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## **Abstract**

This study analyzes a panel of nearly 800 deposit-taking institutions in Japan during the period from March 1992 to March 2003. We are concerned with two questions that are relevant to the design of a new regulatory framework for Japanese banking: 1) whether depositors respond to bank risks as standard theories expect, and, if they do, 2) whether the responsiveness is significant enough to discipline deposit-taking institutions. The empirical results obtained in this paper clearly show that Japanese depositors in the 1990s responded to the risks of financial institutions as expected: riskier institutions attract smaller amounts of deposits and are required to pay higher deposit rate. Moreover, the observed risk sensitivities are larger for international bank depositors and smaller for cooperative depositors, and continued to increase until a setback at March 2003. These findings were generally in line with the standard theory predictions. They also indicate that Japanese depositors have a disciplinary nature, and that the discipline is affected by changes in regulatory frameworks, especially those of deposit insurance. It is, therefore, important for policy-makers to design financial systems (and safety nets) so as to make the best use of the depositor discipline.

Key words: depositor discipline, banking crisis, financial institution

JEL Classification: G21, G32

## 1. Introduction

Frequent banking crises around the world have revived the public's concerns over the soundness of financial systems, and prompted calls for stricter regulation on banks to curtail their excessive risk taking. It should be noted, however, that tighter regulation may result in welfare losses. Alternatively, one modern view holds that regulators may more efficiently control the risk-taking of banks by subjecting them to increased depositor discipline, defined as the discipline imposed by depositors on bank stockholders and managers. Depositor discipline on banking organizations has recently attracted significant attention among policymakers and researchers alike.<sup>1</sup>

Most earlier studies on discipline focused on U.S. experiences, and generally found support for the presence of market discipline by depositors (see the survey by Flannery (1998), and Demirgüç-Kunt and Kane (2002)). Martinez Peria and Schmukler (2001), who studied the experiences of Argentina, Chile and Mexico during their banking crises, also confirm depositor discipline. Demirgüç-Kunt and Huizinga (2003) and Hosono et al. (2004) examined a larger dataset of cross-country bank-level observations to show that many countries retain some degree of depositor discipline, though the discipline depends on bank regulations, deposit insurance, and stage of financial development.

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<sup>1</sup> For example, the Basel Committee on Banking Supervision has recognized that market discipline becomes increasingly important in contemporary dynamic and complex financial systems; it complements the government's regulatory and supervisory activities. This recognition is incorporated in Pillar 3 of the New Basel Capital Accord.

This paper empirically investigates depositor discipline by examining Japan's deposit-taking institutions in the 1990s. We are concerned with two questions that are relevant to the design of a regulatory framework for the banking system: 1) whether depositors respond to bank risks as standard theories expect they will, and, if they do, 2) whether the responsiveness is significant enough to discipline deposit-taking institutions.

Although depositor discipline is practically important for policy-makers, there are only a few empirical studies on this issue in Japan. Hosono (2003) and Tsuru (2003) inspected Japanese commercial banks in the 1990s, and found that Japanese depositors distinguished healthy banks from risky ones, and that their discipline depends on the deposit insurance design. Murata and Hori (2005) focused on much smaller deposit-taking cooperatives, and found that discipline holds even for small-account depositors, who are mostly insured, suggesting some role for restitution costs. Inakura and Shimizutani (2005) used a household-level survey to conclude that Japanese depositors become risk-sensitive ahead of the payoff scheme reintroduction.

Japan's experiences during this period deserve a careful examination for at least a few reasons. First, our sample covers the experience of Japan's financial "big bang" reform from the traditional "convoy system" to a certain market based system. Second, Japan—the world's second-largest economy, underwent incomparable financial crises and considerable shifts of

deposits among institutions in the 1990s. Third, partly due to the crises, the deposit insurance scheme was reestablished and modified several times over the period. In view of the sweeping reforms and the incomparable crises, Japan's experiences offer us an opportunity to see whether depositors can tell a good bank from a bad one during a crisis.

Besides the historical perspectives, a larger dataset of this study that covers both banks and smaller institutions enables us to compare depositor behavior among financial institutions of various types, such as banks and deposit-taking cooperatives. Since the clientele of those institutions are largely different, the comparison among the types offers us an invaluable observation to confirm the working of depositor discipline in detail. In this paper, we divide our dataset into three institutional categories: international operation banks, domestic operation banks, and *Shinkin* banks and credit cooperatives.

In addition, most previous studies focused only on whether depositor discipline exists and/or whether it is affected by policy schemes. However, it is also important to check whether the depositors' responsiveness is significant enough to actually discipline banking institutions. This paper tries to quantitatively evaluate the magnitude of depositors' sensitivity to detected bank risks, by utilizing the estimates from reduced-form equations of deposit growth and deposit interest rate.

The remainder of this paper is organized as follows. Section 2 briefly describes the

Japanese financial crises in the 1990s and the “big bang” reform. Section 3 explains our dataset and empirical methodology. Section 4 discusses our findings on depositor discipline and evaluates how the findings are related with historical developments and type of financial institutions. Section 5 concludes.

## 2. Financial Crises and Big Bang Reform

### 2.1 Japan’s Financial Crises in the 1990s

Traditionally, the regulatory authorities alone have played the bank-disciplining role in Japan.<sup>2</sup> Banking policy—the so-called the “convoy system”—had fully protected deposits on an informal basis. The most important safety net in the framework was the implicit blanket protection of deposits through public confidence in the authorities’ ability to avoid financial instability. However, setbacks in the latter half of the 1990s revealed the bank discipline administered by the authorities to be obsolete. Banks that suffered from a deterioration in balance sheets after the bubble burst embarked on undesirable high-risk investments to recover their losses while counting on government bailouts<sup>3</sup>. The severity of Japan’s financial crisis reached an unprecedented level: roughly 17 percent of financial institutions failed since the 1990s, including the three gigantic bank failures that totaled losses of some \$300 billion. Moreover the Deposit Insurance Corporation of Japan spent more than ¥37 trillion for financial assistance to financial failures and recapitalization of surviving banks from FY1992 to FY2003. And yet, around ¥27 trillion in non-performing loans remained as of March, 2004.

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<sup>2</sup> See Hoshi and Kashyap (2001) for a detailed discussion on the financial regulatory frameworks in Japan.

<sup>3</sup> Boot and Thakor (1993) argued theoretically that the regulatory authorities, who are responsible for both ex ante and ex post monitoring, may have incentives to overlook misconduct by banks and to adopt “forbearance policies” to protect their own reputations.

## 2.2 “Big Bang” Reform to Phase in Open Competition

After the breakdown of the convoy system, hopes for a disciplinary role among depositors mounted in Japan. Depositors are not entitled to any special benefits, even if a bank’s high-risk investments succeed, while they will suffer some portion of losses in case of failure. Therefore, depositors have incentives to curb the risk-taking activities of banks, and their option to shift deposits from risky banks to safer ones may be able to perform a disciplinary role.

Following the announcement of Japan’s “big bang” reform in 1996 to phase in open competition, Japanese authorities took a sequence of actions to establish a new framework that emphasizes the disciplinary function of depositors. Those actions included: strict enforcement of bank capital standards, enhancement of public disclosure, prompt closing of inferior banks, a move toward limited deposit insurance, and other schemes that utilize market forces. Since the success of the new framework partly rests on the presence of depositor sensitivity to bank risks, empirical verification of their critical eye is essential to Japanese policy design.

## 3. Data and Methodology

### 3.1 Data

Our data sources are *Nikkei Financial Data CD-ROM for Banks, Financial Statements*

*of Shinkin Banks in Japan*, and *Financial Statements of Credit Cooperatives in Japan*, the last two of which are edited by Financial Book Consultants, Ltd. (*Kinyu tosho konsarutanto sha*). The sample institutions are composed of city banks, first and second regional banks, *shinkin* banks, and credit cooperatives. Although we exclude trust banks, long-term credit banks, and labor banks, our sample occupies close to 95 percent of all insured financial institutions (or 90 percent of total insured deposits) in Japan, comprising the largest-ever coverage on Japanese financial deposit-taking institutions. We use unbalanced panel data from March 1992 to March 2003.

To improve the reliability of our analyses, we made the following cuts. First, for the institutions that failed, we deleted the observations in the previous year of the incidents. This is because those data are not necessarily available for all the failed institutions, and also because the deposit rates (calculated as interest expenses divided by interest paying debt) immediately before the failure are less reliable due to discrete changes of related variables. Second, if an institution was involved in a merger with another bank, or acquired the business of a failed institution, we excluded it from our sample for that year. For credit cooperatives, we include regional ones only, since other types of credit cooperatives may have their own behavioral principles other than economic ones.<sup>4</sup> These selections leave us with a sample of 788 institutions (10 city banks, 62 first regional banks, 65

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<sup>4</sup> There are four types of credit cooperatives in Japan: regional, occupational, industrial, and Korean national.

second regional banks, 426 *shinkin* banks, and 225 credit cooperatives) in FY1992 to 462 in FY2002.

Total bank-year sample consists of roughly 7,400, the largest dataset on deposit-taking institutions ever studied in Japan.

### 3.2 Methodology and Bank Fundamental Variables

To examine the ability of depositors to tell banks apart and their sensitivity to bank risks, we look at the effect of deposit-taking institutions both on deposit growth and interest rates. As it is readily verified in the followings, we can distinguish depositor behavior from bank behavior by analyzing both of the two variables.<sup>5</sup>

Consider the following simple two-equation structural model of deposit market:

$$Deposit_{i,t} = a_{0,i} + a_1 Interest_{i,t} + a_2 Fundamentals_{i,t-1} + \sum_{k=1}^n a_{3,k} X(k)_{i,t} + \varepsilon_{it} \quad (1)$$

$$Deposit_{i,t} = b_{0,i} + b_1 Interest_{i,t} + b_2 Fundamentals_{i,t-1} + \sum_{k=1}^n b_{3,k} X(k)_{i,t} + \mu_{it} \quad (2)$$

where the first equation represents supply of deposits by banks, and the second represents demand for deposits by depositors, respectively.  $Interest_{i,t}$  is the interest rate on deposits of

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<sup>5</sup> Martinez Peria and Schmukler (2001) and Hosono (2003) made arguments for the need of the two set of equations—for deposits and for interest rates—to test for the existence of depositor discipline. The argument below follows the derivation of Murata and Hori (2005).

institution  $i$  in year  $t$ ,  $Fundamentals_{i,t-1}$  represents a bank fundamental variable that takes higher value when institution  $i$  is in good shape in year  $t-1$ ,  $X(k)_{i,t}$  is an exogenous control variable  $k$ , and  $\varepsilon_{it}$  and  $\mu_{it}$  are disturbances. Since our main interest is in depositor sensitivity to bank risks, we want to confirm the fact that depositors shifted their deposits from risky banks to safer banks, i.e.  $b_2 > 0$ . To avoid the simultaneity bias, we run the following two reduced form regressions, derived from the equations (1) and (2) above:

$$Deposit_{i,t} = \mu_i + d_t + \alpha Fundamentals_{i,t-1} + \sum_{k=1}^n \gamma_k X(k)_{i,t} + \upsilon_{it} \quad (3)$$

$$Interest_{i,t} = \varphi_i + k_t + \beta Fundamentals_{i,t-1} + \sum_{k=1}^n \phi_k X(k)_{i,t} + \omega_{it} \quad (4)$$

where  $\alpha = \frac{a_1 b_2 - b_1 a_2}{a_1 - b_1}$ ,  $\beta = \frac{b_2 - a_2}{a_1 - b_1}$ ,  $\gamma_k = \frac{a_1 b_{3,k} - b_1 a_{3,k}}{a_1 - b_1}$ , and  $\phi_k = \frac{b_{3,k} - a_{3,k}}{a_1 - b_1}$ .

Assuming normal market conditions for deposits, we could expect  $a_1 < 0$  and  $b_1 > 0$ <sup>6</sup>. If we additionally assume  $a_2 \leq 0$ , a positive coefficient on the bank fundamental variable in equation (3), i.e.  $\alpha > 0$ , ensures  $b_2 > 0$ . However, if the possibility that  $a_2 > 0$  exists, we cannot determine the sign of coefficient  $b_2$  only from the  $\alpha$  estimate. In fact, risky Japanese

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<sup>6</sup> If we assume that the expected return on uninsured deposits can differ among depositors, the demand schedule of depositors should be upward sloping, since some depositors expect lower returns and others higher returns. See Park and Peristiani (1998) for further discussion.

banks in 1990s are said to have been forced to reduce their assets to comply with regulatory capital standards and to cause a positive correlation between bank fundamentals and deposits, i.e.  $a_2 > 0$ . Under such situations, the reduced form coefficient  $\alpha$  may turn positive even if  $b_2 \leq 0$  contrary to our expectations of depositor discipline. Therefore, to confirm  $b_2 > 0$  from the reduced form regressions, we have to make use not only of  $\alpha$  but also of  $\beta$ . As is easily verified, the combination of  $\alpha > 0$  and  $\beta < 0$  is a sufficient condition for risk-sensitive bank depositors ( $b_2 > 0$ )<sup>7</sup>.

As our *Fundamentals*  $ls_{i,t-1}$ , we tried two variables that are reported to have significant connections with depositor bank selection in Murata and Hori (2005). The first variable is a capital-asset ratio<sup>8</sup>, which is defined as the ratio of own capital to total assets. The capital-asset ratio represents the bank's asset risks, and it occupies the interest of the general public in Japan as an indicator of bank health, especially after the introduction of the Basel capital standard in March 1993. If depositors are concerned about bank risks and responding rationally to the potential risks, we expect the capital ratio to have a positive effect on deposits and a negative effect on deposit interest rates. The second variable is bank profitability, which is measured by the ratio of operational profits to total assets. Since high profitability is directly connected with

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<sup>7</sup> Assuming  $a_1 < 0$  and  $b_1 > 0$ ,  $\alpha = \frac{a_1 b_2 - b_1 a_2}{a_1 - b_1} > 0$  and  $\beta = \frac{b_2 - a_2}{a_1 - b_1} < 0$  mean  $a_1 b_2 - b_1 a_2 < 0$  and

$b_2 - a_2 > 0$ . Therefore, if  $a_2 > 0$ , then  $b_2 > a_2 > 0$ , and if  $a_2 \leq 0$ , then  $b_2 > b_1 a_2 / a_1 \geq 0$ .

<sup>8</sup> We use the capital-asset ratio, which is simply defined as capital divided by total assets, rather than the BIS capital ratio, since that for *Shinkin* and Credit cooperatives is not available.

bank strength, we expect this profitability variable also to have a positive influence on deposit growth and a negative effect on deposit interest rates.

As one of our control variables  $X(k)_{i,t}$ , we include the logarithm of total assets as a size proxy. Since trust remained in the “too-big-to-fail” commitment up until the Hokkaido Takushoku Bank (HTB) failure in November 1997, the size proxy should have some influence on deposit shifts among institutions. We also included changes in postal savings by prefectures, changes in the ratio of working-age population to total population by prefecture, and the average lending rates of financial institutions by prefecture as our control variables in the reduced form regressions with fixed effects and year dummies.

Table 3 reports the summary statistics of our dataset: Table 3-1 summarizes all samples used in this paper, and Tables 3-2, 3-3, and 3-4 summarize the data by three institutional categories, i.e., international operation banks, domestic operation banks, and *Shinkin* banks and credit cooperatives. The first four rows of each table give us scale information for the institutions (in billions of yen), and the lower six rows summarize the statistics for the variables included in our regression analyses below.

## 4. Empirical Results

### 4.1 Basic Results

To study the effects of bank characteristics on depositor behavior, we run the reduced-form regressions (3) and (4) above. To take account of possible idiosyncrasies of each institution, we report the result of panel regressions (within estimates) for the period from FY1992 to FY2002.

The first four columns of Table 4 report the regression results of the deposit growth equation and the deposit rate equation, with the capital-asset ratio (column [1] and [2]) or with the profit ratio (column [3] and [4]) as our *Fundamentals*  $ls_{i,t-1}$  variable. For both fundamental variables, the estimated coefficient in the deposit growth regression is significant positive ( $\alpha > 0$ ) and that in the deposit rate regression is significant negative ( $\beta < 0$ ). As described in the previous section, combination of  $\alpha > 0$  and  $\beta < 0$  is a sufficient condition for the presence of the risk-sensitive depositors. Therefore, the results clearly show a basis of depositor discipline exists in the Japanese deposit market over the estimation period from FY1992 to FY2002.

The parameters on logarithm of total assets represent mixed results. The negative coefficients in the interest rate equations suggest that depositors require higher interest rates to smaller banks, which is consistent with the trust in “too-big-to fail” commitment. On the other hand, the coefficients in the deposit growth equations have a negative sign, implying that

depositors prefer to put their deposits in smaller banks. The coefficients on changes in log of postal savings by prefecture has a positive sign, contrary to our expectation, but not statistically significant.

#### 4.2 Results with Parameter Shift Dummies

Having seen the presence of the risk-sensitive depositors—a necessary condition for satisfactory depositor discipline on banks, throughout the period examined—we next try dummy variables that allow for parameter shifts over the years. Previous studies all agree in reporting that depositor sensitivity to bank risks in Japan changed over time, complying with the historical developments. We selected FY1995 (March 1996), FY1999 (March 2000), FY2001 (March 2002) and FY2002 (March 2003) as our timings of the potential parameter shifts, following Hori and Murata (2005).

The jargon “pay-off” started to appear in the Japanese major newspapers after the mid 1990s, and two large credit cooperatives (Cosmo and Kizu), along with Hyogo Bank, failed in FY1995. The second timing of parameter shifts (March 1999) is the month one year before the scheduled closing day of the blanket guarantee.<sup>9</sup> The third timing (March 2002) is the month just before the reintroduction of pay-off to time deposits in Japan. It is during these three

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<sup>9</sup> In the end, closing day was postponed by one year to March 2002.

timings that we are supposed to observe intensified preferences for healthier institutions. On the other hand, the last selection (March 2003) allows us to observe a relaxation of depositor discipline. In FY2002, the Japanese government announced the postponement of payoff reintroduction to demand deposits,<sup>10</sup> and introduced newly defined deposits with full protection.

Columns five to eight of Table 4 report the results with those structural change shift dummies. Two out of four estimated coefficients on the basic variables, which correspond to the observations until FY1994, turn their signs and lose their statistical significance after the inclusion of the shift dummies, suggesting relatively weak discipline until the mid 1990s. The coefficients on newly added shift dummies, now, make up for the lost explanatory power of the fundamental variables tracking the changes in depositor sensitivity to bank risks over time. The coefficients on the capital ratio in the deposit growth equation increased incrementally until FY2001, and decreased in FY2002, as expected. Together with the coefficients in the interest rate equation, which turn negative after FY1995, estimated parameter shifts show that depositors intensified and relaxed their sensitivity to the capital ratio, in compliance with the historical developments of regulatory schemes. Coefficients on the profit ratio (in columns [7] and [8]) also confirm the changes of risk sensitivity, in consonance with the times. The

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<sup>10</sup> Although the payoff scheme was reintroduced for time deposits in April 2002, unlimited protection for demand deposits was extended initially until March 2003, and finally until March 2005.

coefficient in the deposit growth equation turns positive in FY1995 and continues to increase until the setback in FY2002. Though the profit rate coefficients in the deposit rate equation moves irregularly, their sums are consistently positive, ensuring positive  $b_2$  in the demand equation (2) for deposits.

It may not be clear why the coefficients on capital asset ratio and profitability in the interest rate equations increased in 1999FY. One possible explanation consistent with our orderly depositors is that  $a_2$  in equation (1) becomes larger in 1999FY, implying that risky banks made their deposit rate lower to reduce their deposit for the purpose of satisfying the BIS standard on capital ratio.

#### 4.3 Comparison Among Heterogeneous Institution

One notable advantage of the large dataset we use in this study is its coverage of heterogeneous institutions, i.e. city banks, regional banks, *shinkin* banks and credit cooperatives. Having confirmed the presence of risk sensitive depositors and transitions of their sensitivities to accommodate the institutional developments over years, we proceed to examine the difference of depositor responses among types of institutions.

As reported in Table 3 average size of banks and cooperatives (*shinkin* banks and credit cooperatives) are substantially different; they are based on fairly different foundations,

and are subject to different regulations. Among others, depositors to cooperatives are mostly individuals or small and medium enterprises (SMEs) that are supposed not to have expertise in evaluating the risk of bank failures.<sup>11</sup> In addition, since deposits at cooperatives or smaller institutions tend to add up to small amounts—i.e., less than the maximum insurance payments per depositor (¥10 million + interest)—the ratio of deposits fully protected by deposit insurance is presumed to be high.<sup>12</sup> Therefore, depositors of smaller institutions may be less-sensitive to the risk of bank failures, and their responses reflect the financial literacy of small-account depositors and the importance of non-pecuniary restitution costs in bank selection. On the other hand, the responses of depositors to larger institutions reflect the sensitivity of large-account depositors who are subject to the payoff risks, and who are supposed to have some expertise in bank evaluation.

The first four columns of Table 5 report regression results with dummy variables that allow for parameter differences among institutions of different types. We divide the sample institutions into three categories: i) international banks, ii) domestic banks, and iii) deposit-taking cooperatives, i.e. *shinkin* banks and credit cooperatives<sup>13</sup> that operate

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<sup>11</sup> Small and medium enterprises and individuals generally cannot afford the search costs to find a good bank in comparison with large firms and financial experts.

<sup>12</sup> The ratio of deposits that amounted less than ¥ 10 million (per depositor) was 38 percent of total outstanding deposits in city banks, 56 percent in regional banks, and 68 percent in *shinkin* banks in March 2000. This ratio is not available for credit cooperatives, but is naturally expected to be higher than that of *shinkin* banks.

<sup>13</sup> As illustrated in Table 3 by categories, average size of international banks (measured in deposit balance) is far larger than that of the other categories, i.e. 5.4 times that of domestic banks and 40 times that of cooperatives. Moreover, the 8 percent capital standard applied to the international banks is, needless to say, stricter than the 4 percent standard applied to other categories.

domestically. We then compared the coefficients using the second category, i.e. domestic banks, as our base.

The signs on the baseline coefficients, which correspond to the behavior of regional bank depositors, decisively prove the presence of disciplinary depositors. However, what's more interesting is the pattern of coefficients on interaction terms for other categories. The parameter shifts observed on the institution dummies, i.e. the international bank dummy and the cooperative dummy, are generally consistent with our inferences. Probably reflecting the different shares of large-account depositors, who are relatively well-informed and subject to higher payoff risks, in each category the coefficients on the two key fundamental variables, i.e. capital ratio and profit ratio, are larger for the international banks and smaller for the cooperatives in the deposit growth regressions, hinting at more risk-sensitive depositors at larger institutions, as expected. Although the observed patterns of coefficients in the deposit rate equations are not necessarily clear-cut, coefficients on the capital ratio are consistently negative, ensuring depositor rational responses to the ratio.

The right half (column [5] to [8]) of Table 5 reports results that incorporate parameter shifts both over time and over institution type. Although we do not provide detailed descriptions due to space limitations, the estimated coefficients for each category are generally consistent with the pattern inferred from the standard banking theory.

#### 4.4 Identification Restriction and Quantitative Evaluation

The qualitative arguments (on the signs of the coefficients) in the previous section hold up well without any identifying restrictions in the structural equations. However, with proper restrictions, we may be able to identify the coefficients in question, i.e.  $b_2$ , quantitatively. Let us suppose that one of the coefficients on the control variables, for example  $b_{3,1}$ , is naturally assumed to be zero in equation (2). Then we can calculate the structural parameter  $b_2$  using the reduced form coefficients as  $b_2 = \alpha - b_1\beta = \alpha - (\gamma_1 / \phi_1)\beta$ .

Among the control variables in our regression model, a parameter restriction on the lending rate term is probably the most convincing. Although high lending rates surely urge banks to supply more deposits, we have no ground for believing that the rates directly affect the demand for deposits by depositors. Therefore, from the reduced form parameter estimates, we can calculate  $b_1$  through  $b_1 = \gamma_1 / \phi_1$ , i.e.  $1.8581/0.2342 = 7.933$  and derive structural parameter  $b_2$  is 0.929 for the basic result with capital ratio regressions. Detailed results on models with the parameter shift dummies are shown in Table 6.

Of course, the qualitative natures of derived  $b_2$ s are not different from those of previous sections. More informatively, derived structural parameters indicate that estimated  $b_2$ s are positive for all cases, regardless of some positive coefficients on profit ratio terms observed

in the deposit rate regressions. This indicates that Japanese depositors consistently appreciated the difference between healthy banks and risky banks. The ordering of the parameter size, especially on the capital asset ratio, is also in line with our theoretical conjectures: derived coefficients on the fundamental variables are large for international banks and small for cooperatives<sup>14</sup>, and they continue to increase until the setback in FY2002, keeping step with the changes of institutional settings.

Finally, the most notable finding from the derived structural parameters ( $b_{2,j}$ s) is their quantitative magnitude. Taking an example of the capital ratio parameter, estimated elasticity for the international banks indicates that, if a capital asset ratio of a certain bank falls by one percentage point, the annual growth of demand for deposits in the bank declines by two to three percent. The elasticity for the domestic banks is roughly about one and that for the deposit-taking cooperatives is a smaller, but still tangible, 0.8. Observed diverse elasticity among institutions of different types indicates that deposit-taking institutions are exposed to some market pressure, even without the payoff risks of limited coverage, though the pressure is modest by any definition. When depositors are subject to a significant payoff risk, they become sensitive to bank fundamentals and probably exercise disciplinary power that complements the

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<sup>14</sup> As shown in the third and fourth panels of Table 6, the ordering of the parameter size on the capital asset ratio is perfectly in line with our theoretical conjectures, though this is not applicable to parameter size on operational profits. Our findings may indicate that depositors regard the capital asset ratio as a most important variable in evaluating bank fundamentals, possibly affected by the Basel Accord (ratified in 1988) and by subsequent policies following the accord in Japan (see Table 2 for references).

regulation by the authorities.

## 6. Conclusion

This paper empirically investigated the issues of depositor discipline by examining Japanese deposit-taking institutions since the 1990s. We are concerned with two questions that are relevant to the design of a new regulatory framework for Japanese banking: 1) whether depositors respond to bank risks as standard theories expect, and, if they do, 2) whether the responsiveness is significant enough to discipline deposit-taking institutions. To address these issues, we set up a dataset that covers close to 95 percent of all insured financial institutions in Japan, and examined the differences in depositor risk sensitivity among types of deposit-taking institutions, as well as the transitions over the sample period from FY1992 to FY2003.

The results obtained in this paper show that Japanese depositors rightly responded to the risks of financial institutions as predicted by standard arguments. Observed risk sensitivities rose during FY1995, FY1999, and FY2001, and fell during FY2003. The first shift is associated with the failures of Hyogo Bank and the two large credit cooperatives. The second and third shifts suggest that depositors acted on that timing in anticipation of the reintroduction of a “pay-off” scheme, and the setback in FY2002 implies that depositors slack off their discipline in face of the postponement of the payoff reintroduction. Ordering of the parameter size among

types of institutions also confirms our theoretical conjectures: that risk sensitivities are larger for international bank depositors and smaller for cooperative depositors. The derived structural parameters on the bank fundamentals in deposit demand equation, especially those for international banks, are large enough to discipline the deposit-taking institutions.

The findings of this paper clearly show that Japanese depositors have a disciplinary nature, and that their behaviors are affected by changes in regulatory frameworks, especially those of deposit insurance. It is, therefore, important for policy-makers to design financial systems (and safety nets) so as to make the best use of the discipline imposed by depositors on the banking institutions.

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**Table 1 A Comparison: Shinkin Banks and Credit Cooperatives vs. Banks**

	Shinkin Banks and Credit Cooperatives	Banks
Purpose	To facilitate smooth financing for small and medium-sized businesses and individuals in a specified location.	Provision of financial services to a range of corporate entities and individuals without restriction on location
Structure	A nonprofit, cooperative association with members. In principle, operates it on the basis of one vote per member. The focus is on generating benefits for members and the local community.	A stock company with the business focused on generating profits for the stock holders.
Geographical location of business and branches	Restricted to a geographical area; the development of branches has occurred to maximize effectiveness within the region.	In principle, no restriction on geographical location and branches are established to enhance efficiency. In general, the location of branches is focused on major cities.
Customers	Companies (subject to certain size restrictions) and individuals who live or work with the specified region. In principle, lending is restricted to members but loans may be approved to non-members within certain fixed criteria.	Companies and individuals in general, with a focus on larger corporations and financially strong institutions. There are no restrictions on who can place deposits.
Area of business	Deposits, loans, foreign exchange, and related transactions.	Deposits, loans, foreign exchange, and related transactions.
Regulator	Financial Supervisory Agency (Prefectures for Credit Cooperatives until March 2000).	Financial Supervisory Agency.
# of institutions as of March 2002	596 (Shinkin 349, Credit Cooperative 247)	164
Deposits per institutions as of March 2002	¥199 billion (Shinkin ¥292, Credit Cooperative ¥67)	¥2,915 billion
Share of deposits by individuals as of March 2001	76.3% (Shinkin 76.3%, Credit Cooperative 79.5%)	62.3%

**Table 2 Chronology of Events**

Year	Month	Events	Month	Laws, Measures, and Policies	# of failed institutions for each fiscal year		
					Bank	Shinkin bank	Credit cooperative
71			Jul.	Deposit insurance corporation established.			
86			Apr.	MOF introduces the new standard that the capital ratio of financial institutions should be 4% or higher for domestically operating banks and 6% or higher for internationally operating banks (For shinkin banks and credit cooperatives the ratio was set to be applied from FY1990).			
88			Jul.	Basel Accord			
91							
92			Mar.	MOF announces that the capital ratio of financial institutions that operate overseas should be 8%.		1	
93						1	1
94	Dec.	Resolution of Tokyo Kyowa Credit and Anzen credit cooperatives announced. MOF announced that the estimated outstanding of NPLs of the deposit-taking					4
95	Jun.	financial institutions in March 1995 was about 40 trillion yen.					
	Jul.	Cosmo Credit Cooperative ordered to suspend operations.					
	Aug.	Kizu Credit Cooperative ordered to suspend operations. Resolution of Hyogo Bank announced.		Dec.	Financial system research council releases final report on measures for the maintenance of financial system stability. (Introduction of special treatment of blanket guarantee of deposit insurance for the next five years was recommended.)	2	
96	Nov.	Financial system reform (Japanese version of the big bang) announced. Hanwa Bank ordered to suspend operations.	Jun.	Three bills, including the amended Deposit insurance law, were passed (special treatment of blanket guarantee of deposit insurance introduced until the end of March 2001).	1	1	6
97	Nov.	Sanyo Securities files application for rehabilitation. Resolution of Hokkaido Takushoku Bank announced. Yamaichi Securities announces suspension of operations.	Jun.	Government published a detailed plan of Japan's version of the big bang.	3		14
			Dec.	A bill to amend the Deposit insurance law passed (financial assistance to specified merger).			
98	Jun.	Financial supervisory agency (FSA) inaugurated.	Apr.	Prompt corrective action (PCA) introduced.	5		25
	Oct.	LTCB placed under special public administration.	Jun.	Four bills implementing the big bang (financial reform law, SPC law, revision of 13 laws to comply with SPC law, and the obligation netting law) passed.			
	Dec.	NCB placed under special public administration.					
99			Dec.	Three ruling parties agree to postpone lifting of special measures concerning the deposit insurance system (end-March 2001 to end-March 2002).	5	10	29
2000			Apr.	Supervision of credit cooperative transferred from local governments to FSA.		2	12
2001					2	13	41
2002			Apr.	The coverage of deposit protection up to ¥10 mil. reintroduced for time deposits (Unlimited protection for demand deposits continues until March 2003.)			
			Jul.	Minister of financial services announced the continuation of unlimited protection for demand deposits until March 2005.			
			Dec.	A bill to amend the deposit insurance law passed (Introduce full protection for payment and settlement deposits from April 2005 (as a permanent measure)).			

Note: Prepared by the author using the information published by the Financial services agency, Deposit insurance corporation and Financial Book Consultants Ltd.

**Table 3 Basic Statistics (FY1992-FY2002)**

## 3-1 All Samples

Variable	Obs	Mean	Std. Dev.	Min	Max
Total Assets	7,400	1,057,800	5,105,986	3,098	81,900,000
Total Deposits	7,400	797,959	3,276,355	2,782	45,300,000
Capital	7,400	41,792	183,183	-8,791	3,046,448
Operational Profits	7,248	6,264	29,862	-8,457	559,154
Growth Rate of Deposits	7,400	0.017	0.036	-0.328	0.323
Deposit Interest Rate	7,400	0.015	0.014	0.000	0.063
Capital to Asset Ratios (t-1)	7,400	0.050	0.018	-0.049	0.147
Profits to Asset Ratio (t-1)	7,248	0.006	0.004	-0.079	0.105
ln (Total Assets) (t-1)	7,400	12.114	1.580	8.039	18.222
Lending Rate by Prefecture (t-1)	7,400	0.035	0.012	0.019	0.064

## 3-2 International Operation Banks

Variable	Obs	Mean	Std. Dev.	Min	Max
Total Assets	508	10,400,000	16,700,000	458,074	81,900,000
Total Deposits	508	7,225,433	10,300,000	403,291	45,300,000
Capital	508	383,773	588,356	12,537	3,046,448
Operational Profits	508	58,865	96,935	1,286	559,154
Growth Rate of Deposits	508	0.007	0.041	-0.293	0.139
Deposit Interest Rate	508	0.022	0.013	0.001	0.052
Capital to Asset Ratios (t-1)	508	0.041	0.008	0.020	0.073
Profits to Asset Ratio (t-1)	508	0.006	0.002	0.000	0.015
ln (Total Assets) (t-1)	508	15.350	1.124	13.035	18.222
Lending Rate by Prefecture (t-1)	508	0.039	0.012	0.019	0.064

## 3-3 Domestic Operation Banks

Variable	Obs	Mean	Std. Dev.	Min	Max
Total Assets	868	1,537,538	1,788,327	135,246	30,300,000
Total Deposits	868	1,334,052	1,401,096	122,358	20,400,000
Capital	868	61,429	81,702	2,710	1,359,495
Operational Profits	868	9,270	11,572	-2,848	166,757
Growth Rate of Deposits	868	0.011	0.037	-0.269	0.214
Deposit Interest Rate	868	0.012	0.013	0.001	0.048
Capital to Asset Ratios (t-1)	868	0.038	0.010	0.001	0.072
Profits to Asset Ratio (t-1)	868	0.006	0.002	-0.005	0.017
ln (Total Assets) (t-1)	868	13.878	0.834	11.815	17.225
Lending Rate by Prefecture (t-1)	868	0.032	0.011	0.019	0.064

## 3-4 Cooperatives (Shinkin Banks and Credit Cooperatives)

Variable	Obs	Mean	Std. Dev.	Min	Max
Total Assets	6,024	202,245	303,628	3,098	3,282,097
Total Deposits	6,024	178,688	272,712	2,782	3,035,546
Capital	6,024	10,123	14,128	-8,791	145,440
Operational Profits	5,872	1,269	1,947	-8,457	22,946
Growth Rate of Deposits	6,024	0.019	0.035	-0.328	0.323
Deposit Interest Rate	6,024	0.015	0.014	0.000	0.063
Capital to Asset Ratios (t-1)	6,024	0.052	0.019	-0.049	0.147
Profits to Asset Ratio (t-1)	5,872	0.006	0.005	-0.079	0.105
ln (Total Assets) (t-1)	6,024	11.587	1.119	8.039	15.004
Lending Rate by Prefecture (t-1)	6,024	0.035	0.012	0.019	0.064

**Table 4 Response of Growth of Deposits and the Interest Rates Paid on Deposits to Bank Fundamentals (Panel Regressions, FY1992-FY2002)**

	Capital Asset Ratio		Operational Profits/Total Assets		Capital Asset Ratio		Operational Profits/Total Assets	
	[1] Growth Rate of Deposits	[2] Deposit Rate	[3] Growth Rate of Deposits	[4] Deposit Rate	[5] Growth Rate of Deposits	[6] Deposit Rate	[7] Growth Rate of Deposits	[8] Deposit Rate
Bank Fundamentals (t-1)	0.7549 *** ( 0.0500 )	-0.0220 *** ( 0.0028 )	0.7109 *** ( 0.1015 )	-0.0440 *** ( 0.0057 )	0.5319 *** ( 0.0705 )	0.0030 ( 0.0039 )	-0.0888 ( 0.1851 )	-0.0859 *** ( 0.0105 )
x FY1995 Shift Dummy					0.1505 *** ( 0.0508 )	-0.0319 *** ( 0.0028 )	0.5029 ** ( 0.2306 )	0.0228 * ( 0.0130 )
x FY1999 Shift Dummy					0.1406 *** ( 0.0528 )	0.0082 *** ( 0.0029 )	0.7123 *** ( 0.2615 )	0.0582 *** ( 0.0148 )
x FY2001 Shift Dummy					0.1992 *** ( 0.0751 )	0.0049 ( 0.0042 )	1.8161 *** ( 0.4169 )	-0.0266 ( 0.0236 )
x FY2002 Shift Dummy					-0.5269 *** ( 0.0913 )	0.0016 ( 0.0051 )	-1.8302 *** ( 0.4318 )	0.0362 ( 0.0244 )
ln (Total Assets) (t-1)	-0.0369 *** ( 0.0042 )	-0.0016 *** ( 0.0002 )	-0.0330 *** ( 0.0043 )	-0.0016 *** ( 0.0002 )	-0.0395 *** ( 0.0042 )	-0.0013 *** ( 0.0002 )	-0.0352 *** ( 0.0043 )	-0.0018 *** ( 0.0002 )
Lending Rate by Prefecture (t-1)	1.8581 *** ( 0.2755 )	0.2342 *** ( 0.0154 )	1.5785 *** ( 0.2743 )	0.2421 *** ( 0.0155 )	1.8937 *** ( 0.2754 )	0.2302 *** ( 0.0153 )	1.5034 *** ( 0.2736 )	0.2422 *** ( 0.0155 )
dln (Postal Savings by Prefecture)	-0.0002 ( 0.0057 )	0.0001 ( 0.0003 )	0.0009 ( 0.0056 )	0.00003 ( 0.0003 )	-0.0039 ( 0.0057 )	0.0001 ( 0.0003 )	0.0003 ( 0.0056 )	0.0001 ( 0.0003 )
P-value of F-test: Coeff. on all dummies =0	-	-	-	-	0.000	0.000	0.0000	0.0000
R-sq:	0.2037	0.9878	0.1863	0.9879	0.2108	0.9880	0.1946	0.9880
Number of Observations	7400	7400	7248	7248	7400	7400	7248	7248

Notes: Standard errors are in parentheses. \*\*\*, \*\*, and \* indicate statistical significance at 1, 5 and 10 percent, respectively. Estimated coefficients for fixed effects and year dummies are not reported in the table.

**Table 5 Response of Growth of Deposits and the Interest Rates Paid on Deposits to Bank Fundamentals by Bank Type**

	Capital Asset Ratio		Operational Profits/Total Assets		Capital Asset Ratio		Operational Profits/Total Assets	
	[1] Growth Rate of Deposits	[2] Deposit Rate	[3] Growth Rate of Deposits	[4] Deposit Rate	[5] Growth Rate of Deposits	[6] Deposit Rate	[7] Growth Rate of Deposits	[8] Deposit Rate
BankFundamentals (t-1)	0.8924 *** ( 0.1337 )	-0.0276 *** ( 0.0075 )	1.0714 ** ( 0.4619 )	0.0342 ( 0.0260 )	0.5350 *** ( 0.2023 )	0.0164 ( 0.0109 )	0.5867 ( 0.8244 )	-0.1672 *** ( 0.0447 )
x International Operation Dummy	1.3259 *** ( 0.2469 )	0.0027 ( 0.0138 )	1.3396 ( 0.9295 )	0.2268 *** ( 0.0523 )	0.6786 ** ( 0.3250 )	-0.0786 *** ( 0.0176 )	0.1419 ( 1.3153 )	-0.4710 *** ( 0.0714 )
x Cooperative Dummy	-0.2249 ( 0.1428 )	0.0063 ( 0.0080 )	-0.4003 ( 0.4674 )	-0.0843 *** ( 0.0263 )	-0.1783 ( 0.1979 )	-0.0156 ( 0.0107 )	-0.7243 ( 0.8135 )	0.0910 ** ( 0.0441 )
x FY1995 Shift Dummy					0.2193 * ( 0.1141 )	-0.0075 ( 0.0062 )	-0.0957 ( 0.6054 )	0.1849 *** ( 0.0328 )
x FY1995 Shift x Intl Op Dummy					0.1959 * ( 0.1083 )	0.0700 *** ( 0.0059 )	1.2287 * ( 0.7385 )	0.4938 *** ( 0.0401 )
x FY1995 Shift x Cooperative Dummy					-0.0168 ( 0.0887 )	-0.0145 *** ( 0.0048 )	0.5828 ( 0.5634 )	-0.1654 *** ( 0.0306 )
x FY1999 Shift Dummy					-0.0012 ( 0.1048 )	-0.0175 *** ( 0.0057 )	-0.0635 ( 0.5197 )	-0.0556 ** ( 0.0282 )
x FY1999 Shift x Intl Op Dummy					0.4212 *** ( 0.1385 )	-0.0151 ** ( 0.0075 )	5.7313 *** ( 0.9316 )	-0.1278 ** ( 0.0505 )
x FY1999 Shift x Cooperative Dummy					0.1558 ** ( 0.0786 )	0.0194 *** ( 0.0042 )	0.8017 * ( 0.4613 )	0.1106 *** ( 0.0250 )
x FY2001 Shift Dummy					0.6788 *** ( 0.1224 )	-0.0024 ( 0.0066 )	4.1067 *** ( 0.7250 )	-0.0805 ** ( 0.0393 )
x FY2001 Shift x Intl Op Dummy					-0.0196 ( 0.1869 )	-0.0056 ( 0.0101 )	3.6372 ** ( 1.6576 )	-0.1159 ( 0.0899 )
x FY2001 Shift x Cooperative Dummy					-0.4271 *** ( 0.0866 )	0.0066 ( 0.0047 )	-2.6579 *** ( 0.6544 )	0.0637 * ( 0.0355 )
x FY2002 Shift Dummy					-0.8408 *** ( 0.1473 )	-0.0039 ( 0.0080 )	-2.6473 *** ( 0.7870 )	0.0070 ( 0.0427 )
x FY2002 Shift x Intl Op Dummy					-0.4729 * ( 0.2576 )	-0.0055 ( 0.0139 )	-7.2184 *** ( 2.2291 )	-0.0690 ( 0.1209 )
x FY2002 Shift x Cooperative Dummy					0.2865 *** ( 0.1017 )	0.0040 ( 0.0055 )	1.0876 ( 0.7513 )	0.0301 ( 0.0408 )
ln (Total Assets) (t-1)	-0.0339 *** ( 0.0042 )	-0.0016 *** ( 0.0002 )	-0.0311 *** ( 0.0043 )	-0.0015 *** ( 0.0002 )	-0.0350 *** ( 0.0042 )	-0.0012 *** ( 0.0002 )	-0.0297 *** ( 0.0043 )	-0.0016 *** ( 0.0002 )
Lending Rate by Prefecture (t-1)	1.8980 *** ( 0.2747 )	0.2343 *** ( 0.0154 )	1.5751 *** ( 0.2742 )	0.2392 *** ( 0.0154 )	1.9324 *** ( 0.2736 )	0.2335 *** ( 0.0148 )	1.5514 *** ( 0.2717 )	0.2406 *** ( 0.0147 )
dln (Postal Savings by Prefecture)	0.0008 ( 0.0057 )	0.0001 ( 0.0003 )	0.0010 ( 0.0056 )	0.00004 ( 0.0003 )	-0.0037 ( 0.0057 )	0.0001 ( 0.0003 )	0.0016 ( 0.0056 )	0.00004 ( 0.0003 )
International Operation Dummy	-0.0608 *** ( 0.0104 )	-0.0004 ( 0.0006 )	-0.0158 *** ( 0.0059 )	-0.0016 *** ( 0.0003 )	-0.0404 *** ( 0.0125 )	0.0014 ** ( 0.0007 )	-0.0140 ** ( 0.0065 )	0.0009 ** ( 0.0004 )
P-value of F-test: Coeff. on all dummies =0	0.0000	0.7259	0.0954	0.0000	0.0000	0.0000	0.0000	0.0000
R-sq:	0.2104	0.9878	0.1883	0.988	0.2256	0.9889	0.2100	0.9891
Number of Observations	7400	7400	7248	7248	7400	7400	7248	7248

Notes: Standard errors are in parentheses. \*\*\*, \*\*, and \* indicate statistical significance at 1, 5 and 10 percent, respectively. Estimated coefficients for fixed effects and year dummies are not reported in the table.

**Table 6 Indirect Estimates of the Structural Coefficients on Bank Fundamentals Variables in the Demand Equation (2).**

<b>Bank Fundamental Variable</b>	<b>C/A (Capital to Asset Ratio)</b>					<b>Operational Profits/Total Assets</b>				
	<b>FY92-FY03</b>					<b>FY92-FY03</b>				
[1] <b>Bank Fundamentals (t-1)</b>	<b>0.929</b>					<b>0.998</b>				
<b>(cf) Interest Elasticity (b1)</b>	<b>7.933</b>					<b>6.520</b>				
	<b>FY92-FY95</b>	<b>FY96-FY99</b>	<b>FY00-FY01</b>	<b>FY02</b>	<b>FY03</b>	<b>FY92-FY95</b>	<b>FY96-FY99</b>	<b>FY00-FY01</b>	<b>FY02</b>	<b>FY03</b>
[2] <b>Bank Fundamentals (t-1)</b>	<b>0.507</b>	<b>0.920</b>	<b>0.994</b>	<b>1.152</b>	<b>0.612</b>	<b>0.444</b>	<b>0.806</b>	<b>1.157</b>	<b>3.138</b>	<b>1.083</b>
<b>(cf) Interest Elasticity (b1)</b>	<b>8.226</b>					<b>6.206</b>				
	<b>FY92-FY03</b>					<b>FY92-FY03</b>				
[3] <b>Bank Fundamentals (t-1)</b>	<b>2.420</b>					<b>0.692</b>				
<b>Interanational</b>	<b>1.116</b>					<b>0.846</b>				
<b>Domestic</b>	<b>0.840</b>					<b>1.001</b>				
<b>Cooperatives</b>	<b>8.103</b>					<b>6.585</b>				
<b>(cf) Interest Elasticity (b1)</b>	<b>8.103</b>					<b>6.585</b>				
	<b>FY92-FY95</b>	<b>FY96-FY99</b>	<b>FY00-FY01</b>	<b>FY02</b>	<b>FY03</b>	<b>FY92-FY95</b>	<b>FY96-FY99</b>	<b>FY00-FY01</b>	<b>FY02</b>	<b>FY03</b>
[4] <b>Bank Fundamentals (t-1)</b>	<b>1.728</b>	<b>1.626</b>	<b>2.315</b>	<b>3.041</b>	<b>1.805</b>	<b>4.843</b>	<b>1.600</b>	<b>8.450</b>	<b>17.461</b>	<b>7.994</b>
<b>Interanational</b>	<b>0.399</b>	<b>0.681</b>	<b>0.753</b>	<b>1.522</b>	<b>0.714</b>	<b>1.665</b>	<b>0.376</b>	<b>0.416</b>	<b>5.297</b>	<b>2.604</b>
<b>Domestic</b>	<b>0.350</b>	<b>0.734</b>	<b>0.872</b>	<b>1.089</b>	<b>0.534</b>	<b>0.353</b>	<b>0.714</b>	<b>1.098</b>	<b>2.655</b>	<b>0.856</b>
<b>Cooperatives</b>	<b>8.276</b>					<b>6.447</b>				
<b>(cf) Interest Elasticity (b1)</b>	<b>8.276</b>					<b>6.447</b>				

Notes: Structural Coefficients above are calculated based on the reduced form coefficient estimates that are reported in Table 4 and 5.