d}$$

6.1.3 Physical capital

Physical capital comprises land and buildings and movable assets. The cost of physical capital $C^K_{i,t}$ is determined by first calculating the input of land $x^L_{K,i,t}$ and its service price $p^L_{K,t}$ and the input of buildings and movable assets $x^B_{K,i,t}$ and its service price $p^B_{K,i,t}$, and then finding the sum of each input multiplied by its service price ($C^K_{i,t} = p^L_{K,t} \cdot x^L_{K,i,t} + p^B_{K,i,t} \cdot x^B_{K,i,t}$). The physical capital price $p_{K,i,t}$ is assumed to be the bilateral index of $p^L_{K,t}$ and $p^B_{K,i,t}$ in the same manner as with the current goods price, and the amount (input) of physical capital $x_{K,i,t}$ is determined by dividing $C^K_{i,t}$ by $p_{K,i,t}$.

Here, $x^L_{K,i,t}$ and $x^B_{K,i,t}$ are determined through the following three steps. First, find the nominal stocks for land and buildings and movable assets, respectively. The nominal stock for buildings and movable assets is determined by subtracting "the book value of primary land in possession" in source (a) from "land, buildings, and movable assets" in the same source. For the nominal stock for land, we use "the book value of primary land in possession" in source (a), which is unchanged until fiscal year 1996. For fiscal year 1997, the nominal stock for land is determined by subtracting "land revaluation difference" in source (a) from this data. From fiscal year 1998 onwards, the nominal stock for land is determined by further subtracting the "deferred tax liability" in the same source. However, in the case that the obtained value is negative, we judge that "the book value of primary land in possession" is not accurate, and for fiscal years from fiscal year 1997 onwards with positive values, we calculate "the book value of primary land in possession/(land revaluation difference + deferred tax liability)" for each fiscal year, determine the mean value, multiply the mean value by the "land revaluation difference + deferred tax liability" in fiscal years with negative values, and determine the (adjusted) "book value of primary land in possession." We then find the nominal stock of land by subtracting the "land revaluation difference" and the "deferred tax liability."

We amend "the book value of primary land in possession" in this manner from fiscal year 1997 onwards because the revaluation of land (revaluation of previously valuated land using the current price) based on the Act on Revaluation of Land was carried out from fiscal year 1997 onwards. The revaluation difference, namely, the amount obtained by deducting the book value immediately before the revaluation from the revaluation amount for the land for which the revaluation was performed, was equal to the "land revaluation difference" in fiscal year 1997, and from fiscal year 1998 onwards was approximately equal to this amount with the "deferred tax liability" added.[46] However, since data on the "deferred tax liability" in fiscal year 1998 is unavailable for several banks, for these banks we find the mean value of the "deferred tax liability/land revaluation difference" for the several years prior and multiply this value by the "land revaluation difference" in fiscal year 1998 to find the "deferred tax liability."

Second, for land and buildings and movable assets, respectively, we calculate the real stock in the oldest fiscal year for which data is available and the real flow in each subsequent fiscal year. The real stock is determined by deflating the nominal stock in the oldest fiscal year for which data is available, and the real flow is found by deflating the nominal stock calculated by subtracting the nominal stock in time $t-1$ from the nominal stock in time t. For the deflators for real stock and real flow, we use the urban land price index (commercial urban land nationwide) [source: Urban Land Price Index National Wooden House Market Index (Japan Real Estate Institute),

[46] Strictly speaking, from fiscal year 1998 onwards "revaluation difference" = "land revaluation difference" + the "deferred tax liability related to revaluation." The "deferred tax liability" includes minor elements other than the "deferred tax liability related to revaluation," but we have confirmed that they are approximately equal.

referred to hereinafter as source (c)] in the case of land and the deflator for gross capital formation (private non-residential investment) [source: National Economic Accounting (Cabinet Office), referred to hereinafter as source (d)] in the case of buildings and movable assets.

Third, for land and buildings and movable assets, respectively, with the real stock in the oldest fiscal year for which data is available as the benchmark, we cumulatively add it to the real flow in each subsequent fiscal year.

Here, $p^L_{K,t}$ and $p^B_{K,i,t}$ are determined using the following formulae:

$$p^L_{K,t} = p^L_{D,t} \cdot r^K_t \tag{6.1.3a}$$

$$p^B_{K,i,t} = p^B_{D,t} \cdot \left[r^K_t + d^K_{i,t} - \frac{p^B_{D,t} - p^B_{D,t-1}}{p^B_{D,t}} \right] \tag{6.1.3b}$$

The variables on the right-hand side of the equations are as follows:

- $p^L_{D,t}$: Urban land price index (commercial urban land nationwide) (source (c))
- r^K_t : Yield on bank coupon debentures (five years) (source: Financial and Economic Statistics Monthly from the Bank of Japan)
- $p^B_{D,t}$: Deflator for gross capital formation (private non-residential investment) (source (d))
- $d^K_{i,t}$: Rate of depreciation= [depreciation (source (a))]/$x^B_{K,i,t}$

Regarding the service price of land, we have not included the rate of depreciation and capital gains in the calculation formula after taking into account the following two considerations. First, the depreciation of land is normally zero. Second, the capital gains during the bubble period (fiscal year 1987 to fiscal year 1990) were extremely large, so that if these gains are included in the calculation formula, the service price of land will become negative.

Using Eqs.(6.1.3a) and (6.1.3b), $p_{K,i,t}$ is found as follows:

$$
\begin{aligned}
p_{K,i,t} \quad &= \quad \exp\left[\left(\frac{w_{L,i,t}^{KM}+\bar{w}_L^{KM}}{2}\right)\cdot\left(\ln p_{K,t}^L-\overline{\ln p_K^L}\right)\right. \\
&\qquad \left. +\left(\frac{w_{B,i,t}^{KM}+\bar{w}_B^{KM}}{2}\right)\cdot\left(\ln p_{K,i,t}^B-\overline{\ln p_K^B}\right)\right], \qquad (6.1.3c)
\end{aligned}
$$

where $w_{j,i,t}^{KM}$ $(j \in \{L, B\})$ is given by the following equations:

$$
w_{L,i,t}^{KM} \quad = \quad \frac{p_{K,t}^L \cdot x_{K,i,t}^L}{p_{K,t}^L \cdot x_{K,i,t}^L + p_{K,i,t}^B \cdot x_{K,i,t}^B}, \qquad (6.1.3d)
$$

$$
w_{B,i,t}^{KM} \quad = \quad \frac{p_{K,i,t}^B \cdot x_{K,i,t}^B}{p_{K,t}^L \cdot x_{K,i,t}^L + p_{K,i,t}^B \cdot x_{K,i,t}^B}, \qquad (6.1.3e)
$$

$\bar{w}_j^{KM}$ $(j \in \{L, B\})$ is the sample mean of $w_{j,i,t}^{KM}$ $(j \in \{L, B\})$, and $\overline{\ln p_K^L}$ and $\overline{\ln p_K^B}$ are the sample means of $\ln p_{K,t}^L$ and $\ln p_{K,i,t}^B$, respectively.

6.1.4 Certificates of deposit and other liabilities

The creation of data for the real amount (input) of certificates of deposit and other liabilities ($q_{CD,i,t+1}$) is as stated in Table 3.1 in Section 3.1.1. The interest rate of certificates of deposit and other liabilities ($H_{CD,i,t+1}^R$) is as shown in Table 6.1.4 below. Furthermore, nominal costs are found as the product of $p_{G,t+1} \cdot q_{CD,i,t+1}$ and $H_{CD,i,t+1}^R$.

<<Insert Table 6.1.4 about here>>

6.2 Stochastic Endogenous Holding-Revenue Rates and Holding-Cost Rates

6.2.1 Actual composition of SEHRR and SEHCR and method of creating data for $\zeta_{j,i,t+1}$

According to Homma (2009, pp.6-9), SEHRR and SEHCR at the end of fiscal year t (= the beginning of fiscal year $t+1$) ($h_{j,i,t+1}$)[47] is expressed as ($h_{j,i,t+1} = h^R_{j,i,t} + \zeta_{j,i,t+1}$), the total of the certain or predictable components at the beginning of fiscal year t ($h^R_{j,i,t}$) and the uncertain or unpredictable components at the end of fiscal year t ($\zeta_{j,i,t+1}$). Here, we explain in detail the actual composition of $h_{j,i,t+1}$ and the method of creating data for $\zeta_{j,i,t+1}$.

First, we use the notation $H_{j,i,t+1}$ for the actual holding-revenue rate or holding-cost rate at the end of fiscal year t (= the beginning of fiscal year $t+1$) and conclude that

$$\begin{aligned} H_{j,i,t+1} &= h_{j,i,t+1} = h^R_{j,i,t} + \zeta_{j,i,t+1} \\ & \qquad (j = SL, LL, S, C, CL, A, DD, TD, CM)\,. \end{aligned} \tag{6.2.1.1}$$

On this basis, we split up $H_{j,i,t+1}$ so that it corresponds to components of $h^R_{j,i,t}$ as follows:

$$H_{j,i,t+1} = \begin{cases} H^R_{j,i,t+1} + H^Q_{j,i,t+1} + H^S_{j,i,t+1} - H^D_{j,i,t+1} & (j = SL, LL) \\ H^R_{j,i,t+1} + H^S_{j,i,t+1} + H^C_{j,i,t+1} - H^D_{j,i,t+1} & (j = S, A) \\ 0 & (j = C) \\ H^R_{j,i,t+1} & (j = CL, CM) \\ H^R_{j,i,t+1} + H^Q_{j,i,t+1} + h^I_{j,i,t} + r^D_{i,t} \cdot \kappa_{j,i,t} - H^S_{j,i,t+1} & (j = DD, TD) \end{cases}. \tag{6.2.1.2}$$

Here, the methods of creating the data for the components of $H_{j,i,t+1}$ ($j = SL, LL, S, CL, A, DD, TD, CM$) and the components of $\zeta_{j,i,t+1}$

[47] In Section 2 of the present paper and in Homma (2009, pp.6-9), the notation $h_{i,j,t+1}$ is used. Here, the subscripts j, i, and t indicate financial goods, financial firms, and time, respectively. We switched i and j because this notation is easier to use in the case that we are specifically designating financial goods as the subject of the discussion. Below, we also switch i and j in the notation for $r_{i,j,t}$, $r^Q_{i,j,t}$, $h^S_{i,j,t}$, $h^C_{i,j,t}$, $h^D_{i,j,t}$, and $h^I_{i,j,t}$.

$(j = SL, LL, S, CL, A, DD, TD, CM)$ included in $H_{j,i,t+1}$ are as follows:

(1) $H^R_{j,i,t+1}$ **(**$j = SL, LL, DD, TD$**).** $H^R_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ are respectively the actual collected interest rate for short-term loans, the actual collected interest rate for long-term loans, the actual paid interest rate for demand deposits, and the actual paid interest rate for time deposits at the end of fiscal year t (= the beginning of fiscal year $t+1$). The components of $h^R_{j,i,t}$ $(j = 1, \ldots, N_A + N_L)$ correspond to $r_{j,i,t}$ $(j = 1, \ldots, N_A + N_L)$ in Homma (2009, pp.6-9). However, in Homma (2009, pp.6-9), it is assumed that there is no uncertainty in the collected interest rate and the paid interest rate and that the collected interest rate and the paid interest rate are expressed by $r_{j,i,t}$ only, whereas, here, we conclude that uncertainty exists. This is because the data we actually use is not from the beginning, but rather from the end of fiscal year t, and, due to data restrictions, we have been forced to use proxy variables for several exogenous factors that have an impact on the collected interest rate or paid interest rate. As can be inferred from the latter point, in Homma (2009, pp.6-9, Definitions 2 and 3) $r_{j,i,t}$ is formulated endogenously (as a function of a vector of exogenous variables that have an impact on $r_{j,i,t}$ and the outstanding amount of asset j or the outstanding amount of liability j in the overall market). Taking this into account, $H^R_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ is formulated as follows:

$$H^R_{j,i,t+1} = r_{j,i}\left(Q_{j,t}, \mathbf{z}^R_{j,i,t}\right) + \zeta^R_{j,i,t+1} \ (j = SL, LL, DD, TD), \qquad (6.2.1.3)$$

where $Q_{j,t}$ $(j = SL, LL, DD, TD)$ are respectively the total loans in the short-term loan market (total loans from all banks), the total loans in the long-term loan market, the total deposits in the demand deposit market (total deposits in all banks), and the total deposits in the time deposit market at the beginning of fiscal year t (= end of fiscal year $t-1$). Furthermore, $\mathbf{z}^R_{j,i,t}$ $(j = SL, LL, DD, TD)$ is the vector of exogenous variables, respectively, having an impact on the collected interest rate for short-term loans, the collected interest rate for long-term loans, the paid interest rate for demand deposits, and the paid interest rate for time deposits during the same time period as $Q_{j,t}$ $(j = SL, LL, DD, TD)$. Moreover, $\zeta^R_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ are the components of these collected interest rates and paid interest rates, which show uncertainty. Here, $r_{j,i}\left(Q_{j,t}, \mathbf{z}^R_{j,i,t}\right)$ $(j = SL, LL, DD, TD)$ is one of the components of $h^R_{j,i,t}$ $(j = SL, LL, DD, TD)$, and $\zeta^R_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ is one of the components of $\zeta_{j,i,t+1}$ $(j = SL, LL, DD, TD)$. The specific method of finding $\zeta^R_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ is to consider $\zeta^R_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ to be the error term of a regression equation, specify $r_{j,i}\left(Q_{j,t}, \mathbf{z}^R_{j,i,t}\right)$ $(j = SL, LL, DD, TD)$, and estimate Eq.(6.2.1.3).

(2) $H^R_{j,i,t+1}$ $(j = S, A, CL, CM)$ $H^R_{j,i,t+1}$ $(j = S, A, CL, CM)$ are respectively the actual (*ex post*) interest rate of securities, the interest rate of other financial assets, the interest rate of due from banks and call loans, and the interest rate of call money and borrowed money at the end of fiscal year t (= beginning of fiscal year $t+1$). Just as in the case of $H^R_{j,i,t+1}$ $(j = SL, LL, DD, TD)$, the components of $h^R_{j,i,t}$ $(j = 1, \ldots, N_A + N_L)$ correspond to $r_{j,i,t}$ $(j = 1, \ldots, N_A + N_L)$ in Homma (2009, pp.6-9). If we follow the assumptions of Homma (2009, pp.6-9), there is no uncertainty in these interest rates, and the interest rates are endogenous (a function of the vector of exogenous variables having an impact on these interest rates and the outstanding amount of each asset or each liability in the overall market). However, from the perspective of industrial organization theory, there is almost no evidence that the market in which these interest rates are determined is an imperfect competition market. For this reason, we consider these interest rates to be exogenous. Consequently, we assume that

$$H^R_{j,i,t+1} = r_{j,i,t} \ (j = S, A, CL, CM) \tag{6.2.1.4}$$

Strictly speaking, in Homma (2009, pp.6-9), $r_{j,i,t}$ is the contractual interest rate at the beginning of fiscal year t. However, the data we can actually use to calculate the interest rate is the data from the end of the fiscal year, so we are forced to assume that the interest rates calculated *ex post* using this data are equal to the contractual interest rate at the beginning of the fiscal year.

(3) $H^Q_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ $H^Q_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ are respectively the actual uncollected interest rate for short-term loans, the actual uncollected interest rate for long-term loans, the actual unpaid interest rate for demand deposits, and the actual unpaid interest rate for time deposits at the end of fiscal year t (= beginning of fiscal year $t+1$). The components of $h^R_{j,i,t}$ $(j = 1, \ldots, N_A + N_L)$ correspond to $r^Q_{j,i,t}$ $(j = 1, \ldots, N_A + N_L)$ in Homma (2009, pp.6-9). According to Homma (2009, pp.6-9, Definitions 2 and 3), these uncollected interest rates and unpaid interest rates comprise the certain or predictable components expressed by $r^Q_{j,i,t}$ and the uncertain or unpredictable components, which are some of the components of $\zeta_{j,i,t+1}$ $(j = 1, \ldots, N_A + N_L)$, and $r^Q_{j,i,t}$ is expressed as a function of the vector of exogenous variables having an impact on $r^Q_{j,i,t}$, and the outstanding amount of asset j or the outstanding amount of liability j in the overall market. Nevertheless, there is no positive reason to conclude that $r^Q_{j,i,t}$ depends on the outstanding amount of asset j or the outstanding amount of liability j in the overall market. Therefore, we consider that $r^Q_{j,i,t}$ depends only on the vector of exogenous variables. Consequently, $H^Q_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ is formulated as follows:

$$H^Q_{j,i,t+1} = r^Q_{j,i}\left(\mathbf{z}^Q_{j,i,t}\right) + \zeta^Q_{j,i,t+1} \ (j = SL, LL, DD, TD), \qquad (6.2.1.5)$$

where $\mathbf{z}^Q_{j,i,t}$ $(j = SL, LL, DD, TD)$ is the vector of exogenous variables that have an impact on, respectively, the uncollected interest rate for short-term loans, the uncollected interest rate for long-term loans, the unpaid interest rate for demand deposits, and the unpaid interest rate for time deposits at the beginning of fiscal year t (= end of fiscal year $t-1$). Furthermore, $\zeta^Q_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ are the components of these uncollected interest rates and unpaid interest rates, which show uncertainty. In the same manner as in the case of $\zeta^R_{j,i,t+1}$ $(j = SL, LL, DD, TD)$, the specific method of finding $\zeta^Q_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ is to consider $\zeta^Q_{j,i,t+1}$ $(j = SL, LL, DD, TD)$ to be the error term of a regression equation, specify $r^Q_{j,i}\left(\mathbf{z}^Q_{j,i,t}\right)$ $(j = SL, LL, DD, TD)$, and estimate Eq.(6.2.1.5).

(4) $H^S_{j,i,t+1}$ **(**$j = SL, LL, S, A, DD, TD$**)** $H^S_{j,i,t+1}$ ($j = SL, LL, S, A, DD, TD$) are respectively the actual service charge rates for short-term loans, long-term loans, securities, other financial assets, demand deposits, and time deposits at the end of fiscal year t (= beginning of fiscal year $t+1$). The components of $h^R_{j,i,t}$ ($j = 1, \ldots, N_A + N_L$) correspond to $h^S_{j,i,t}$ ($j = 1, \ldots, N_A + N_L$) in Homma (2009, pp.6-9). According to Homma (2009, pp.6-9, Definitions 2 and 3), in the same manner as with $H^R_{j,i,t+1}$ and $H^Q_{j,i,t+1}$ ($j = SL, LL, DD, TD$), the aforementioned service charge rates comprise the certain or predictable components expressed by $h^S_{j,i,t}$ and the uncertain or unpredictable components, which are some of the components of $\zeta_{j,i,t+1}$ ($j = 1, \ldots, N_A + N_L$), and the $h^S_{j,i,t}$ is expressed as a function of the vector of exogenous variables having an impact on $h^S_{j,i,t}$, and the outstanding amount of asset j or the outstanding amount of liability j in the overall market. However, due to restrictions on the available data, strict creation of data for $H^S_{j,i,t+1}$ ($j = SL, LL, S, A, DD, TD$) matching the assumptions of Homma (2009, pp.6-9) is difficult. For this reason, we do not formulate $h^S_{j,i,t}$ endogenously, and $h^S_{j,i,t}$ is treated as an exogenous variable. Consequently, $H^S_{j,i,t+1}$ ($j = SL, LL, S, A, DD, TD$) is formulated as follows:

$$H^S_{j,i,t+1} = h^S_{j,i,t} + \zeta^S_{j,i,t+1} \ \ (j = SL, LL, S, A, DD, TD)\,, \tag{6.2.1.6}$$

where $\zeta^S_{j,i,t+1}$ ($j = SL, LL, S, A, DD, TD$) are respectively the components of actual service charge rates for short-term loans, long-term loans, securities, other financial assets, demand deposits, and time deposits that show uncertainty at the end of fiscal year t (= beginning of fiscal year $t+1$). The specific method of finding these is as follows.

First, from Eq.(6.2.1.6), the conditional expected value of $H^S_{j,i,t+1}$ with the exogenous state variable vector $\mathbf{z}_{i,t}$ in Homma (2009, p.17) as the condition is expressed as

$$E\left[\left.H^S_{j,i,t+1}\right|\mathbf{z}_{i,t}\right] = h^S_{j,i,t} + E\left[\left.\zeta^S_{j,i,t+1}\right|\mathbf{z}_{i,t}\right].$$

Furthermore, from the relationship between the normal (unconditional) expected value and the conditional expected value the following equation is established:

$$
\begin{aligned}
E\left[H^S_{j,i,t+1}\right] &= E\left[E\left[H^S_{j,i,t+1}\middle|\,\mathbf{z}_{i,t}\right]\right] = E\left[h^S_{j,i,t} + E\left[\zeta^S_{j,i,t+1}\middle|\,\mathbf{z}_{i,t}\right]\right] \\
&= h^S_{j,i,t} + E\left[E\left[\zeta^S_{j,i,t+1}\middle|\,\mathbf{z}_{i,t}\right]\right] \\
&= h^S_{j,i,t} + E\left[\zeta^S_{j,i,t+1}\right].
\end{aligned}
$$

Here, just as in Theorem 1 in Section 2 and Homma (2009, pp.21-22, Theorem 1), we assume that $E\left[\zeta^S_{j,i,t+1}\middle|\,\mathbf{z}_{i,t}\right] = 0$. Consequently, we have

$$
E\left[\zeta^S_{j,i,t+1}\right] = E\left[E\left[\zeta^S_{j,i,t+1}\middle|\,\mathbf{z}_{i,t}\right]\right] = E\left[0\right] = 0.
$$

Therefore, the following equation is established:

$$
E\left[H^S_{j,i,t+1}\right] = h^S_{j,i,t}\ \ (j = SL, LL, S, A, DD, TD)\,. \tag{6.2.1.7}
$$

From Eqs.(6.2.1.6) and (6.2.1.7), $\zeta^S_{j,i,t+1}$ is expressed as follows:

$$
\begin{aligned}
\zeta^S_{j,i,t+1} &= H^S_{j,i,t+1} - h^S_{j,i,t} = H^S_{j,i,t+1} - E\left[H^S_{j,i,t+1}\right] \\
&\quad (j = SL, LL, S, A, DD, TD)\,.
\end{aligned} \tag{6.2.1.8}
$$

Consequently, if we stipulate the actual calculation method for $E\left[H^S_{j,i,t+1}\right]$ $(= h^S_{j,i,t})$, we can find $\zeta^S_{j,i,t+1}$. Here, we stipulate this method as follows:

$$
E\left[H^S_{j,i,t+1}\right] = \frac{H^S_{j,i,t} + H^S_{j,i,t+1}}{2}\ \ (j = SL, LL, S, A, DD, TD)\,. \tag{6.2.1.9}
$$

From Eqs.(6.2.1.8) and (6.2.1.9), at this time, $\zeta^S_{j,i,t+1}$ is determined as follows:

$$
\begin{aligned}
\zeta^S_{j,i,t+1} &= H^S_{j,i,t+1} - E\left[H^S_{j,i,t+1}\right] = H^S_{j,i,t+1} - \frac{H^S_{j,i,t} + H^S_{j,i,t+1}}{2} \\
&= \frac{H^S_{j,i,t+1} - H^S_{j,i,t}}{2}\ \ (j = SL, LL, S, A, DD, TD)\,.
\end{aligned} \tag{6.2.1.10}
$$

(5) $H^C_{j,i,t+1}$ **$(j = S, A)$** $H^C_{j,i,t+1}$ $(j = S, A)$ are respectively the actual rates of capital gains for securities and other financial assets at the end of fiscal year

t (= beginning of fiscal year $t+1$). The components of $h^R_{j,i,t}$ $(j = 1, \ldots, N_A)$ correspond to $h^C_{j,i,t}$ $(j = 1, \ldots, N_A)$ in Homma (2009, p.7). According to Homma (2009, p.7), the actual rate of capital gains comprises the certain or predictable components expressed by $h^C_{j,i,t}$ and the uncertain or unpredictable components, which are some of the components of $\zeta_{j,i,t+1}$ $(j = 1, \ldots, N_A)$, and $h^C_{j,i,t}$ is assumed to be exogenous. For this reason, $H^C_{j,i,t+1}$ $(j = S, A)$ is formulated in the same manner as $H^S_{j,i,t+1}$ $(j = SL, LL, S, A, DD, TD)$ (Eq.(6.2.1.6)):

$$H^C_{j,i,t+1} = h^C_{j,i,t} + \zeta^C_{j,i,t+1} \ (j = S, A)\,, \tag{6.2.1.11}$$

where $\zeta^C_{j,i,t+1}$ $(j = S, A)$ are respectively the components of the actual rates of capital gains for securities and other financial assets that show uncertainty at the end of fiscal year t (= beginning of fiscal year $t+1$). The specific methods of finding $h^C_{j,i,t}$ $(j = S, A)$ and $\zeta^C_{j,i,t+1}$ $(j = S, A)$ are as follows:

$$\begin{aligned} h^C_{j,i,t} &= E\left[H^C_{j,i,t+1}\right] = \frac{H^C_{j,i,t} + H^C_{j,i,t+1}}{2} \ (j = S, A)\,, && (6.2.1.12) \\ \zeta^C_{j,i,t+1} &= H^C_{j,i,t+1} - h^C_{j,i,t} = H^C_{j,i,t+1} - \frac{H^C_{j,i,t} + H^C_{j,i,t+1}}{2} \\ &= \frac{H^C_{j,i,t+1} - H^C_{j,i,t}}{2} \ (j = S, A)\,, && (6.2.1.13) \end{aligned}$$

which are the same as Eqs.(6.2.1.9) and (6.2.1.10), respectively.

(6) $H^D_{j,i,t+1}$ $(j = SL, LL)$ $H^D_{j,i,t+1}$ $(j = SL, LL)$ are respectively the actual default loss rate for the short-term loans and the actual default loss rate for the long-term loans at the end of fiscal year t (= beginning of fiscal year $t+1$). The components of $h^R_{j,i,t}$ $(j = 1, \ldots, N_A)$ correspond to $h^D_{j,i,t}$ $(j = 1, \ldots, N_A)$ in Homma (2009, pp.6-9). According to Homma (2009, pp.6-9, Definitions 2 and 3), in the same manner as with $H^R_{j,i,t+1}$ and $H^Q_{j,i,t+1}$ $(j = SL, LL)$, the aforementioned default loss rate comprises the certain or predictable components expressed by $h^D_{j,i,t}$ and the uncertain or unpredictable components, which are some of the components of $\zeta_{j,i,t+1}$ $(j = 1, \ldots, N_A)$, and the $h^D_{j,i,t}$ is expressed as a function of the vector of exogenous variables having an impact on $h^D_{j,i,t}$, and the short-term or long-term loan balance in the overall market. Nevertheless, in the same manner as with $r^{Q}_{j,i,t}$ ($j = SL, LL, DD, TD$), there is no confirmed reason to conclude that $h^{D}_{j,i,t}$ depends on the short-term or long-term loan balance in the overall market. Therefore, we consider that $h^{D}_{j,i,t}$ depends only on the vector of exogenous variables. Consequently, $H^{D}_{j,i,t+1}$ ($j = SL, LL$) is formulated in the same manner as $H^{Q}_{j,i,t+1}$ ($j = SL, LL$) (Eq.(6.2.1.5)), as follows:

$$H^{D}_{j,i,t+1} = h^{D}_{j,i}\left(\mathbf{z}^{D}_{j,i,t}\right) + \zeta^{D}_{j,i,t+1} \ \ (j = SL, LL)\,, \qquad (6.2.1.14)$$

where $\mathbf{z}^{D}_{j,i,t}$ ($j = SL, LL$) is the vector of exogenous variables that have an impact, respectively, on the default loss rate for short-term loans and the default loss rate for long-term loans at the beginning of fiscal year t (= end of fiscal year $t-1$). Furthermore, $\zeta^{D}_{j,i,t+1}$ ($j = SL, LL$) are the components of these default loss rates and the rate of provisions and reserve funds that show uncertainty. The specific method of finding $\zeta^{D}_{j,i,t+1}$ ($j = SL, LL$) is the same as that for $\zeta^{R}_{j,i,t+1}$ and $\zeta^{Q}_{j,i,t+1}$ ($j = SL, LL$). Namely, consider $\zeta^{D}_{j,i,t+1}$ ($j = SL, LL$) to be the error term of a regression equation, specify $h^{D}_{j,i}\left(\mathbf{z}^{D}_{j,i,t}\right)$ ($j = SL, LL$), and estimate Eq.(6.2.1.14).

(7) $H^{D}_{j,i,t+1}$ **($j = S, A$)** $H^{D}_{j,i,t+1}$ ($j = S, A$) are respectively the actual rate of provisions and reserve funds for securities and the actual rate of provisions and reserve funds for other financial assets at the end of fiscal year t (= beginning of fiscal year $t+1$). In the same manner as with $H^{D}_{j,i,t+1}$ ($j = SL, LL$), the components of $h^{R}_{j,i,t}$ ($j = 1, \ldots, N_A$) correspond to $h^{D}_{j,i,t}$ ($j = 1, \ldots, N_A$) in Homma (2009, pp.6-9), and these rates of provisions and reserve funds comprises the certain or predictable components expressed by $h^{D}_{j,i,t}$ and the uncertain or unpredictable components, which are some of the components of $\zeta_{j,i,t+1}$ ($j = 1, \ldots, N_A$). Furthermore, $h^{D}_{j,i,t}$ is expressed as a function of the vector of exogenous variables having an impact on $h^{D}_{j,i,t}$ and the outstanding amount of securities or other financial assets in the overall market. However, there are restrictions on the available data for the vector of exogenous variables. Therefore, in the same manner as with $H^{S}_{j,i,t+1}$ ($j = SL, LL, S, A, DD, TD$) and $H^{C}_{j,i,t+1}$ ($j = S, A$), we do not formulate $h^{D}_{j,i,t}$

endogenously, and $h^D_{j,i,t}$ is treated as an exogenous variable. Consequently, $H^D_{j,i,t+1}$ $(j = S, A)$ is formulated in the same manner as in Eqs.(6.2.1.6) and (6.2.1.11), as follows:

$$H^D_{j,i,t+1} = h^D_{j,i,t} + \zeta^D_{j,i,t+1} \ (j = S, A)\,, \qquad (6.2.1.15)$$

where $\zeta^D_{j,i,t+1}$ $(j = S, A)$ are respectively the components of the actual rates of provisions and reserve funds for securities and other financial assets that show uncertainty at the end of fiscal year t (= beginning of fiscal year $t+1$). The specific methods of finding $h^D_{j,i,t}$ $(j = S, A)$ and $\zeta^D_{j,i,t+1}$ $(j = S, A)$ are the same as Eqs.(6.2.1.12) and (6.2.1.13), respectively, as follows:

$$\begin{aligned} h^D_{j,i,t} &= E\left[H^D_{j,i,t+1}\right] = \frac{H^D_{j,i,t} + H^D_{j,i,t+1}}{2} \ (j = S, A)\,, \qquad (6.2.1.16) \\ \zeta^D_{j,i,t+1} &= H^D_{j,i,t+1} - h^D_{j,i,t} = H^D_{j,i,t+1} - \frac{H^D_{j,i,t} + H^D_{j,i,t+1}}{2} \\ &= \frac{H^D_{j,i,t+1} - H^D_{j,i,t}}{2} \ (j = S, A)\,. \qquad (6.2.1.17) \end{aligned}$$

(8) $h^I_{j,i,t}$ $(j = DD, TD)$ $h^I_{j,i,t}$ $(j = DD, TD)$ are respectively the actual insurance premium rates for the demand deposits and time deposits at the beginning of fiscal year t (= end of fiscal year $t-1$). These are the components of $h^R_{j,i,t}$ $(j = N_A + 1, \ldots, N_A + N_L)$ and are identical to those in Homma (2009, pp.8-9). According to Homma (2009, pp.8-9, Definition 3), in the same manner as with $H^R_{j,i,t+1}$ and $H^Q_{j,i,t+1}$ $(j = DD, TD)$, the insurance premium rate comprises the certain or predictable components expressed by $h^I_{j,i,t}$ and the uncertain or unpredictable components, which are some of the components of $\zeta_{j,i,t+1}$ $(j = N_A + 1, \ldots, N_A + N_L)$, and $h^I_{j,i,t}$ is expressed as a function of the vector of exogenous variables having an impact on $h^I_{j,i,t}$ and the outstanding amount of demand deposits or time deposits in the overall market. Nevertheless, Japan's deposit insurance rate is stipulated by the Deposit Insurance Corporation of Japan, which was established through equity investment by the government, the Bank of Japan, and private financial institutions, and so is considered to be exogenous. For this reason, in the same manner as $h^S_{j,i,t}$ $(j = DD, TD)$, we do not formulate $h^I_{j,i,t}$ endogenously and $h^I_{j,i,t}$ is treated as an exogenous variable. Furthermore, the uncertain or unpredictable components are assumed to be zero.

(9) $r^D_{i,t}$ $r^D_{i,t}$ is the subjective discount rate at the beginning of fiscal year t (= end of fiscal year $t-1$), which is the same as the rate in Homma (2009, pp.8-9). In the strict sense defined by Homma (2009, pp.8-9), there is no counterpart to this data, so we estimate this variable as a parameter.

Based on the above consideration, $\zeta_{j,i,t+1}$ $(j = SL, LL, S, CL, A, DD, TD, CM)$ is found as the total of each component as follows:

$$\zeta_{j,i,t+1} = \begin{cases} \zeta^R_{j,i,t+1} + \zeta^Q_{j,i,t+1} + \zeta^S_{j,i,t+1} - \zeta^D_{j,i,t+1} & (j = SL, LL) \\ \zeta^S_{j,i,t+1} + \zeta^C_{j,i,t+1} - \zeta^D_{j,i,t+1} & (j = S, A) \\ 0 & (j = C, CL, CM) \\ \zeta^R_{j,i,t+1} + \zeta^Q_{j,i,t+1} + \zeta^I_{j,i,t+1} - \zeta^S_{j,i,t+1} & (j = DD, TD) \end{cases} . \tag{6.2.1.18}$$

In Homma (2009, pp.7-8, Definition 2), $\zeta_{C,i,t+1}$ is assumed to be nonzero. However, actually creating the data is extremely difficult and so here it is assumed to be zero.[48] We also assume that $\zeta_{j,i,t+1}$ $(j = CL, CM)$ is zero, but as stated above, this is because it is thought that there is actually no uncertainty in $H^R_{j,i,t+1}$, which is a single component of $H_{j,i,t+1}$ $(j = CL, CM)$.

6.2.2 Creation of data for components of $H_{j,i,t+1}$ $(j = SL, LL, S, CL, A, DD, TD, CM)$

6.2.2.1 Creation of data for components of $H_{j,i,t+1}$ $(j = SL, LL)$

From Eq.(6.2.1.2), $H_{j,i,t+1}$ $(j = SL, LL)$ is composed of $H^k_{j,i,t+1}$ $(j = SL, LL;$ $k = R, Q, S, D)$. Furthermore, from Eq.(6.2.1.3), the certain components of $H^R_{j,i,t+1}$ $(j = SL, LL)$ are expressed as $\left(r_{j,i}\left(Q_{j,t}, \mathbf{z}^R_{j,i,t}\right),\ j = SL, LL\right)$, a function of $Q_{j,t}$ $(j = SL, LL)$ and $\mathbf{z}^R_{j,i,t}$ $(j = SL, LL)$, and from Eqs.(6.2.1.5) and (6.2.1.14), the certain components of $H^k_{j,i,t+1}$ $(j = SL, LL;\ k = Q, D)$ are expressed as $\left(r^Q_{j,i}\left(\mathbf{z}^Q_{j,i,t}\right),\ h^D_{j,i}\left(\mathbf{z}^D_{j,i,t}\right),\ j = SL, LL\right)$, a function of $\mathbf{z}^k_{j,i,t}$ $(j = SL, LL;\ k = Q, D)$. Nevertheless, due to data restrictions, for $\mathbf{z}^k_{j,i,t}$

[48] The creation of data for the uncertain refundment claims and other uncertain flexible payments of deposits and rate of cash equivalents indicated by $\zeta_{C,i,t+1}$ should be a priority going forward.

($j = SL, LL$; $k = R, Q, D$), we assume that short-term loans (subscript $j = SL$) and long-term loans (subscript $j = LL$) are identical (subscript $j = L$), and we also assume that the collected interest rate (subscript $k = R$) and the uncollected interest rate (subscript $k = Q$) are identical (subscript $k = RQ$). Namely, we assume that $\mathbf{z}^k_{SL,i,t} = \mathbf{z}^k_{LL,i,t} \left(= \mathbf{z}^k_{L,i,t}\right)$ ($k = R, Q, D$) and $\mathbf{z}^R_{L,i,t} = \mathbf{z}^Q_{L,i,t} \left(= \mathbf{z}^{RQ}_{L,i,t}\right)$.[49] The data for $H^k_{j,i,t+1}$ ($j = SL, LL$; $k = R, Q, S, D$), $Q_{j,t}$ ($j = SL, LL$), and $\mathbf{z}^k_{L,i,t}$ ($k = RQ, D$), the data creation, and the sources of the data are shown in Table 6.2.2.1.

<<Insert Table 6.2.2.1 about here>>

6.2.2.2 Creation of data for components of $H_{j,i,t+1}$ ($j = S, A$) From Eq.(6.2.1.2), $H_{j,i,t+1}$ ($j = S, A$) is composed of $H^k_{j,i,t+1}$ ($j = S, A$; $k = R, S, C, D$). From Eqs.(6.2.1.4), (6.2.1.6), (6.2.1.11), and (6.2.1.15), $H_{j,i,t+1}$ ($j = S, A$) is expressed as the sum of the certain components and the uncertain or unpredictable components, but these components are all assumed to be exogenous. The data, data creation, and sources of the data are shown in Table 6.2.2.2.

<<Insert Table 6.2.2.2 about here>>

6.2.2.3 Creation of data for components of $H_{j,i,t+1}$ ($j = CL, CM$) From Eq.(6.2.1.2), $H_{j,i,t+1}$ ($j = CL, CM$) is composed of $H^R_{j,i,t+1}$ ($j = CL, CM$) only. From Eq.(6.2.1.4), $H_{j,i,t+1}$ ($j = CL, CM$) comprises the certain components only, which are assumed to be exogenous. The data, data creation, and sources of the data are shown in Table 6.2.2.3.

<<Insert Table 6.2.2.3 about here>>

6.2.2.4 Creation of data for components of $H_{j,i,t+1}$ ($j = DD, TD$) From Eq.(6.2.1.2), $H_{j,i,t+1}$ ($j = DD, TD$) is composed of $H^k_{j,i,t+1}$ ($j = DD, TD$;

[49] However, we do not assume that the prime rate, which is an element of $\mathbf{z}^{RQ}_{L,i,t}$, is identical for short-term loans and long-term loans, and we use the short-term prime rate and the long-term prime rate, respectively.

$k = R, Q, S$), $h^I_{j,i,t}$ ($j = DD, TD$), $\kappa_{j,i,t}$ ($j = DD, TD$), and $r^D_{i,t}$. Furthermore, from Eq.(6.2.1.3), the certain components of $H^R_{j,i,t+1}$ ($j = DD, TD$) are expressed as ($r_{j,i}\left(Q_{j,t}, \mathbf{z}^R_{j,i,t}\right)$, $j = DD, TD$), a function of $Q_{j,t}$ ($j = DD, TD$), and $\mathbf{z}^R_{j,i,t}$ ($j = DD, TD$), and from Eq.(6.2.1.5), the certain components of $H^Q_{j,i,t+1}$ ($j = DD, TD$) are expressed as ($r^Q_{j,i}\left(\mathbf{z}^Q_{j,i,t}\right)$, $j = DD, TD$), a function of $\mathbf{z}^Q_{j,i,t}$ ($j = DD, TD$). Nevertheless, due to data restrictions, for $\mathbf{z}^k_{j,i,t}$ ($j = DD, TD$; $k = R, Q$), we assume that these are identical for all of the banks, and that demand deposits (subscript $j = DD$) and time deposits (subscript $j = TD$) are identical (subscript $j = D$). We also assume that the paid interest rate (subscript $k = R$) and the unpaid interest rate (subscript $k = Q$) are identical (subscript $k = RQ$). Namely, we assume that $\mathbf{z}^k_{DD,i,t} = \mathbf{z}^k_{TD,i,t}\left(= \mathbf{z}^k_{D,t}\right)$ ($k = R, Q$) and $\mathbf{z}^R_{D,t} = \mathbf{z}^Q_{D,t}\left(= \mathbf{z}^{RQ}_{D,t}\right)$. For $h^I_{j,i,t}$ ($j = DD, TD$) and $\kappa_{j,i,t}$ ($j = DD, TD$), we assume $h^I_{j,i,t} = h^I_{j,t}$ and $\kappa_{j,i,t} = \kappa_{j,t}$. The data for $H^k_{j,i,t+1}$ ($j = DD, TD$; $k = R, Q, S$), $Q_{j,t}$ ($j = DD, TD$), $h^I_{j,t}$ ($j = DD, TD$), $\kappa_{j,t}$ ($j = DD, TD$), and $\mathbf{z}^{RQ}_{D,t}$, the data creation, and the sources of the data are shown in Table 6.2.2.4.

<<Insert Table 6.2.2.4 about here>>

6.2.3 Specification of the endogenous components of SEHRR and SEHCR

6.2.3.1 Specification of $r_{j,i}\left(Q_{j,t}, \mathbf{z}^R_{j,i,t}\right)$ in Eq.(6.2.1.3) and $r^Q_{j,i}\left(\mathbf{z}^Q_{j,i,t}\right)$ in Eq.(6.2.1.5) (Subscripts of both functions $j = SL, LL, DD, TD$)

First, in order to simplify the equations below, we assume that

$$r_{j,i}\left(Q_{j,t}, \mathbf{z}^R_{j,i,t}\right) = r^R_{j,i}\left(Q_{j,t}, \mathbf{z}^R_{j,i,t}\right)\ (j = SL, LL, DD, TD)\,. \qquad (6.2.3.1.1)$$

From Section 6.2.2.1, we have

$$\mathbf{z}^k_{SL,i,t} = \mathbf{z}^k_{LL,i,t}\left(= \mathbf{z}^k_{L,i,t}\right)\ (k = R, Q, D)\,, \mathbf{z}^R_{L,i,t} = \mathbf{z}^Q_{L,i,t}\left(= \mathbf{z}^{RQ}_{L,i,t}\right),$$

and from Section 6.2.2.4, we have

$$\mathbf{z}^k_{DD,i,t} = \mathbf{z}^k_{TD,i,t}\left(= \mathbf{z}^k_{D,t}\right)\ (k = R, Q)\,, \mathbf{z}^R_{D,t} = \mathbf{z}^Q_{D,t}\left(= \mathbf{z}^{RQ}_{D,t}\right).$$

Therefore,

$$
\begin{aligned}
r_{j,i}^{R}\left(Q_{j,t},\mathbf{z}_{j,i,t}^{R}\right) &= r_{j,i}^{R}\left(Q_{j,t},\mathbf{z}_{L,i,t}^{RQ}\right)\ (j=SL,LL)\,, && (6.2.3.1.2a)\\
r_{j,i}^{Q}\left(\mathbf{z}_{j,i,t}^{Q}\right) &= r_{j,i}^{Q}\left(\mathbf{z}_{L,i,t}^{RQ}\right)\ (j=SL,LL)\,, && (6.2.3.1.2b)\\
r_{j,i}^{R}\left(Q_{j,t},\mathbf{z}_{j,i,t}^{R}\right) &= r_{j,i}^{R}\left(Q_{j,t},\mathbf{z}_{D,t}^{RQ}\right)\ (j=DD,TD)\,, && (6.2.3.1.3a)\\
r_{j,i}^{Q}\left(\mathbf{z}_{j,i,t}^{Q}\right) &= r_{j,i}^{Q}\left(\mathbf{z}_{D,t}^{RQ}\right)\ (j=DD,TD)\,, && (6.2.3.1.3b)
\end{aligned}
$$

For ease of estimation and interpretation of the parameter to be estimated, we specify the above equations, respectively, as follows:

$$
\begin{aligned}
r_{j,i}^{R}\left(Q_{j,t},\mathbf{z}_{L,i,t}^{RQ}\right) &= \sum_{i}\alpha_{j,i}^{R}\cdot D_{i}^{B}+\left(\sum_{s}\beta_{j,s}^{R}\cdot D_{s}^{YA}\right)\cdot\ln Q_{j,t}\\
&\quad+\sum_{l\in\{1,2,3,4,6,7,8,9,10,11\}}\gamma_{j,l}^{R}\cdot z_{L,l,i,t}^{RQ}+\gamma_{j,5}^{R}\cdot\ln z_{L,5,i,t}^{RQ}\\
&\quad (j=SL,LL)\,, \qquad (6.2.3.1.4a)\\
r_{j,i}^{Q}\left(\mathbf{z}_{L,i,t}^{RQ}\right) &= \sum_{i}\alpha_{j,i}^{Q}\cdot D_{i}^{B}+\sum_{l\in\{1,2,3,4,6,7,8,9,10,11\}}\gamma_{j,l}^{Q}\cdot z_{L,l,i,t}^{RQ}+\gamma_{j,5}^{Q}\cdot\ln z_{L,5,i,t}^{RQ}\\
&\quad (j=SL,LL)\,, \qquad (6.2.3.1.4b)\\
r_{j,i}^{R}\left(Q_{j,t},\mathbf{z}_{D,t}^{RQ}\right) &= \sum_{i}\alpha_{j,i}^{R}\cdot D_{i}^{B}+\left(\sum_{s}\beta_{j,s}^{R}\cdot D_{s}^{YA}\right)\cdot\ln Q_{j,t}+\gamma_{j,1}^{R}\cdot\ln z_{D,1,t}^{RQ}\\
&\quad+\sum_{l=2}^{4}\gamma_{j,l}^{R}\cdot z_{D,l,t}^{RQ} \qquad (j=DD,TD)\,, \qquad (6.2.3.1.5a)\\
r_{j,i}^{Q}\left(\mathbf{z}_{D,t}^{RQ}\right) &= \sum_{i}\alpha_{j,i}^{Q}\cdot D_{i}^{B}+\gamma_{j,1}^{Q}\cdot\ln z_{D,1,t}^{RQ}+\sum_{l=2}^{4}\gamma_{j,l}^{Q}\cdot z_{D,l,t}^{RQ}\\
&\quad (j=DD,TD)\,, \qquad (6.2.3.1.5b)
\end{aligned}
$$

where D_i^B is the individual bank dummy variable [which has the value one (1) in the case of the i-th bank and the value zero (0) otherwise], which takes into account the existence of the individual effect due to a bank's efforts to improve the discrimination and quality (uncollected or unpaid) of its interest rates through its own initiatives. Regarding improving the quality, examples include tightening loan screening and monitoring (to the extent possible at low cost) and streamlining of the settlement system. Furthermore, D_s^{YA} is the period dummy variable in the case that the period covered by the analysis is split into several sub-periods (the dummy variable is equal to 1 in period s and 0 in other periods), and $Q_{j,t}$ $(j = SL, LL, DD, TD)$ is a variable for taking into account market imperfection caused by oligopoly (i.e., total assets or liabilities in the market). Moreover, $z_{L,l,i,t}^{RQ}$ $(l = 1 \sim 11)$ is a variable for controlling various aspects of the impact of the administered interest rate and the risks of borrowers, and $z_{D,l,t}^{RQ}$ $(l = 1 \sim 4)$ is a variable to control the impact of the income of the depositors and the alternative financial products to deposits (government bonds, postal savings, and investment trusts).[50]

From Eqs.(6.2.3.1.1) through (6.2.3.1.5), Eqs.(6.2.1.3) and (6.2.1.5) are

[50] We took the logarithms of the second and fourth terms of the right-hand side of Eq.(6.2.3.1.4a), the third term of the right-hand side of Eq.(6.2.3.1.4b), the second and third terms of the right-hand side of Eq.(6.2.3.1.5a), and the second term of the right-hand side of Eq.(6.2.3.1.5b) because the units of these variables were not percentages (%) (unnamed units). Therefore, if we do not take the logarithms, the parameters of these variables will become dependent on the units. Taking the logarithms has the advantage that the parameters of these variables can be interpreted as elasticity, and so no longer depend on the units. The units of all of the variables other than these variables are percentage (%) (although not multiplied by 100), so this concern does not apply to these variables.

expressed as follows:

$$H^R_{j,i,t+1} = \sum_i \alpha^R_{j,i} \cdot D^B_i + \left(\sum_s \beta^R_{j,s} \cdot D^{YA}_s\right) \cdot \ln Q_{j,t} + \sum_{l\in\{1,2,3,4,6,7,8,9,10,11\}} \gamma^R_{j,l} \cdot z^{RQ}_{L,l,i,t} + \gamma^R_{j,5} \cdot \ln z^{RQ}_{L,5,i,t} + \zeta^R_{j,i,t+1} \quad (j = SL, LL)\,, \tag{6.2.3.1.6a}$$

$$H^Q_{j,i,t+1} = \sum_i \alpha^Q_{j,i} \cdot D^B_i + \sum_{l\in\{1,2,3,4,6,7,8,9,10,11\}} \gamma^Q_{j,l} \cdot z^{RQ}_{L,l,i,t} + \gamma^Q_{j,5} \cdot \ln z^{RQ}_{L,5,i,t} + \zeta^Q_{j,i,t+1} \quad (j = SL, LL)\,, \tag{6.2.3.1.6b}$$

$$H^R_{j,i,t+1} = \sum_i \alpha^R_{j,i} \cdot D^B_i + \left(\sum_s \beta^R_{j,s} \cdot D^{YA}_s\right) \cdot \ln Q_{j,t} + \gamma^R_{j,1} \cdot \ln z^{RQ}_{D,1,t} + \sum_{l=2}^{4} \gamma^R_{j,l} \cdot z^{RQ}_{D,l,t} + \zeta^R_{j,i,t+1} \quad (j = DD, TD)\,, \tag{6.2.3.1.7a}$$

$$H^Q_{j,i,t+1} = \sum_i \alpha^Q_{j,i} \cdot D^B_i + \gamma^Q_{j,1} \cdot \ln z^{RQ}_{D,1,t} + \sum_{l=2}^{4} \gamma^Q_{j,l} \cdot z^{RQ}_{D,l,t} + \zeta^Q_{j,i,t+1} \quad (j = DD, TD)\,. \tag{6.2.3.1.7b}$$

(These equations become the actual estimation equations.)

6.2.3.2 Specification of $h^D_{j,i}\left(\mathbf{z}^D_{j,i,t}\right)$ ($j = SL, LL$) in Eq.(6.2.1.14) From Section 6.2.2.1, $\mathbf{z}^D_{SL,i,t} = \mathbf{z}^D_{LL,i,t}\left(= \mathbf{z}^D_{L,i,t}\right)$ and $H^D_{SL,i,t+1} = H^D_{LL,i,t+1}\left(= H^D_{L,i,t+1}\right)$, and therefore

$$h^D_{j,i}\left(\mathbf{z}^D_{j,i,t}\right) = h^D_{L,i}\left(\mathbf{z}^D_{L,i,t}\right) \ (j = SL, LL)\,. \tag{6.2.3.2.1}$$

In the same manner as with Eq.(6.2.3.1.4a, b) and Eq.(6.2.3.1.5a, b), considering the easiness of the estimate and the easiness of the interpretation of the parameter to be estimated, we specify this as follows

$$h^D_{L,i}\left(\mathbf{z}^D_{L,i,t}\right) = \sum_i \alpha^D_{L,i} \cdot D^B_i + \sum_{l\in\{1,2,4,5,6,7,8,9,10\}} \gamma^D_{L,l} \cdot z^D_{L,l,i,t} + \gamma^D_{L,3} \cdot \ln z^D_{L,3,i,t}. \tag{6.2.3.2.2}$$

Here, D^B_i is the same kind of individual bank dummy as in Eq.(6.2.3.1.4a, b) and Eq.(6.2.3.1.5a, b) and $z^{D}_{L,l,i,t}$ $(l = 1 \sim 10)$ is the variable for controlling various aspects of the impact of the risks of borrowers in the same manner as in $z^{RQ}_{L,l,i,t}$ $(l = 2, 3, 5 \sim 11)$.

Based on Eqs.(6.2.3.2.1) and (6.2.3.2.2), Eq.(6.2.1.14) is expressed as follows:

$$H^{D}_{L,i,t+1} = \sum_{i} \alpha^{D}_{L,i} \cdot D^{B}_{i} + \sum_{l \in \{1,2,4,5,6,7,8,9,10\}} \gamma^{D}_{L,l} \cdot z^{D}_{L,l,i,t} + \gamma^{D}_{L,3} \cdot \ln z^{D}_{L,3,i,t} + \zeta^{D}_{L,i,t+1}, \tag{6.2.3.2.3}$$

where $\zeta^{D}_{L,i,t+1}$ $(= \zeta^{D}_{SL,i,t+1} = \zeta^{D}_{LL,i,t+1})$ is the error term. (Equation (6.2.3.2.3) becomes the actual estimation equation.)

6.3 Variable Cost Function and Cost Share Equations

The important factors in the specification of the variable cost function are the specification of a functional form that is theoretically flexible,[51] that the estimation is comparatively easy, and that stable estimation results can be obtained. In this section, we attempt to develop such a specification. Furthermore, as defined in Homma (2009, p.10, Definition 5), we take into account the impact on the cost structure of $(\mathbf{z}^{RQ}_{j,i,t};\ j = L, D)$ and the quality variable specified in Tables 6.2.2.1 and 6.2.2.4 and specify the variable cost function so that the types of impacts of the quality variable on the financial goods elasticity of variable cost and cost share and (variable) cost efficiency can be ascertained. More specifically, we attempt to develop the following type of specification. First, we design the specification so that the variable cost financial goods and cost share become a function of the quality variable. Basically, we specify the first-order parameters for the financial goods and factor prices of the translog variable cost function as a function of the quality variable. Second, we add an individual dummy variable so that we can estimate cost efficiency. When doing so, we specify this dummy variable so that cost efficiency depends on time. Basically, we specify the individual

[51] Regarding the definition of flexibility, see Barnett (1983), Diewert and Wales (1987, 1988), and Barnett, Geweke, and Wolfe (1991). Here, we have in mind flexibility in the sense meant by Diewert and Wales (1987), namely, second-order flexibility.

dummy coefficient as a function of the exogenous technical progress (time trend) variable.

Taking into account the above considerations, we specify the variable cost function defined in Homma (2009, p.10, Definition 5) and used in Section 2.1 as follows:

$$
\begin{aligned}
\ln\left(C_{i,t}^{V}/\,p_{V,i,t}^{*}\right) \;=\;& \sum_{i} a_i\left(D_i^{MA},\tau_t^{*}\right)\cdot D_i^{B} + \sum_{j\in\{SL,LL\}} a_j\left(\mathbf{z}_{GL,i,t}^{RQ}\right)\cdot \ln q_{j,i,t}^{*} \\
& + \sum_{j\in\{DD,TD\}} a_j\left(\mathbf{z}_{GD,t}^{RQ}\right)\cdot \ln q_{j,i,t}^{*} + \sum_{j\in\{S,C,CL,A,CM\}} a_j\cdot \ln q_{j,i,t}^{*} \\
& + \sum_{j\in\{L,K,B\}} a_j\left(\mathbf{z}_{G,i,t}^{RQ}\right)\cdot \ln\left(p_{j,i,t}^{*}\,/p_{V,i,t}^{*}+\theta_j\right) \\
& +\frac{1}{2}\cdot \sum\sum_{j,h\in\{SL,LL,S,C,CL,A,DD,TD,CM\}} b_{jh}\cdot \ln q_{j,i,t}^{*}\cdot \ln q_{h,i,t}^{*} \\
& +\frac{1}{2}\cdot \sum\sum_{j,h\in\{L,K,B\}} b_{jh}\cdot \ln\left(p_{j,i,t}^{*}\,/p_{V,i,t}^{*}+\theta_j\right)\cdot \ln\left(p_{h,i,t}^{*}\,/p_{V,i,t}^{*}+\theta_h\right) \\
& +\sum\sum_{j\in\{SL,LL,S,C,CL,A,DD,TD,CM\},h\in\{L,K,B\}} b_{jh}\cdot \ln q_{j,i,t}^{*}\cdot \ln\left(p_{h,i,t}^{*}\,/p_{V,i,t}^{*}+\theta_h\right) \\
& + \sum_{j\in\{SL,LL,S,C,CL,A,DD,TD,CM\}} b_{jT}\cdot \ln q_{j,i,t}^{*}\cdot \tau_t^{*} + \sum_{j\in\{L,K,B\}} b_{jT}\cdot \ln\left(p_{j,i,t}^{*}\,/p_{V,i,t}^{*}+\theta_j\right)\cdot \tau_t^{*} \\
& +\nu_{i,t}, \qquad (6.3.1a)
\end{aligned}
$$

$$
a_i\left(D_i^{MA},\tau_t^{*}\right) = a_i + a_{iMA}\cdot D_i^{MA} + a_{iT}\cdot \tau_t^{*} + a_{iTT}\cdot\left(\tau_t^{*}\right)^2 + a_{iTTT}\cdot\left(\tau_t^{*}\right)^3, \qquad (6.3.1b)
$$

where $C_{i,t}^{V}$ ($\equiv p_{V,i,t}\cdot x_{V,i,t}+p_{L,i,t}\cdot x_{L,i,t}+p_{K,i,t}\cdot x_{K,i,t}+p_{B,i,t}\cdot x_{B,i,t}$) is the variable cost, $p_{V,i,t}$ is the current good price, $x_{V,i,t}$ is the amount (input) of current goods, $p_{L,i,t}$ is the wage, $x_{L,i,t}$ is the amount (input) of labor, $p_{K,i,t}$ is the physical capital price, $x_{K,i,t}$ is the amount (input) of physical capital, $p_{B,i,t}$ is the interest rate of certificates of deposit and other liabilities, and $x_{B,i,t}$ is the outstanding amount of certificates of deposit and other liabilities. Moreover, θ_j ($j = L, K, B$) is a parameter added in order to ensure that the variable cost function in Eq.(6.3.1a) satisfies the concavity condition for the factor prices for a larger sample. We created this parameter with reference to the prior affine transformation presented by Barnett (1985) and we stipulated it as θ_j = [minimum value of $p^*_{j,i,t}/p^*_{V,i,t} \times -0.991$]. Furthermore, in order to facilitate interpretation of the parameter, we standardize the financial goods $q^*_{j,i,t}$ $(j = SL, LL, S, C, CL, A, DD, TD, CM)$ and factor prices $p^*_{j,i,t}$ $(j = V, L, K, B)$ by dividing by the mean value for the total data. Moreover, D^{MA}_i is the M&A dummy variable [a variable that has the value one (1) after an M&A and the value zero (0) before that], τ^*_t is the technical progress variable (time trend, $\tau^*_t = 1 - 1992$), D^B_i is the individual bank dummy variable [a variable that has the value one (1) in the case of the i-th bank and the value zero (0) otherwise], and $\nu_{i,t}$ is the error term. We define the coefficients $a_l\left(\mathbf{z}^{RQ}_{GL,i,t}\right)(l \in \{SL, LL\})$, $a_l\left(\mathbf{z}^{RQ}_{GD,t}\right)(l \in \{DD, TD\})$, and $a_l\left(\mathbf{z}^{RQ}_{G,i,t}\right)(l \in \{K, L, B\})$ as a function of the quality variable

$$\begin{aligned}
\mathbf{z}^{RQ}_{GL,i,t} &\equiv \left(z^{RQ}_{L,4,i,t}, z^{RQ}_{L,5,i,t}, z^{RQ}_{L,8,i,t}, z^{RQ}_{L,10,i,t}, z^{RQ}_{L,11,i,t},\right)', \mathbf{z}^{RQ}_{GD,t} \equiv \left(z^{RQ}_{D,2,t}, z^{RQ}_{D,3,t}, z^{RQ}_{D,4,t}\right)', \\
\mathbf{z}^{RQ}_{G,i,t} &\equiv \left(z^{RQ}_{L,2,i,t}, z^{RQ}_{L,6,i,t}, z^{RQ}_{L,7,i,t}, z^{RQ}_{D,2,t}, z^{RQ}_{D,3,t}\right)',
\end{aligned}$$

specifying them as follows:

$$a_l\left(\mathbf{z}^{RQ}_{GL,i,t}\right) = a_l + \sum_{j\in\{4,5,8,10,11\}} a^{ZL}_{lj} \cdot z^{RQ}_{L,j,i,t} \ (l \in \{SL, LL\}), \tag{6.3.1c}$$

$$a_l\left(\mathbf{z}^{RQ}_{GD,t}\right) = a_l + \sum_{j=2}^{4} a^{ZD}_{lj} \cdot z^{RQ}_{D,j,t} \ (l \in \{DD, TD\}), \tag{6.3.1d}$$

$$a_l\left(\mathbf{z}^{RQ}_{G,i,t}\right) = a_l + \sum_{j\in\{2,6,7\}} a^{ZL}_{lj} \cdot z^{RQ}_{L,j,i,t} + \sum_{j=2}^{3} a^{ZD}_{lj} \cdot z^{RQ}_{D,j,t} \quad (l \in \{K, L, B\}). \tag{6.3.1e}$$

By taking the partial derivative of the translog cost function in Eq.(6.3.1a) with respect to $\ln(p_{j,i,t}/p_{V,i,t})$ $(j = L, K, B)$, we can derive the cost share equations of labor, physical capital, and certificates of deposit and other liabilities. By simultaneously estimating these cost share equations with the variable cost function in Eq.(6.3.1a), we can obtain a more efficient estimate than if we estimate Eq.(6.3.1a) alone.

$$\begin{aligned} S_{i,t}^{h} \;=\;& \frac{p_{h,i,t}^{*}}{p_{h,i,t}^{*}+\theta_h \cdot p_{V,i,t}^{*}} \cdot \left[a_h\left(\mathbf{z}_{G,i,t}^{RQ}\right) + \sum_{j\in\{L,K,B\}} b_{jh}\cdot \ln\left(p_{j,i,t}^{*}/p_{V,i,t}^{*}+\theta_j\right) \right. \\ & \left. + \sum_{j\in\{SL,LL,S,C,CL,A,DD,TD,CM\}} b_{jh}\cdot \ln q_{j,i,t}^{*} \qquad + b_{hT}\cdot \tau_t^{*} \right] + \varepsilon_{i,t}^{h}\ \ (h\in\{K,L,B\}), \end{aligned} \tag{6.3.2}$$

where $S_{i,t}^{h}$ $(h\in\{K,L,B\})$ is the cost share of each input factor $(=\ (p_{j,i,t}\cdot x_{j,i,t})/\,C_{i,t}^{V}$ $=\ \partial \ln\left(C_{i,t}^{V}/\,p_{V,i,t}^{*}\right)/\partial \ln\left(p_{j,i,t}^{*}/p_{V,i,t}^{*}\right)$, where $x_{j,i,t}$ is the input of the j-th factor), and $\varepsilon_{i,t}^{h}$ is the error term.

7 Appendix: Estimation Results of the EGURM

7.1 Loan Rate and Deposit Rate Functions

The estimation results of Eqs.(6.2.3.1.6a, b), (6.2.3.1.7a, b), and (6.2.3.2.3) are shown in Tables 7.1.1 through 7.1.8.

<<Insert Table 7.1.1 about here>>
<<Insert Table 7.1.2 about here>>
<<Insert Table 7.1.3 about here>>
<<Insert Table 7.1.4 about here>>
<<Insert Table 7.1.5 about here>>
<<Insert Table 7.1.6 about here>>
<<Insert Table 7.1.7 about here>>
<<Insert Table 7.1.8 about here>>

7.2 Variable Cost Function

The estimation results of Eqs.(6.3.1a) and (6.3.2) are shown in Table 7.2.1, and the estimation results of $a_i\left(D_i^{MA},\tau_t^{*}\right)$ are shown in Table 7.2.2.

<<Insert Table 7.2.1 about here>>
<<Insert Table 7.2.2 about here>>

Table 3.1: Financial Goods Data and its Service Function

Table 3.1: Financial Goods Data and Corresponding Service Function

	Variable	Name	Service function	Data and creation of the data	Source (Note 1)
	$p_{G,t+1}$	General price index	–	GDP deflator	(b)
Financial Assets	$q_{SL,i,t+1}$	Short-term loans	Settlement of accounts	[Loans for a period of one year or less, or with no period stipulated (= overdraft + bankers' acceptances and discounted bills + loans on bills)]/ $p_{G,t+1}$	(a)
	$q_{LL,i,t+1}$	Long-term loans	Financial intermediation	[Loans for a period in excess of one year (= loans on deeds)]/ $p_{G,t+1}$	(a)
	$q_{S,i,t+1}$	Securities	Financial intermediation	[Trading assets (trading securities) + trading assets (derivatives of trading securities) + trading assets (securities) + trading assets (derivatives of securities) - trading liabilities (trading securities sold for short sales) - trading liabilities (derivatives of trading securities) - trading liabilities (securities related to trading transactions sold for short sales) - trading liabilities (derivatives of securities related to trading transactions) + total trading securities + total securities + depreciation of bonds - retirement of government bonds, etc. + write-offs of stocks and other securities]/ $p_{G,t+1}$	(a)
	$q_{C,i,t+1}$	Cash	Settlement of accounts	Cash/ $p_{G,t+1}$	(a)
	$q_{CL,i,t+1}$	Due from banks and call loans	Settlement of accounts	[Due from banks + call loans]/ $p_{G,t+1}$	(a)
	$q_{A,i,t+1}$	Other financial assets	Financial intermediation	[Money held in trust + bills bought + monetary claims and bills bought + foreign bills bought + foreign bills receivable + due to foreign banks + due from foreign banks + (total other assets - accrued income - financial derivative instruments (asset) and credit relevant to derivatives) - foreign bills sold - foreign bills payable]/ $p_{G,t+1}$	(a)
Liabilities	$q_{DD,i,t+1}$	Demand deposits	Settlement of accounts	[Current deposits + ordinary deposits + savings deposits + deposits at notice + installment savings]/ $p_{G,t+1}$	(a)
	$q_{TD,i,t+1}$	Time deposits	Financial intermediation (Note 2)	[Time deposits]/ $p_{G,t+1}$	(a)
	$q_{CM,i,t+1}$	Call money and borrowed money	Settlement of accounts	[Call money + borrowed money]/ $p_{G,t+1}$	(a)
Variable Input	$q_{CD,i,t+1}$	Certificates of deposit and other liabilities	Financial intermediation	[Certificates of deposit + bonds + bills sold + payables under repurchase agreements + commercial paper + due to foreign banks + due from foreign banks + corporate bonds + convertible bonds + (total other liabilities - accrued expenses - financial derivative instruments (liability) and obligation relevant to derivatives)]/ $p_{G,t+1}$	(a)

(Note) 1. The sources of the data are as follows: (a) The Nikkei NEEDS Company (Bank) Data File CD-ROM (Nikkei Media Marketing, Inc.) and (b) The National Economic Accounting (Cabinet Office).

2. However, time deposits with a period of less than six months for which the

depositor is not an individual provide a settlement service.

Table 4.1: Estimation Results of Stochastic Euler Equations

Table 4.1: Estimation Results of Stochastic Euler Equations

Parameter	Estimate	Standard Error	*t*-statistic	*p*-value
Utility Function				
γ_{7586} (1975-1986)	0.709058	0.029679	23.8907	0.000
γ_{8789} (1987-1989)	0.943351	0.031458	29.9877	0.000
γ_{9095} (1990-1995)	0.766062	0.016985	45.1031	0.000
γ_{9601} (1996-2001)	0.804701	0.733752×10^{-3}	1096.69	0.000
γ_{0207} (2002-2007)	0.676386	0.444245×10^{-2}	152.255	0.000
$\alpha_{e,7586}$ (1975-1986)	0.303715×10^{-2}	0.112171×10^{-2}	2.70760	0.007
$\alpha_{e,8789}$ (1987-1989)	-0.284524×10^{-2}	0.434088×10^{-2}	-0.655454	0.512
$\alpha_{e,9095}$ (1990-1995)	0.717981×10^{-2}	0.227717×10^{-2}	3.15295	0.002
$\alpha_{e,9601}$ (1996-2001)	0.129797×10^{-2}	0.400666×10^{-2}	0.323953	0.746
$\alpha_{e,0207}$ (2002-2007)	0.209067×10^{-2}	0.292592×10^{-3}	7.14534	0.000
ϕ_{π}	0.213931×10^{8}	3395.22	6300.95	0.000
ϕ_{e}	40427.0	0.137324×10^{-8}	0.294391×10^{14}	0.000
Subjective Rate of Time Preference				
δ^{S}	0.099778	0.046006	2.16878	0.030
$E\left[\partial u^{*}_{i,t+1} \big/ \partial \pi^{QS*}_{i,t+1} \middle\| \mathbf{z}_{i,t}\right]$ (Eqs. (29a), (29b), (31a), and (31b))				
$b^{MU}_{L,1}$ (($z^{RQ}_{L,1,i,t}$))	-0.771490	0.724347	-1.06508	0.287
$b^{MU}_{L,2}$ (($z^{RQ}_{L,2,i,t}$))	0.133409	0.082446	1.61814	0.106
$b^{MU}_{L,4}$ (($z^{RQ}_{L,4,i,t}$))	-0.071821	0.196516	-0.365473	0.715

$b_{L,5}^{MU}$ $((\ln z_{L,5,i,t}^{RQ}))$	0.931507×10^{-2}	0.757295×10^{-2}	1.23004	0.219
$b_{L,6}^{MU}$ $((z_{L,6,i,t}^{RQ}))$	-0.100290	0.043959	-2.28142	0.023
$b_{L,7}^{MU}$ $((z_{L,7,i,t}^{RQ}))$	0.087812	0.048622	1.80600	0.071
$b_{L,8}^{MU}$ $((z_{L,8,i,t}^{RQ}))$	0.175797	0.065302	2.69204	0.007
$b_{L,9}^{MU}$ $((z_{L,9,i,t}^{RQ}))$	0.179860	0.051997	3.45901	0.001
$b_{L,10}^{MU}$ $((z_{L,10,i,t}^{RQ}))$	-0.093373	0.065219	-1.43169	0.152
$b_{L,11}^{MU}$ $((z_{L,11,i,t}^{RQ}))$	-0.050878	0.039563	-1.28600	0.198
$b_{D,1}^{MU}$ $((\ln z_{D,1,t}^{RQ}))$	-0.033642	0.014189	-2.37101	0.018
$b_{D,2}^{MU}$ $((z_{D,2,t}^{RQ}))$	-0.324335	0.386155	-0.839909	0.401
$b_{D,3}^{MU}$ $((z_{D,3,t}^{RQ}))$	0.926474	0.482166	1.92148	0.055
$b_{D,4}^{MU}$ $((z_{D,4,t}^{RQ}))$	0.389739×10^{-5}	0.535758×10^{-5}	0.727453	0.467
b_{S}^{MU} $((r_{S,i,t}))$	-0.172327	0.189028	-0.911650	0.362
b_{CL}^{MU} $((r_{CL,i,t}))$	-0.026669	0.067848	-0.393061	0.694
b_{A}^{MU} $((r_{A,i,t}))$	0.032341	0.017352	1.86380	0.062
b_{CM}^{MU} $((r_{CM,i,t}))$	0.057061	0.063390	0.900159	0.368
b_{CD}^{MU} $((p_{B,i,t}))$	-0.063213	0.021828	-2.89596	0.004
b_{I}^{MU} $((h_{TD,t-1}^{I}))$	-30.7625	24.0484	-1.27919	0.201
b_{κ}^{MU} $((\kappa_{TD,t-1}))$	-1.61975	0.763286	-2.12208	0.034
a_2^{MU} (Shinsei Bank)	1.39800	0.177104	7.89368	0.000
a_3^{MU} (Aozora Bank)	1.37495	0.183106	7.50900	0.000
a_4^{MU} (Mizuho Bank)	1.43167	0.182540	7.84306	0.000
a_5^{MU} (Sakura Bank)	1.43656	0.183102	7.84570	0.000
a_6^{MU}	1.42263	0.182074	7.81349	0.000

(Mizuho Corporate Bank)				
a_7^{MU} (Bank of Tokyo-Mitsubishi UFJ)	1.42719	0.182652	7.81369	0.000
a_8^{MU} (Asahi Bank)	1.42200	0.184491	7.70772	0.000
a_9^{MU} (UFJ Bank)	1.42701	0.181834	7.84787	0.000
a_{10}^{MU} (Sumitomo Mitsui Banking Corp.)	1.42889	0.181983	7.85181	0.000
a_{11}^{MU} (Resona Bank)	1.44148	0.181327	7.94959	0.000
a_{12}^{MU} (Tokai Bank)	1.42914	0.181707	7.86506	0.000
a_{13}^{MU} (Hokkaido Takushoku Bank)	1.44099	0.182963	7.87584	0.000
a_{14}^{MU} (Taiyo Kobe Bank)	1.42849	0.182427	7.83049	0.000
a_{15}^{MU} (Bank of Tokyo)	1.32040	0.187119	7.05647	0.000
a_{16}^{MU} (Saitama Bank)	1.42827	0.182019	7.84678	0.000
Conjectural Derivative				
$\rho_{SL,7586}$ (1975-1986)	0.711132	0.783290	0.907878	0.364
$\rho_{SL,8789}$ (1987-1989)	-0.935697	8.40830	-0.111283	0.911
$\rho_{SL,9095}$ (1990-1995)	2.38858	5.14496	0.464257	0.642
$\rho_{SL,9601}$ (1996-2001)	0.082899	4.12871	0.020079	0.984
$\rho_{SL,0207}$	0.187808	4.10336	0.045769	0.963

(2002-2007)				
$\rho_{LL,7586}$ (1975-1986)	1.00442	1.47666	0.680193	0.496
$\rho_{LL,8789}$ (1987-1989)	0.086713	7.16856	0.012096	0.990
$\rho_{LL,9095}$ (1990-1995)	2.93477	4.43296	0.662033	0.508
$\rho_{LL,9601}$ (1996-2001)	0.710611	6.69762	0.106099	0.916
$\rho_{LL,0207}$ (2002-2007)	0.551783	3.63936	0.151616	0.879
$\rho_{DD,9295}$ (1992-1995)	-0.999456	21.9468	-0.045540	0.964
$\rho_{DD,9601}$ (1996-2001)	-0.949747	35.9673	-0.026406	0.979
$\rho_{DD,0207}$ (2002-2007)	-0.960432	25.2971	-0.037966	0.970
$\rho_{TD,8589}$ (1985-1989)	1.02627	0.574045	1.78779	0.074
$\rho_{TD,9095}$ (1990-1995)	0.595449	0.743474	0.800901	0.423
$\rho_{TD,9601}$ (1996-2001)	1.01543	0.829179	1.22462	0.221
$\rho_{TD,0207}$ (2002-2007)	1.02608	0.697260	1.47159	0.141
Number of Observations	349			
Order of MA for the Error Term	1			
Test for Overidentification [*p*-value]	176.260 [0.999]			
Value Function	0.505044			

Note: 1. The exogenous state variables in double parentheses represent the elements of $\mathbf{z}_{i,t}$ in Eqs. (29a) and (29b).

2. The GMM estimates take into account the heteroskedasticity of an unknown

form in error terms and autocorrelation, in which case we specify a first-order moving average process. Bartlett kernels were specified for the kernel density to insure positive definiteness of the covariance matrix of the orthogonal conditions, when the number of autocorrelation terms is positive.

Table 4.2.1: Estimation Results of the Relative Risk-Aversion

Table 4.2.1: Estimation Results of the Relative Risk-Aversion

Relative Risk-Aversion	Estimates
$1-\gamma_{7586}$	0.290942 (9.80287) [0.000]
$1-\gamma_{8789}$	0.056649 (1.80079) [0.072]
$1-\gamma_{9095}$	0.233938 (13.7735) [0.000]
$1-\gamma_{9601}$	0.195299 (266.165) [0.000]
$1-\gamma_{0207}$	0.323614 (72.8459) [0.000]

Note: 1. $1-\gamma_s$ represents the relative risk-aversion in period *s*, where γ_s is the risk attitude parameter. For example, $1-\gamma_{9601}$ represents the relative risk-aversion in the period of 1996-2001.

2. The numbers in parentheses represent asymptotic *t*-values.

3. The numbers in brackets represent estimated *p*-values.

Table 4.2.2: Estimation Results of the Reference Rate (Risk-Free Rate)

Table 4.2.2: Estimation Results of the Reference Rate (Risk-Free Rate)

Periods	Reference Rate (Risk-Free Rate)	Call Rate
1975-2007 (all periods)	0.010233 (5.79772) [0.000]	0.042973
1975-1986	0.011917 (4.28790) [0.000]	0.067114
1987-1989	0.0088886 (4.48890) [0.000]	0.043786
1990-1995	0.017572 (4.00431) [0.000]	0.041338
1996-2001	0.0051072 (7.88712) [0.000]	0.0025722
1996-1998	0.0035103 (1.55825) [0.119]	0.0041639
1999-2001	0.0069940 (2.16013) [0.031]	0.00061879
2002-2007	-0.0044852 (-1.13645) [0.256]	0.0012408

Note: 1. The numbers in parentheses represent asymptotic *t*-values.

2. The numbers in brackets represent estimated *p*-values.

Table 4.3.1: Estimation Results of SURPs, CURPs, and GURPs

Table 4.3.1: Estimation Results of SURPs, CURPs, and GURPs

GURP and Components	Short-Term Loans	Long-Term Loans	Demand Deposits	Time Deposits
GURP (= Marginal Variable Cost)	0.02250	0.02051	0.01058	-0.02537
Risk-Adjustment Effect	-0.005315 (-2.707) [0.007] ((-0.2363))	-0.02117 (-11.12) [0.000] ((-1.032))	0.008916 (4.623) [0.000] ((0.8425))	0.02586 (12.14) [0.000] ((-1.019))
Equity Capital Effect	0.004260 (5.191) [0.000] ((0.1894))	0.004260 (5.191) [0.000] ((0.2077))	-0.004260 (-5.191) [0.000] ((-0.4025))	-0.004260 (-5.191) [0.000] ((0.1679))
CURP	0.02355 (16.47) [0.000]	0.03742 (30.16) [0.000]	0.005927 (4.453) [0.000]	-0.04697 (-30.76) [0.000]
Market Structure and Conduct Effect	-0.0006529 (-1.000) [0.317] ((-0.02902))	-0.001369 (-2.027) [0.043] ((-0.06675))	-0.1386×10^{-5} (-0.002769) [0.998] ((-0.000131))	-0.004928 (-7.684) [0.000] ((0.1942))
SURP	0.02420 (14.69) [0.000] ((1.076))	0.03878 (23.18) [0.000] ((1.891))	0.005928 (3.795) [0.000] ((0.5602))	-0.04204 (-25.40) [0.000] ((1.657))

Note: 1. The numbers in parentheses represent asymptotic *t*-values.

2. The numbers in brackets represent estimated *p*-values.

3. The numbers in double parentheses represent proportions with respect to GURPs.

Table 4.3.2: Estimation Results of SURPs, CURPs, and GURPs of Short-Term Loans

Table 4.3.2: Estimation Results of SURPs, CURPs, and GURPs of Short-Term Loans

GURP and Components	1975-1986	1987-1989	1990-1995	1996-2001	2002-2007
GURP (= Marginal Variable Cost)	0.04605	0.006121	0.001394	0.005163	0.002211
Risk-Adjustment Effect	0.002825 (2.188) [0.029] ((0.06135))	-0.02138 (-6.802) [0.000] ((-3.493))	-0.01952 (-4.589) [0.000] ((-14.00))	0.01075 (1.984) [0.047] ((2.083))	-0.01342 (-3.398) [0.001] ((-6.068))
Equity Capital Effect	0.005611 (2.605) [0.009] ((0.1218))	-0.002981 (-0.6533) [0.514] ((-0.4870))	0.01072 (3.173) [0.002] ((7.692))	0.001841 (0.3239) [0.746] ((0.3565))	0.003699 (7.382) [0.000] ((1.673))
CURP	0.03762 (16.25) [0.000]	0.03048 (9.724) [0.000]	0.01019 (2.912) [0.004]	-0.007431 (-2.705) [0.007]	0.01193 (3.202) [0.001]
Market Structure and Conduct Effect	-0.0005260 (-2.180) [0.029] ((-0.0114))	-0.0000218 (-0.007648) [0.994] ((-0.0036))	-0.001474 (-0.6574) [0.511] ((-1.058))	-0.0005721 (-0.2623) [0.793] ((-0.1108))	-0.0008011 (-0.2893) [0.772] ((-0.3623))
SURP	0.03814 (16.00) [0.000] ((0.8282))	0.03050 (15.77) [0.000] ((4.984))	0.01167 (2.609) [0.009] ((8.370))	-0.006859 (-10.55) [0.000] ((-1.328))	0.01273 (3.374) [0.001] ((3.022))

Note: 1. The numbers in parentheses represent asymptotic t-values.

2. The numbers in brackets represent estimated p-values.

3. The numbers in double parentheses represent proportions with respect to GURPs.

Table 4.3.3: Estimation Results of SURPs, CURPs, and GURPs of Long-Term Loans

Table 4.3.3: Estimation Results of SURPs, CURPs, and GURPs of Long-Term Loans

GURP and Components	1975-1986	1987-1989	1990-1995	1996-2001	2002-2007
GURP (= Marginal Variable Cost)	0.01780	0.02031	0.01609	0.02637	0.03101
Risk-Adjustment Effect	-0.04335 (-28.33) [0.000] ((-2.436))	-0.02434 (-8.806) [0.000] ((-1.199))	-0.01263 (-2.918) [0.004] ((-0.7851))	0.02171 (7.538) [0.000] ((0.8231))	0.008846 (4.036) [0.000] ((0.2852))
Equity Capital Effect	0.005611 (2.605) [0.009] ((0.3152))	-0.002981 (-0.6533) [0.514] ((-0.1468))	0.01072 (3.173) [0.002] ((0.6666))	0.001841 (0.3239) [0.746] ((0.06981))	0.003699 (7.382) [0.000] ((0.1193))
CURP	0.05554 (20.760) [0.000]	0.04763 (13.13) [0.000]	0.01799 (3.956) [0.000]	0.002825 (0.4861) [0.627]	0.01847 (8.158) [0.000]
Market Structure and Conduct Effect	-0.0007453 (-1.359) [0.174] ((-0.0419))	-0.0005305 (-0.1516) [0.880] ((-0.0261))	-0.002546 (-0.8866) [0.375] ((-0.1583))	-0.001456 (-0.2554) [0.798] ((-0.0552))	-0.001693 (-0.4258) [0.670] ((-0.0546))
SURP	0.05628 (23.12) [0.000] ((3.162))	0.04816 (24.46) [0.000] ((2.371))	0.02054 (4.553) [0.000] ((1.277))	0.004280 (6.513) [0.000] ((0.1623))	0.02016 (5.302) [0.000] ((0.6501))

Note: 1. The numbers in parentheses represent asymptotic *t*-values.

2. The numbers in brackets represent estimated *p*-values.

3. The numbers in double parentheses represent proportions with respect to GURPs.

Table 4.3.4: Estimation Results of SURPs, CURPs, and GURPs of Demand Deposits

Table 4.3.4: Estimation Results of SURPs, CURPs, and GURPs of Demand Deposits

GURP and Components	1975-1986	1987-1989	1990-1995	1996-2001	2002-2007
GURP (= Marginal Variable Cost)	-0.01662	0.04078	0.06767	0.009432	-0.003034
Risk-Adjustment Effect	-0.01468 (-11.95) [0.000] ((0.8835))	0.03191 (6.434) [0.000] ((0.7825))	0.06033 (12.53) [0.000] ((0.8915))	0.006491 (2.472) [0.013] ((0.6882))	0.006007 (3.164) [0.002] ((-1.980))
Equity Capital Effect	-0.005611 (-2.605) [0.009] ((0.3376))	0.002981 (0.6533) [0.514] ((0.0731))	-0.01072 (-3.173) [0.002] ((-0.1585))	-0.001841 (-0.3239) [0.746] ((-0.1952))	-0.003699 (-7.382) [0.000] ((1.219))
CURP	–	–	0.01807 (4.995) [0.000]	0.004782 (1.065) [0.287]	-0.005342 (-2.888) [0.004]
Market Structure and Conduct Effect	–	–	-0.2855×10^{-4} (-0.02281) [0.982] ((-0.000422))	-0.6229×10^{-5} (-0.001397) [0.999] ((-0.00066))	-0.5425×10^{-5} (-0.001564) [0.999] ((0.001788))
SURP	0.003675 (1.665) [0.096] ((-0.221))	0.005888 (3.196) [0.001] ((0.1444))	0.01811 (4.179) [0.000] ((0.2674))	0.004789 (7.346) [0.000] ((0.5077))	-0.005336 (-1.425) [0.154] ((1.759))

Note: 1. The numbers in parentheses represent asymptotic *t*-values.
2. The numbers in brackets represent estimated *p*-values.
3. The numbers in double parentheses represent proportions with respect to GURPs.

Table 4.3.5: Estimation Results of SURPs, CURPs, and GURPs of Time Deposits

Table 4.3.5: Estimation Results of SURPs, CURPs, and GURPs of Time Deposits

GURP and Components	1975-1986	1987-1989	1990-1995	1996-2001	2002-2007
GURP (= Marginal Variable Cost)	-0.02603	-0.02315	-0.02034	-0.02886	-0.02876
Risk-Adjustment Effect	0.03380 (26.51) [0.000] ((-1.299))	0.04478 (9.136) [0.000] ((-1.934))	0.03126 (6.879) [0.000] ((-1.537))	-0.004289 (-1.132) [0.257] ((0.1486))	0.005587 (2.274) [0.023] ((-0.1943))
Equity Capital Effect	-0.005611 (-2.605) [0.009] ((0.2155))	0.002981 (0.6533) [0.514] ((-0.1288))	-0.01072 (-3.173) [0.002] ((0.5274))	-0.001841 (-0.3239) [0.746] ((0.06378))	-0.003699 (-7.382) [0.000] ((0.1286))
CURP	-0.05422 (-22.64) [0.000]	-0.07092 (-27.53) [0.000]	-0.04087 (-10.20) [0.000]	-0.02273 (-4.693) [0.000]	-0.03065 (-12.00) [0.000]
Market Structure and Conduct Effect	-0.0008696 (-12.210) [0.000] ((0.03341))	-0.006781 (-3.533) [0.000] ((0.2929))	-0.006806 (-2.156) [0.031] ((0.3347))	-0.01063 (-2.428) [0.015] ((0.3684))	-0.01239 (-2.933) [0.003] ((0.4307))
SURP	-0.05335 (-22.34) [0.000] ((2.050))	-0.06414 (-32.30) [0.000] ((2.770))	-0.03406 (-7.474) [0.000] ((1.675))	-0.01210 (-18.26) [0.000] ((0.4192))	-0.01826 (-4.811) [0.000] ((0.6349))

Note: 1. The numbers in parentheses represent asymptotic *t*-values.

2. The numbers in brackets represent estimated *p*-values.

3. The numbers in double parentheses represent proportions with respect to GURPs.

Table 4.4.1: Estimation Results of Factors in the Cost Efficiency

Table 4.4.1: Estimation Results of Factors in the Cost Efficiency

Independent Variables (Parameters)	Equation (35)	Equation (36)	Equation (37)
Loans for Small and Medium Firms per Case (β^{LSMFC} , β^{LE})	-0.000865114 (-8.29401) [0.000]	–	-0.00101886 (-7.19252) [0.000]
Employees per Branch (β^{EB} , γ^{LE})	–	0.00228688 (2.36606) [0.018]	0.00268288 (2.37936) [0.017]
Constant Term (α^{LSMFC} , α^{EB} , α^{LE})	0.790926 (50.4747) [0.000]	0.649631 (11.9524) [0.000]	0.659662 (11.6606) [0.000]
Adjusted R-squared	0.085668	0.067564	0.143802
Number of Observations	331	349	331
Order of MA for the Error Term	6	11	12
Test for Overidentification [p-value]	20.2516 [0.122]	19.3177 [0.153]	19.4499 [0.148]
Value Function	0.061183	0.055352	0.058761

Note: 1. The numbers in parentheses represent estimated t-values.

2. The numbers in brackets represent estimated p-values.

3. The GMM estimates take into account the heteroskedasticity of an unknown form in error terms and autocorrelation, in which case we specify a moving average process. Bartlett kernels were specified for the kernel density to insure positive definiteness of the covariance matrix of the orthogonal conditions, when the number of autocorrelation terms is positive.

Table 4.4.2: Estimation Results of Factors in the Risk-Adjustment Effects: Eq.(32)

Table 4.4.2: Estimation Results of Factors in the Risk-adjustment Effects: Eq.(32)

Independent Variables (Parameters)	Short-Term Loans	Long-Term Loans	Demand Deposits	Time Deposits
Short-Term Prime Rate (β^R_{SL})	0.103561 (1.75009) [0.080]	—	—	—
Long-Term Prime Rate (β^R_{LL})	—	-0.325332 (-8.35438) [0.000]	—	—
Interest Rate of Ordinary Savings (β^R_{DD})	—	—	0.403824 (3.23753) [0.001]	—
Yield on Government Bonds (β^R_{TD})	—	—	—	-0.103763 (-3.70091) [0.000]
Cost Efficiency (β^E_j)	0.034107 (5.62417) [0.000]	-0.031586 (-9.92534) [0.000]	-0.123998 (-14.7751) [0.000]	0.034251 (9.68613) [0.000]
Sum of Capital, Capital Reserve, and Corporate Bonds 1975-1986($\beta^{CCRCB}_{j,1}$)	0.167385 $\times 10^{-7}$ (0.533470) [0.594]	-0.156691 $\times 10^{-7}$ (-0.856728) [0.392]	-0.103373 $\times 10^{-6}$ (-2.42135) [0.015]	0.172116 $\times 10^{-6}$ (10.6106) [0.000]
Sum of Capital, Capital Reserve, and Corporate Bonds 1987-1989($\beta^{CCRCB}_{j,2}$)	-0.354500 $\times 10^{-7}$ (-4.08585) [0.000]	0.214590 $\times 10^{-7}$ (6.00490) [0.000]	0.683509 $\times 10^{-7}$ (4.40654) [0.000]	0.627868 $\times 10^{-7}$ (12.6811) [0.000]
Sum of Capital, Capital Reserve, and Corporate Bonds 1990-1995($\beta^{CCRCB}_{j,3}$)	-0.676627 $\times 10^{-8}$ (-1.42962) [0.153]	0.223194 $\times 10^{-7}$ (12.1135) [0.000]	0.381060 $\times 10^{-7}$ (4.99995) [0.000]	0.170082 $\times 10^{-7}$ (8.40000) [0.000]
Sum of Capital, Capital Reserve, and Corporate Bonds 1996-2001($\beta^{CCRCB}_{j,4}$)	0.149083 $\times 10^{-7}$ (5.14175) [0.000]	0.275788 $\times 10^{-7}$ (18.3361) [0.000]	0.505048 $\times 10^{-8}$ (1.68851) [0.091]	-0.227016 $\times 10^{-7}$ (-13.5353) [0.000]
Sum of Capital, Capital Reserve, and Corporate Bonds	0.138375 $\times 10^{-7}$ (9.12397) [0.000]	0.101391 $\times 10^{-7}$ (12.7794) [0.000]	-0.829159 $\times 10^{-8}$ (-6.46714) [0.000]	-0.863491 $\times 10^{-8}$ (-12.0423) [0.000]

2002-2007($\beta_{j,5}^{CCRCB}$)				
Constant Term (α_j)	-0.043483 (-8.77938) [0.000]	0.00641773 (2.84436) [0.004]	0.094781 (15.4961) [0.000]	0.00761250 (3.13376) [0.002]
R-squared	0.067048	0.395511	0.089365	0.414411
Number of Observations	348			
Order of MA for the Error Term	3			
Test for Overidentification [*p*-value]	84.8697 [0.860]			
Value Function	0.243879			

Note: 1. The numbers in parentheses represent estimated *t*-values.

2. The numbers in brackets represent estimated *p*-values.

3. The GMM estimates take into account the heteroskedasticity of an unknown form in error terms and autocorrelation, in which case we specify a third-order moving average process. Bartlett kernels were specified for the kernel density to insure positive definiteness of the covariance matrix of the orthogonal conditions, when the number of autocorrelation terms is positive.

Table 4.4.3: Estimation Results of Factors in the Risk-Adjustment Effects: Eq.(33)

Table 4.4.3: Estimation Results of Factors in the Risk-adjustment Effects: Eq.(33)

Independent Variables	Short-Term Loans	Long-Term Loans	Demand Deposits	Time Deposits
Loan Loss Provision Rate (β^X_{SL} , β^X_{LL})	-1.44926 (-12.3975) [0.000]	0.459855 (11.2065) [0.000]	–	–
Proportion of Loans for Small and Medium Firms (β^Y_{SL} , β^Y_{LL})	0.055029 (9.22319) [0.000]	0.012583 (2.84891) [0.004]	–	–
Reserve Requirement Ratio for Demand Deposits (β^X_{DD})	–	–	-1.23148 (-4.44735) [0.000]	–
Reserve Requirement Ratio for Time Deposits (β^X_{TD})	–	–	–	-2.11247 (-6.48245) [0.000]
Insurance Rate of Demand Deposits (β^Y_{DD})	–	–	-147.359 (-14.9518) [0.000]	–
Insurance Rate of Time Deposits (β^Y_{TD})	–	–	–	-4.46603 (-1.10332) [0.270]
Cost Efficiency (β^E_j)	0.018361 (2.83705) [0.005]	-0.035260 (-10.2094) [0.000]	-0.136206 (-12.6037) [0.000]	0.038820 (9.67045) [0.000]
Sum of Capital, Capital Reserve, and Corporate Bonds 1975-1986($\beta^{CCRCB}_{j,1}$)	0.463533 $\times 10^{-7}$ (1.46696) [0.142]	-0.673060 $\times 10^{-7}$ (-3.83759) [0.000]	-0.344566 $\times 10^{-6}$ (-7.06632) [0.000]	0.146316 $\times 10^{-6}$ (7.74527) [0.000]
Sum of Capital, Capital Reserve, and Corporate Bonds 1987-1989($\beta^{CCRCB}_{j,2}$)	-0.526508 $\times 10^{-7}$ (-4.54695) [0.000]	0.259310 $\times 10^{-7}$ (7.01765) [0.000]	0.144838 $\times 10^{-7}$ (0.785960) [0.432]	0.679238 $\times 10^{-7}$ (10.7775) [0.000]
Sum of Capital, Capital	-0.205441 $\times 10^{-7}$	0.257833 $\times 10^{-7}$	-0.969975 $\times 10^{-8}$	0.773087 $\times 10^{-8}$

Reserve, and Corporate Bonds 1990-1995($\beta_{j,3}^{CCRCB}$)	(-4.29046) [0.000]	(13.8478) [0.000]	(-0.953017) [0.341]	(3.04340) [0.002]
Sum of Capital, Capital Reserve, and Corporate Bonds 1996-2001($\beta_{j,4}^{CCRCB}$)	0.201500 $\times 10^{-7}$ (7.75083) [0.000]	0.315587 $\times 10^{-7}$ (22.3626) [0.000]	0.667186 $\times 10^{-8}$ (2.07836) [0.038]	-0.264939 $\times 10^{-7}$ (-17.4616) [0.000]
Sum of Capital, Capital Reserve, and Corporate Bonds 2002-2007($\beta_{j,5}^{CCRCB}$)	0.168504 $\times 10^{-7}$ (10.3703) [0.000]	0.101240 $\times 10^{-7}$ (17.0855) [0.000]	0.298375 $\times 10^{-8}$ (1.38738) [0.165]	-0.856891 $\times 10^{-8}$ (-10.4196) [0.000]
Constant Term (α_j)	-0.049166 (-9.34123) [0.000]	-0.017647 (-4.20234) [0.000]	0.186376 (14.3085) [0.000]	0.034050 (5.51701) [0.000]
R-squared	0.272264	0.400180	0.089128	0.432594
Number of Observations	348			
Order of MA for the Error Term	3			
Test for Overidentification [p-value]	85.4652 [0.771]			
Value Function	0.245590			

Note: 1. The numbers in parentheses represent estimated t-values.

2. The numbers in brackets represent estimated p-values.

3. The GMM estimates take into account the heteroskedasticity of an unknown form in error terms and autocorrelation, in which case we specify a third-order moving average process. Bartlett kernels were specified for the kernel density to insure positive definiteness of the covariance matrix of the orthogonal conditions, when the number of autocorrelation terms is positive.

Table 4.5.1: Estimation Results of Extended Generalized Lerner Indices

Table 4.5.1: Estimation Results of Extended Generalized Lerner Indices

EGLI and Components	Short-Term Loans	Long-Term Loans	Demand Deposits
EGLI	0.070561 (1.11518) [0.265]	0.471201 (20.6544) [0.000]	-0.785097 (-1.66912) [0.095]
Risk-Adjustment Effects	0.219585 (3.25441) [0.001] ((3.112))	0.545741 (17.7974) [0.000] ((1.15819))	-1.50390 (-2.12183) [0.034] ((1.91556))
Equity Capital Effects	-0.175998 (-6.25764) [0.000] ((-2.49428))	-0.109838 (-5.90248) [0.000] ((-0.233102))	0.718570 (2.41594) [0.016] ((-0.915264))
Market Structure and Conduct Effects (GLI)	0.026973 (1.03405) [0.301] ((0.382273))	0.035298 (2.16751) [0.030] ((0.074911))	0.000233839 (0.00277038) [0.998] ((-0.000297847))

Note: 1. The numbers in parentheses represent asymptotic *t*-values.

2. The numbers in brackets represent estimated *p*-values.

3. The numbers in double parentheses represent proportions to extended generalized Lerner indices.

Table 4.5.2: Estimation Results of Extended Generalized Lerner Indices of Long-Term Loans

Table 4.5.2: Estimation Results of Extended Generalized Lerner Indices of Long-Term Loans

EGLI and Components	1975-1986	1987-1989	1990-1995	1996-2001	2002-2007
EGLI	0.6838 (50.00) [0.000]	0.5783 (33.54) [0.000]	0.2168 (1.260) [0.208]	-5.161 (-5.456) [0.000]	-0.5383 (-1.855) [0.064]
Risk-Adjustment Effects	0.7702 (25.60) [0.000] ((1.126))	0.5054 (9.978) [0.000] ((0.8739))	0.6149 (4.603) [0.000] ((2.836))	-5.071 (-2.968) [0.003] ((0.9826))	-0.4388 (-2.707) [0.007] ((0.8151))
Equity Capital Effects	-0.09969 (-2.374) [0.018] ((-0.1458))	0.06190 (0.6525) [0.514] ((0.1070))	-0.5221 (-2.525) [0.012] ((-2.408))	-0.4301 (-0.3349) [0.738] ((0.0833))	-0.1835 (-9.935) [0.000] ((0.3409))
Market Structure and Conduct Effects (GLI)	0.01324 (1.330) [0.184] ((0.01937))	0.01101 (0.1518) [0.879] ((0.01905))	0.1240 (0.9248) [0.355] ((0.5718))	0.3401 (0.2541) [0.799] ((-0.06590))	0.08398 (0.4557) [0.649] ((-0.1560))

Note: 1. The numbers in parentheses represent asymptotic t-values.

2. The numbers in brackets represent estimated p-values.

3. The numbers in double parentheses represent proportions to extended generalized Lerner indices.

Table 6.1.4: Data for $H^{R}_{CD,i,t+1}$ and Creation of the Data

Table 6.1.4: Data for $H^{R}_{CD,i,t+1}$ and Creation of the Data

Variable	Quantity	Data and Creation of the Data	Source (Note)
$I^{R}_{CD,i,t+1}$	Interest paid on certificates of deposit and other liabilities	Interest Paid on CDs + Provisions for Installment Savings + Interest Paid on Bills Sold + Interest Paid on REPO Sale Transactions + Interest on Commercial Paper + Interest Paid on Corporate Bonds + Interest Paid on Convertible Bonds + Interest Paid on Bonds + Amortization of Discount on Debentures + Other Interest Paid + Amortization of Bond Issue Expenses + Other Business Expenses	(a)
$H^{R}_{CD,i,t+1}$	Interest rate of certificates of deposit and other liabilities	$I^{R}_{CD,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{CD,i,t+1} \right)$	(a),(b)

(Note) The sources of the data are as follows: (a) The Nikkei NEEDS Company (Bank) Data File CD-ROM (Nikkei Media Marketing, Inc.) and (b) The National Economic Accounting (Cabinet Office).

Table 6.2.2.1: Data for $H_{j,i,t+1}$ ($j = SL, LL$) and Creation of the Data

Table 6.2.2.1: Data for $H_{j,i,t+1}$ ($j = SL, LL$) and Creation of the Data

Variable	Quantity	Data and Creation of the Data	Source (Note)
$I^{Q}_{SL,i,t+1}$	Accrued interest on short-term loans	Accrued Income (Interest on Loans and Bills Discounted) $\times \dfrac{q_{SL,i,t+1}}{q_{SL,i,t+1} + q_{LL,i,t+1}}$	(a)
$I^{R}_{SL,i,t+1}$	Collected interest on short-term loans	Contracted Interest Rate for Short-Term Loans $\times$ Loans on Bills + Discounts on Bills + Overdraft Interest Rate $\times$ Overdraft	(a),(b)
$I^{S}_{SL,i,t+1}$	Service charge revenue from short-term loans	(Other Income on Service Transactions − Other Expenses on Service Transactions) $\times$ $q_{SL,i,t+1} \big/ \left(q_{SL,i,t+1} + q_{LL,i,t+1} + q_{S,i,t+1} + q_{DD,i,t+1} + q_{TD,i,t+1} \right)$	(a)
$I^{D}_{SL,i,t+1}$	Default loss on short-term loans	[Provisions for Possible Loan Loss Reserve + Bad Debts Written-off + Other Ordinary Expenses (until fiscal year 1999) + Transfer to Reserve for Possible Losses on Sales of Loans (fiscal year 2000 onwards)] $\times \dfrac{q_{SL,i,t+1}}{q_{SL,i,t+1} + q_{LL,i,t+1}}$	(a)
$H^{R}_{SL,i,t+1}$	Collected interest rate for short-term loans	$I^{R}_{SL,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{SL,i,t+1} \right)$	(a),(b),(c)
$H^{Q}_{SL,i,t+1}$	Uncollected interest rate for short-term loans	$I^{Q}_{SL,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{SL,i,t+1} \right)$	(a),(c)
$H^{S}_{SL,i,t+1}$	Service charge rate for short-term loans	$I^{S}_{SL,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{SL,i,t+1} \right)$	(a),(c)
$H^{D}_{SL,i,t+1}$	Default loss rate for short-term loans	$I^{D}_{SL,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{SL,i,t+1} \right)$	(a),(c)
$I^{R}_{LL,i,t+1}$	Collected interest on long-term loans	Interest on Loans and Bills Discounted - $I^{R}_{SL,i,t+1}$	(a),(b)

$I^{Q}_{LL,i,t+1}$	Accrued interest on long-term loans	Accrued Income (Interest on Loans and Bills Discounted) $\times \dfrac{q_{LL,i,t+1}}{q_{SL,i,t+1}+q_{LL,i,t+1}}$	(a)
$I^{S}_{LL,i,t+1}$	Service charge revenue from long-term loans	(Other Income on Service Transactions − Other Expenses on Service Transactions) $\times$ $q_{LL,i,t+1}\big/\left(q_{SL,i,t+1}+q_{LL,i,t+1}+q_{S,i,t+1}+q_{DD,i,t+1}+q_{TD,i,t+1}\right)$	(a)
$I^{D}_{LL,i,t+1}$	Default loss on long-term loans	[Provisions for Possible Loan Loss Reserve + Bad Debts Written-off + Other Ordinary Expenses (until fiscal year 1999) + Transfer to Reserve for Possible Losses on Sales of Loans (fiscal year 2000 onwards)] $\times \dfrac{q_{LL,i,t+1}}{q_{SL,i,t+1}+q_{LL,i,t+1}}$	(a)
$H^{R}_{LL,i,t+1}$	Collected interest rate for long-term loans	$I^{R}_{LL,i,t+1}\big/\left(p_{G,t+1}\cdot q_{LL,i,t+1}\right)$	(a),(b),(c)
$H^{Q}_{LL,i,t+1}$	Uncollected interest rate for long-term loans	$I^{Q}_{LL,i,t+1}\big/\left(p_{G,t+1}\cdot q_{LL,i,t+1}\right)$	(a),(c)
$H^{S}_{LL,i,t+1}$	Service charge rate for long-term loans	$I^{S}_{LL,i,t+1}\big/\left(p_{G,t+1}\cdot q_{LL,i,t+1}\right)$	(a),(c)
$H^{D}_{LL,i,t+1}$ $(=H^{D}_{SL,i,t+1})$	Default loss rate for long-term loans	$I^{D}_{LL,i,t+1}\big/\left(p_{G,t+1}\cdot q_{LL,i,t+1}\right)$	(a),(c)
$Q_{SL,t}$	Amount of stock in the overall short-term loan market	Total of $q_{SL,i,t}$ for all of the banks included in the analysis	(a)
$Q_{LL,t}$	Amount of stock in the overall long-term loan market	Total of $q_{LL,i,t}$ for all of the banks included in the analysis	(a)
$\mathbf{z}^{RQ}_{L,i,t}$ $z^{RQ}_{L,1,i,t}$	Prime rate	For long-term loans, the long-term prime rate, and for short-term loans, the short-term prime rate	(a),(b)

	$z_{L,2,i,t}^{RQ}$	Capital ratio of borrower firms	Weighted average of the equity capital ratio by corporate firm industry type, weighted by the proportion of loans in each industry	(a),(d)
	$z_{L,3,i,t}^{RQ}$	Ratio of operating profit to total capital of borrower firms	Weighted average of the ratio of operating profit to total capital by corporate firm industry type, weighted by the proportion of loans in each industry	(a),(d)
	$z_{L,4,i,t}^{RQ}$	Loan loss provision rate	[Possible Loan Losses] /[$p_{G,t} \cdot q_{SL,i,t} + p_{G,t} \cdot q_{LL,i,t}$]	(a)
	$z_{L,5,i,t}^{RQ}$	Loan per case	[$p_{G,t} \cdot q_{SL,i,t} + p_{G,t} \cdot q_{LL,i,t}$] /[Number of Borrowers]	(a)
	$z_{L,6,i,t}^{RQ}$	Proportion of loans for small and medium firms	[Loans and Discounts for Small Business] /[$p_{G,t} \cdot q_{SL,i,t} + p_{G,t} \cdot q_{LL,i,t}$]	(a)
	$z_{L,7,i,t}^{RQ}$	Herfindahl index of loan proportions classified by industry	Herfindahl index using loan proportions classified by industry	(a)
	$z_{L,8,i,t}^{RQ}$	Herfindahl index of loan proportions classified by mortgage	Herfindahl index using loan proportions classified by mortgage	(a)
	$z_{L,9,i,t}^{RQ}$	Proportion of loans for real estate business	[Loans for Real Estate Business]/[Total Loans Classified by Industry]	(a)
	$z_{L,10,i,t}^{RQ}$	Proportion of loans secured by real estate	[Loans Secured by Real Estate]/[Total Lending by Type of Collateral]	(a)
	$z_{L,11,i,t}^{RQ}$	Proportion of loans without collateral and without warranty	[Loans without Collateral and without Warranty]/[Total Lending by Type of Collateral]	(a)
$\mathbf{z}_{L,i,t}^{D}$	$z_{L,1,i,t}^{D}$	Capital ratio of borrower firms	Same as $z_{L,2,i,t}^{RQ}$.	(a),(d)

	$z^{D}_{L,2,i,t}$	Ratio of operating profit to total capital of borrower firms	Same as $z^{RQ}_{L,3,i,t}$.	(a),(d)
	$z^{D}_{L,3,i,t}$	Loan per case	Same as $z^{RQ}_{L,5,i,t}$.	(a)
	$z^{D}_{L,4,i,t}$	Proportion of loans for small and medium firms	Same as $z^{RQ}_{L,6,i,t}$.	(a)
	$z^{D}_{L,5,i,t}$	Herfindahl index of loan proportions classified by industry	Same as $z^{RQ}_{L,7,i,t}$.	(a)
	$z^{D}_{L,6,i,t}$	Herfindahl index of loan proportions classified by mortgage	Same as $z^{RQ}_{L,8,i,t}$.	(a)
	$z^{D}_{L,7,i,t}$	Proportion of loans for real estate business	Same as $z^{RQ}_{L,9,i,t}$.	(a)
	$z^{D}_{L,8,i,t}$	Proportion of loans secured by real estate	Same as $z^{RQ}_{L,10,i,t}$.	(a)
	$z^{D}_{L,9,i,t}$	Proportion of loans without collateral and without warranty	Same as $z^{RQ}_{L,11,i,t}$.	(a)
	$z^{D}_{L,10,i,t}$	Dummy for unusual default loss rate	Dummy variable = 1 if $H^{D}_{SL,i,t+1}$ $(=H^{D}_{LL,i,t+1})$ > 0.008 and = 0 if $H^{D}_{SL,i,t+1}$ is $\leq$ 0.008.	(a),(c)

(Notes) The sources of the data are as follows: (a) The Nikkei NEEDS Company (Bank) Data File CD-ROM (Nikkei Media Marketing, Inc.), (b) Economic Statistics Annual from the Bank of Japan, (c) The National Economic Accounting (Cabinet Office), and (d) Corporate Enterprise Annual Statistics from the Ministry of Finance.

Table 6.2.2.2: Data for $H_{j,i,t+1}$ ($j = S, A$) and Creation of the Data

Table 6.2.2.2: Data for $H_{j,i,t+1}$ ($j = S, A$) and Creation of the Data

Variable	Quantity	Data and Creation of the Data	Source (Note)
$I^R_{S,i,t+1}$	Net revenue from management of securities	Interest and Dividends on Securities + (Gains from Trading Securities − Expense on Trading Securities) + (Gains from Specified-Trade Securities − Expense on Specified-Trade Securities) + (Profits on Redemptions of Government Bonds, etc. − Losses on Redemptions of Government Bonds, etc.)	(a)
$I^S_{S,i,t+1}$	Service charge revenue from securities	(Other Income on Service Transactions − Other Expenses on Service Transactions) × $q_{S,i,t+1} / \left(q_{SL,i,t+1} + q_{LL,i,t+1} + q_{S,i,t+1} + q_{DD,i,t+1} + q_{TD,i,t+1} \right)$	(a)
$I^C_{S,i,t+1}$	Capital gain from securities	(Profit on Trading in Trading Securities − Losses on Trading in Trading Securities) + (Profits on Sales of Government Bonds, etc. − Losses on Sales of Government Bonds, etc.) + (Profits on Sales of Stocks and Other Securities − Losses on Sales of Stocks and Other Securities − Write-offs of Stocks and Other Securities)	(a)
$I^D_{S,i,t+1}$	Securities provisions and reserve funds	(Transfer to Reserves for Price Fluctuations of Government Bonds − Reversal from Reserves for Price Fluctuations of Government Bonds) + (Transfer to Reserves against Possible Losses on Trading in Trading Securities − Reversal from Reserves for Possible Losses on Trading in Trading Securities) + (Transfer to Securities Transaction Liability Reserve − Reversal from Securities Transaction Liability Reserve)	(a)
$I^R_{A,i,t+1}$	Net revenue from management of other financial assets	(Gains on Money Trusts − Losses on Money Trusts) + Interest on Bills Bought + Interest from REPO purchase transactions + Interest Received on Interest Rate Swaps + Other Interest Received	(a)
$I^S_{A,i,t+1}$	Service charge revenue from other financial assets	(Exchange Commissions Earned − Exchange Commissions Paid) × ((Foreign Bills Bought + Foreign Bills Receivable − Foreign Bills Sold − Foreign Bills Payable)/(Current Deposits + Ordinary Deposits + Foreign Bills Bought + Foreign Bills Receivable − Foreign Bills Sold − Foreign Bills Payable))	(a)
$I^C_{A,i,t+1}$	Capital gain from other financial assets	(Gains from Financial Derivative Instruments − Expense on Financial Derivative Instruments) + (Gains from Other Specified Trades − Expense on Other Specified Trades) + (Profits on Foreign	(a)

		Exchange Transactions – Losses on Foreign Exchange Transactions) + (Other Business Income - Other Business Expenses)	
$I^{D}_{A,i,t+1}$	Provisions and reserve funds for other financial assets	(Transfer to Reserve for Possible Losses on Sales of Loans – Reimbursement to Reserve for Possible Losses on Sales of Loans) + (Transfer to Liability Reserves for Financial Futures Transactions – Reversal from Liability Reserves for Financial Futures Transactions)	(a)
$H^{R}_{S,i,t+1}$	Interest rate of securities	$I^{R}_{S,i,t+1}\big/\left(p_{G,t+1}\cdot q_{S,i,t+1}\right)$	(a),(b)
$H^{S}_{S,i,t+1}$	Service charge rate for securities	$I^{S}_{S,i,t+1}\big/\left(p_{G,t+1}\cdot q_{S,i,t+1}\right)$	(a),(b)
$H^{C}_{S,i,t+1}$	Rate of capital gains for securities	$I^{C}_{S,i,t+1}\big/\left(p_{G,t+1}\cdot q_{S,i,t+1}\right)$	(a),(b)
$H^{D}_{S,i,t+1}$	Rate of provisions and reserve funds for securities	$I^{D}_{S,i,t+1}\big/\left(p_{G,t+1}\cdot q_{S,i,t+1}\right)$	(a),(b)
$H^{R}_{A,i,t+1}$	Interest rate of other financial assets	$I^{R}_{A,i,t+1}\big/\left(p_{G,t+1}\cdot q_{A,i,t+1}\right)$	(a),(b)
$H^{S}_{A,i,t+1}$	Service charge rate for other financial assets	$I^{S}_{A,i,t+1}\big/\left(p_{G,t+1}\cdot q_{A,i,t+1}\right)$	(a),(b)
$H^{C}_{A,i,t+1}$	Rate of capital gains for other financial assets	$I^{C}_{A,i,t+1}\big/\left(p_{G,t+1}\cdot q_{A,i,t+1}\right)$	(a),(b)
$H^{D}_{A,i,t+1}$	Rate of provisions and reserve funds for other financial assets	$I^{D}_{A,i,t+1}\big/\left(p_{G,t+1}\cdot q_{A,i,t+1}\right)$	(a),(b)

(Note) The sources of the data are as follows: (a) The Nikkei NEEDS Company (Bank) Data File CD-ROM (Nikkei Media Marketing, Inc.) and (b) The National Economic Accounting (Cabinet Office).

Table 6.2.2.3: Data for $H_{j,i,t+1}$ ($j = CL, CM$) and Creation of the Data

Table 6.2.2.3: Data for $H_{j,i,t+1}$ ($j = CL, CM$) and Creation of the Data

Variable	Quantity	Data and Creation of the Data	Source (Note)
$I^R_{CL,i,t+1}$	Interest on due from banks and call loans	Interest on Due from Banks + Interest on Call Loans	(a)
$I^R_{CM,i,t+1}$	Interest on call money and borrowed money	Interest on Borrowed Money + Interest on Call Money	(a)
$H^R_{CL,i,t+1}$	Interest rate of due from banks and call loans	$I^R_{CL,i,t+1} / \left(p_{G,t+1} \cdot q_{CL,i,t+1} \right)$	(a),(b)
$H^R_{CM,i,t+1}$	Interest rate of call money and borrowed money	$I^R_{CM,i,t+1} / \left(p_{G,t+1} \cdot q_{CM,i,t+1} \right)$	(a),(b)

(Note) The sources of the data are as follows: (a) The Nikkei NEEDS Company (Bank) Data File CD-ROM (Nikkei Media Marketing, Inc.) and (b) The National Economic Accounting (Cabinet Office).

Table 6.2.2.4: Data for $H_{j,i,t+1}$ ($j = DD, TD$) and Creation of the Data

Table 6.2.2.4: Data for $H_{j,i,t+1}$ ($j = DD, TD$) and Creation of the Data

Variable	Quantity	Data and Creation of the Data	Source (Note)
$I^{Q}_{DD,i,t+1}$	Unpaid interest on demand deposits	Accrued Expenses (Interest Paid on Deposits) $\times \dfrac{q_{DD,i,t+1}}{q_{DD,i,t+1} + q_{TD,i,t+1}}$	(a)
$I^{R}_{DD,i,t+1}$	Paid interest on demand deposits	○ (June 21, 1992 and earlier) Mean Annual Interest Rate for Ordinary Deposits × Ordinary Deposits + Mean Annual Interest Rate for Installment Savings × (Installment Savings + Savings Deposits) + Mean Annual Interest Rate for Deposits at Notice × Deposits at Notice ○ (From June 22, 1992 to October 16, 1994) Mean Annual Interest Rate for Ordinary Deposits × Ordinary Deposits + Mean Annual Interest Rate for Installment Savings × Installment Savings + Mean Annual Interest Rate for Savings Deposits × Savings Deposits + Mean Annual Interest Rate for Deposits at Notice × Deposits at Notice ○ (October 17, 1994 onwards) Mean Annual Interest Rate for Ordinary Deposits × (Ordinary Deposits + Deposits at Notice) + Mean Annual Interest Rate for Installment Savings × Installment Savings + Mean Annual Interest Rate for Savings Deposits × Savings Deposits	(a),(b)
$I^{S}_{DD,i,t+1}$	Service charge revenue from demand deposits	(Exchange Commissions Earned − Exchange Commissions Paid) × ((Current Deposits + Ordinary Deposits)/(Current Deposits + Ordinary Deposits + Foreign Bills Bought + Foreign Bills Receivable − Foreign Bills Sold − Foreign Bills Payable)) + (Other Income on Service Transactions − Other Expenses on Service Transactions) × $q_{DD,i,t+1} \big/ \left(q_{SL,i,t+1} + q_{LL,i,t+1} + q_{S,i,t+1} + q_{DD,i,t+1} + q_{TD,i,t+1} \right)$	(a)
$I^{R}_{TD,i,t+1}$	Paid interest on time deposits	Interest Paid on Deposits − $I^{R}_{DD,i,t+1}$	(a),(b)
$I^{Q}_{TD,i,t+1}$	Unpaid interest on time deposits	Accrued Expenses (Interest Paid on Deposits) $\times \dfrac{q_{TD,i,t+1}}{q_{DD,i,t+1} + q_{TD,i,t+1}}$	(a)

$I^{S}_{TD,i,t+1}$	Service charge revenue from time deposits	(Other Income on Service Transactions − Other Expenses on Service Transactions) × $q_{TD,i,t+1} \big/ \left(q_{SL,i,t+1} + q_{LL,i,t+1} + q_{S,i,t+1} + q_{DD,i,t+1} + q_{TD,i,t+1} \right)$	(a)
$H^{R}_{DD,i,t+1}$	Paid interest rate for demand deposits	$I^{R}_{DD,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{DD,i,t+1} \right)$	(a),(b),(c)
$H^{Q}_{DD,i,t+1}$	Unpaid interest rate for demand deposits	$I^{Q}_{DD,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{DD,i,t+1} \right)$	(a),(c)
$H^{S}_{DD,i,t+1}$	Service charge rate for demand deposits	$I^{S}_{DD,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{DD,i,t+1} \right)$	(a),(c)
$Q_{DD,t}$	Amount of stock in the overall demand deposit market	Total of $q_{DD,i,t}$ for all banks included in the analysis	(a)
$h^{I}_{DD,t}$	Insurance rate of demand deposits	○ (Fiscal year 2000 and earlier) Insurance rates (1) ○ (From fiscal year 2001 to fiscal year 2002) Specified Deposit Insurance Rate × Current Deposits/(Current Deposits + Ordinary Deposits + Savings Deposits + Deposits at Notice + Installment Savings) + Insurance Rates for Other Deposits, etc. × (Ordinary Deposits + Savings Deposits + Deposits at Notice + Installment Savings)/(Current Deposits + Ordinary Deposits + Savings Deposits + Deposits at Notice + Installment Savings) ○ (From fiscal year 2003 onwards) Deposit Insurance Rate Used in Settlement of Accounts × Current Deposits/(Current Deposits + Ordinary Deposits + Savings Deposits + Deposits at Notice + Installment Savings) + Insurance Rates for General Deposits, etc. × (Ordinary Deposits + Savings Deposits + Deposits at Notice + Installment Savings)/(Current Deposits + Ordinary Deposits + Savings Deposits + Deposits at Notice + Installment Savings)	(d)
$\kappa_{DD,t}$	Reserve requirement	Reserve rate of "Other Deposits"	(e)

	ratio for demand deposits		
$H^{R}_{TD,i,t+1}$	Paid interest rate for time deposits	$I^{R}_{TD,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{TD,i,t+1} \right)$	(a),(b), (c)
$H^{Q}_{TD,i,t+1}$	Unpaid interest rate for time deposits	$I^{Q}_{TD,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{TD,i,t+1} \right)$	(a),(c)
$H^{S}_{TD,i,t+1}$	Service charge rate for time deposits	$I^{S}_{TD,i,t+1} \big/ \left(p_{G,t+1} \cdot q_{TD,i,t+1} \right)$	(a),(c)
$Q_{TD,t}$	Amount of stock in the overall time deposit market	Total of $q_{TD,i,t}$ for all banks included in the analysis	(a)
$h^{I}_{TD,t}$	Insurance rate of time deposits	○ (Fiscal year 2000 and earlier) Insurance rates (1) ○ (From fiscal year 2001 to fiscal year 2002) Insurance rates for other deposits, etc. ○ (From fiscal year 2003 onwards) Insurance rates for general deposits, etc.	(d)
$\kappa_{TD,t}$	Reserve requirement ratio for time deposits	Reserve rate of “time and savings deposits (including certificates of deposit)”	(e)
$\mathbf{z}^{RQ}_{D,t}$ $z^{RQ}_{D,1,t}$	Depositor’s Income	Disposable income for workers’ households (except farmers)	(f)
$z^{RQ}_{D,2,t}$	Yield on government bonds	○ Fiscal year 1984 and earlier: Subscribers’ yield on 10-year interest-bearing government bonds ○ Fiscal year 1985 onwards: Yield on 10-year government bonds	(g)
$z^{RQ}_{D,3,t}$	Postal savings interest rate	For demand deposits, use the interest rate of ordinary savings, and for time deposits, use the interest rate of postal savings certificates.	(h)
$z^{RQ}_{D,4,t}$	Benchmark index of Japanese stock investment trust	TOPIX	(i)

(Note) The sources of the data are as follows: (a) The Nikkei NEEDS Company (Bank) Data File CD-ROM (Nikkei Media Marketing, Inc.), (b) Economic Statistics Annual from the Bank of Japan, (c) The National Economic Accounting (Cabinet Office), (d) Deposit Insurance Corporation of Japan web site (http://www.dic.go.jp/shikumi/hoken/suii.html),

(e) Bank of Japan web site (reserve rate in the reserve requirement regime) (http://www.boj.or.jp/statistics/boj/other/reservereq/junbi.htm),

(f) Family Income and Expenditure Survey from the Ministry of Internal Affairs and Communications, (g) Bank of Japan web site [Financial Markets (interest rate, yield, foreign exchange rate etc.)] (http://www.stat-search.boj.or.jp/ssi/cgi-bin/famecgi2?cgi=$nme_a000&lstSelection=5),

(h) Financial and Economic Statistics Monthly from the Bank of Japan, and (i) Monthly Statistics Report from the Tokyo Stock Exchange.

Table 7.1.1: Estimation Results of $r_{SL,i}^{R}\left(Q_{SL,t},\mathbf{z}_{L,i,t}^{RQ}\right)$, $r_{SL,i}^{Q}\left(\mathbf{z}_{L,i,t}^{RQ}\right)$, and $h_{L,i}^{D}\left(\mathbf{z}_{L,i,t}^{D}\right)$

Table 7.1.1: Estimation Results of $r_{SL,i}^{R}\left(Q_{SL,t},\mathbf{z}_{L,i,t}^{RQ}\right)$, $r_{SL,i}^{Q}\left(\mathbf{z}_{L,i,t}^{RQ}\right)$, and $h_{L,i}^{D}\left(\mathbf{z}_{L,i,t}^{D}\right)$

Parameters (Independent Variables)	$r_{SL,i}^{R}\left(Q_{SL,t},\mathbf{z}_{L,i,t}^{RQ}\right)$ Eq. (6.2.3.1.6a)	$h_{L,i}^{D}\left(\mathbf{z}_{L,i,t}^{D}\right)$ Eq. (6.2.3.2.3)	$r_{SL,i}^{Q}\left(\mathbf{z}_{L,i,t}^{RQ}\right)$ Eq. (6.2.3.1.6b)
$\beta_{SL,7479}^{R}$ (1974-1979) ($D_{7479}^{YA}\cdot\ln Q_{SL,t}$)	-0.00539692 (-3.97349) [0.000]	–	–
$\beta_{SL,8089}^{R}$ (1980-1989) ($D_{8089}^{YA}\cdot\ln Q_{SL,t}$)	-0.00513776 (-3.69835) [0.000]	–	–
$\beta_{SL,9099}^{R}$ (1990-1999) ($D_{9099}^{YA}\cdot\ln Q_{SL,t}$)	-0.00533830 (-3.85038) [0.000]	–	–
$\beta_{SL,0008}^{R}$ (2000-2008) ($D_{0008}^{YA}\cdot\ln Q_{SL,t}$)	-0.00553183 (-4.00099) [0.000]	–	–
$\gamma_{SL,1}^{R}$, $\gamma_{SL,1}^{Q}$ ($z_{L,1,i,t}^{RQ}$)	0.719494 (34.4448) [0.000]	–	0.183150 (4.44216) [0.000]
$\gamma_{SL,2}^{R}$, $\gamma_{L,1}^{D}$, $\gamma_{SL,2}^{Q}$ ($z_{L,2,i,t}^{RQ}(=z_{L,1,i,t}^{D})$)	-0.059027 (-5.80004) [0.000]	-0.033388 (-1.79080) [0.073]	-0.023599 (-5.79168) [0.000]
$\gamma_{L,2}^{D}$, $\gamma_{SL,3}^{Q}$ ($z_{L,3,i,t}^{RQ}(=z_{L,2,i,t}^{D})$)	–	-0.200552 (-2.58120) [0.010]	0.097171 (2.49030) [0.013]
$\gamma_{SL,4}^{Q}$ ($z_{L,4,i,t}^{RQ}$)	–	–	-0.025640 (-5.11739) [0.000]
$\gamma_{SL,5}^{R}$, $\gamma_{L,3}^{D}$ ($\ln z_{L,5,i,t}^{RQ}(=\ln z_{L,3,i,t}^{D})$)	0.00182022 (1.95662) [0.050]	0.00588197 (2.08485) [0.037]	–
$\gamma_{SL,6}^{R}$ ($z_{L,6,i,t}^{RQ}$)	-0.010473 (-2.82976) [0.005]	–	–
$\gamma_{SL,7}^{R}$, $\gamma_{L,5}^{D}$ ($z_{L,7,i,t}^{RQ}(=z_{L,5,i,t}^{D})$)	0.014693 (1.68028) [0.093]	0.035407 (1.40357) [0.160]	–
$\gamma_{SL,8}^{Q}$	–	–	0.014968 (2.18983)

($z^{RQ}_{L,8,i,t}$)			[0.029]
$\gamma^{R}_{SL,9}$ ($z^{RQ}_{L,9,i,t}$)	-0.022102 (-2.64681) [0.008]	—	—
$\gamma^{R}_{SL,10}$, $\gamma^{Q}_{SL,10}$ ($z^{RQ}_{L,10,i,t}$)	0.029020 (2.44053) [0.015]	—	0.00954082 (2.27924) [0.023]
$\gamma^{D}_{L,9}$, $\gamma^{Q}_{SL,11}$ ($z^{RQ}_{L,11,i,t} (= z^{D}_{L,9,i,t})$)	—	-0.032238 (-3.38761) [0.001]	-0.00981033 (-2.73508) [0.006]
$\gamma^{D}_{L,10}$ ($z^{D}_{L,10,i,t}$)	—	0.020505 (5.69358) [0.000]	—
R-squared: $r^{R}_{SL,i}\left(Q_{SL,t}, \mathbf{z}^{RQ}_{L,i,t}\right)$ and $h^{D}_{L,i}\left(\mathbf{z}^{D}_{L,i,t}\right)$ Adjusted R-squared: $r^{Q}_{SL,i}\left(\mathbf{z}^{RQ}_{L,i,t}\right)$	0.861057	0.257976	0.733298
Number of Observations	448		102
Log likelihood	2609.23		592.464
Schwarz B.I.C.	-2442.68		-548.526

Note: 1. The numbers in parentheses represent estimated *t*-values.

2. The numbers in brackets represent estimated *p*-values.

3. $r^{R}_{SL,i}\left(Q_{SL,t}, \mathbf{z}^{RQ}_{L,i,t}\right)$ and $h^{D}_{L,i}\left(\mathbf{z}^{D}_{L,i,t}\right)$ are estimated simultaneously, and $r^{Q}_{SL,i}\left(\mathbf{z}^{RQ}_{L,i,t}\right)$ is a single-equation estimation.

4. The multivariate regression estimates take into account the heteroskedasticity of an unknown form in error terms.

5. The estimation results of $\alpha^{R}_{SL,i}$, $\alpha^{Q}_{SL,i}$, and $\alpha^{D}_{L,i}$ are shown in Table 7.1.2.

Table 7.1.2: Estimation Results of $\alpha^{R}_{SL,i}$, $\alpha^{Q}_{SL,i}$, and $\alpha^{D}_{L,i}$

Table 7.1.2: Estimation Results of $\alpha^{R}_{SL,i}$, $\alpha^{Q}_{SL,i}$, and $\alpha^{D}_{L,i}$

Japanese City Bank	$\alpha^{R}_{SL,i}$ Eq. (6.2.3.1.6a)	$\alpha^{D}_{L,i}$ Eq. (6.2.3.2.3)	$\alpha^{Q}_{SL,i}$ Eq. (6.2.3.1.6b)
Industrial Bank of Japan (i=1)	0.105828 (4.11640) [0.000]	-0.015572 (-0.954195) [0.340]	-0.000791411 (-0.509539) [0.610]
Shinsei Bank (i=2)	0.107240 (4.18584) [0.000]	-0.012851 (-0.821137) [0.412]	0.00281340 (2.18442) [0.029]
Aozora Bank (i=3)	0.104387 (4.06457) [0.000]	-0.00495902 (-0.288033) [0.773]	0.000300601 (0.153119) [0.878]
Mizuho Bank (i=4)	0.110798 (4.23591) [0.000]	-0.00508457 (-0.424924) [0.671]	-0.000853029 (-0.511385) [0.609]
Sakura Bank (i=5)	0.111644 (4.29092) [0.000]	-0.00330963 (-0.288725) [0.773]	-0.00102476 (-0.576457) [0.564]
Mizuho Corporate Bank (i=6)	0.110756 (4.28312) [0.000]	-0.00354779 (-0.299047) [0.765]	0.000442613 (0.283002) [0.777]
Bank of Tokyo-Mitsubishi UFJ (i=7)	0.110904 (4.23356) [0.000]	-0.00322535 (-0.280109) [0.779]	0.000156616 (0.095779) [0.924]
Asahi Bank (i=8)	0.112751 (4.30187) [0.000]	-0.00356939 (-0.306152) [0.759]	-0.00214404 (-1.10582) [0.269]
UFJ Bank (i=9)	0.113227 (4.38058) [0.000]	-0.00173841 (-0.152750) [0.879]	-0.0000880687 (-0.057607) [0.954]
Sumitomo Mitsui Banking Corp. (i=10)	0.111767 (4.31481) [0.000]	-0.00300916 (-0.260263) [0.795]	-0.0000840831 (-0.052320) [0.958]
Resona Bank (i=11)	0.113674 (4.37639) [0.000]	0.000132742 (0.012389) [0.990]	-0.00170537 (-0.955591) [0.339]
Tokai Bank (i=12)	0.111702 (4.28367) [0.000]	-0.00179301 (-0.153308) [0.878]	-0.000867956 (-0.535349) [0.592]
Hokkaido Takushoku Bank (i=13)	0.112073 (4.30772) [0.000]	-0.0000664859 (-0.00671755) [0.995]	–
Taiyo Kobe Bank (i=14)	0.111295 (4.24939) [0.000]	-0.00514575 (-0.431044) [0.666]	–
Bank of Tokyo	0.106130	-0.016327	–

(i=15)	(4.18833) [0.000]	(-0.753708) [0.451]	
Saitama Bank (i=16)	0.113803 (4.34190) [0.000]	-0.00207611 (-0.198379) [0.843]	—

Note: 1. The numbers in parentheses represent estimated t-values.

2. The numbers in brackets represent estimated p-values.

3. $\alpha^{R}_{SL,i}$ in $r^{R}_{SL,i}\left(Q_{SL,t},\mathbf{z}^{RQ}_{L,i,t}\right)$ and $\alpha^{D}_{L,i}$ in $h^{D}_{L,i}\left(\mathbf{z}^{D}_{L,i,t}\right)$ are estimated simultaneously, and $\alpha^{Q}_{SL,i}$ in $r^{Q}_{SL,i}\left(\mathbf{z}^{RQ}_{L,i,t}\right)$ is a single-equation estimation.

4. The multivariate regression estimates take into account the heteroskedasticity of an unknown form in error terms.

Table 7.1.3: Estimation Results of $r_{LL,i}^{R}\left(Q_{LL,t},\mathbf{z}_{L,i,t}^{RQ}\right)$ and $r_{LL,i}^{Q}\left(\mathbf{z}_{L,i,t}^{RQ}\right)$

Table 7.1.3: Estimation Results of $r_{LL,i}^{R}\left(Q_{LL,t},\mathbf{z}_{L,i,t}^{RQ}\right)$ and $r_{LL,i}^{Q}\left(\mathbf{z}_{L,i,t}^{RQ}\right)$

Parameters (Independent Variables)	$r_{LL,i}^{R}\left(Q_{LL,t},\mathbf{z}_{L,i,t}^{RQ}\right)$ Eq. (6.2.3.1.6a)	$r_{LL,i}^{Q}\left(\mathbf{z}_{L,i,t}^{RQ}\right)$ Eq. (6.2.3.1.6b)
$\beta_{LL,7479}^{R}$ (1974-1979) ($D_{7479}^{YA}\cdot\ln Q_{LL,t}$)	-0.00905938 (-2.03434) [0.042]	–
$\beta_{LL,8089}^{R}$ (1980-1989) ($D_{8089}^{YA}\cdot\ln Q_{LL,t}$)	-0.00858125 (-1.96984) [0.049]	–
$\beta_{LL,9099}^{R}$ (1990-1999) ($D_{9099}^{YA}\cdot\ln Q_{LL,t}$)	-0.00880228 (-2.07408) [0.038]	–
$\beta_{LL,0008}^{R}$ (2000-2008) ($D_{0008}^{YA}\cdot\ln Q_{LL,t}$)	-0.00888071 (-2.05718) [0.040]	–
$\gamma_{LL,1}^{R}$, $\gamma_{LL,1}^{Q}$ ($z_{L,1,i,t}^{RQ}$)	0.668557 (13.8069) [0.000]	0.140912 (9.05467) [0.000]
$\gamma_{LL,2}^{R}$, $\gamma_{LL,2}^{Q}$ ($z_{L,2,i,t}^{RQ}$)	-0.049139 (-3.37685) [0.001]	-0.017122 (-4.97399) [0.000]
$\gamma_{LL,3}^{Q}$ ($z_{L,3,i,t}^{RQ}$)	–	0.071643 (1.99960) [0.046]
$\gamma_{LL,4}^{Q}$ ($z_{L,4,i,t}^{RQ}$)	–	-0.021977 (-3.67949) [0.000]
$\gamma_{LL,5}^{R}$ ($\ln z_{L,5,i,t}^{RQ}$)	0.00432024 (1.72046) [0.085]	–
$\gamma_{LL,8}^{Q}$ ($z_{L,8,i,t}^{RQ}$)	–	0.016339 (2.44910) [0.014]
$\gamma_{LL,9}^{R}$, $\gamma_{LL,9}^{Q}$ ($z_{L,9,i,t}^{RQ}$)	-0.031469 (-2.84537) [0.004]	-0.00699254 (-1.82942) [0.067]
$\gamma_{LL,10}^{R}$, $\gamma_{LL,10}^{Q}$ ($z_{L,10,i,t}^{RQ}$)	0.025684 (2.70080) [0.007]	0.010726 (2.54720) [0.011]

$\gamma^{Q}_{LL,11}$ ($z^{RQ}_{L,11,i,t}$)	–	-0.00970290 (-2.74949) [0.006]
Adjusted R-squared	0.887837	0.801220
Number of Observations	447	102
Log likelihood	1491.26	608.073
Schwarz B.I.C.	-1414.98	-561.823

Note: 1. The numbers in parentheses represent estimated t-values.

2. The numbers in brackets represent estimated p-values.

3. $r^{R}_{LL,i}\left(Q_{LL,t}, \mathbf{z}^{RQ}_{L,i,t}\right)$ and $r^{Q}_{LL,i}\left(\mathbf{z}^{RQ}_{L,i,t}\right)$ are single-equation estimations.

4. The multivariate regression estimates take into account the heteroskedasticity of an unknown form in error terms.

5. The estimation results of $\alpha^{R}_{LL,i}$ and $\alpha^{Q}_{LL,i}$ are shown in Table 7.1.4.

Table 7.1.4: Estimation Results of $\alpha_{LL,i}^{R}$ and $\alpha_{LL,i}^{Q}$

Table 7.1.4: Estimation Results of $\alpha_{LL,i}^{R}$ and $\alpha_{LL,i}^{Q}$

Japanese City Bank	$\alpha_{LL,i}^{R}$ Eq. (6.2.3.1.6a)	$\alpha_{LL,i}^{Q}$ Eq. (6.2.3.1.6b)
Industrial Bank of Japan (i=1)	0.167674 (2.40975) [0.016]	-0.00195328 (-0.818185) [0.413]
Shinsei Bank (i=2)	0.168859 (2.39566) [0.017]	0.00253025 (1.11594) [0.264]
Aozora Bank (i=3)	0.163590 (2.36871) [0.018]	-0.000136780 (-.043790) [0.965]
Mizuho Bank (i=4)	0.170699 (2.32423) [0.020]	-0.00197716 (-0.797511) [0.425]
Sakura Bank (i=5)	0.173797 (2.35649) [0.018]	-0.00203239 (-0.758987) [0.448]
Mizuho Corporate Bank (i=6)	0.172682 (2.35545) [0.019]	-0.000711376 (-0.305304) [0.760]
Bank of Tokyo-Mitsubishi UFJ (i=7)	0.175499 (2.38312) [0.017]	-0.000876271 (-0.358605) [0.720]
Asahi Bank (i=8)	0.171636 (2.31842) [0.020]	-0.00344413 (-1.24691) [0.212]
UFJ Bank (i=9)	0.175272 (2.36347) [0.018]	-0.000890028 (-0.372343) [0.710]
Sumitomo Mitsui Banking Corp. (i=10)	0.176032 (2.38834) [0.017]	-0.00106245 (-0.435798) [0.663]
Resona Bank (i=11)	0.171298 (2.30680) [0.021]	-0.00246548 (-0.894499) [0.371]
Tokai Bank (i=12)	0.171962 (2.33095) [0.020]	-0.00196218 (-0.804173) [0.421]
Hokkaido Takushoku Bank (i=13)	0.168216 (2.25946) [0.024]	–
Taiyo Kobe Bank (i=14)	0.172075 (2.34489) [0.019]	–
Bank of Tokyo (i=15)	0.186070	–

	(2.75036) [0.006]	
Saitama Bank (i=16)	0.173640 (2.34006) [0.019]	–

Note: 1. The numbers in parentheses represent estimated t-values.

2. The numbers in brackets represent estimated p-values.

3. $\alpha_{LL,i}^{R}$ in $r_{LL,i}^{R}\left(Q_{LL,t}, \mathbf{z}_{L,i,t}^{RQ}\right)$ and $\alpha_{LL,i}^{Q}$ in $r_{LL,i}^{Q}\left(\mathbf{z}_{L,i,t}^{RQ}\right)$ are single-equation estimations.

4. The multivariate regression estimates take into account the heteroskedasticity of an unknown form in error terms.

Table 7.1.5: EstimationResults of $r^{R}_{DD,i}\left(Q_{DD,t},\mathbf{z}^{RQ}_{D,t}\right)$ and $r^{Q}_{DD,i}\left(\mathbf{z}^{RQ}_{D,t}\right)$

Table 7.1.5: EstimationResults of $r^{R}_{DD,i}\left(Q_{DD,t},\mathbf{z}^{RQ}_{D,t}\right)$ and $r^{Q}_{DD,i}\left(\mathbf{z}^{RQ}_{D,t}\right)$

Parameters (Independent Variables)	$r^{R}_{DD,i}\left(Q_{DD,t},\mathbf{z}^{RQ}_{D,t}\right)$ Eq. (6.2.3.1.7a)	$r^{Q}_{DD,i}\left(\mathbf{z}^{RQ}_{D,t}\right)$ Eq. (6.2.3.1.7b)
$\beta^{R}_{DD,9299}$ (1992-1999) ($D^{YA}_{9299}\cdot\ln Q_{DD,t}$)	0.00115203 (10.0592) [0.000]	–
$\beta^{R}_{DD,0008}$ (2000-2008) ($D^{YA}_{0008}\cdot\ln Q_{DD,t}$)	0.00112227 (9.84849) [0.000]	–
$\gamma^{R}_{DD,1}$, $\gamma^{Q}_{DD,1}$ ($\ln z^{RQ}_{D,1,t}$)	0.000751220 (1.08466) [0.278]	0.017431 (2.64896) [0.008]
$\gamma^{R}_{DD,2}$, $\gamma^{Q}_{DD,2}$ ($z^{RQ}_{D,2,t}$)	-0.039622 (-21.6787) [0.000]	0.220839 (3.10781) [0.002]
$\gamma^{R}_{DD,3}$, $\gamma^{Q}_{DD,3}$ ($z^{RQ}_{D,3,t}$)	0.167194 (19.3166) [0.000]	-0.041205 (-0.137432) [0.891]
$\gamma^{R}_{DD,4}$, $\gamma^{Q}_{DD,4}$ ($z^{RQ}_{D,4,t}$)	0.00000150663 (13.8124) [0.000]	-0.00000207429 (-1.21812) [0.223]
Adjusted R-squared	0.873870	0.738942
Number of Observations	179	100
Log likelihood	1149.79	515.486
Schwarz B.I.C.	-1097.92	-478.645

Note: 1. The numbers in parentheses represent estimated *t*-values.

2. The numbers in brackets represent estimated *p*-values.

3. $r^{R}_{DD,i}\left(Q_{DD,t},\mathbf{z}^{RQ}_{D,i,t}\right)$ and $r^{Q}_{DD,i}\left(\mathbf{z}^{RQ}_{D,i,t}\right)$ are single-equation estimations.

4. The multivariate regression estimates take into account the heteroskedasticity of an unknown form in error terms.

5. The estimation results of $\alpha^{R}_{DD,i}$ and $\alpha^{Q}_{DD,i}$ are shown in Table 7.1.6.

Table 7.1.6: Estimation Results of $\alpha^{R}_{DD,i}$ and $\alpha^{Q}_{DD,i}$

Table 7.1.6: Estimation Results of $\alpha^{R}_{DD,i}$ and $\alpha^{Q}_{DD,i}$

Japanese City Bank	$\alpha^{R}_{DD,i}$ Eq. (6.2.3.1.7a)	$\alpha^{Q}_{DD,i}$ Eq. (6.2.3.1.7b)
Industrial Bank of Japan (i=1)	-0.031867 (-2.95886) [0.003]	-0.223239 (-2.61834) [0.009]
Shinsei Bank (i=2)	-0.031762 (-2.94986) [0.003]	-0.218483 (-2.57068) [0.010]
Aozora Bank (i=3)	-0.031774 (-2.95103) [0.003]	-0.221177 (-2.60334) [0.009]
Mizuho Bank (i=4)	-0.031915 (-2.96410) [0.003]	-0.226857 (-2.66662) [0.008]
Sakura Bank (i=5)	-0.031570 (-2.93119) [0.003]	-0.227315 (-2.66521) [0.008]
Mizuho Corporate Bank (i=6)	-0.031956 (-2.96790) [0.003]	-0.225878 (-2.65547) [0.008]
Bank of Tokyo-Mitsubishi UFJ (i=7)	-0.031930 (-2.96544) [0.003]	-0.226176 (-2.65862) [0.008]
Asahi Bank (i=8)	-0.031921 (-2.96384) [0.003]	-0.227036 (-2.66288) [0.008]
UFJ Bank (i=9)	-0.031643 (-2.93863) [0.003]	-0.226045 (-2.65155) [0.008]
Sumitomo Mitsui Banking Corp. (i=10)	-0.031625 (-2.93712) [0.003]	-0.226180 (-2.65866) [0.008]
Resona Bank (i=11)	-0.031929 (-2.96534) [0.003]	-0.226120 (-2.65796) [0.008]
Tokai Bank (i=12)	-0.031759 (-2.94877) [0.003]	-0.226756 (-2.65830) [0.008]
Hokkaido Takushoku Bank (i=13)	-0.032041 (-2.97577) [0.003]	—
Bank of Tokyo (i=15)	-0.031675 (-2.94159) [0.003]	—

Note: 1. The numbers in parentheses represent estimated t-values.

2. The numbers in brackets represent estimated p-values.

3. $\alpha^{R}_{DD,i}$ in $r^{R}_{DD,i}\left(Q_{DD,t},\mathbf{z}^{RQ}_{D,t}\right)$ and $\alpha^{Q}_{DD,i}$ in $r^{Q}_{DD,i}\left(\mathbf{z}^{RQ}_{D,t}\right)$ are single-equation estimations.

4. The multivariate regression estimates take into account the heteroskedasticity of an unknown form in error terms.

Table 7.1.7: Estimation Results of $r_{TD,i}^{R}\left(Q_{TD,t},\mathbf{z}_{D,t}^{RQ}\right)$ and $r_{TD,i}^{Q}\left(\mathbf{z}_{D,t}^{RQ}\right)$

Table 7.1.7: Estimation Results of $r_{TD,i}^{R}\left(Q_{TD,t},\mathbf{z}_{D,t}^{RQ}\right)$ and $r_{TD,i}^{Q}\left(\mathbf{z}_{D,t}^{RQ}\right)$

Parameters (Independent Variables)	$r_{TD,i}^{R}\left(Q_{TD,t},\mathbf{z}_{D,t}^{RQ}\right)$ Eq. (6.2.3.1.7a)	$r_{TD,i}^{Q}\left(\mathbf{z}_{D,t}^{RQ}\right)$ Eq. (6.2.3.1.7b)
$\beta_{TD,8589}^{R}$ (1985-1989) ($D_{8589}^{YA}\cdot\ln Q_{TD,t}$)	0.048967 (3.02812) [0.002]	–
$\beta_{TD,9099}^{R}$ (1990-1999) ($D_{9099}^{YA}\cdot\ln Q_{TD,t}$)	0.049397 (3.06009) [0.002]	–
$\beta_{TD,0008}^{R}$ (2000-2008) ($D_{0008}^{YA}\cdot\ln Q_{TD,t}$)	0.049017 (3.00460) [0.003]	–
$\gamma_{TD,1}^{R}$, $\gamma_{TD,1}^{Q}$ ($\ln z_{D,1,t}^{RQ}$)	-0.212727 (-17.5762) [0.000]	0.017852 (3.06240) [0.002]
$\gamma_{TD,2}^{R}$, $\gamma_{TD,2}^{Q}$ ($z_{D,2,t}^{RQ}$)	1.48008 (2.25947) [0.024]	0.065037 (1.27768) [0.201]
$\gamma_{TD,3}^{R}$, $\gamma_{TD,3}^{Q}$ ($z_{D,3,t}^{RQ}$)	-0.948063 (-2.07614) [0.038]	0.141353 (1.65651) [0.098]
Adjusted R-squared	0.764764	0.730451
Number of Observations	288	100
Log likelihood	754.957	513.294
Schwarz B.I.C.	-692.664	-478.756

Note: 1. The numbers in parentheses represent estimated *t*-values.

2. The numbers in brackets represent estimated *p*-values.

3. $r_{TD,i}^{R}\left(Q_{TD,t},\mathbf{z}_{D,t}^{RQ}\right)$ and $r_{TD,i}^{Q}\left(\mathbf{z}_{D,t}^{RQ}\right)$ are single-equation estimations.

4. The multivariate regression estimates take into account the heteroskedasticity of an unknown form in error terms.

5. The estimation results of $\alpha_{TD,i}^{R}$ and $\alpha_{TD,i}^{Q}$ are shown in Table 7.1.8.

Table 7.1.8: Estimation Results of $\alpha^{R}_{TD,i}$ and $\alpha^{Q}_{TD,i}$

Table 7.1.8: Estimation Results of $\alpha^{R}_{TD,i}$ and $\alpha^{Q}_{TD,i}$

Japanese City Banks	$\alpha^{R}_{TD,i}$ Eq. (6.2.3.1.7a)	$\alpha^{Q}_{TD,i}$ Eq. (6.2.3.1.7b)
Industrial Bank of Japan (i=1)	1.89404 (6.29853) [0.000]	-0.229450 (-3.01426) [0.003]
Shinsei Bank (i=2)	1.86632 (6.21498) [0.000]	-0.224554 (-2.96479) [0.003]
Aozora Bank (i=3)	1.86000 (6.19393) [0.000]	-0.227295 (-3.00094) [0.003]
Mizuho Bank (i=4)	1.84822 (6.15472) [0.000]	-0.233002 (-3.07072) [0.002]
Sakura Bank (i=5)	1.85808 (6.18062) [0.000]	-0.233481 (-3.06776) [0.002]
Mizuho Corporate Bank (i=6)	1.85458 (6.17591) [0.000]	-0.232053 (-3.05774) [0.002]
Bank of Tokyo-Mitsubishi UFJ (i=7)	1.85119 (6.16462) [0.000]	-0.232321 (-3.06175) [0.002]
Asahi Bank (i=8)	1.83934 (6.11661) [0.000]	-0.233247 (-3.06414) [0.002]
UFJ Bank (i=9)	1.85981 (6.18729) [0.000]	-0.232118 (-3.05393) [0.002]
Sumitomo Mitsui Banking Corp. (i=10)	1.86936 (6.22512) [0.000]	-0.232325 (-3.06180) [0.002]
Resona Bank (i=11)	1.84492 (6.14371) [0.000]	-0.232265 (-3.06102) [0.002]
Tokai Bank (i=12)	1.84408 (6.13402) [0.000]	-0.232955 (-3.05905) [0.002]
Hokkaido Takushoku Bank (i=13)	1.83464 (6.10522) [0.000]	–
Taiyo Kobe Bank (i=14)	1.83493 (6.13111) [0.000]	–
Bank of Tokyo (i=15)	1.85656	–

	(6.17851) [0.000]	
Saitama Bank (i=16)	1.83327 (6.11931) [0.000]	–

Note: 1. The numbers in parentheses represent estimated t-values.

2. The numbers in brackets represent estimated p-values.

3. $\alpha^{R}_{TD,i}$ in $r^{R}_{TD,i}\left(Q_{TD,t},\mathbf{z}^{RQ}_{D,t}\right)$ and $\alpha^{Q}_{TD,i}$ in $r^{Q}_{TD,i}\left(\mathbf{z}^{RQ}_{D,t}\right)$ are single-equation estimations.

4. The multivariate regression estimates take into account the heteroskedasticity of an unknown form in error terms.

Table 7.2.1: Estimation Results of the Variable Cost Function

Table 7.2.1: Estimation Results of the Variable Cost Function

Parameter	Estimate	Standard Error	t-statistic	p-value
a_{SL}	-0.011206	0.239196	-0.046847	0.963
a_{SL4}^{ZL}	-11.6033	3.14913	-3.68461	0.000
a_{SL5}^{ZL}	-0.184740×10^{-3}	0.137525×10^{-3}	-1.34332	0.179
a_{SL8}^{ZL}	-1.11255	0.455395	-2.44303	0.015
a_{SL10}^{ZL}	2.02776	0.549019	3.69342	0.000
a_{SL11}^{ZL}	1.52882	0.273827	5.58318	0.000
a_{LL}	1.26480	0.218511	5.78828	0.000
a_{LL4}^{ZL}	4.71197	2.14691	2.19477	0.028
a_{LL5}^{ZL}	0.882228×10^{-4}	0.656615×10^{-4}	1.34360	0.179
a_{LL8}^{ZL}	-0.106242	0.467884	-0.227069	0.820
a_{LL10}^{ZL}	-1.69642	0.371399	-4.56763	0.000
a_{LL11}^{ZL}	-0.693534	0.245140	-2.82914	0.005
a_{DD}	-0.022146	0.108309	-0.204473	0.838
a_{DD2}^{ZD}	-2.06570	0.915970	-2.25521	0.024
a_{DD3}^{ZD}	0.765345	1.23080	0.621829	0.534
a_{DD4}^{ZD}	-0.919990×10^{-4}	0.296553×10^{-4}	-3.10228	0.002
a_{TD}	-1.08579	0.155710	-6.97313	0.000
a_{TD2}^{ZD}	-1.83598	1.78093	-1.03091	0.303
a_{TD3}^{ZD}	5.85375	1.22509	4.77820	0.000
a_{TD4}^{ZD}	0.412465×10^{-4}	0.443486×10^{-4}	0.930052	0.352
a_S	0.496511	0.048925	10.1485	0.000
a_C	-0.166379	0.040742	-4.08368	0.000

a_{CL}	0.255867	0.022429	11.4076	0.000
a_{A}	0.236199	0.022881	10.3228	0.000
a_{CM}	-0.063213	0.034544	-1.82994	0.067
a_{V}	0.255440	0.026890	9.49946	0.000
a_{V2}^{ZL}	-0.716688	0.135220	-5.30016	0.000
a_{V6}^{ZL}	0.072278	0.028910	2.50010	0.012
a_{V7}^{ZL}	0.215569	0.067368	3.19988	0.001
a_{V2}^{ZD}	-0.749582	0.303758	-2.46770	0.014
a_{V3}^{ZD}	-0.043256	0.330054	-0.131058	0.896
a_{L}	0.157626	0.013451	11.7189	0.000
a_{L2}^{ZL}	-0.096172	0.047677	-2.01714	0.044
a_{L6}^{ZL}	-0.129324×10^{-2}	0.013063	-0.099000	0.921
a_{L7}^{ZL}	-0.071534	0.025802	-2.77236	0.006
a_{L2}^{ZD}	0.480177	0.123027	3.90303	0.000
a_{L3}^{ZD}	-0.937174	0.117866	-7.95117	0.000
a_{K}	0.092660	0.586729×10^{-2}	15.7927	0.000
a_{K2}^{ZL}	-0.162895	0.024853	-6.55423	0.000
a_{K6}^{ZL}	-0.015779	0.704377×10^{-2}	-2.24012	0.025
a_{K7}^{ZL}	-0.026061	0.013245	-1.96760	0.049
a_{K2}^{ZD}	0.016179	0.103760	0.155925	0.876
a_{K3}^{ZD}	0.114420	0.104338	1.09663	0.273
a_{B}	0.235496	0.041520	5.67192	0.000
a_{B2}^{ZL}	1.19495	0.150962	7.91557	0.000
a_{B6}^{ZL}	-0.045887	0.029426	-1.55937	0.119
a_{B7}^{ZL}	0.025276	0.071147	0.355265	0.722

a_{B2}^{ZD}	-0.638782	0.537247	-1.18899	0.234
a_{B3}^{ZD}	2.52677	0.494030	5.11461	0.000
b_{SLSL}	-1.47055	0.294867	-4.98716	0.000
b_{LLLL}	-1.08123	0.197197	-5.48297	0.000
b_{DDDD}	-1.24676	0.161810	-7.70507	0.000
b_{TDTD}	-1.76445	0.378900	-4.65679	0.000
b_{SS}	-0.656476×10^{-2}	0.225511	-0.029111	0.977
b_{CC}	-0.065978	0.048952	-1.34782	0.178
b_{CLCL}	0.091475	0.022578	4.05142	0.000
b_{AA}	-0.060973	0.055820	-1.09232	0.275
b_{CMCM}	-0.962882×10^{-2}	0.091021	-0.105787	0.916
b_{VV}	-0.227582	0.013938	-16.3277	0.000
b_{LL}	0.019327	0.941528×10^{-3}	20.5271	0.000
b_{KK}	0.966178×10^{-2}	0.320038×10^{-3}	30.1895	0.000
b_{BB}	0.032094	0.231916×10^{-2}	13.8387	0.000
b_{SLLL}	-0.873397	0.219979	-3.97037	0.000
b_{SLDD}	1.52270	0.188276	8.08759	0.000
b_{SLTD}	1.73086	0.316586	5.46726	0.000
b_{SLS}	-0.158785	0.151180	-1.05030	0.294
b_{SLC}	-0.210447	0.082195	-2.56034	0.010
b_{SLCL}	-0.640909	0.061893	-10.3551	0.000
b_{SLA}	-0.320640	0.083123	-3.85740	0.000
b_{SLCM}	0.451752	0.110794	4.07739	0.000
b_{SLV}	-0.091221	0.016964	-5.37739	0.000
b_{SLL}	-0.019416	0.624015×10^{-2}	-3.11141	0.002
b_{SLK}	-0.030497	0.397615×10^{-2}	-7.66996	0.000

b_{SLB}	0.185538	0.024408	7.60149	0.000
b_{SLT}	-0.055993	0.018282	-3.06270	0.002
b_{LLDD}	0.466088	0.220156	2.11709	0.034
b_{LLTD}	0.965165	0.363802	2.65299	0.008
b_{LLS}	0.629322	0.217121	2.89849	0.004
b_{LLC}	0.078096	0.150987	0.517240	0.605
b_{LLCL}	-0.201644	0.064712	-3.11604	0.002
b_{LLA}	-0.156343	0.078716	-1.98618	0.047
b_{LLCM}	0.576515	0.105673	5.45567	0.000
b_{LLV}	-0.016882	0.013102	-1.28845	0.198
b_{LLL}	-0.038619	0.682434×10^{-2}	-5.65899	0.000
b_{LLK}	-0.015244	0.433582×10^{-2}	-3.51581	0.000
b_{LLB}	0.145998	0.021645	6.74502	0.000
b_{LLT}	0.040227	0.019948	2.01658	0.044
b_{DDTD}	-0.818347	0.186413	-4.38996	0.000
b_{DDS}	0.331611	0.153354	2.16239	0.031
b_{DDC}	0.119250	0.077988	1.52908	0.126
b_{DDCL}	0.242269	0.048537	4.99142	0.000
b_{DDA}	0.140885	0.056163	2.50848	0.012
b_{DDCM}	-0.589384	0.082608	-7.13467	0.000
b_{DDV}	0.084136	0.956180×10^{-2}	8.79914	0.000
b_{DDL}	0.032771	0.397289×10^{-2}	8.24864	0.000
b_{DDK}	0.026201	0.261646×10^{-2}	10.0140	0.000
b_{DDB}	-0.210376	0.014582	-14.4270	0.000
b_{DDT}	0.022634	0.015522	1.45816	0.145
b_{TDS}	-0.183707	0.225123	-0.816029	0.414

b_{TDC}	-0.143542	0.139289	-1.03053	0.303
b_{TDCL}	0.457348	0.080497	5.68158	0.000
b_{TDA}	0.272595	0.083695	3.25701	0.001
b_{TDCM}	-0.890801	0.142120	-6.26795	0.000
b_{TDV}	0.093025	0.021330	4.36124	0.000
b_{TDL}	0.019627	0.847581×10^{-2}	2.31568	0.021
b_{TDK}	0.029807	0.526647×10^{-2}	5.65986	0.000
b_{TDB}	-0.186969	0.032767	-5.70596	0.000
b_{TDT}	0.012623	0.024541	0.514366	0.607
b_{SC}	-0.058117	0.123426	-0.470867	0.638
b_{SCL}	-0.166232	0.053943	-3.08163	0.002
b_{SA}	0.065569	0.071412	0.918179	0.359
b_{SCM}	-0.295337	0.111978	-2.63745	0.008
b_{SV}	0.068341	0.014805	4.61621	0.000
b_{SL}	-0.013442	0.568928×10^{-2}	-2.36269	0.018
b_{SK}	0.015362	0.380729×10^{-2}	4.03476	0.000
b_{SB}	-0.050027	0.021535	-2.32305	0.020
b_{ST}	-0.047570	0.015040	-3.16301	0.002
b_{CCL}	0.017835	0.027596	0.646288	0.518
b_{CA}	-0.061494	0.027014	-2.27641	0.023
b_{CCM}	0.149164	0.050393	2.96002	0.003
b_{CV}	-0.019176	0.649752×10^{-2}	-2.95121	0.003
b_{CL}	0.012193	0.374187×10^{-2}	3.25857	0.001
b_{CK}	-0.101293×10^{-2}	0.168215×10^{-2}	-0.602162	0.547
b_{CB}	-0.014152	0.010502	-1.34749	0.178
b_{CT}	-0.026172	0.011009	-2.37741	0.017

b_{CLA}	0.493614×10^{-2}	0.023666	0.208578	0.835
b_{CLCM}	0.162353	0.035312	4.59761	0.000
b_{CLV}	-0.858860×10^{-2}	0.654258×10^{-2}	-1.31272	0.189
b_{CLL}	-0.022244	0.226021×10^{-2}	-9.84146	0.000
b_{CLK}	-0.674786×10^{-2}	0.142739×10^{-2}	-4.72741	0.000
b_{CLB}	0.080223	0.831269×10^{-2}	9.65068	0.000
b_{CLT}	0.338154×10^{-2}	0.513763×10^{-2}	0.658190	0.510
b_{ACM}	0.064009	0.039211	1.63244	0.103
b_{AV}	-0.067210	0.895921×10^{-2}	-7.50176	0.000
b_{AL}	-0.019397	0.395244×10^{-2}	-4.90754	0.000
b_{AK}	-0.021864	0.177890×10^{-2}	-12.2909	0.000
b_{AB}	0.150221	0.011823	12.7063	0.000
b_{AT}	0.930652×10^{-2}	0.601327×10^{-2}	1.54766	0.122
b_{CMV}	-0.040144	0.906286×10^{-2}	-4.42952	0.000
b_{CML}	0.034518	0.369895×10^{-2}	9.33187	0.000
b_{CMK}	0.845882×10^{-2}	0.285323×10^{-2}	2.96465	0.003
b_{CMB}	-0.069294	0.015397	-4.50054	0.000
b_{CMT}	0.025861	0.882351×10^{-2}	2.93087	0.003
b_{VL}	0.282542	0.012666	22.3072	0.000
b_{VK}	0.012236	0.297915×10^{-2}	4.10724	0.000
b_{VB}	-0.067195	0.471773×10^{-2}	-14.2432	0.000
b_{VT}	-0.010363	0.192058×10^{-2}	-5.39583	0.000
b_{LK}	-0.161413×10^{-2}	0.775926×10^{-3}	-2.08026	0.038
b_{LB}	0.013725	0.152633×10^{-2}	8.99189	0.000
b_{LT}	0.287794×10^{-2}	0.858119×10^{-3}	3.35378	0.001
b_{KB}	0.230691×10^{-2}	0.415997×10^{-3}	5.54551	0.000

b_{KT}	-0.744554$\times 10^{-3}$	0.544210$\times 10^{-3}$	-1.36814	0.171
b_{BT}	0.307274$\times 10^{-2}$	0.237181$\times 10^{-2}$	1.29553	0.195
R-squared	Variable Cost Function		0.990899	
	Share of Labor		0.428258	
	Share of Physical Capital		0.300492	
	Share of Certificate of Deposit and Other Liabilities		0.673045	
Number of Observations	349			
Order of MA for the Error Term	3			
Test for Overidentification [*p*-value]	87.7852 [0.986]			
Value Function	0.251534			

Note: 1. The GMM estimates take into account the heteroskedasticity of an unknown form in error terms and autocorrelation, in which case we specify a third-order moving average process. Bartlett kernels were specified for the kernel density to insure positive definiteness of the covariance matrix of the orthogonal conditions, when the number of autocorrelation terms is positive.

2. The estimates of a_V, a_{Vj}^{ZL} ($j = 2,6,7$), a_{Vj}^{ZD} ($j = 2,3$), b_{jV} (j = *SL*, *LL*, *DD*, *TD*, *S*, *C*, *CL*, *A*, *CM*), and b_{Vj} ($j = V, L, K, B, T$) are calculated from the condition of linear homogeneity with respect to factor prices.

3. To improve the precision of estimation, we use different instrumental variables for each equation. More specifically, we use the following instrumental variables:

-Instruments for all of the equations: D_i^B,

$\ln q_{j,i,t-1}^*$ (j=*SL*,*LL*,*DD*,*TD*,*S*,*C*,*CL*,*A*,*CM*), and $\ln\left(p_{j,i,t}^*/p_{V,i,t}^* + \theta_j\right)$ (j=*L*,*K*,*B*),

-Instruments for the variable cost function: $D_i^B \cdot \tau_t^*$, $D_i^B \cdot \left(\tau_t^*\right)^2$, $D_i^B \cdot \left(\tau_t^*\right)^3$,

$D_i^B \cdot D_i^{MA}$ (i=4,5,6,7,8,9,10,11), $D_7^B \cdot D_7^{MAS}$, $z_{L,1,i,t}^{RQ} \cdot \ln q_{j,i,t-1}^*$ (j=*SL*,*LL*),

$z^{RQ}_{L,h,i,t-1} \cdot \ln q^*_{j,i,t-1}$ (h=4,5,6,7,8,9,10,11, j=SL,LL),

$z^{RQ}_{D,h,i,t} \cdot \ln q^*_{j,i,t-1}$ (h=2,3,4, j=DD,TD), $z^{RQ}_{L,2,i,t} \cdot \ln\left(p^*_{j,i,t} / p^*_{V,i,t} + \theta_j \right)$ (j=L,K,B),

$z^{RQ}_{L,h,i,t-1} \cdot \ln\left(p^*_{j,i,t} / p^*_{V,i,t} + \theta_j \right)$ (h=6,7,j=L,K,B),

$z^{RQ}_{D,h,i,t} \cdot \ln\left(p^*_{j,i,t} / p^*_{V,i,t} + \theta_j \right)$ (h=2,3,j=L,K,B),

$\ln q^*_{j,i,t-1} \cdot \ln q^*_{h,i,t-1}$ (j,h=SL,LL,DD,TD,S,C,CL,A,CM),

$\ln q^*_{j,i,t-1} \cdot \ln\left(p^*_{h,i,t} / p^*_{V,i,t} + \theta_h \right)$ (j=SL,LL,DD,TD,S,C,CL,A,CM,h=L,K,B),

$\ln q^*_{j,i,t-1} \cdot \tau^*_t$ (j= SL,LL,DD,TD,S,C,CL,A,CM),

$\ln\left(p^*_{j,i,t} / p^*_{V,i,t} + \theta_j \right) \cdot \ln\left(p^*_{h,i,t} / p^*_{V,i,t} + \theta_h \right)$ (j,h= L,K,B), and

$\ln\left(p^*_{j,i,t} / p^*_{V,i,t} + \theta_j \right) \cdot \tau^*_t$ (j= L,K,B), and

-Instruments for the (respective) cost share equations: $z^{RQ}_{L,2,i,t}$, $z^{RQ}_{L,h,i,t-1}$ (h=6,7),

$z^{RQ}_{D,h,i,t}$ (h=2,3), $z^{RQ}_{L,2,i,t} \cdot \ln\left(p^*_{j,i,t} / p^*_{V,i,t} + \theta_j \right)$ (j=L,K,B),

$z^{RQ}_{L,h,i,t-1} \cdot \ln\left(p^*_{j,i,t} / p^*_{V,i,t} + \theta_j \right)$ (h=6,7,j=L,K,B), and

$z^{RQ}_{D,h,i,t} \cdot \ln\left(p^*_{j,i,t} / p^*_{V,i,t} + \theta_j \right)$ (h=2,3,j=L,K,B),

where D^{MAS}_7 is an M&A dummy variable for the Bank of Tokyo-Mitsubishi UFJ (taking a value of one for 2006-2007).

4. The estimation results of $a_i\left(D^{MA}_i, \tau^*_t \right)$ are shown in Table 7.2.2.

Table 7.2.2: Estimation Results of $a_i\left(D_i^{MA}, \tau_t^*\right)$

Table 7.2.2: Estimation Results of $a_i\left(D_i^{MA}, \tau_t^*\right)$

Parameter	Estimate	Standard Error	t-statistic	p-value
Shinsei Bank (i=2)				
a_2	12.0325	0.903239	13.3215	0.000
a_{2T}	0.010383	0.064288	0.161505	0.872
Aozora Bank (i=3)				
a_3	16.3822	1.79836	9.10952	0.000
a_{3T}	-0.574088	0.315962	-1.81695	0.069
a_{3TT}	0.021069	0.014057	1.49880	0.134
Mizuho Bank (i=4)				
a_4	13.7382	0.071789	191.369	0.000
a_{4MA}	0.650187	0.124072	5.24041	0.000
a_{4T}	-0.024588	0.839652×10^{-2}	-2.92841	0.003
a_{4TT}	-0.607976×10^{-2}	0.132949×10^{-2}	-4.57302	0.000
a_{4TTT}	-0.402154×10^{-4}	0.401993×10^{-4}	-1.00040	0.317
Sakura Bank (i=5)				
a_5	13.1582	0.057950	227.059	0.000
a_{5MA}	0.326917	0.066247	4.93485	0.000
a_{5T}	-0.053796	0.010761	-4.99914	0.000
a_{5TT}	-0.459135×10^{-2}	0.183520×10^{-2}	-2.50183	0.012
a_{5TTT}	-0.200960×10^{-4}	0.748695×10^{-4}	-0.268413	0.788
Mizuho Corporate Bank (i=6)				
a_6	13.5991	.075167	180.920	0.000
a_{6MA}	-0.398321	0.608196	-0.654922	0.513
a_{6T}	-0.032742	0.764325×10^{-2}	-4.28377	0.000

a_{6TT}	-0.658587×10^{-2}	0.159246×10^{-2}	-4.13566	0.000
a_{6TTT}	-0.704059×10^{-4}	0.503883×10^{-4}	-1.39727	0.162
Bank of Tokyo-Mitsubishi UFJ (i=7)				
a_{7}	13.7309	.076644	179.151	0.000
a_{7MA}	0.070990	0.079451	0.893513	0.372
a_{7MAS}	0.520363	0.146318	3.55639	0.000
a_{7T}	-0.019294	0.898381×10^{-2}	-2.14760	0.032
a_{7TT}	-0.693826×10^{-2}	0.174065×10^{-2}	-3.98603	0.000
a_{7TTT}	-0.588682×10^{-4}	0.426836×10^{-4}	-1.37918	0.168
Asahi Bank (i=8)				
a_{8}	13.1972	0.078997	167.060	0.000
a_{8MA}	0.716199	0.097796	7.32338	0.000
a_{8T}	-0.050684	0.011955	-4.23956	0.000
a_{8TT}	-0.221147×10^{-2}	0.207396×10^{-2}	-1.06630	0.286
a_{8TTT}	0.124025×10^{-3}	0.591536×10^{-4}	2.09666	0.036
UFJ Bank (i=9)				
a_{9}	13.3014	0.054305	244.938	0.000
a_{9MA}	-0.171003	0.047189	-3.62375	0.000
a_{9T}	-0.032396	0.759889×10^{-2}	-4.26328	0.000
a_{9TT}	-0.405901×10^{-2}	0.144980×10^{-2}	-2.79969	0.005
a_{9TTT}	0.479170×10^{-4}	0.429516×10^{-4}	1.11561	0.265
Sumitomo Mitsui Banking Corp. (i=10)				
a_{10}	13.1813	0.050658	260.203	0.000
a_{10MA}	-0.333155	0.132440	-2.51551	0.012
a_{10T}	-0.036398	0.768179×10^{-2}	-4.73819	0.000
a_{10TT}	-0.302973×10^{-2}	0.114768×10^{-2}	-2.63988	0.008
a_{10TTT}	0.116457×10^{-3}	0.227719×10^{-4}	5.11407	0.000

Resona Bank (i=11)				
a_{11}	13.3363	.059718	223.322	0.000
a_{11MA}	-0.370582	0.097146	-3.81469	0.000
a_{11T}	0.618331×10^{-2}	0.013618	0.454048	0.650
a_{11TT}	-0.226607×10^{-2}	0.125251×10^{-2}	-1.80922	0.070
a_{11TTT}	-0.276875×10^{-4}	0.335602×10^{-4}	-0.825008	0.409
Tokai Bank (i=12)				
a_{12}	13.3907	0.046530	287.787	0.000
a_{12T}	-0.037937	0.879949×10^{-2}	-4.31122	0.000
a_{12TT}	-0.569933×10^{-2}	0.140497×10^{-2}	-4.05656	0.000
a_{12TTT}	-0.717537×10^{-5}	0.426065×10^{-4}	-0.168410	0.866
Hokkaido Takushoku Bank (i=13)				
a_{13}	13.5225	0.093070	145.295	0.000
a_{13T}	0.023954	0.019965	1.19975	0.230
a_{13TT}	-0.127579×10^{-2}	0.325717×10^{-2}	-0.391687	0.695
a_{13TTT}	-0.354720×10^{-4}	0.110732×10^{-3}	-0.320343	0.749
Taiyo Kobe Bank (i=14)				
a_{14}	13.1387	0.239284	54.9085	0.000
a_{14T}	-0.194461	0.081987	-2.37186	0.018
a_{14TT}	-0.021787	0.921062×10^{-2}	-2.36540	0.018
a_{14TTT}	-0.491910×10^{-3}	0.283143×10^{-3}	-1.73732	0.082
Bank of Tokyo (i=15)				
a_{15}	13.8651	0.110427	125.558	0.000
a_{15T}	0.343690×10^{-2}	0.022740	0.151137	0.880
a_{15TT}	-0.879911×10^{-2}	0.291351×10^{-2}	-3.02011	0.003
a_{15TTT}	-0.392879×10^{-3}	0.105301×10^{-3}	-3.73100	0.000
Saitama Bank (i=16)				

a_{16}	12.6929	0.145549	87.2070	0.000
a_{16T}	-0.181020	0.049607	-3.64907	0.000
a_{16TT}	-0.015181	0.579630×10^{-2}	-2.61904	0.009
a_{16TTT}	-0.320842×10^{-3}	0.180024×10^{-3}	-1.78222	0.075

Note: 1. The GMM estimates take into account the heteroskedasticity of an unknown form in error terms and autocorrelation, in which case we specify a third-order moving average process. Bartlett kernels were specified for the kernel density to insure positive definiteness of the covariance matrix of the orthogonal conditions, when the number of autocorrelation terms is positive.

2. To improve the precision of estimation, we use different instrumental variables for each equation.

3. a_{7MAS} is an M&A dummy coefficient for the Bank of Tokyo-Mitsubishi UFJ (2006-2007).