Capital Allocation and Bank Management Based on the Quantification of Credit Risk

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1. The Need for Quantification of Credit Risk

Liberalization and deregulation have recently accelerated. It is therefore useful to keep risk within a certain level in relation to capital, considering that financial institutions must control their risk appropriately to maintain the safety and soundness of their operation. In 1988, the Basle Capital Accord—International Convergence of Capital Measurement and Capital Standards—introduced a uniform framework for the implementation of risk-based capital rules. However, this framework applies the same "risk weight" (a ratio applied to assets for calculation of aggregated risk assets) to loans to all the private corporations, regardless of their creditworthiness. Such an approach might encourage banks to eliminate loans that can be terminated easily while maintaining loans with higher risk.

As shareholder-owned companies, banks are expected to maximize return on equity during this competitive era, while performing sound and safe banking functions as financial institutions with public missions. Banks are finding it useful to conduct business according to the management method that requires them to maintain risk within capital and to use risk-adjusted return on allocated capital as an index of profitability based on more accurate quantification of credit risk.

2. Outline of the Model for the Quantification of Credit Risk

2.1. Basic Definitions for the Quantification of Credit Risk

"Credit risk" (also referred to as maximum loss), in a narrow sense, is defined as the worst expected loss (measured at a 99 percent confidence interval) that an existing portfolio (a specific group) might incur until all the assets in it mature. (We set the longest period at five years here.) Capital should cover credit risk—the maximum loss exceeding the predicted amount.

"Credit cost" (also referred to as expected loss) is defined as the loss expected within one year. Credit cost should be regarded as a component of the overall cost of the loan and accordingly be covered by the loan interest.

"Loss amount" is defined as the cumulative loss we incur over a specific time horizon because of the obligor's default. Loss amount is equal to the decrease in the present value of the cash flows related to a loan caused by setting the value of the cash flows (after the default) at zero: Loss

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amount equals value in consideration of default less value in case no default occurs.

Here, the loan is regarded as a bond that pays an annual fixed rate. The minimum unit period for a loan is one year; any shorter periods are to be rounded up to the nearest year. The value of each cash flow after default is zero. The discount rate can be determined only for one currency that is applied to all the transactions. Mark-to-market in case of downgrades or upgrades of credit rating is not performed. Loss amount consists of principal plus unpaid interest.

$$Loss\ amount = PV_d - PV_0,$$

$$PV_d = \sum_{t=1}^{d-1} D_t \bullet r \bullet P + D_d \bullet \lambda \bullet P,$$

$$PV_0 = \sum_{t=1}^{M} D_t \bullet r \bullet P + D_M \bullet P.$$

Here, d denotes the year of default, M the maturity of the loan, D_t the discount rate for year t, r the interest rate of the loan, P the outstanding balance of the loan, and λ the recovery rate. We set at zero the discount rate and the interest rate of the loan.

The above measurement does not include new lendings or rollovers that might be extended in the future. Prepayment is not considered, and the risks until the contract matures will be analyzed. (We set the longest period, however, at five years.)

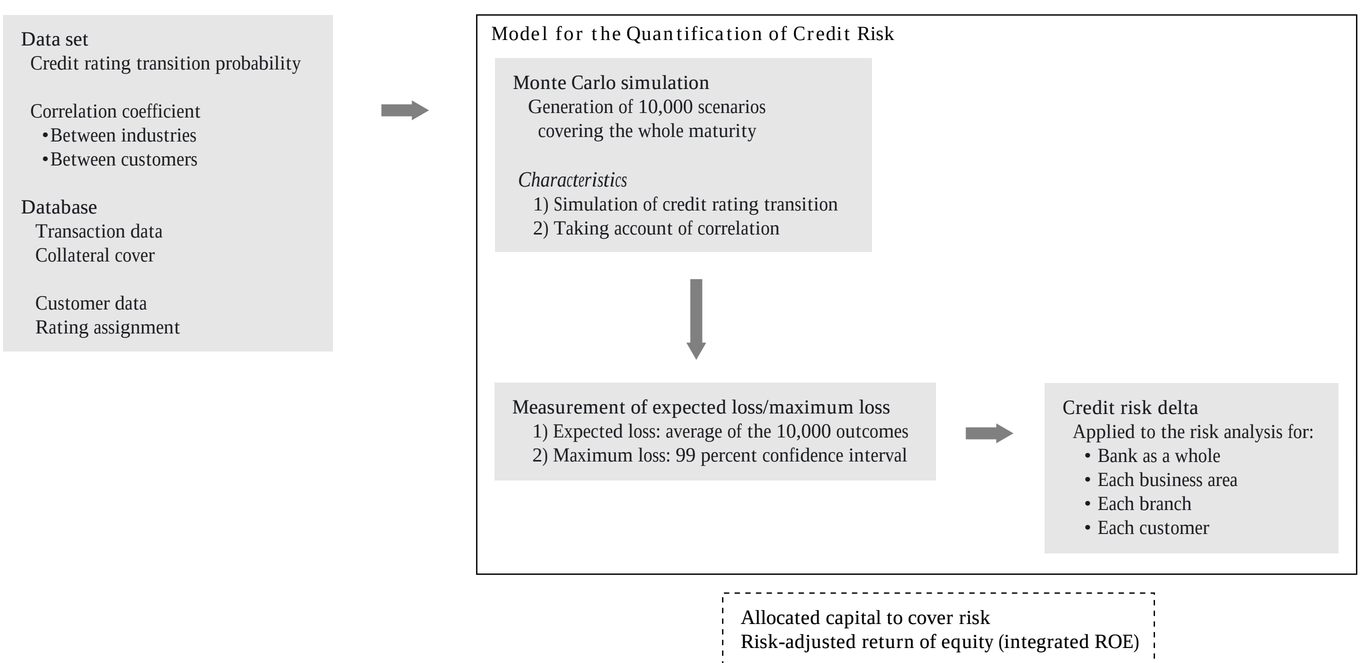
"Recovery rate" is defined as the ratio of 1) the current price of the collateral multiplied by the factors according to the internal rule to 2) the principal amount of each loan on the basis of the present perspective of recovery. In calculations of the loss amount, the amount that can be recovered is deducted from the principal amount of each loan (corresponding to $D_d \cdot \lambda \cdot P$ in the above formulas). "Uncovered balance" is loan balance less collateral coverage amount obtained by using the above recovery rate. We do not consider the fluctuation of the recovery amount in the future.

2.2. Characteristics of the Model for the Quantification of Credit Risk

First, we use Monte Carlo simulation in our model (Figure 1). When dealing with credit risk—as opposed to market risk—we must contend with a probability distribution function that is not normal. We overcome this problem

Figure 1

Fundamental Framework of the Model for the Quantification of Credit Risk



by relying on simulation approaches instead of analytical methods.

Scenarios of credit rating transition (including default) in the future for each obligor are generated through simulation. We then calculate the loss amount that we may incur for each scenario. We repeat this process 10,000 times and measure the distribution of the results. Since no distribution of profit and loss is assumed in the simulation approach, we can more precisely calculate and easily understand factors such as the average loss amounts and confidence intervals.

Second, with respect to each obligor's credit rating transition in Monte Carlo simulation, we take into account the correlation between individual obligors. Simulation in consideration of "chain default" is therefore possible, and we can generate distributions sufficiently skewed toward the loss side. This also permits the control of concentration risk—that is, the risk that exposures are concentrated in, for example, one industry.

Finally, for our model, we devise a method so that the risk amount in a particular category can be simply obtained by performing the Monte Carlo simulation for the entire portfolio, measuring the ratio of the calculated risk amount to the uncovered balance of each loan, and summing individual risks.

3. Data Set

3.1. Credit Rating Transition Matrix

"Credit rating transition matrix" is defined as a matrix that shows the probability of credit rating migration in one year, including a default case for each rating category. The probability is calculated on the basis of number of customers. A matrix is generated for each year. In this model, we obtain the mean and volatility of credit rating migration through the bootstrap (resampling) method. Therefore, the data set is nothing more than several years' matrices.

We construct the credit rating transition matrices using internal data (Table 1). The numbers of customers who went through credit rating migration are summed across categories.

$$\text{Probability of transition from rating } m \text{ to } n = \frac{\text{Number of customers whose ratings migrated from } m \text{ to } n}{\text{Number of customers with rating } m.}$$

3.2. Correlation

"Correlation" is defined as a data set to incorporate the correlation between industries in the simulation. It is a matrix of correlations between industry scores obtained from the internal data. The industry score is the average score of the customers in each industry. Incorporation of credit rating transition correlation into the simulation enables us to quantify the credit risk in consideration of chain default

Table 1
Example: Transition Matrix

	Year *n*+1													
Year *n*	1	2	3	4a	4b	4c	5a	5b	5c	6a	6b	6c	7	D
1	0.81	0.13	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.01	0.76	0.17	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.03	0.84	0.02	0.03	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
4a	0.00	0.00	0.00	0.69	0.15	0.07	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00
4b	0.00	0.00	0.00	0.25	0.33	0.21	0.10	0.05	0.03	0.02	0.01	0.00	0.01	0.00
4c	0.00	0.00	0.00	0.07	0.19	0.33	0.24	0.09	0.04	0.02	0.01	0.00	0.01	0.00
5a	0.00	0.00	0.00	0.03	0.06	0.19	0.36	0.21	0.08	0.04	0.02	0.01	0.01	0.00
5b	0.00	0.00	0.00	0.01	0.02	0.07	0.21	0.35	0.18	0.07	0.04	0.02	0.02	0.00
5c	0.00	0.00	0.00	0.01	0.01	0.02	0.08	0.22	0.33	0.18	0.08	0.03	0.03	0.01
6a	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.08	0.22	0.35	0.16	0.06	0.06	0.01
6b	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.04	0.09	0.23	0.32	0.16	0.11	0.02
6c	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.11	0.25	0.30	0.22	0.03
7	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.05	0.10	0.17	0.56	0.06
D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00

across industries. We assume that each of the nine industries specified in the Industry Classification Table of the Bank of Japan consists of only one company.

To estimate the correlation between industries, we first measure and standardize the average industry score. In this paper, we use the weighted average according to the sales amount. We then measure the correlations between industries with respect to the logarithmic rate of change in industry score.

3.3. Industry Contribution Rate

"Industry contribution rate" is defined as the degree to which each company's fluctuation can be described by the movement factors (independent variables) representing the industry to which each company belongs. Our model focuses on industries as independent variables among others such as country and company group. The contribution rate corresponds to the coefficient of determination in regression analysis in that the square root of the coefficient of determination is equal to the industry contribution rate.

In this model, several industries are independent variables. The ratio of each independent variable's impact is its industry ratio. The square of the variable's multiple coefficient of correlation is its industry contribution rate.

We estimate the industry contribution rate as the correlation coefficient by using regression analysis on the relative movement of scores for individual companies against industry scores (calculated in Section 2.2). We assume in our model that the movement of the scores for individual companies can be described by one industry only. (See the simple regression model below.)

$$X_{j,y} = \alpha_j + \beta j M_{i,y} + \varepsilon_j ,$$

where $x_{j,y}$ denotes the score of company j for year y; α and β denote the regression coefficient; $m_{i,y}$ denotes the average score of industry i for year y; and ε_j denotes the error term.

Because it is difficult to apply individually the industry contribution rate measured for each company (because of data reliability questions and operational limitations), we use one identical industry contribution rate for one industry. We calculate the industry contribution rate to be uniformly applied to one industry by averaging the industry contribution rates of the companies with scores that are positively correlated with those of the relevant industry.

Here, however, the average of the industry contribution rates calculated for each industry is uniformly applied to all customers. The average of the industry contribution rates with positive correlation is 0.5.

3.4. Correlation between Individual Companies

The correlation between individual companies is calculated on the basis of the above analysis. The correlation between company 1 in industry i and company 2 in industry j is given as: $\rho_{12} = C_{ij} \cdot r_1 \cdot r_2$, where C_{ij} denotes the correlation between industry i and industry j, r_1 denotes the industry contribution rate of company 1, and r_2 denotes the industry contribution rate of company 2.

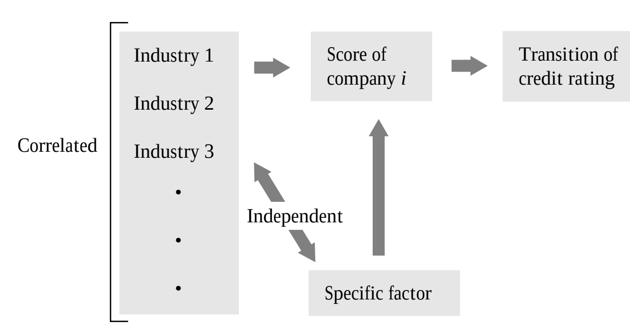
Because both r_1 and r_2 are 0.5, $r_1 \cdot r_2 = 0.25$. That is, the correlation between companies in the same industry is 0.25. The maximum correlation between companies in different industries is 0.25 (distributed between 0.1 and 0.2).

4. Monte Carlo Simulation

4.1. Credit Rating Transition Scenario

Two factors are incorporated into the credit rating transition model, that is, the specific factor for each company and the correlation between industries (Figure 2). In our model, we assume no distribution of profit and loss attributable to credit risk. The default scenarios in the future are generated by moving the following two factors

Figure 2
Credit Rating Transition Model

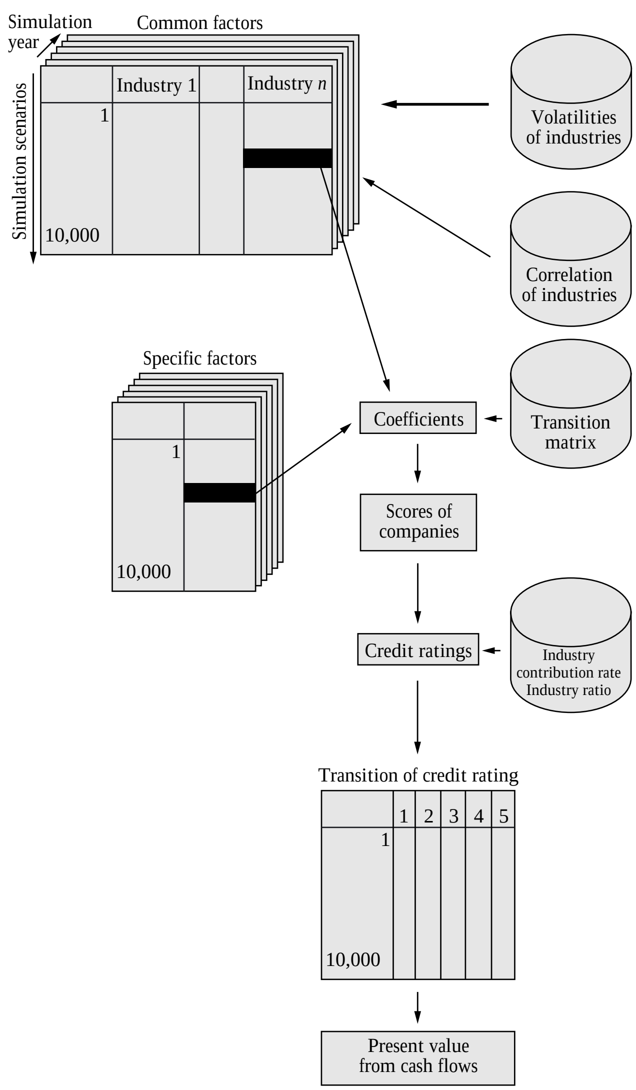


through Monte Carlo simulation: movement of credit rating transition probabilities, including default, and uncertainty of credit rating transition of each customer, including default, under a given credit rating transition probability (Figure 3).

As for movement of credit rating transition probabilities, calculating the standard deviation of credit rating transition probabilities—based on the data for a five-year period only—may not be adequate in light of data reliability. In our model, we generate the simulation of movement of credit rating transition probabilities using the bootstrap method as follows.

Figure 3

Flowchart of Monte Carlo Simulation



The matrices for each year in the future to be used in simulation are selected at random from given sets of matrices by creating random numbers. Although it is possible to put discretionary weight on selection, the same probability is applied in our model. We use selected matrices as the transition probability in the future.

Regarding uncertainty of credit rating transition (credit rating transition scenario), the credit rating is moved annually. The credit rating transition variable V_i is defined for each customer. V_i follows normal distribution. Mean μ and standard deviation σ can take discretionary numbers. Credit rating is moved as follows.

We determined the credit rating transition matrix used in the simulation for each year after incorporating the correlation (described later). Z_{mn}, defined as follows, is determined with a given credit rating transition matrix $[P_{m \to n}]$, according to the credit rating transition.

$$
\begin{aligned}
P_{m \to 1} &= 1 - F(Z_{m1}) \\
P_{m \to 2} &= F(Z_{m1}) - F(Z_{m2}) \\
&\vdots \\
P_{m \to 7} &= F(Z_{m6}) - F(Z_{m7}) \\
P_{m \to d} &= F(Z_{m7}),
\end{aligned}
$$

where $P_{m \to n}$ denotes the rate of transition from rating *m* to *n*, and *F* denotes the cumulative distribution function of $N(\mu, \sigma^2)$.

The credit rating of customer *i*, whose current rating is *l*, will be *m* after one year, which is the largest number that satisfies $Z_{lm} < V_i$, where the credit rating transition variable V_i for customer *i* is created at random.

Credit rating transition variable V_i, in consideration of correlation, is created to incorporate the correlation into the customer's credit rating transition. We use the following regression model on the assumption that each company's movement can be explained by the industry movement.

$$V_i = a_i + b_{1i} X_1 + b_{2i} X_2 + \ldots + \varepsilon_i ,$$

where X_j denotes the driving factor common to industry *j*—multivariate normal distribution, b_{ji} denotes the sensitivity of company *i* to the driving factor of industry *j*, and ε_i denotes the movement specific to company *i*.

Coefficients are determined by the industry contribution rate and the industry ratio, defined respectively, as follows:

Industry contribution rate : $\sqrt{\dfrac{Var\left(\sum_j b_{ji} X_j\right)}{Var(V_i)}}$

Industry ratio: $b_{1i} : b_{2i} : \ldots$

The mean and standard deviation of V_i can take discretionary numbers. For the sake of simplicity, we adjust the coefficients in the following analysis so that V_i will follow standard normal distribution. Here, we move the rating on the condition that one industry consists of one company.

V_i : Credit rating transition variable $\sim$N(0,1) for company *i* is defined as $V_i = r_i X_{G(i)} + \sqrt{1 - r_i^2}\varepsilon_j$

i : Company

G(*i*): Industry of company *i*

$X_{G(i)}$: Variable ~ N(0,1) common to the industry of company *i*

ε_i : Variable ~ N(0,1) specific to company *i*

r_i : Industry contribution rate of company *i* to industry *G(i)*

$\rho_{\varepsilon_i \varepsilon_i} = \begin{cases} 0 \ (I \neq J) \\ 1 (I = J) \end{cases}$ (The correlation between different company variables is 0)

$\rho_{\varepsilon_i X_{G(j)}} = 0$ (The correlation between company variable and industry variable is 0)

$\rho_{X_{G(i)} X_{G(j)}}$: Coefficient of correlation between industries *G*(*i*) and *G*(*j*) (given correlation matrix)

$\rho_{V_i V_j} = r_i \cdot r_j \cdot \rho_{X_{G(i)} X_{G(j)}}$

Random number X_m is created by function of multivariate normal distribution $\sim$ N(0,C).

4.2. Result of Calculation

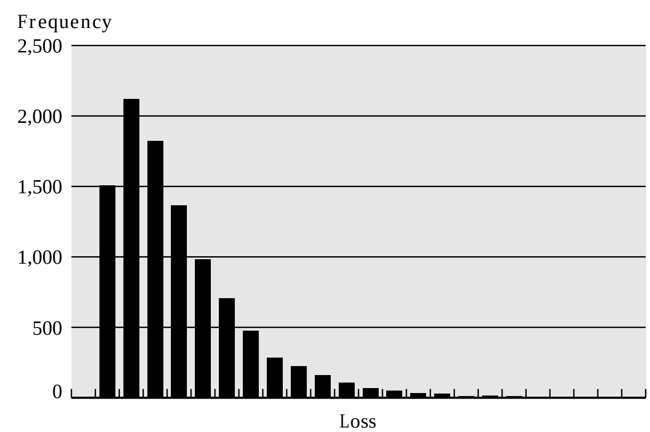
Table 2 compares the amounts of required capital, which are identical to the maximum loss (see Section 6.1), based on the regulations of the Bank for International Settlements (BIS) and the qualification of credit risk with respect to our loan portfolio in a certain category at a certain time.

The required capital calculated by using the quantification of credit risk, which considers obligors' creditworthiness, is more effective than that based on a uniform formula without such consideration. The correlation between individual companies has been incorporated into the credit rating transition of each company in the Monte Carlo simulation. This incorporation enables us to perform the simulation assuming chain default and to generate distributions skewed sufficiently toward the loss side. This incorporation also enables us to manage functions such as concentration risk or the risk of concentration of credit in, for example, a particular industry (Figure 4).

Table 2
Comparison of Required Capital

	Required Capital (Millions of Yen)	Ratio to the Risk Asset (Percent)
Risk asset	17,326,350	—
Required capital, based on BIS regulations	1,386,108	8.00
Required capital, based on the quantification of credit risk	693,889	4.00

Figure 4
Distribution of Losses



5. Credit Risk Delta

5.1. Credit Risk Delta

Japanese city banks have tens of thousands of clients whose creditworthiness ranges from triple A to unrated (for example, privately owned businesses). Monte Carlo simulation is therefore inappropriate for each new lending transaction since the simulation demands a heavy calculation load and accordingly a lengthy credit approval process. In our model, we perform Monte Carlo simulation once for all the portfolios and then calculate the risk ratio on the uncovered balance of each loan on the basis of the simulation result. We have devised a method to calculate the risk amount in a particular category by summing individual risks. We introduce the concept of credit risk delta to achieve this purpose. The credit risk delta is a measurement of the marginal increase in the risk of the entire portfolio when loans to one segment that constitutes the portfolio are increased. The maximum credit risk delta is measured at a 99 percent confidence interval. The average of credit risk deltas is equal to the expected loss, but the delta's maximum does not correspond to the maximum loss.

$$\text{Credit risk delta by segment} = \frac{\text{the credit risk after 10 percent increase in loans to a segment} - \text{the present credit risk}}{\text{10 percent of the loans to the segment.}}$$

Our model uses a 13-x-2 segmentation based on credit rating (thirteen grades) and loan period (one year or less, over one year). Two cases are considered for each segment (that is, a new loan and an increase in an existing loan). Accordingly, credit risk deltas are measured in 13-x-2-x-2 patterns.

5.2. Method of Measuring the Credit Risk Delta: Part 1

We consider two patterns of increase in loan amount:

- To increase the amount of an existing loan. This is the case where the balance of the existing loans in the relevant segment is increased at a certain ratio.
- To add a new loan client. This is the case where a new loan client is added to the relevant segment on the assumption that the attributes of the new loan are essentially the same as those of existing loans.

In light of actual banking practice, both of the above are extreme cases. Reality is expected to lie in the middle. Accordingly, we determine that the credit risk delta is the average of the results in the two cases. Methods of measurement differ depending on the patterns mentioned above.

Increase in the Amount of an Existing Loan

The profit and loss attributed to each customer are proportionate to the principal amount of the loan. With respect to a client whose loan is increased at a certain ratio, therefore, the same coefficient should be applied to the profit and loss. The increment is the credit risk delta. It is not necessary to run a new Monte Carlo simulation.

New Loan Client

The default of a new loan client is not perfectly linked to that of an existing loan. Therefore, it is necessary to run a new Monte Carlo simulation. In our model, the Monte Carlo simulation (generation of default scenarios) is performed separately for the entire loan portfolio, including new loan clients selected at random in a certain proportion from existing loan clients in the relevant segment. New loan clients are deemed to be new on the assumption that new loan attributes are essentially the same as those of existing loans. The credit risk delta is the increment of the loss attributable to the addition of new loan clients.

This method makes it difficult to obtain the credit risk delta at a desired confidence interval because of the characteristics of the simulation. (The confidence interval for the measurement of credit risk delta under a certain scenario may not always correspond to that for the entire portfolio, which is 99 percent, for example.)

5.3. Method of Measuring the Credit Risk Delta: Part 2

Although it is possible to calculate credit risk delta only using the method described in Section 5.2, the order of the risk ratios measured therein, as mentioned above, may not always correspond to the credit ratings, hence an unrealistic outcome. In our model, we determine the credit risk delta on the basis of the analysis of its distribution, as described below.

Figure 5 presents the distribution of loss amounts for the entire portfolio. Figure 6 is an example of the credit risk delta measurement for each segment in the case of an increase in the amount of existing loans in the segment that covers rating 6a and periods longer than one year. We determined that the credit risk delta is the increment of the risk amount when the loan balance in such a segment is increased by 10 percent.

Figures 5 and 6 show that the credit risk delta increases monotonically with the width of the confidence interval for maximum loss. Therefore, the credit risk delta corresponds to the confidence interval for the maximum loss (the method described in Section 5.2). On the other hand, the credit risk delta fluctuates significantly at each particular point. Accordingly, the risk amount based simply on the credit risk delta at the relevant confidence interval may move a great extent when the confidence interval is slightly shifted. Consequently, the distribution of the observed credit risk deltas should be statistically analyzed to find out the relationship between credit risk delta and the confidence interval as follows.

First, the credit risk delta ratio is equal to the credit risk delta (measured above) divided by the increment of loan balance (loan balance JPY95,400 million × 10 percent). The ratio is depicted in Figure 7. To improve the visual observation, the vertical axis represents the fourth root of the credit risk delta ratio.

Figure 8 plots the fourth root of credit risk delta ratio on the vertical axis with the horizontal axis representing the standard normal variables (Q-Q plotting), which replace the confidence intervals in Figure 7. Figure 8 shows that the credit risk delta in Q-Q plotting is distributed almost linearly. That is, the fourth root of credit risk delta follows approximately normal distribution.

Then, we estimate the regression coefficient by performing regression analysis on this Q-Q plotting. Since the distribution can be approximated by a linear graph, we estimate the relationship between confidence interval and credit risk delta ratio through the linear regression function in this analysis.

Credit risk delta V is given as $v = (a + bx)^4$, where x denotes the standard normal variable corresponding to the confidence interval in the standard normal distribution (2.33 for 99 percent).

The regression analysis for the example presented in Figure 8 gives the following result: a=0.437, b=0.0867

Figure 5

Distribution of the Portfolio's Losses

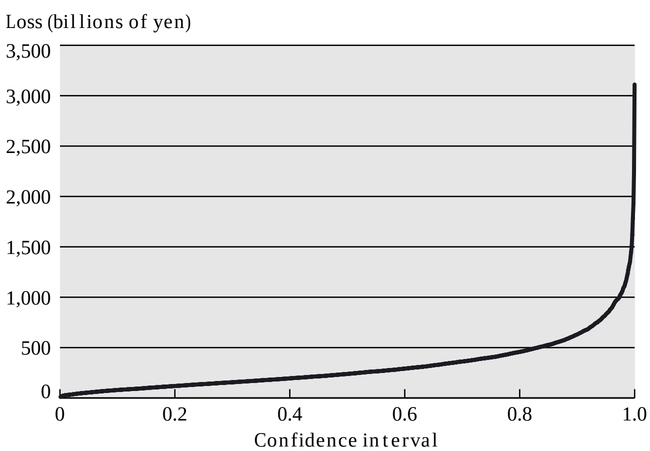


Figure 6

Credit Risk Delta Measurement: An Example

Marginal Risk (Rating 6a and Periods Longer Than One Year)

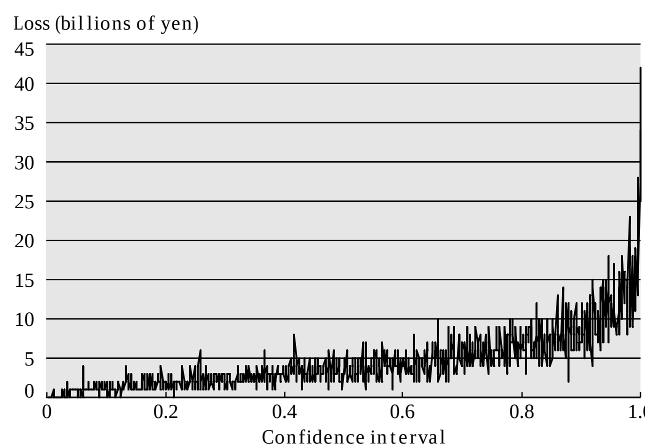


Figure 7

Credit Risk Delta Ratio

Fourth Root of Credit Risk Delta (Rating 6a and Periods Longer Than One Year)

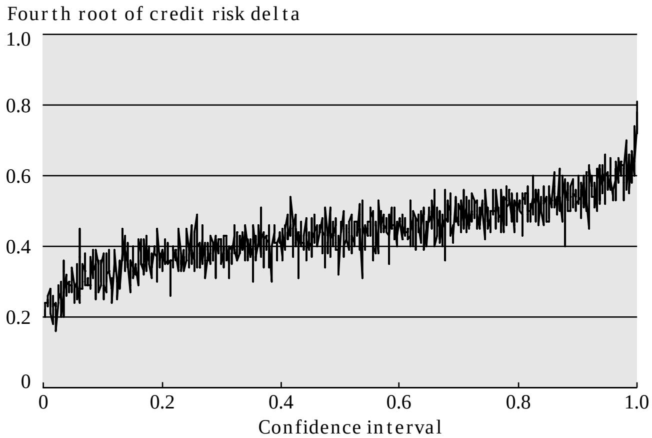
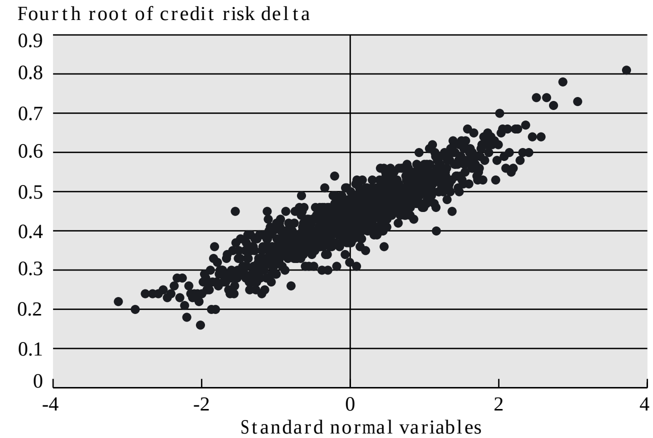


Figure 8

Credit Risk Delta Ratio Measured in Q–Q Plotting

(Rating 6a and Periods Longer Than One Year)



(coefficient of determination $R^2 = 0.83$, number of samples = 10, 000). That is, the credit risk delta ratio of the existing loans in the segment that covers rating 6a and periods longer than one year is estimated at $(0.437 + 0.0867 \times 2.33)^4 = 0.167$ (16.7 percent).

5.4. Compilation of the Results and Adjustment of the Credit Risk Deltas

We now classify in thirteen ratings the rates measured for 13-x-2-x-2 categories. For each rating, we calculate the average of the rates for the periods of one year or less and more than one year (weighted average according to outstanding balance) as well as the average of those for new loan clients and existing loans (arithmetic mean).

Credit risk delta is regarded as the degree of effect that an individual risk has on the portfolio. In our model, we made an adjustment to equate the sum of the credit risk deltas with the risk of the entire portfolio so that risks ranging from those of an individual company to those of the whole portfolio can be interpreted consistently through credit risk delta (Table 3). The sum for all the clients is Σ.

When Σ Credit Risk Delta < the Risk Amount for the Entire Portfolio

We adjust the credit risk deltas by multiplying them with a constant—risk amount for the entire portfolio/Σ marginal risk—so that their sum will equal the risk amount for the entire portfolio.

When Σ Credit Risk Delta > the Risk Amount for the Entire Portfolio

We do not adjust the credit risk deltas. We regard Σ credit risk delta as the risk amount for the entire portfolio. Furthermore, the capital required for credit risk is assumed to be equal to credit risk.

6. Business Management Based on the Quantification of Risk

6.1. Allocation of Capital

The amount of capital required to cover each type of risk can be quantified based on the concept of maximum loss, a measurement common to all risks. We assign capital to each risk as “allocated capital.” Required capital equals the

Table 3
RESULT OF CREDIT RISK DELTA CALCULATION

Rating	Credit Cost (Percent)	Credit Risk (Percent)	Asset (Millions of Yen)	Uncovered Balance (Millions of Yen)	Required Capital (Millions of Yen)	Percent-to-Asset Ratio	BIS Regulation (Percent)
1	0.00	0.00	1,194,230	1,185,094	0	0.00	8.00
2	0.00	0.00	876,139	846,015	0	0.00	8.00
3	0.00	0.03	1,712,623	1,555,640	467	0.03	8.00
4a	0.05	1.38	725,792	488,218	6,737	0.93	8.00
4b	0.07	2.07	865,106	546,752	11,318	1.31	8.00
4c	0.12	2.79	1,221,975	744,359	20,768	1.70	8.00
5a	0.20	4.05	1,744,059	1,068,275	43,265	2.48	8.00
5b	0.31	5.87	1,951,575	1,131,679	66,430	3.40	8.00
5c	0.71	9.18	1,788,003	952,833	87,470	4.89	8.00
6a	1.05	12.21	1,824,986	1,034,857	126,356	6.92	8.00
6b	1.54	15.33	1,330,100	670,638	102,809	7.73	8.00
6c	1.88	16.66	912,579	477,417	79,538	8.72	8.00
7	3.37	21.10	1,179,183	704,891	148,732	12.61	8.00
TOTAL			17,326,350	11,406,668	693,889	4.00	8.00

risk amount measured as maximum loss and is kept below the allocated capital amount. This enables us to keep the risk amount within the capital and to perform safe and sound bank management. Table 4 gives an example.

6.2. INTEGRATION OF PROFITABILITY MEASUREMENT

We measure the profitability of each business area using risk-adjusted return on allocated capital (integrated ROE), not return on asset (ROA). We calculate the integrated ROE as follows:

Integrated ROE =
(net business profit − expected loss)/allocated capital.

The ratio of profit net of expected loss to the risk actually taken is termed “risk-return ratio.”

Risk-return ratio =
(net business profit − expected loss)/capital required to cover risk.

The risk-return ratio is useful when assessing the profitability of each business area or reviewing the capital allocation because it (more than others) provides tools for decision making on the input of more capital and resources in the more profitable existing business lines.

We use the allocated capital utilization ratio to measure the rate of usage of the allocated capital.

Allocated capital utilization ratio =
capital required to cover risk/allocated capital.

With these indices, we can consistently measure the profitability of the bank as a whole, each business area, each branch, and each customer.

6.3. EVALUATION OF PERFORMANCE

Evaluation of profitability by customers using integrated ROE in the example in Table 5 is as follows: Although Customer B yields a better interest rate spread (or interest rate spread minus credit cost) than Customer A, its profitability—in light of credit risk—is lower than that of A.

Table 4
ALLOCATION OF CAPITAL: AN EXAMPLE
Billions of Yen

	Required Capital Based on BIS Regulations	Required Capital Based on the Quantification	Allocated Capital
Risk asset 41,042	41,042 x 8% = 3,283	Credit risk 1,465	1,538
		Interest rate risk [ALM] 87	712
		Equity risk 543	570
Market risk in trading 316	25	Market risk 25	416
41,358	3,308	2,120	3,236

Table 5
PROFITABILITY BY CUSTOMER

Customer	Credit Rating	Loan Amount (Millions of Yen)	Profit (Millions of Yen)	Credit Cost (Millions of Yen)	Credit Risk (Millions of Yen)	Integrated ROE (Percent)
A	5b	1,000	10	3.10	58.70	11.75
			(1.00%)	(0.31%)	(5.87%)	
B	5c	1,000	15	7.10	91.80	8.61
			(1.50%)	(0.71%)	(9.18%)	

Notes: Recovery rate is zero. Percentages in parentheses show annual rate on loan amount.

Table 6
PERFORMANCE EVALUATION

	Comparison between the Previous Month and This Month				
Grade	Integrated ROE	Risk-Return Ratio	Allocated Capital Utilization Ratio	Evaluation	
A	Up	Up	Up	Very good	Capital utilization ratio increased. Profitability improved.
B	Up	Up	Down	Good	Although profitability was improved, capital utilization ratio declined. Potential remains.
C	Up	Down	Up	Good/fair	Although both capital utilization ratio and profitability were improved, the profitability of new business was low.
D	Down	Up	Down	Good/fair	Both capital utilization ratio and profitability declined. Return on risk improved.
E	Down	Down	Up	Poor	Although capital utilization ratio increased, it did not lead to improved profitability.
F	Down	Down	Down	Poor	Capital utilization ratio declined. Profit decreased as well.
			More than 100%	Warning	Risk (capital required to cover risk) exceeds the allocated capital. Need for reduction.

The integrated ROE, risk-return ratio, and allocated capital utilization ratio employed together enable us to evaluate the performance of each branch. Table 6 shows the possible combinations of the three indices and the corresponding evaluations.

7. CONCLUSION

Safe and sound banking is maintained through the allocation and control of capital by the use of integrated risk management techniques that are based on quantification of the risks inherent in the banking business. Furthermore, business management with the integrated ROE (that is, risk-adjusted ROE) facilitates efficient utilization of capital. Such management contributes to the growth of a bank's profitability. By promoting this type of management at Japanese banks with large portfolios of transactions—both in number and amount—the concept of credit risk delta is an effective method. The credit risk delta helps to quantify risks while taking into account the types of business management city banks use. This management method provides consistent and simple measurement applicable to all the levels—from individual customers up to branches and the bank as a whole.

ENDNOTE

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