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Optimal Premiums for the Deposit Insurance System

An empirical work on the deposit insurance system of Japan

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and
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Abstract

Deposit insurance plays an important role in protecting depositors, ensuring that their assets are secure even when banking failures occur. Japan started its deposit insurance system in 1971 in order to protect depositors against financial turmoil and increase their sense of security. In this research, we first shed light on the structure of the deposit insurance system, and mention examples from Japan, a country that has more than four decades of experience in this field. After this, we offer an Optimal Premium Model (OPM) through which we calculate the optimal premium for the deposit insurance system. In order to find the optimal rates we use a Vector Error Correction (VEC) method, an approach proposed for forecasting financial assistance. Using optimal premium rates is a necessity for deposit insurance agencies in order to maintain financial system stability and protect depositors by ensuring the settlement of funds connected to failed financial institutions. We calculated this optimal rate for Japan during the period of 1992 Q1 – 2011 Q4, and found that the optimal rate for the Japanese deposit insurance system is higher than its current rate. Put simply, in order to secure financial system stability, Japan needs to raise the premium rate.

Keywords: Deposit Insurance, Optimal Premium Model (OPM), Banking Default, Deposit Insurance Corporation of Japan (DICJ)

1- Introduction,

Deposit insurance is a key element in modern banking because it guarantees the financial safety of deposits at depository financial institutions. If an insured depository institution fails to fulfill

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Its obligations to its depositors, the insuring agency will step in to honor the principal and accrued interests up to a predetermined ceiling. An important issue under this system, however, is how to price deposit insurance (Horvitz, 1983; Kane, 1986). In order to determine the optimal premium rates that depository financial institutions are obliged to pay to this insuring agency, the consensus method tends toward adopting a risk-based deposit insurance scheme according to banking defaults. To achieve this goal, several models for assessing banking defaults have been proposed: Merton, 1977; Santomero and Vinso, 1977; Buser et.al, 1981; Avery et.al, 1985; Goodman and Santomero, 1986; Ronn and Verma, 1986; Acharya and Dreyfus, 1989; Barr et.al. 1994, Bartholdy et.al, 2003; and more recently by Yoshino and Hirano, 2011.

However, we found few studies that researched how to forecast and estimate optimal and fair premium rates for deposit insurance. It is crucial for each country to select optimal and fair premium rates in order to maintain financial system stability, thereby protecting depositors and ensuring the settlement of funds related to failed financial institutions. In this paper, the optimal rate refers to a rate that covers the operational expenditures of an insuring agency and provides sufficient funds to said insuring agency in order to financially assist any failed depositary financial institutions. This insurance agency also keeps a fair amount of liability reserves at the end of the financial period in order to secure further failures. A high premium rate reduces the capital adequacy of individual financial institutions, which will endanger the stability of the financial system. Low premium rates, however, will reduce the security of the financial system.

This paper is structured as follows: In section 1-1, we explain about the deposit insurance system and its history in Japan. In 1-2, we talk about the basic mechanisms of the Japanese deposit insurance system. In 1-3, we ask how the deposit insurance system works, and in 1-4 we examine the deposit insurance premium. The second section contains the economic model, in which we explain about the Optimal Premium Model (OPM) in section 2-1, and figure out how to forecast future financial assistance for deposit insurance corporations in section 2-2. The third section is for data analysis and empirical works, including: 3-1 Data Analysis, 3-2 Vector Error Correction Model (VECM) for financial assistances forecasting, and 3-3 Scenario analysis for financial assistance and optimal premium forecasting. The fourth section contains this paper's conclusions.

1-1 Deposit Insurance System and The History of it in Japan,

Deposit insurance is generally considered an important part of the regulatory structure for the banking system. This structure should protect the ''safety and soundness'' of the banking system while providing banks with the appropriate rules and incentives to allocate credit and liquidity efficiently. An important role of deposit insurance within the regulatory structure is to limit the risk of bank runs by guaranteeing that depositors receive some, or all, of their deposited funds with reasonable speed even if their banks fail and must be shut down (Diamond and Dybvig, 1983). Academics, policymakers and others have debated the costs and benefits of explicit deposit insurance for almost two centuries, going back to the early 1800s when several states in the U.S. adopted various deposit insurance schemes to protect their state banking systems (Calomiris and White, 1994). This debate continued through 1933, when the U.S. became the first country to provide such insurance on a national basis, and until today as well (Chernykh and Cole, 2011).

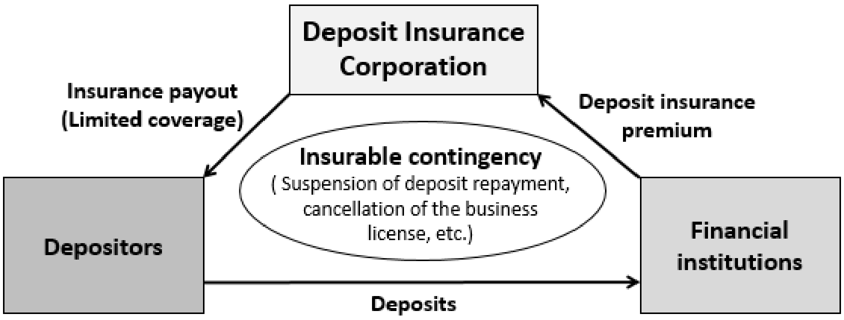
In Japan, The Deposit Insurance Corporation of Japan (hereinafter referred to as the "DICJ")) was established on July 1, 1971 as the administrative organ of Japan's deposit insurance system under the Deposit Insurance Law[2].This step was based on a recommendation issued in July 1970 by the Financial System Research Committee, an advisory board to the Minister of Finance. The original capital of JPY 450 million was subscribed one third each from the Japanese government, the Bank of Japan[3] and the private financial institutions. The government subsequently subscribed additional capital of JPY 5 billion in July 1996 to administer work related to non-performing housing loans, as well as guarantees transferred from the former Housing Loan Administration Corporation. The current share of the Japanese government stands at around 95% of total capital. The supervising authorities of the DICJ are the Ministry of Finance and Financial Services Agency (FSA). In the 1990's, accumulated non-performing loans in the financial system became a major issue following the collapse of the bubble economy, and the number of failed financial institutions increased significantly. The government has since taken many initiatives to ensure Japan's financial stability and, by doing so, push the economy back onto a recovery track with various legislative steps, including a series of amendments to the Deposit Insurance Law that took place from 1996 until today. These amendments significantly enabled the DICJ to expand its activities and mandate, while maintaining the DICJ's role as the main player in the deposit insurance system.

1-2. Basic Mechanism of the Deposit Insurance System of Japan

Under the deposit insurance system of Japan, depository financial institutions pay insurance premiums to the DICJ, and the DICJ makes a certain amount of insurance payouts to protect depositors in the event of a failure of a financial institution.

Fig 1. Basic mechanism of the deposit insurance system

[2] Law No.34 of April 1, 1971
[3] Bank of Japan (BOJ) is the central bank of Japan



As shown in Fig. 1, when a depositor makes a deposit at a financial institution that is covered by the deposit insurance system, an insurance relationship is automatically established among the depositor, the financial institution, and the DICJ, based on the Deposit Insurance Act; in other words, a three-way relationship of trust is established among these three parties. Insurance premiums, which constitute the fund source of the deposit insurance system, are paid to the DICJ every year by financial institutions according to the total amount of their deposits during the previous fiscal year. Depositors are not required to make any special arrangements for deposit insurance.

1-3. How does the deposit insurance system work?

As its name suggests, the deposit insurance system is intended primarily to provide for the payment of insurance claims when an insurable contingency occurs. Specifically, there are two methods of protection: the insurance payout method, whereby insurance payouts are made directly to depositors, and a second method, whereby the business of a failed financial institution is transferred to a different financial institution, and the DICJ provides assistance to this second institution. To illustrate how this works, let us consider the scenario of a financial institution failing on a Friday, and the DICJ being appointed as the financial administrator (here, we assume the adoption of the second method). In such a case, the DICJ dispatches staff to the failed financial institution and asks them to undertake the work of the financial administrator. The staff make preparations to enable the financial institution to resume business the following Monday so that deposits covered by the deposit insurance system (fully covered deposits) can be repaid to depositors. The amounts are based on the identification of deposits for each depositor (name-based aggregation of deposits) at the time of the failure.

Fig 2. Flow of resolution procedures

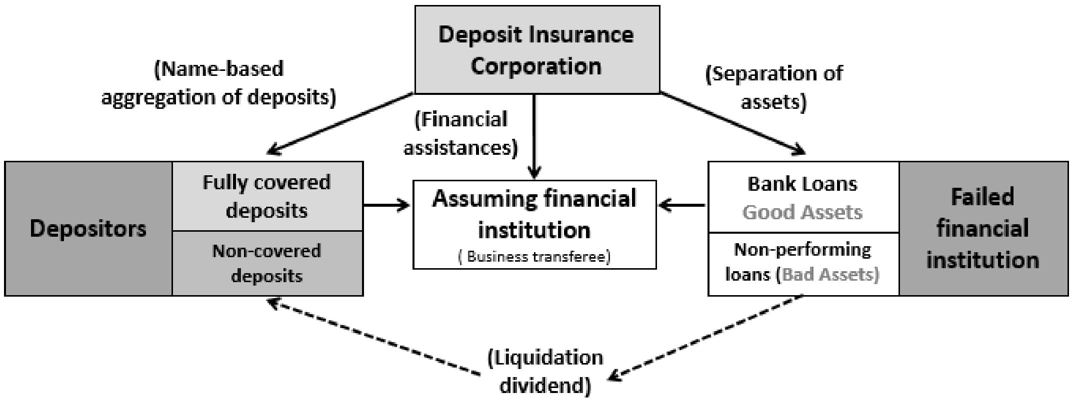


Fig. 2 shows the flow of resolution procedures. After resuming business the following Monday, the failed financial institution repays insured deposits and carries out operations related to payment and settlement. Ultimately, the DICJ will look for a financial institution that will accept a transfer of the failed financial institution's assets that are sound or not seriously impaired (i.e. good assets), in addition to any insured deposits. The DICJ provides necessary financial assistance to facilitate this transfer. Meanwhile, non-covered deposits and other debts are repaid approximately a year later, based on a revitalization plan formulated in accordance with the Civil Rehabilitation Act. There is no guarantee, however, that non-covered deposits will be fully repaid, and the percentage of repayment depends on the liquidation percentages of non-performing loans (bad assets).

By looking at the history of deposit insurance systems in Japan, we found that there are several changes in the scope of deposits to be guaranteed and the protection amounts. In the sections that follow, we shed light on the major changes that began in July 1986, when the financial assistance and partial payment system was introduced. Subsequently, in June 1996, insurance payouts became based on a method of placing deposits, and exceptional measures for full protection of deposits and other claims systems were developed.

Table 1. Changes in the scope of deposits, etc. and protection

	From July 1971	From June 1974	From July 1986	From June 1996	From April 2002	From April 2003	From April 2005	
Current deposits Ordinary deposits Specified deposits	Up to ¥1 million in principal	Up to ¥3 million in principal	Up to ¥10 million in principal	Fully protected				Deposits for payment and settlement purposes
								General deposits,

Time deposits Installment savings, etc.		Up to a total of ¥10 million in principal plus interest thereon payable until the day of the failure,

Source: DICJ Annual Report 2011/2012

At the end of March 2002, the DICJ abolished full protection of deposits, except for certain specific deposits (current deposits, ordinary deposits and specified deposits). In April 2003, deposits for payment purposes, settlement purposes, and settlement obligation all received full protection. Finally, however, in March 2005 full protection of specific deposits was abolished (Deposits that meet the requirements for payment and settlement purposes have continued to be fully protected since April 2005.).

1-4. Deposit insurance premiums

Deposit insurance premiums constitute a source of funds for operations such as financial assistance and insurance payout, and insured financial institutions must pay their insurance premiums to the DICJ. According to Japanese financial regulation, an insured financial institution calculates the amount of premiums it must pay by multiplying the insurance premium rate by the balance of eligible deposits, etc. for the previous fiscal year (the average daily balance for business days during the previous fiscal year). This is carried out with regard to each general deposit, and deposits for payment and settlement purposes and must have their insurance premiums paid within the first three months of each fiscal year (semiannual installments are also acceptable).

Table 2. Trend in the Insurance Premium Rates in Japan

	Premium rate		Effective rate [4]
From 1971 onward *(when the system began)*	0.006%		0.006%
From FY[5]1982 onward	0.008%		0.008%
From FY1986 onward	0.012%		0.012%
From FY1996 onward	0.048%		0.084%
	Specific deposits[6]	Other deposits[7]	
FY2001	0.048%	0.048%	0.084%
FY2002	0.094%	0.080%	0.084%

[4] Including the rate (0.036%) of the special insurance premium (provided for in Article 19, paragraph 1 of the Supplementary Provisions of the Deposit Insurance Act), which was in place between FY 1996 and FY 2001. The rate for FY 2002 is the weighted average of the rates for specific deposits and other deposits, and the rate for the period from FY 2003 onward is the weighted average of the rates for deposits for payments and settlement purposes and general deposits, etc.
[5] FY stands for Japanese fiscal year (1 April – 31 March)
[6] Specific deposits are current deposits, ordinary deposits and specified deposits, and other deposits, etc.
[7] Deposits other than specific deposits, such as time deposits.

	Deposit for payment and settlement purposes[8]	General deposits, etc.[9]	
From FY2003 onward	0.090%	0.080%	0.084%
FY2005	0.115%	0.083%	0.084%
From FY2006 onward	0.110%	0.080%	0.084%
FY2008	0.108%	0.081%	0.084%
FY2009	0.107%	0.081%	0.084%
From FY2010 onward	0.107%	0.082%	0.084%
FY2012[10]	0.107% (0.089%)	0.082% (0.068%)	0.084% (0.070%)

Source: DICJ Annual Report 2011/2012

Table 2 shows the changes in insurance premium rates in deposit insurance for different account types in Japan during the period of FY 1971 – FY 2012. As indicated by the table, the current weighted average premium rate is 0.084%.

2. Model,

2.1. Optimal Premium Model (OPM),

The main purpose of this paper is to provide a model for estimating optimal and fair premium rates for the deposit insurance system. The definition of the optimal rate in this paper is a rate that covers operational expenditures of an insuring agency and provides sufficient funds to the insuring agency in order to assist a failed depositary financial institution financially, while also allowing the insuring agency to keep a fair amount of liability reserves at the end of each period in order to insure against further failures. High premium rates will reduce the capital adequacy of individual financial institutions, which will in turn endanger the stability of the financial system. On the other hand, low premium rates will reduce the safety of the financial system in general. Therefore, it is crucial for each country to look for an optimal premium rate that strikes a good balance between these extremes. In addition, it is also critical to recognize that the level of liability reserves should not be too high or low.

As we reviewed the literature containing studies in this field, we found few papers that account for the estimation of an optimal and fair premium rate of deposit insurance. One of the papers that we found that mentioned this point was by Hwang et al. (1997). Their analysis indicates that the higher the equity capital, profitability, or liquidity, the lower the probability of a bank failure. These authors used the estimated probabilities of bankruptcy for the banks that failed in 1990

[8] Until FY 2004, deposits for payment and settlement purposes were the same as specific deposits, and general deposits, etc. were the same as other deposits. From FY 2005 onward, deposits for payment and settlement purposes comprised deposits meeting three requirements — bearing no interest, payable on demand, and capable of providing payment and settlement services — and specified settlement obligations,

[9] Deposits other than deposits for payment and settlement purposes, such as time deposits.

[10] For FY 2012, the premium rate and effective rate in the parentheses will be applied if there is neither (i) insurance contingency, (ii) order for a financial administrator to manage the business and properties of the failed financial institution, nor (iii) decision by the Prime Minister to take measures stipulated in Article 102, Paragraph 1, Item 2 or 3 of the Deposit Insurance Act during the fiscal year.

and 1991 (out-of-sample predictions) to calculate the actuarial fair insurance premiums. In this research, however, we are going to forecast optimal and fair premium rates based on a logical risk-based scheme, according to a financial assistance forecasting model called the Optimal Premium Model (OPM). The variables that we used to shape our financial assistance forecasting model are: GDP, stock prices, land prices, and interest rates. In order to find future optimal premium rates, we formed our OPM model by setting the accumulated discount value of the Deposit Insurance Corporation's incomes as being equal to: The sum of the accumulated discount values of operational expenditures, the accumulated discount value of the Deposit Insurance Corporations' financial assistance, and the discounted value of the Deposit Insurance Corporation's future reserves. We believe that this method is useful for both countries like Japan, which already have a deposit insurance system, and for countries that intend to launch one. This method will be useful in finding these countries' future optimal premium rates and raising the safety level of their financial systems.

The equation below explains the general outline of this method:
Accumulated discounted incomes of the Deposit Insurance Corporation (including future expected incomes) = Accumulated discount operational expenditures of the Deposit Insurance Corporation (including future expected operational expenditures) + Accumulated discount financial assistances of the Deposit Insurance Corporation to failed financial institutions (including future expected financial assistances) + discounted desired future reserves of the Deposit Insurance Corporation at the end of the period.

Accumulated discounted incomes of the Deposit Insurance Corporation[11]:

$$PVI = \frac{\tau_1 D_0}{1+r_1} + \frac{\tau_2 D_1}{(1+r_2)^2} + \ldots + \frac{\tau_t D_{t-1}}{(1+r_t)^t} + \frac{\tau_{t+1} D_t}{(1+r_{t+1})^{t+1}} + \ldots + \frac{\tau_{t+n} D_{t+n-1}}{(1+r_{t+n})^{t+n}} \tag{1}$$

Accumulated discounted operational expenditures of The Deposit Insurance Corporation:

$$PVE = \frac{E_1}{1+r_1} + \frac{E_2}{(1+r_2)^2} + \ldots + \frac{E_t}{(1+r_t)^t} + \frac{E_{t+1}}{(1+r_{t+1})^{t+1}} + \ldots + \frac{E_{t+n}}{(1+r_{t+n})^{t+n}} \tag{2}$$

Accumulated discounted financial assistances of the Deposit Insurance Corporation:

$$PVF_A = + \frac{F_{A_1}}{1+r_1} + \frac{F_{A_2}}{(1+r_2)^2} + \ldots + \frac{F_{A_t}}{(1+r_t)^t} + \frac{F_{A_{t+1}}}{(1+r_{t+1})^{t+1}} + \ldots + \frac{F_{A_{t+n}}}{(1+r_{t+n})^{t+n}} \tag{3}$$

Discounted desired future reserves of the Deposit Insurance Corporation at the end of the period:

$$PVRES = \frac{RES_{t+n}}{(1+r_{t+n})^{t+n}} \tag{4}$$

[11] The premium rates needs to be multiplied by the amount of eligible deposits in the previous fiscal year.

where PVI denotes the accumulated discount incomes of the Deposit Insurance Corporation in the first year[12], D is amount of eligible deposits, τ is the deposit insurance premium rate, r stands for the long-term interest rate that is used for discounting values, PVE stands for the accumulated discount operational expenditures of the Deposit Insurance Corporation (e.g., personnel costs and equipment costs), PVF_A is the accumulated discount financial assistance of the Deposit Insurance Corporation, and as the current year is year t, so for (t+1,…,t+n), this is the anticipated amount of financial assistance which will be forecast using our Vector Error Correction Model (VECM). This model will be explained later in this section and in section 3-2. Finally, $PVRES$ is the discounted desired future reserves of the Deposit Insurance Corporation at the end of period of the year t+n.

The equation below shows the OPM:

$$PVI = PVE + PVF_A + PVRES \tag{5}$$

By substituting Eq. 1 to 4 in Eq. 5, we arrive at the expanded version of OPM results:

$$\begin{aligned} &\frac{\tau_1 D_0}{1+r_1} + \frac{\tau_2 D_1}{(1+r_2)^2} + \dots + \frac{\tau_t D_{t-1}}{(1+r_t)^t} + \frac{\tau_{t+1} D_t}{(1+r_{t+1})^{t+1}} + \dots + \frac{\tau_{t+n} D_{t+n-1}}{(1+r_{t+n})^{t+n}} = \frac{E_1}{1+r_1} + \frac{E_2}{(1+r_2)^2} + \\ &\dots + \frac{E_t}{(1+r_t)^t} + \frac{E_{t+1}}{(1+r_{t+1})^{t+1}} + \dots + \frac{E_{t+n}}{(1+r_{t+n})^{t+n}} + \frac{F_{A_1}}{1+r_1} + \frac{F_{A_2}}{(1+r_2)^2} + \dots + \frac{F_{A_t}}{(1+r_t)^t} + \frac{F_{A_{t+1}}}{(1+r_{t+1})^{t+1}} + \\ &\dots + \frac{F_{A_{t+n}}}{(1+r_{t+n})^{t+n}} + \frac{RES_{t+n}}{(1+r_{t+n})^{t+n}} \end{aligned} \tag{6}$$

In order to find optimal deposit insurance premium rate[13] from t+1 to t+n, we need to solve the equation above. This method has two conditions; A) the only source of income for the Deposit Insurance Corporation is insurance premium income, B) the only expenditures that the Deposit Insurance Corporation has are operational expenditures and the funds provided as financial assistance for banking failures (payment to depositors). However, it is possible to modify each of these two conditions; for example, the Deposit Insurance Corporation can have another source of income, as Japan had after the asset price bubble burst. During the period of 1998-2002, the Japanese financial system experienced 158 cases of failure[14], with an average of about 32 cases in each year. The largest was in 2002 when the number of cases climbed to 51. This resulted in huge amounts of assistance being paid into special operation funds. Other

[12] The first year is the year that the deposit insurance system is launched in the country of our estimation. This could also be the year that the banking system had a structural change or experienced a financial crisis and then was supposed to calculate the optimal premium rate following that specific year.

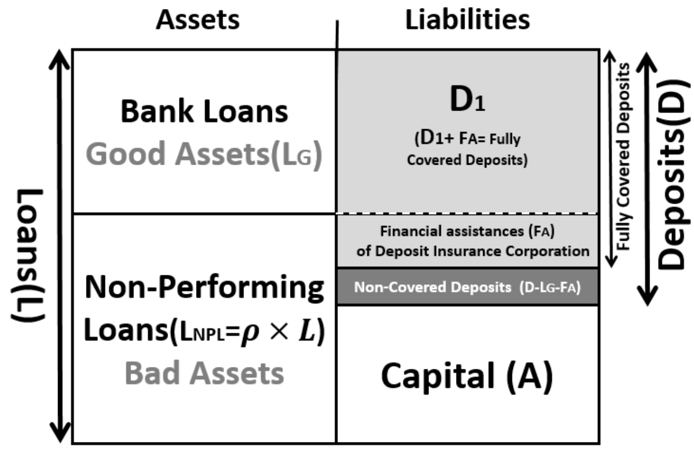
[14] So far, the DICJ has provided financial assistance in a total of 182 cases of financial institution failure.
All of these occurred after 1992 under the provisions of Articles 64 and 118 of the Deposit Insurance Act and Article 72 of the Financial Revitalization Act.

sources of income should be added to right hand side of Eq. 1. When other expenditures are present, they are added to right hand side of Eq. 2.

2.2. What is the Best Way of Forecasting Future Financial Assistance from the Deposit Insurance Corporation?

The figure below shows a bank's balance sheet. Each part of this balance sheet is based off of the following sections.

Fig 3. Bank's balance sheet



Source: Authors

As mentioned earlier, the current year in OPM is year t, so financial assistance provided by the Deposit Insurance Corporation in the future ($F_{A_{t+1}} ... F_{A_{t+n}}$) have yet to be determined. For this reason, we need to estimate their expected values. In order to define what variables have an impact on the Deposit Insurance Corporation's financial assistance, we referred to an earlier study of Yoshino and Hirano (2011), which contained research for finding the optimal capital ratio requirement of banks:

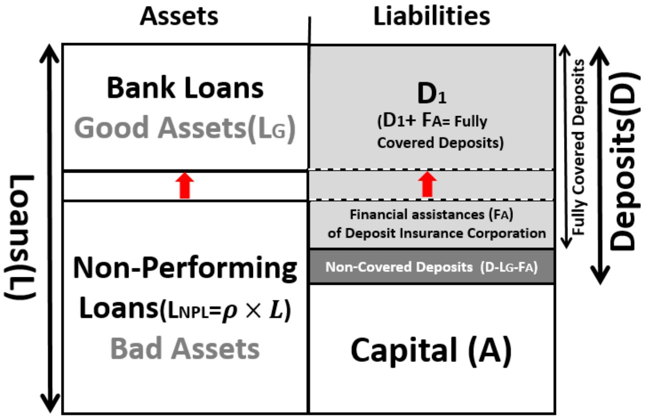
$$L_{NPL} = \rho(Y, P_S, P_L, i_B) \times L \qquad (7)$$

Where Y, P_S, P_L, i_B, L and ρ are: GDP, stock prices, land prices, safe interest rates[15], total loans and expected percent of loans that would result in default. In Yoshino and Hirano's model, they explain that the amount of non-performing loans (L_{NPL}) depends on the various economic factors mentioned above. When land prices increase collateral value increases as well, so default risk ρ will decline. When business conditions improve, Increases in GDP growth and stock prices cause a reduction in default risk ρ, and when there is a rise in the government bond interest rate, one of

[15] Interest rates on safe assets such as the government bonds interest rate.

the safest asset interest rates, banks tend to invest more in a safe asset that will reduce default risks.[16]

Fig. 4 Changes in assistance from the Deposit Insurance Corporation (F_A) Following changes in loan default risk ρ



Source: Authors

As indicated in Fig. 4, financial assistance from the Deposit Insurance Corporation (F_A) following a bank default is a function of L_{NPL}. Therefore, it is a function of economic factors such as GDP, stock prices, land prices, and government bond interest rates. When GDP, land price, stock price, and government bond interest rates rise, banks are faced with a lower default risk from loans and therefore require less assistance from the Deposit Insurance Corporation.

Fig. 4 shows that when the amount of non-performing loans increases, demand for financial assistance from the Deposit Insurance Corporation will rise as well, hence:

$$F_A = f(Y, P_S, P_L, i_B) \tag{8}$$

where F_A is the total amount of financial assistance provided by the deposit insurance corporation for the failures of financial institutions in each year. Better economic situation, higher land price, and higher government bond rates (safe assets) will result in lower risk of default, lower non-performing loans, and decreased demand for financial assistance from the Deposit Insurance Corporation (F_A).

[16] Banks are assumed to maximize their profit. Each bank lends money to a risky sector and invests in risky securities:

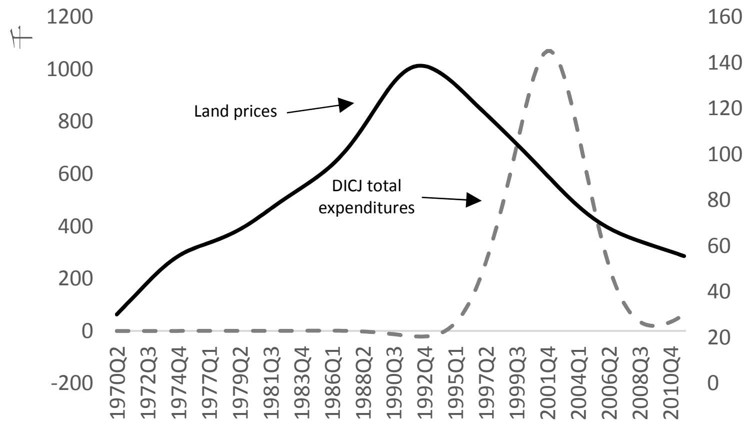
$\pi = r_L \times L - \rho(Y, P_S, P_L, i_B) \times L - r_D \times D - C(L, D)$

where r_L is the interest rate on bank loans, r_D is the interest rate that the banks pays for deposits and $C(L,D)$ is various costs from operations of the bank (e.g., personnel costs and equipment costs). These depend on the amount of bank loans and deposits, (Yoshino and Hirano 2013). Each bank maximizes the above equation subject to the constraints below:

$L_G + L_{NPL} = D_{Cov+}D_{Non-Cov} + A : D_{Cov} = D_1 + F_A$ Where L_G is good loans, L_{NPL} is non-performing loans, D_{Cov} is covered deposits, which consist of D_1 (as explained in Fig. 3 and Fig. 4) $+F_A$. $D_{Non-Cov}$ is non-covered deposits.

$$(Y, P_S, P_L, i_B) \downarrow \Rightarrow \rho \uparrow \Rightarrow L_{NPL} \uparrow \Rightarrow F_A \uparrow \quad (9)$$

Fig. 5 DICJ Expenditures and Land price in Japan



Note: Since data was quarterly, in order to have a contiguous curve we have done exponential smoothing.

Fig 5. Exhibits DICJ Total expenditures and land prices in Japan during 1970 Q2 – 2011Q4. Here, the DICJ total expenditures contain both operational costs and financial assistance. As it is clear before the first financial failure in Japan, which happened in 1992, DICJ expenditures were extremely low, and consisted of just the operational costs. Following the collapse of the bubble economy in Japan, the number of failed financial institutions in the country increased significantly. As the figure shows, land prices started to decrease starting in 1992, but DICJ expenditures reached their peak in 2002. This means that the number of defaults had been increasing for a decade after the bubble burst, and the recovery started once this number peaked. As the data shows, the absolute value of DICJ liability reserves reached their highest point in 2002, indicating that there was a great deal of demand for this corporation's ability to financially support failed institutions. This support was mainly carried out using government contributions.

3- Data Analysis and VECM Model

3-1- Data Analysis

In order to evaluate the stationarity of all series, we used an Augmented Dickey–Fuller (ADF) test. The results that we found imply that, with the exception of GDP, which was stationary in log-level, all other variables are non-stationary in log-level. These variables include DICJ financial assistance, land price, stock price, and government bond interest rate. However, when we applied the unit root test to the first difference of log-level variables, we were able to reject the null hypothesis of unit roots for each of the variables. These results suggest that the financial assistance of DICJ, land price, stock price, and government bond interest rate variables each contain a unit root. Once the unit root test was performed and it was discovered that the variables are non-stationary in level and stationary in first differences level, they were integrated of order one. After this, the next step was to apply a cointegration analysis to examine whether a long-run relationship exists among these variables.

3-2- Vector Error Correction Model (VECM) for financial assistance forecasting

We conducted a cointegration analysis using Johansen's technique in order to identify the cointegrating vectors among the following: Financial assistance, GDP, land price, stock price, and government bond interest rate variables. After this analysis was complete, we identified the cointegrating vectors among these variables and set up Vector Error Correction Models (VECM) to uncover the long-run relationships that connect these variables.

One critical problem of the (VAR/VEC) models is that there is a choice of lags. Ivanov and Kilian (2005) suggested six criteria for lag order selection: the Schwarz Information Criterion (SIC), the Hannan–Quinn Criterion (HQC), the Akaike Information Criterion (AIC), the general-to-specific sequential Likelihood Ratio (LR) test, a small-sample correction to that test (SLR), and the Lagrange Multiplier (LM) test. We selected optimal lag numbers using Akaike Information Criterion (AIC) standards, which suggested 2 lags:

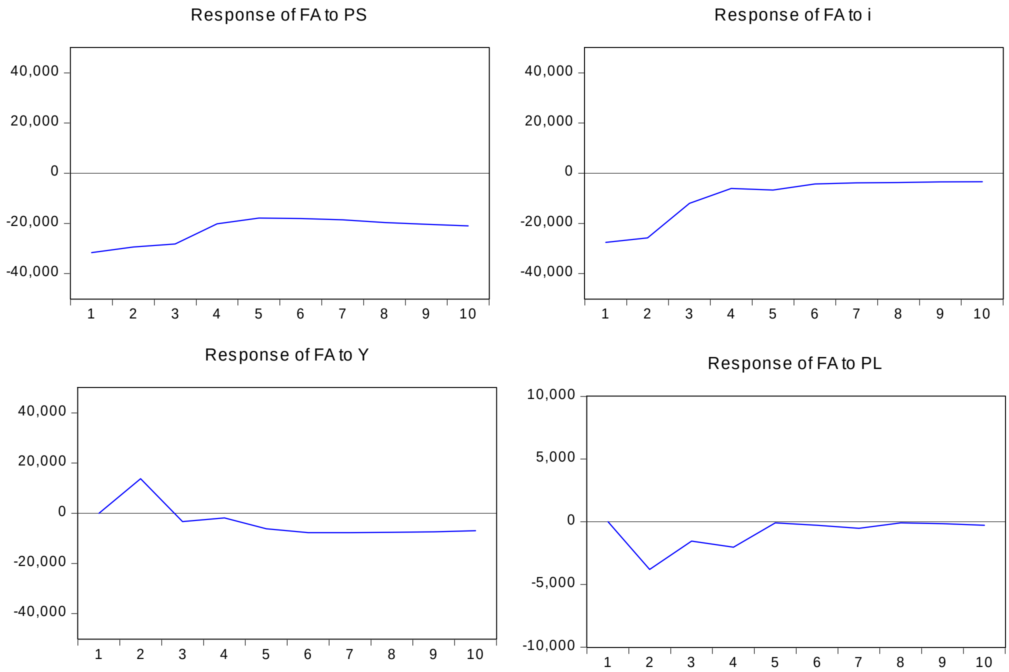
$$
\begin{aligned}
& d(LOG(F_A)) = 0.38\times(LOG(P_S(-1)) + 0.06\times LOG(F_A(-1)) - 0.05\times i_b(-1) - 6.83\times LOG(Y(-1)) - \\
& 0.29\times LOG(P_L(-1)) + 222.29) - 0.28\times d(LOG(P_S(-1))) + 0.03\times d(LOG(P_S(-2))) - \\
& 0.06\times d(LOG(F_A(-1))) + 0.03\times d(LOG(F_A(-2))) - 0.43\times d(i_b(-1)) - 0.16\times d(i_b(-2)) + \\
& 7.46\times d(LOG(Y(-1))) - 5.89\times d(LOG(Y(-2))) - 0.12\times d(LOG(P_L(-1))) - \\
& 0.52\times d(LOG(P_L(-2))) + 0.02
\end{aligned}
\tag{9}
$$

Eq. 9 shows our estimated VECM for DICJ financial assistance forecasting, with the substituted coefficients using data from 1990 Q1 – 2011 Q4.

We next subjected our Vector Error Correction Model (VECM) to an impulse response analysis, in order to examine the effects of GDP, land price, stock price and government bond interest rate movements during the period of 1990 Q1 – 2011 Q4 on the DICJ's financial assistance.

Fig 7. Response of DICJ Financial Assistance[17]

[17] Cholesky one S.D.



As it is clear from this data, responses of financial assistance to GDP (Y), stock price (P_S) and government bond interest rate (i_b) movements act exactly as indicated by the studies mentioned earlier. A negative shock: Lower stock prices, lower land prices and lower government bond (safe asset) interest rate results in a higher risk of default ρ, a higher non-performing loan amount L_{NPL}, and a greater demand for financial assistance from the Deposit Insurance Corporation F_A. This is exactly what happened following the collapse of the bubble economy in Japan in the 1990's. The response to land price (P_L) movements, matches the events that actually occurred. Following the collapse of the bubble economy, GDP growth rates started to decrease but land prices were still rising. Over time they eventually began to decrease with lags, so in the first part of the 4th chart in the figure above, we see that when the price of land is increasing, F_A will decrease. With the decrease of land prices, demand for F_A begins to increase, due in large part to higher default risk that results from larger accumulated non-performing loans.

3-3- Scenario Analysis for Financial Assistance and Optimal Premium Forecasting

In this section, we subject our OPM to a scenario analysis in order to forecast future expected values of both DICJ financial assistance and the optimal premium rates. Here, we define three scenarios and use them to calculate these two expected variables.

Scenario No.1:

Assumptions: i) GDP, land price, stock price, government bond interest rates, and eligible deposits growth rates during $(t,\ldots,t+n)$ are null in each year, and the values of these variables remain constant throughout the period. ii) Desired future reserve of the Deposit Insurance Corporation in $(t+n)$ is null.

$Y_t = Y_{t+1} = ... = Y_{t+n}, P_{Lt} = P_{Lt+1} = ... = P_{Lt+n}, \ P_{St} = P_{St+1} = ... = P_{St+n}, i_{Bt} = i_{Bt+1} = ... = i_{Bt+n},$
$D_t = D_{t+1} = ... = D_{t+n}$ and $RES_{t+n} = 0$

Table 3. Results of Scenario No. 1

Year / Quarter	Estimation of the expected growth rate of DICJ total expenditures[18] in each quarter (%)	Expected estimation for DICJ total expenditure amounts in each quarter (million yen)	Optimal deposit insurance premium rate[19] (2013Q1-2016Q4)
2013Q1	-0.111	180,200.81	
2013Q2	-0.174	179,887.95	
2013Q3	-0.169	179,584.13	
2013Q4	-0.171	179,277.13	
2014Q1	-0.171	178,971.05	
2014Q2	-0.171	178,665.37	
2014Q3	-0.171	178,360.23	
2014Q4	-0.171	178,055.60	0.409% (0.2472%)
2015Q1	-0.171	177,751.50	
2015Q2	-0.171	177,447.91	
2015Q3	-0.171	177,144.84	
2015Q4	-0.171	176,842.29	
2016Q1	-0.171	176,540.26	
2016Q2	-0.171	176,238.74	
2016Q3	-0.171	175,937.74	
2016Q4	-0.171	175,637.25	

Scenario No.2:

Assumptions: i) GDP, land price, stock price and eligible deposits growth rates during $(t,\ldots,t+n)$ in each year are 2% greater than their value in the previous year. ii) Desired future reserve of the Deposit Insurance Corporation in $(t+n)$ is null, iii) Government bond interest rates keep constant throughout the period.

$$1.02 \times Y_t = Y_{t+1}, \cdots, 1.02 \times Y_{t+n-1} = Y_{t+n}$$
$$1.02 \times P_{Lt} = P_{Lt+1}, \cdots, 1.02 \times P_{Lt+n-1} = P_{Lt+n}$$
$$1.02 \times P_{St} = P_{St+1}, \cdots, 1.02 \times P_{St+n-1} = P_{St+n}$$
$$1.02 \times D_t = D_{t+1}, \cdots, 1.02 \times D_{t+n-1} = D_{t+n}$$
$$i_{Bt} = i_{Bt+1} = ... = i_{Bt+n} \quad \text{And} \quad RES_{t+n} = 0$$

Table 4. Results of Scenario No. 2

[18] Including both: operational expenditures and financial assistance to failed financial instructions.
[19] The value outside of parenthesis found on the condition that we take 1992 as the initial year. The value inside the parenthesis is calculated if we take the year 2000 as the initial year of our calculations. During 1992-2000 DICJ expenditures reached their peak because of the bubble economy collapse. After 2000, the economic recovery reduced DICJ expenditures. This means that the optimal premium rate is higher in the first case.

Year / Quarter	Estimation of the expected growth rate of DICJ total expenditures in each quarter (%)	Expected estimation for DICJ total expenditure amounts in each quarter (million yen)	Optimal deposit insurance premium rate (2013Q1-2016Q4)
2013Q1	-0.11%	180,200.81	0.403% (0.2469%)
2013Q2	-0.15%	179,930.50	
2013Q3	-0.19%	179,589.39	
2013Q4	-0.20%	179,228.64	
2014Q1	-0.21%	178,846.45	
2014Q2	-0.22%	178,444.55	
2014Q3	-0.24%	178,022.95	
2014Q4	-0.25%	177,581.85	
2015Q1	-0.26%	177,121.39	
2015Q2	-0.27%	176,641.73	
2015Q3	-0.28%	176,143.03	
2015Q4	-0.29%	175,625.44	
2016Q1	-0.31%	175,089.16	
2016Q2	-0.32%	174,534.35	
2016Q3	-0.33%	173,961.19	
2016Q4	-0.34%	173,369.89	

Scenario No.3:

Assumptions: i) GDP, land price, stock price, and eligible deposits growth rates during ($t,\ldots,t+n$) in each year are -2% from their value in the previous year. ii) Desired future reserve of the Deposit Insurance Corporation in ($t+n$) is null, iii) Government bond interest rates remain constant throughout the period.

$$0.98\times Y_t = Y_{t+1},\cdots,0.98\times Y_{t+n-1} = Y_{t+n}$$

$$0.98\times P_{Lt} = P_{Lt+1},\cdots,0.98\times P_{Lt+n-1} = P_{Lt+n}$$

$$0.98\times P_{St} = P_{St+1},\cdots,0.98\times P_{St+n-1} = P_{St+n}$$

$$0.98\times D_t = D_{t+1},\cdots,0.98\times D_{t+n-1} = D_{t+n}$$

$$i_{Bt} = i_{Bt+1} = \ldots = i_{Bt+n} \quad \text{and} \quad RES_{t+n} = 0$$

$$RES_{t+n} = 0$$

Table 5. Results of Scenario No. 3

Year / Quarter	Estimation of the expected growth rate of DICJ total expenditures in each quarter (%)	Expected estimation for DICJ total expenditure amounts in each quarter (million yen)	Optimal deposit insurance premium rate (2013Q1-2016Q4)
2013Q1	-0.11%	180,200.81	0.415% (0.2475%)
2013Q2	-0.20%	179,845.19	
2013Q3	-0.15%	179,578.82	
2013Q4	-0.14%	179,325.85	
2014Q1	-0.13%	179,096.31	
2014Q2	-0.12%	178,887.46	
2014Q3	-0.10%	178,699.65	
2014Q4	-0.09%	178,532.70	
2015Q1	-0.08%	178,386.58	
2015Q2	-0.07%	178,261.22	
2015Q3	-0.06%	178,156.58	
2015Q4	-0.05%	178,072.62	

2016Q1	-0.04%	178,009.31
2016Q2	-0.02%	177,966.63
2016Q3	-0.01%	177,944.55
2016Q4	0.00%	177,943.07

As the results from Tables 3, 4 and 5 show, the estimated optimal deposit insurance premium rate of the DICJ for the period of 2013 Q1 – 2016 Q4 under the conditions of scenarios 1, 2 and 3 are 0.409%, 0.403%, and 0.415%, respectively, if we use 1992 as the initial year. If we use 2000 as the initial year, however the values of this rate are: 0.2472%, 0.2469% and 0.2475%, respectively. As Table 2 shows, however, for FY 2012 the actual weighted average premium rate of the DICJ was 0.084%. This means that our results are between 3 to 5 times greater than the current rate. One of the reasons that a portion of this huge difference occurred is that, according to the DICJ Act, the government may subsidize some of the expenses incurred by the DICJ. In our method, however, premium income is the only source of income of the DICJ, which means that the optimal premium rate will be higher.

Another result of this estimation is that during good economic conditions when GDP, land prices, and stock prices are increasing, and the size of eligible deposits are expanding, the optimal premium rate should be reduced because of decreases in default risk and non-performing loans. On the other hand, in economic recessions in which GDP, land prices, and stocks prices are decreasing, premium rates need to be raised because the default risk and accumulated non-performing loans increase. As our estimations shows, however, the differences between the premium rates shown in these three scenarios are not large.

4- Conclusion

In this research we used an Optimal Premium Model (OPM) to calculate the optimal premium rate for the deposit insurance system. Using optimal premium rates is a necessity for deposit insurance agencies in order to maintain financial system stability, protect depositors, and ensure the settlement of funds related to failed financial institutions. In this paper, the optimal rate is defined as a rate that covers the operational expenditures of an insuring agency and provides sufficient funds so that said insuring agency can financially assist any failed depository financial institutions while retaining a fair amount of liability reserves at the end of each period in order to secure further failures. High premium rates reduce the capital adequacy of individual financial institutions, which can in turn endanger the stability of the financial system. Low premium rates, however, will reduce the overall safety of the financial system.

We forecasted this optimal rate for Japan for the period of 2013 Q1 – 2016 Q4, and compared it with the current rates. We found that the optimal rate for the Japanese deposit insurance system is higher than the rate currently being applied, implying that Japan needs to raise the premium rate in order to secure the stability of the financial system.

Another result of the estimations in this paper is the implication that the premium rate should be reduced during good economic conditions because of a decrease in default risk and non-performing loans. On the other hand, however, the premium rates need to be increased during economic recessions when GDP, land prices, and stock prices fall because the default risk and accumulated non-performing loans increase. As our estimations show, however, there is currently little variation between the optimal premium rates in good and bad economic conditions.

In closing, the financial industry has expressed the opinion that if the capital adequacy of individual financial institutions is enhanced through a reduction in deposit insurance premiums, the overall stability of the financial system will also be improved. In order to reduce systemic risk, however, it is not sufficient to improve only the financial soundness of individual financial institutions; the enhancement of safety nets such as deposit insurance system is also essential. Hence looking at our results, it becomes vital that deposit insurance agencies adopt optimal premium rates.

Reference:

Acharya, S. & Dreyfus, J. (1989). Optimal Banking Reorganization Policies and the Pricing of Federal Deposit Insurance. Journal of Finance, 44(5), 1313-1333.

Avery, R. B., Hanweck, G. A. & Kwast, M. L. (1985). An Analysis of Risk-Based Deposit Insurance for Commercial Banks. Research Papers in Banking and Financial Economics, 79, Board of Governors of the Federal Reserve System (U.S.)

Bartholdy, J., Boyle, G. W. and Stover, R. D. (2003), Deposit insurance and the risk premium in bank deposit rates. Journal of Banking & Finance, 27(4), 699-717.

Buser, S. A., Chen, A. H. & Kane, E. J. (1981). Federal Deposit Insurance, Regulatory Policy and Optimal Bank Capital. Journal of Finance, 36(1), 5l-60.

Calomiris, C., White, E., 1994. The Origins of Federal Deposit Insurance. In: Goldin, C., Libecap, G. (Eds.), The Regulated Economy: A Historical Approach to Political Economy. University of Chicago Press, Chicago, pp. 145–188.

Chernykh, L. & Cole, R. A. (2011). Does Deposit Insurance Improve Financial Intermediation? Evidence From the Russian experiment, Journal of Banking & Finance. 35(2): 388-402.

Diamond, D.W., Dybvig, P. H., 1983. Bank Runs, Deposit Insurance, and Liquidity. Journal of Political Economy, 91(3), 401–419.

Goodman, L.S., & Santomero, A. M. (1986). Variable-Rate Deposit Insurance: A re-examination. Journal of Banking and Finance, 10(2), 203-218.

Horvitz, P.M. (1983). The Case against Risk-Adjusted Deposit Insurance Premiums. Housing Finance Review, 2, 253-264.

Hwang, D., Lee, C. F. and Liaw, K. T., (1997). Forecasting bank failures and deposit insurance premium. International Review of Economics & Finance, 6(3), 317-334.

Kane, E. J. (1986). Appearance and Reality in Deposit Insurance: The Case for Reform. Journal of Banking and Finance, 10(2), 175-188.

Ivanov, V. & Kilian, L. (2005). A Practitioner's Guide to Lag Order Selection for VAR Impulse Response Analysis. Studies in Nonlinear Dynamics and Econometrics, 9(1), 1-36.

Merton, R. C. (1977). An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees An Application of Modem Option Pricing Theory. Journal of Banking and Finance, 1(1), 3-l1.

Ronn, E. I. & Verma, A. K. (1986). Pricing Risk-Adjusted Deposit Insurance: An Option-Based Model. Journal of Finance, 41(4), 871-895.

Barr, R. S., Seiford, L. M. and Siems T. F. (1994), Forecasting Bank Failure: A Non-Parametric Frontier Estimation Approach, Recherches Économiques de Louvain / Louvain Economic Review, 60(4), 417-429

Santomero A. M. & Vinso, J. D. (1977). Estimating the Probability of Failure for Commercial Banks and the Banking System. Journal of Banking and Finance, 1(2), 185-205.

Yoshino, Naoyuki, Tomohiro Hirano, and Kakeru Miura (2009). The Optimal Basel Capital Requirement to Cope with Pro-cyclicality: A Theoretical Approach. FRTS Discussion Papers No. DP2009-6. Japan: Financial Research Center (FSA Institute), Financial Services Agency (FSA), Government of Japan. Available at www.fsa.go.jp/frtc/english/seika/discussion.html

Yoshino, Naoyuki and Hirano, Tomohiro (2011), Pro-cyclicality of the Basel Capital Requirement Ratio and Its Impact on Banks. Asian Economic Papers, 10(2): 22-36

Yoshino, Naoyuki and Hirano, Tomohiro (2013), Counter-cyclical Buffer of the Basel Capital Requirement and Its Empirical Analysis: Current Developments in Monetary and Financial law

6: 417-429, International Monetary fund, Washington, U.S.A

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