The Depositor Discipline Hypothesis –The Transition to an Interaction Effect–*

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This research demonstrates that the bank depositor discipline hypothesis must be analyzed in the context of an interaction effect between bank demand for deposits and customer supply of deposits. Only when this interaction effect is considered can the real effect of bank-specific risks on the equilibrium interest rate and the equilibrium quantity of funds be determined. The analysis in the paper covers three effects: 1) the interest rate effect; 2) the quantity effect; and, 3) the interaction effect. Previous empirical studies found evidence that depositors penalize riskier banks by requiring higher interest rates or by withdrawing their deposits. Empirical research using recent American and Japanese bank data make clear that including the interaction effect has substantial methodological advantages over approaches that consider only the interest rate and quantity effect. Thus, the main contribution is a theoretically explanation of why the bank depositor discipline hypothesis must be tested with a methodology that includes the interaction effect in its reduced-form equations.

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I. INTRODUCTION

The New Basel Accord, which will be implemented at the end of 2006, has three pillars: a minimum capital requirement, a supervisory review process, and market discipline. Since the First Consultative paper on the New Accord was released in June 1999, the third pillar, market discipline, has received much attention.

Since the beginning of the 1980s, there have been arguments in the United States and European countries over whether bank holding companies (BHCs) or banks themselves should issue mandatory subordinated debt and Certificates of Deposit (CD) to enhance market discipline. Meanwhile, since Big Bang in 1996, Japanese financial authorities have been reforming the financial system with an emphasis on disposals of non-performing loans. Nevertheless, Japanese authorities are also currently emphasizing market discipline. As a result, financial institutions in Japan have been writing off substantial amounts of non-performing loans and have improved their profitability. Up to the present, only the government supervisor of banks has policed bank risk in Japan. Yet, with the increasing size and complexity of banks and the turbulent economic environment

surrounding banking institutions, it is no longer feasible for only the government regulator to monitor, control, and discipline banking institutions. It is widely agreed that not only the government regulator but also bank stakeholders such as depositors, stockholders, and debt holders should share the role of policing banks, thereby

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enhancing market discipline¹.

This paper reviews the previous empirical literature concerning the depositor discipline hypothesis.² The paper classifies the depositor discipline hypothesis into three effects as follows: 1) an interest rate effect, 2) a quantity effect, and 3) an interaction effect. To date, there are a few empirical studies at the micro level that examine the interaction effect. This effect is analyzed in terms of both the interest paid on and the quantities of deposits using Japanese bank data. Thus, this paper reviews the depositor discipline hypothesis in order to prepare for further empirical study in light of the interaction effect.

The remainder of the paper is organized as follows. Section 2 discusses the reasons why depositor discipline is important for the financial system in the 21st century.³ Section 3 surveys previous empirical studies related to depositor discipline and explains the interest rate effect, the growth effect, and the interaction effect. Section 4 concludes and discusses the depositor discipline hypothesis for further empirical study.

II. WHY DEPOSITOR DISCIPLINE?

According to Berger (1991), market discipline in the banking sector can be described as a situation where bank stakeholders face costs that increase as banks undertake risks, and take action based on these costs.

Risk assessments utilizing market discipline by bank stakeholders could contribute to surveillance in the following two ways. First, market signals about bank risk such as yields or prices on subordinated debt, Jumbo-CDs, and stocks might flag troubled banks on a daily basis that could be missed by surveillance tools based on quarterly, semi-annual, or annual financial statements. In this way, bank stakeholders may improve efficiency by pressuring some of the relatively inefficient banks to become more efficient or to exit the banking industry. Second, market signals may reduce the moral hazard incentives of banks undertaking excessive risks that are created by deposit insurance guarantees. In this way, if

the regulators cede greater control to market forces in the sense that more timely or accurate market signals reflect emerging problems of banks before conventional surveillance tools, regulators could lower the cost of supervising banks [Martinez-Peria & Schmukler, 2001; Gilbert, Meyer, & Vaughan, 2003)].

In theory, insured deposits should be insensitive to bank risk because they are fully covered. Uninsured depositors would be the primary monitors of banks because they are exposed to bank risk taking behavior and may lose their deposits above the deposit-insurance ceiling when banks fail (Park & Peristiani, 1998). However, some empirical studies find that insured depositors are responsive to the financial condition of banks as well, suggesting that insured depositors are concerned about the solvency of banks. For example, Kane (1987) finds that small depositors have been able to discriminate between solvent and insolvent depository institutions even in banking crises. Likewise, Cook & Spellman (1994) find that Savings and Loans (S&Ls) offering interest rates on small-CDs generally rise and fall together with the banks' financial conditions.⁴ In addition, Park & Peristiani (1998) find that insured depositors at riskier thrifts are uneasy about financial risk, but the evidence for market discipline by insured depositors is less profound than that for uninsured depositors. Martinez-Peria & Schmukler (2001) also find that even insured depositors can discipline banks in developing countries such as Argentina, Chile, and Mexico during the 1980s and 1990s. According to Flannery (1998), depositors are concerned not only about the solvency of individual banks, but also about the solvency of the Deposit Insurance Corporation (DIC) and the willingness of the government to support the insurer. Thus, the findings imply that depositors do not perceive insured deposits as being perfectly safe.

In summary, all depositors may penalize riskier banks by requiring higher interest rates or by withdrawing their deposits due to their exposure to bank risk taking, especially; those who hold demand deposits or CD may do so. (Calomiris & Kahn, 1991). Overall, it is essential to examine market discipline not only for uninsured deposits but also for insured deposits because there is potential for depositors as a whole to discipline banks in

1 See Kobayashi (2003) for an empirical test of market discipline by subordinated debt holders in the Japanese market. Also, see Yamori & Kobayashi (2004) for an empirical test of market discipline by stockholders.

2 Genay (1999) first uses the term "the market discipline hypothesis" to define bank stakeholders disciplining banks through the market.

3 See Kobayashi (2004) for details on the Japanese financial reform.

4 An S&L is an American depository financial institution, federally or state chartered, holding its assets mostly in residential mortgages.

addition to the government regulator.

III. THE TRANSITION TO AN INTERACTION EFFECT

A. Framework

For simplicity, the authors assume that the main sources of liabilities in banking firms are deposits and assets from bank lending, and assume that demand for

bank lending is given. Figure 1 depicts a simple model of bank liability management, first discussed by Klein (1971) that shows the interest rates and quantities to be tested.

The depositor discipline hypothetical tests are divided into three effects as follows: 1) an interest rate effect, 2) a quantity effect, and 3) an interaction effect. The interest rate effect of deposits is analyzed in terms of moving σ_1 from

(1) Insured deposits

(2) Uninsured deposits

(Arranged by the author from Jordan (2000))

where,

SI: Supply (Marginal Cost) of Insured Deposits

SU: Supply of Uninsured Deposits

D: Demand (Marginal Revenue) from Lending

* An interest rate is called "cost" by banks demand side.

Figure 1: A Simple Model of Bank Liability Management

to σ_2 . The quantities effect on insured and uninsured deposits is analyzed in terms of moving from I_1 to I_2 , and decreasing from U_1 to U_2 , respectively. The interaction effect is tested with reduced-form equations to see the interaction between bank-specific risks on the equilibrium interest rate and the equilibrium quantity resulting from the interaction between bank demand for and depositors' supply of deposits.

B. U.S. Banks

Most of the previous studies support the depositor discipline hypothesis.⁵ Most studies analyze U.S. banks or BHCs and examine the relationship between the interest rate paid on deposits, quantities of Jumbo CD and bank-specific risks.

A common place to find evidence of enhanced market discipline by depositors is the Jumbo-CD market because these CDs are time deposits with balances above the deposit-insurance ceiling (\$100,000 in America and ¥10,000,000 in Japan). These studies employ either/both cross-sectional or/and time-series regressions of Jumbo-CD variables on a variety of bank risk proxies (e.g., CAMELS or BOPEC rating etc.) with market risk factors as control variables.⁶ The paper reviews the previous literature in terms of three categories: 1) the interest rates effect, 2) the quantities effect, and 3) the interaction effect. Appendix 2 contains an extensive article-by-article comparison of this research.

The Interest Rate Effect

This group of studies has investigated whether the

interest rates paid on uninsured Jumbo-CD issued by the U.S. banks reflect bank default risk or measures of market risk. Herzig-Marx & Weaver (1979) first discussed the econometric specification of the regression equation for the interest rate effect of the discipline hypothesis by Jumbo-CD holders:

Regression Model 1:

$$I_{i,t} = a_1 I_{i,t} + b_1 BR_{i,t-1} + c_1 MR_{m,t} + d_1 Q_{i,t} + e_{1,i,t} \quad (1)$$

where,

$$I_{i,t} = \frac{\text{Interest Expense on CDs (or Deposits)}}{\text{Average Amount on CDs (or Deposits)}} \times 100\%$$

$BR_{i,t-1}$ = **CAMEL**, a vector of bank-specific risk factors with a lag because balance sheet information is an ex post measure for the public

$MR_{m,t}$ = **Market Risk**, a vector of financial market factors affecting each bank's interest rate or growth

$Q_{i,t} = \log q_{i,t}$, quantity of deposits/CD,
(or $\Delta q_{i,t} = \log q_{i,t} - \log q_{i,t-1}$)

$e_{n,i,t}$ = random error terms

These studies find evidence that uninsured deposits respond to bank risk that is captured by balance sheets and some measures of market risk⁷ [Herzig-Marx & Weaver, 1979; Baer & Brewer, 1986; Hannan & Hanweck, 1988; James, 1988, 1990; Cargill, 1989; Keely, 1990; Ellis & Flannery, 1992; Cook & Spellman, 1994; Brewer & Mondschen, 1994]. Hence, most studies find that the interest rate on Jumbo-CDs is sensitive to bank-specific risk; riskier banks are forced to pay higher interest rates on Jumbo-CDs.⁸

5 However, some articles find no evidence supporting the depositor discipline hypothesis. For example, Crane (1976) finds that, in the 1974 CD market, traditional bank risk measures are less important than other factors such as location although he finds bank risk influences CD rates positively. Furthermore, Crabbe & Post (1994) in analyzing the quantity effect find no evidence of market discipline by depositors. Dewatripont & Tirole (1994) also argue that numerous, small depositors cannot effectively identify or control bank risks because of information costs and coordination problems.

6 CAMELS is used to evaluate bank performance and stands for Capital adequacy, Asset quality, Management, Earnings, Liquidity, and bank's Sensitivity to market risk. Before the "S" component was introduced in January 1997, CAMEL had been used. BOPEC is utilized to evaluate BHCs performance and stands for Bank subsidiaries, Other (non-bank) subsidiaries, Parent company, Earnings, and Capital adequacy of BHCs.

7 Though most studies regress CD interest rates on the financial data of banks in analyzing the interest rate effect, Baer & Brewer (1986) and James (1988, 1990) utilize measures of market risks in lieu of some accounting ratios, and they find a significant positive effect of equity volatility on CD interest rates. Also, Ellis & Flannery (1992) estimated time series models for daily CD risk premiums as a function of innovations in the stock returns of banks, and find evidence of market discipline. However, Goldberg & Lloyd-Davies (1985) find no evidence when analyzing three-month interest rates on large CDs and the proportion of Standby Letters of Credit.

8 However, Gilbert, Meyer, & Vaughan (2001) find that the default premiums on bank CD have much less predictive power than the traditional supervisory screens. See Gilbert et al. (2003, p.11) for a detailed discussion of early warning models.

The Quantity Effect

This group of studies has investigated whether the quantities of Jumbo-CDs issued by the U.S. banks reflect bank default risk or measures of market risk (e.g., Goldberg & Hudgins, 1996, 2002; Calomiris & Wilson, 1998). These studies find that uninsured deposit growth falls as bank risk taking increases. For example, Billet et al. (1998) examine the relationship between changes in bank credit risk as rated by Moody's and quantity of insured deposits, and find evidence that risky banks increase their use of insured deposits following a downgrade. Park & Peristiani (1998) find that risky thrifts attracted smaller amounts of uninsured deposits, but the response of insured depositors was slower, and less dramatic than that of uninsured depositors. A common regression model to test the quantity effect is:

Regression Model 2:

$$Q_{i,t} = a_{2i,t} + b_2 BR_{i,t-1} + c_2 MR_{m,t} + d_2 I_{i,t} + e_{2i,t} \quad (2)$$

In short, the general result is that when banks become riskier, banks shift from uninsured deposits to insured deposits in order to reduce the cost of uninsured deposits.⁹ However, the evidence of depositor discipline as an effect on fully insured deposit growth is intricate and still an open empirical question.

The Interaction Effect

In the case of banking organizations, it is difficult to identify exogenous variables (i and Q), which affect either banks' demand or depositors' supply only, in the structural-form equations. Most studies estimate the effects of bank-specific risks on the equilibrium interest rate and the equilibrium quantity resulting from an interaction between the banks' demand for and depositors' supply of deposits/CDs. Thus, a common methodology to test the interaction effect uses reduced-form equations (See Appendix 1):

The Reduced-form Equations:

$$Q_{i,t} = \pi_{10i,t} + \mu_{i,t} + d_{i,t} + \pi_{11} BR_{i,t-1} + \pi_{12} MR_{m,t} + v_{1i,t} \quad (3)$$

$$I_{i,t} = \pi_{20i,t} + \mu_{i,t} + d_{i,t} + \pi_{21} BR_{i,t-1} + \pi_{22} MR_{m,t} + v_{2i,t} \quad (4)$$

where,

μ_i = bank specific or fixed effects

d_t = time specific effect included to control for macroeconomic and banking sector developments

$v_{i,t}$ = random error terms

$i = 1, \dots, N$ (N is the different number of banks

in each year) at time t .

For example, Park (1995), Park & Peristiani (1998), Martinez-Peria and Schmuckler (2001), Gilbert et al. (2003), and Hall, King, Meyer, & Vaughan (2002a, 2002b) empirically examine the interaction effect and find evidence that interest rates paid on deposits, or the quantity of Jumbo-CDs respond to changes in bank risk. Particularly, Jordan (2000) finds that fully insured deposits increase when banks fail.

Gilbert et al. (2003) and Hall, King, Meyer, & Vaughan (2002a, 2002b) find that interest rates paid on deposits, and the quantity of uninsured CDs are sensitive to bank risks, but interestingly find no evidence that the coefficients are statistically or economically different across two very different sample periods [i.e., pre-FDICIA (Federal Deposit Insurance Corporation Improvement Act; FDICIA) and post-FDICIA]. This implies that the enforcement of FDICIA in 1991 did not affect market discipline in the CD market.¹⁰ Further, Demirgüç-Kunt & Huizinga (2004) using cross-country data over 1990-1997 empirically examine whether the sensitivity of bank interest rates and the growth rate of bank deposits to indicators of bank-specific risk are affected by deposit insurance. They find that riskier banks pay higher interest rates, and find no conclusive evidence that higher or lower deposit growth is affected by deposit insurance.

In summary, it is clear that the interest rates paid on deposits and the quantities of Jumbo-CDs in the interaction effect respond to changes in bank risk. Yet, whether the actual quantity of insured deposits decreases or increases in response to bank risk is still an open empirical question.

C. Japanese Banks

A few empirical papers examine the depositor discipline

9 However, although Jagtiani & Lemieux (2000) find that banks increase reliance on insured deposits when facing financial difficulties, they argue that there is little evidence of market discipline on banks in the uninsured CD market.

10 Furthermore, Gilbert et al. (2003) find no evidence that Jumbo-CDs convey supervisory information, at least during robust economic conditions.

hypothesis in Japan.¹¹ Thus far, Hosono (2002, 2003), Hosono, Iwaki, & Tsuru (2004), Tsuru (2003), Murata & Hori (2005), and Hori, Ito, & Murata (2005) investigate the depositor discipline hypothesis for Japan. Using data from the 1990s Hosono (2003) finds that there is a relationship between interest rates, growth of deposits and factors affecting bank-specific risks. He finds that, among regional banks, both interest rates and growth of deposits are significantly correlated with bank risk measures. Yet, for major Japanese banks, interest rates are not significantly correlated with risks. Growth rates of deposits are only weakly correlated with risk measures. Furthermore, he finds that depositor discipline does not work effectively when government recapitalizes risky banks. Besides setting up a model of bank exit behavior, Hosono (2002) empirically examines the relationship between bank exit measures and bank risk measures.¹² He finds that in the late 1990's there existed a different efficacy in market discipline between major banks and regional banks; depositor discipline was not at work for major banks whereas it was for regional banks.

Contrarily, Hori, Ito, & Murata (2005) find that Japanese depositors in the 1990s did respond to the risks of financial institutions; this includes city banks, first and second regional banks, shinkin banks, and credit

cooperatives (shinkumi). Recent research suggests that although there is potential for depositors to discipline banks in Japan, they seem to mainly discipline regional Japanese banks, not major banks.

In terms of the interaction effect, it is clear that interest rate paid on deposits, quantities of Jumbo-CDs of the interaction effect respond to changes in bank risk. Yet, whether the quantity of insured deposits actually increases or decreases in response to bank risk is an intricate and still open empirical question.

In summary, in the transition to adopting an interaction effect methodology for tests of the depositor discipline hypothesis, the process was first to focus on the interest rate effect, then the quantity effect. However, it is now recognized that the hypothesis must be analyzed in the context of the interaction effect.

IV. CONCLUSION

The objective of this paper was to emphasize the importance of proper analysis of the depositor discipline hypothesis in light of the interaction effect. The paper finds the hypothesis should be analyzed in light of an interaction effect because it is necessary to estimate the effects of bank-specific risks on the equilibrium interest rate and the equilibrium quantity of funds resulting from an interaction between the bank demand for deposits and customers' supply of deposits. The framework is to analyze the focus of previous bank research in terms of the interest rates effect, the quantity effect, and the interaction effect. Previous studies find evidence of a relationship between interest rates, the quantities of CD/deposits and bank-specific risk factors. This suggests that market discipline by depositors will result in higher interest rates on CDs and smaller quantities of CDs as bank risk increases. This implies that depositors penalize riskier banks by requiring higher interest rates or by withdrawing their deposits. The Jumbo-CD market seems very likely impose such discipline. Overall, the findings of previous studies conclude that there is power for depositors to discipline banks in Japan as well as in America. The contribution of the paper is to show that the depositor discipline hypothesis must be tested with a methodology that includes the interaction effect.

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11 Other studies testing market discipline, but not the depositor discipline hypothesis, in Japan include Hosono & Sakuragawa (2003) who investigate whether and how soft budget problems emerged in the Japanese credit market using data over 1991-1999. They find that poorly capitalized banks have a strong incentive to roll over bad loans, so-called "window dressing," in order to satisfy capital adequacy requirements in the current environment of Japan (e.g., the absence of effective governance by shareholders and the absence of appropriate accounting practices). Konishi & Yasuda (2004) using data from Japan over 1990-1999 empirically examine the relationship between measures of bank risk using stock price data and factors affecting bank risk taking behavior such as capital adequacy requirements, *amakudari*, stable shareholders, and franchise value. They find that the capital adequacy requirement, stable shareholders, and franchise value have significant effects on bank risk whereas *amakudari* does not.

12 For example, banks exit measures are the deposit interest rates, the rates of increase in deposits, BIS ratios, and the ratios of capital to total assets. Bank risk measures are bank failure probabilities, real estate loan proportions, disclosed non-performing loan ratios, and market value capital adequacy ratios.

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APPENDIX 1:

Proof of the reduced-form equation: Now, assuming linear supply and demand curves for simplicity, a common demand-supply model from banks' lending and in deposits are (5) and (6). However, in the banks' business it is difficult to identify exogenous variables (i.e., i and q), which affect either banks demand or depositors supply only, in the structural-form equations. Thus, in general, the reduced-form equations are utilized to estimate the model in the empirical studies in the case of banking organizations.

$$\text{Demand function: } q^d = \alpha_1 + \beta_1 i + \gamma_1 MR + u_1 \quad (\beta_1 < 0, \gamma_1 > 0) \quad (5)$$

$$\text{Supply function: } q^s = \alpha_2 + \beta_2 i + \gamma_2 BR + u_2 \quad (\beta_2 > 0, \gamma_2 < 0) \quad (6)$$

$$\text{Equilibrium condition: } q^d = q^s = q$$

In an identification problem, let me solve endogenous variables, i and q , for exogenous, the reduced-form equation is, then, specified as follows:

$$q = \frac{\alpha_1 \beta_2 - \alpha_2 \beta_1}{\beta_2 - \beta_1} + \frac{-\gamma_2 \beta_1}{\beta_2 - \beta_1} BR + \frac{\gamma_1 \beta_2}{\beta_2 - \beta_1} MR + \frac{u_1 \beta_2 - u_2 \beta_1}{\beta_2 - \beta_1}$$

$$i = \frac{\alpha_1 - \alpha_2}{\beta_2 - \beta_1} + \frac{-\gamma_2}{\beta_2 - \beta_1} BR + \frac{\gamma_1}{\beta_2 - \beta_1} MR + \frac{u_1 - u_2}{\beta_2 - \beta_1}$$

$$\text{Now, let } \pi_{10} = \frac{\alpha_1 \beta_2 - \alpha_2 \beta_1}{\beta_2 - \beta_1}, \quad \pi_{11} = \frac{-\gamma_2 \beta_1}{\beta_2 - \beta_1}, \quad \pi_{12} = \frac{\gamma_1 \beta_2}{\beta_2 - \beta_1},$$

$$\pi_{20} = \frac{\alpha_1 - \alpha_2}{\beta_2 - \beta_1}, \quad \pi_{21} = \frac{-\gamma_2}{\beta_2 - \beta_1}, \quad \pi_{22} = \frac{\gamma_1}{\beta_2 - \beta_1},$$

$$v_1 = \frac{u_1 \beta_2 - u_2 \beta_1}{\beta_2 - \beta_1}, \quad v_2 = \frac{u_1 - u_2}{\beta_2 - \beta_1}$$

The reduced-form of the model is, then

$$q = \pi_{10} + \pi_{11} BR + \pi_{12} MR + v_1$$

$$i = \pi_{20} + \pi_{21} BR + \pi_{22} MR + v_2$$

$\hat{\pi}_{ni,nj}$ are reduced-form parameters. Thus, the demand-supply model here is exactly

identified and the model is appropriate. See Green (2000) for a more detailed discussion of simultaneous-equations models.

APPENDIX 2: Summary of Empirical Studies in the U.S. and Japan on the Effectiveness of Depositor Discipline on Banking Organization

1. U.S. Banks

Authors	Sample Characteristics		Method	Explanatory Variables (Bank-specific risks)	Instruments	Evidence of Depositor Discipline
	Data period	Number of Institutions				
A. The Interest Rates Effect						
Crane (1976)	1974	23 banks	Factor Analysis	Locations (e.g., profit or capital rate is less than relevant)	CD	0
Jagtiani & Lemieux (2000)	1980-1995	5 failing banks	OLS	Credit ratings	Uninsured CD	0 (uninsured)
Gilbert et al. (2001)	1991-1996 (yearly)	6852-7255 banks	Logit	Downggrades of CAMELS ratings	Large time deposits	0
Herzig-Marx & Weaver (1979)	1976,1977	30 banks	OLS	Term, assets/cap, asset liquidity, earn/assets, foreign assets/assets	Negotiable CD	++
Goldberg & Lloyd-Davies (1985)	1976-1982	10 largest banks	OLS	The proportion of bank SLCs outstanding to sum of gross loans plus SLCs etc.	Jumbo Negotiable CD	--
Baer & Brewer (1986)	1979-1982	37 BHCs	OLS	Measures of the level and variability of stock prices	Uninsured CD	++
Hannan & Hanweck (1988)	1985	300 banks	OLS	The likelihood of bank insolvency, the variability of assets, bank capitalization	Jumbo-CD	++
James (1988)	1985	300 banks	OLS GLS	Credit risk (loan loss provision/loans), short, financial leverage/assets/market value of capital) (OLS); variance of bank's stock returns, financial leverage (GLS)	Jumbo-CD	++
Cargill (1989)	1984-1986	58 banks	OLS	CAMEL ratings	CD	++
Keely (1990)	1971-1986	85 large BHCs	2SLS	Market-value-of capital/assts	Jumbo-CD	++
Brewer & Mondschen (1994)	1985-1989	74 S&Ls	OLS	Large share of junk bonds	Jumbo-CD	++
Cook & Spellman (1994)	1987-1988	233, 210 observations of thrifts	OLS	Leverage ratio, ROA, intangible goodwill asset	Fully or partially insured CD	++
James (1990)	1986-1987	23 banks in lesser developed countries	OLS	Bank asset risk, domestic loans/capital Foreign loans/capital	Jumbo-CD	++
Ellis & Flannery (1992)	1982-1988	6 large banks	2SLS	Bank stock prices(not bank-risks)	Jumbo-CD	++

APPENDIX 2: Summary of Empirical Studies in the U.S. and Japan on the Effectiveness of Depositor Discipline on Banking Organization (Continued)
1.U.S. Banks (Continued)

Authors	Sample Characteristics		Method	Explanatory Variables (Bank-specific risks)	Instruments	Evidence of Depositor Discipline
	Data period	Number of Institutions				
B. The Quantity Effect						
Crabbe & Post (1994)	1986-1991	41 Downgraded BHCs	OLS	CD rating downgrade	Jumbo-CD	0
Billet et al. (1998)	1990-1995	109 Downgraded BHCs	OLS	Assets, liabilities	Insured deposits	++(insured) --(uninsured)
Goldberg & Hudgins (1996)	1986-1989	2813-2998 S&Ls	Logit OLS	Failure probability, Interest paid on deposits/total deposits	Uninsured deposits	-- (uninsured)
Goldberg & Hudgins (2002)	1984-1994	619 failing and solvent thrifts	ANOVA	None	Jumbo-CD	? (uninsured)
Calomiris & Wilson (1998)	1920-1940 (yearly)	21-55 publicly traded banks in New York City	OLS, 2SLS	Deposit's default premium	Deposits	+
Jagtiani & Lemieux (2000)	1980-1995	5 failing banks	OLS	Credit ratings	Insured deposits Uninsured CD	++ (insured) -- (uninsured)

APPENDIX 2: Summary of Empirical Studies in the U.S. and Japan on the Effectiveness of Depositor Discipline on Banking Organization (Continued)
 1. U.S. Banks (Continued)

Authors	Sample Characteristics		Method	Explanatory Variables (Bank-specific risks)	Instruments	Evidence of Depositor	
	Data period	Number of Institutions				Discipline Interest rates	Quantities
C. The Interaction Effect							
Park (1995)	1985-1992	Banks(11435-9582)	Logit OLS	Failure probability, maturity, total assets, large time deposits/assets	Jumbo-CD	++	-- (uninsured)
Park & Peristiani (1998)	1986-1990	Thrifts(2023-4218)	Logit OLS	Failure probability, size	Jumbo-CD	++	--
Martinez-Peria & Schmuckler (2001)	1991-1996 (monthly)	Argentina (57-155 banks) Chile (21-37 banks) Mexico (10-34 banks)	OLS	CAMEL	Insured, uninsured, time, medium deposits	++	?
Gilbert et al. (2003)	1989-1998 (yearly)	2190-5980 banks	OLS	Maturity	Jumbo-CD	++	++
Hall et al. (2002a)	1988-1995 (before/after FDICIA)	about 4000 banks	OLS	Credit risk (nonaccrual loans/assets), liquidity risk (large time deposits/assets)	Jumbo-CD	+	-
Hall et al. (2002b)	1997-2003	about 4000 banks	OLS	Capital adequacy measures	Jumbo-CD	+	-
Jordan (2000)	1989-1995	65 failing banks	ANOVA	None	Jumbo-CD	++	-- (uninsured) ++ (insured)
Demirguc-Kunt & Huizinga (2004)	1990-1997	51 cross-countries banks	OLS	Equity (book value of capital assets), liquidity (liquid assets/assets), profit (before/after assets)	Deposits	++	--

APPENDIX 2: Summary of Empirical Studies in the U.S. and Japan on the Effectiveness of Depositor Discipline on Banking Organization (Continued)

2. Japanese Banks

Authors	Sample Characteristics		Method	Explanatory Variables (Bank-specific risks)	Instruments	Evidence of Depositor Discipline	
	Data period	Number of Institutions				Interest rates	Quantities
Hosono (2002, 2003)	1992-1999	160 major banks 1016 regional banks in the period	OLS	ROA, disclosed non-performing loan ratios, real estate-related loan share	Deposits	0 (major banks) ++ (regional banks)	- (major banks) ++ (regional banks)
Hosono, Iwaki, & Tsuru (2004)	1992-2002	6222 banks (around 60 countries (i.e., Countries contain 20 banks or more)	OLS	Bank risk (e.g., Liquidity, Profit, Equity), Others (e.g., Overhead Short term debt/total debt, Asset size etc.), Bank regulation variables (e.g., Prompt Corrective Action, Deposit protection etc.)	Deposits	+	-
Hori, Ito, & Murata (2005)	FY1992-FY 2002	788 institutions (10 city, 62 first regional, 65 second regional, 426 shinkin, and 225 credit cooperatives)	OLS	CAR, Profits/Total asset, Lending rate by prefecture	Deposits	++	--
2. Japanese Banks							
Authors	Sample Characteristics		Method	Explanatory Variables (Bank-specific risks)	Instruments	Evidence of Depositor Discipline	
	Data period	Number of Institutions					
Murata & Hori (2005)	FY1992-FY 2002	694 Shinkin & Shinkumi (credit cooperative)	n.a.	n.a.	n.a.	++ (1995, 2000, 2001, 2002)	
Tsuru (2003)	FY1998-FY 2001	120 banks (115 regional and 5 city)	OLS (each year)	Asset Risk Factors (e.g., CAR, Loans/Total assets, Risk management loans/Total loans=Non-performing loan ratio), Banks Liquidity Risk Factors(e.g., Cash+deposits to other banks/Total assets, Banks Profitability Factors (e.g., ROA), Bank size Non-performing loan ratio etc.	Total Deposits Time Deposits (year-on-year growth)	TotalDeposits Asset ++(1998, 1999, 2001; TBTF effects in 2001) Loan -- (1998, 2001) Profitability ++ (2000, 2001) TimeDeposits Asset -- (2001)	
	FY2001	332 Shinkin banks			Total Deposits (growth)	-- (Shinkin)	

(Sources: Constructed by authors from each Journal, Appendix C of the Board of Governors of the Federal Reserve System, and the Secretary of the U.S. Department of the Treasury (2000))

Note: ++, +, --, -, 0, and ? denote the efficacy of depositor discipline as follows:

- 1) ++ denotes positive evidence (e.g., 1% statistically significant) of depositor discipline,
- 2) + denotes weakly positive evidence (e.g., 5% statistically significant) of depositor discipline,
- 3) -- denotes negative evidence of depositor discipline,
- 4) - denotes weakly negative evidence of depositor discipline,
- 5) 0 denotes none of the evidence in depositor discipline, and
- 6) ? denotes mixed evidence due to TBTF policy.

Unless it is specified otherwise, the depositor discipline column shows evidence for all depositors including uninsured and insured; Baer and Brewer (1986) is the exception that proves the efficacy of depositor discipline in examining the relationship between interest rates, quantities of deposits and non-bank-specific risks and bank stock prices.