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Modeling Deposit Outflow in Financial Crises: Application to Branch Management and Customer Relationship Management

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Abstract. Financial crises are severely impacting financial institutions, and each bank must now create strategies for responses to various financial risks. This paper aims to propose models for deposit outflows caused by various financial crises, and to present a framework of knowledge discovery required for bank management to create branch strategies and customer strategies for financial crises. Based on the models proposed in this paper, we understand effects on consumer behavior caused by various financial crises (computer system failure, scandal, natural disaster, etc.), and estimate total amount of deposit outflows. A bank can create appropriate branch strategies and customer strategies according to the knowledge obtained from these models. In order to reflect practical consumer behaviors to the deposit outflow models, this paper constructs the models based on consumer behavior data acquired through questionnaires to consumers.

Keywords: Deposit outflow, financial crisis, branch management, customer relationship

1 Introduction

The financial crisis which erupted in America (subprime problems, the Lehman Brothers bankruptcy, etc.) is having harsh impacts on the economies of each country in the world. Financial institutions throughout the world which held advanced financial products are recording huge losses, and banks cannot provide sufficient loans to companies because of lower capital adequacy ratios. In such circumstances,

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some of the world's financial institutions are facing a bankruptcy crisis. Each government is injecting public funds in an attempt to avoid financial crisis, but even now, danger has not been eliminated.

In Japan, with the 1990s financial crisis due to collapse of the bubble economy, and harsh competition due to deregulation, many financial institutions faced a bankruptcy crisis. In the harsh business environment, Japan's financial institutions thoroughly boosted efficiency to maintain high capital adequacy ratios, and have minimized the impacts from the current global financial crisis. However, these financial institutions have not established specific strategies and procedures to respond to financial crises. Although many financial institutions are actually bankrupt, banks are not studying what strategic actions they should take if their own bank experiences a bank run, when information on their credit insecurity is released, or when a rival bank falls into crisis.

There are various causes of financial crises, with different impacts on bank management. Banks must respond to numerous risks: bank run due to credit insecurity, computer system failure, natural disaster, bank created scandal, etc. These have different effects on account holder behavior resulting in deposit outflows. Banks must understand these different effects, and take appropriate responses. Banks must also respond to events which are not necessarily caused by the bank. When a bank has created a problem, the bank's customers may try to withdraw their deposits and move to the other banks. Thus such an event becomes an opportunity to acquire the deposits for the other banks, and if some effective strategies are taken, they can grab those customers. Knowledge on the behavior of individual consumer behavior is basic information to establish such strategies.

This paper aims to model consumer behavior in terms of deposit outflows resulting from various causes of financial crises, and present a framework for banks to gain basic knowledge for their branch management and customer relationship management. In this paper, as causes of financial crises, we consider computer system failure, scandal, and natural disaster. We use data on consumer behavior of individual depositors collected in a questionnaire survey to model deposit outflows triggered by these events. Our framework can handle different event impacts under various conditions of bank branch environments and customer characteristics. We simulate consumer behavior on deposit outflows by using the model under some scenarios of bank branch environments and customer characteristics, and derive implications for bank management.

This paper is organized as follows. The next chapter reviews previous research related to our study, and clarifies the aim of this research. Section 3 presents the goals of this research, and section 4 models deposit withdrawal behavior of customers during financial crises, and verify the model accuracy by applying questionnaire data on consumer behavior. Section 6 applies the proposed models to estimate deposit outflows during various types of financial crises, and presents important suggestions for management strategies of bank branches and customers. Section 7 summarizes implications for bank management in terms of proposed models, framework which estimates deposit outflow amounts, etc., and finally presents conclusions of this research and future issues.

2 Review of Previous Research

Much research has been done on the bank selection problem (Devlin 2002; Devlin and Gerrard 2004). The most representative research on bank selection models is the 5 factor selection model by Anderson et al. (Anderson et al. 1976). They clarified that account holders choose banks with the following as major criteria: friends' recommendations, reputation of the bank, availability of credit, friendliness of staff and service changes on accounts. For example, Chua (1981) and Ta & Har (2000) showed that recommendations from reliable people such as friends and parents are extremely important factors in choosing a bank. Then, Laroche et al. (1986) and Ying & Chua (1989) presented the concept of service quality, and clarified the criteria by which consumers choose banks. Javalgi et al. (1989) and Khazeh & Decker (1992) clarified the relationships between prices of various services and consumer behavior of customers. Other research indicates that fee elimination and "convenience" (including branch location, service quality, etc.) are important as bank selection criteria (Dupuy and Kehoe 1976; Thwaites and Vere 1995).

Research on international comparisons clarified relationships between bank selection behavior and external environmental factors (cultural characteristics and economic environment) (Bearden et al. 2006). In the context of international marketing, important cultural similarities and differences are known to be divided into the cultural levels of country and organization (Cui et al. 2006; Harvey and Griffith 2002). Hofsted (1980) developed the cultural dimensions of "individualism", "collectivism", "feminine" and "masculine", and claimed that cultural differences measured by these dimensions affect customer behavior for bank selection. It also clarified that there are distinctive ways how they choose banks differ, depending on differences between industrialization of nations (less developed countries, developing countries, developed countries) (Blankson et al. 2007; Kuada and Buatsi 2005; O'Donnell and Jeong 2000).

These previous researches model customer behavior for bank selection in normal times. It does not address consumer behavior during a financial crisis, nor does it sufficiently address consumer behavior from the perspective of deposit outflows. Therefore, it is difficult to gain useful knowledge from these frameworks regarding strategies of branch and customer management which banks should adopt during a financial crisis.

On the other hand, almost all research on financial crises studied the future effects on markets induced by government response and corporate governance during financial crises under a macro perspective. A research on government policy during a financial crisis analyzed the examples of Thailand (Pathan et al., 2006) and South Korea (Choe and Lee, 2003), to verify what kinds of long term impacts on markets result from government policy on bank restructuring during financial crisis. Also, Mitton (2002), La Porta et al. (1999), and Johnson et al. (2000) focused on the relationship between corporate governance and corporate value, and they verified that differences of corporate governance and degree of diversification characterized by level of corporate disclosure, ownership structure, a variety of products and services, etc. affect changes in corporate value after a financial crisis. Almost none of the previous research on financial crises produces models at the individual consumer level, nor does it focus on specific business problems such as deposit outflows.

Accordingly it is difficult to find specific management implications for an individual bank and its branches.

To our best knowledge, the work of Yada et al. is the unique research on a bank-run model during a financial crisis (Yada et al. 2008). They built a model of account holder's bank-runs in financial crises, and used this model to estimate deposit withdrawal amounts during financial crises. This research estimated the total deposit withdrawal amount at a branch when there is credit insecurity of the bank, and verified significant differences of estimated total deposit withdrawal amounts caused by differences of branch location and main customer groups. However, it only addressed a financial crisis caused by credit insecurity, and did not clarify differences in consumer behavior resulting from various causes of financial crises. In addition, this research mainly aimed to understand customer bank-runs, and thus it did not sufficiently investigate consumer behavior from the perspectives of the strategy on branch and customer relationship management of each bank.

In recent years, financial crises have frequently erupted by various causes, and taking some counter measures to the financial crises has become indispensable for banks. The banks must have sufficient information on impact of each type of the financial risks at the level of customer behavior to create effective and operational action plans (branch strategy, customer relationship management, etc.) for each financial risk. This research aims to model consumer behavior in terms of deposit outflows resulting from various causes of financial crises, and present a framework to provide basic knowledge for branch management and customer relationship management at banks. In this paper, we address computer system failure, scandal, and natural disaster as causes of financial crises. We model consumer behavior caused by these events, and estimate deposit outflow amounts.

3 Modeling Deposit Outflow in Financial Crises

3.1 Data Used in Deposit Outflow Models

In order to build a deposit outflow model for financial crises, we take an empirical modeling approach based on data of customer behavior in response to various events which cause financial crises, characteristics of regions where branches are located, and customer characteristics of bank account holders. This paper used data collected through a questionnaire-based investigation on financial panics in an internet survey (Yada et al. 2008). The questionnaire included basic respondent attributes (gender, age, education), and customer characteristics (awareness of deposit insurance, income level, amount of savings, etc.), in addition to customer response in case of computer system failure, scandal, or natural disaster. The data was collected in September 2007 and includes 1,500 samples.

3.2 Models of Deposit Outflow in Financial Crises

3.2.1. Factors Which Affect Consumer Behavior during Financial Crises

We focus on three factors which are considered to affect consumer behavior associated with deposit withdrawals during a financial crisis: event which triggers the financial crisis, branch environment, and customer characteristics.

1) Type of event which triggers the financial crisis
   Financial crises are triggered by various types of events which have negative impacts. Differences in the types of events which cause financial crises are conjectured to cause different consumer behaviors. In this paper, we address three event types: computer system failure (ATM networks, etc.), scandal caused by a bank, and large scale natural disaster.
2) Branch environment
   Banks manage many branches in various regions, and environments of the branches widely vary depending on the regions. The effects of a financial crisis on deposit outflow reflect the differences in the branch environments. Branch environments are strongly influenced by national regions such as Tokyo, Osaka, and Hokkaido in case of Japan and by locations such as suburbs, rural areas, dense residential areas, etc.
3) Customer characteristics
   A branch has various customer groups, and customer behaviors in response to a financial crisis differ depending on the characteristics of those customers. In order to correctly understand the effects of a financial crisis on the branch, one must take into account the differences of behaviors linked to the customer characteristics. Customer groups are considered to be characterized by annual income, awareness of deposit insurance, type of employment, etc.

3.2.2. Models of deposit withdrawal probability in financial crises

A target for estimation in our model is a binary variable representing whether an account holder withdraws his entire deposit, when financial crises occur due to the three types of events. As noted previously, we focus the events which cause financial crises into computer system failure, scandal, and natural disaster. Each account holder is assumed to make a decision whether or not to withdraw his entire deposit from the bank during a financial crisis. Although we do not consider partial withdrawals by the account holders this approximation is considered to provide a statistical expectation of the entire customer behavior in a branch. Upon this approximation, we build a model to estimate the probability of the withdraws by each customer under given conditions. In this paper, we adopt a logistic function to represent the probability distribution (Yada et al. 2008).

We used around 30 explanatory attributes, including (1) demographic characteristics (age, gender, etc.), (2) attributes to show psychological characteristics, including degree of trust on information sources (newspapers, TV, etc.) and communication frequency (frequency of phone calls, etc.), (3) individual attributes including region of residence, annual income, type of employment, etc. We used the stepwise method where we extracted a statistically significant parameter group for each of the three events, and built a sufficiently suitable model.

Let B_{mi} (m = 1, 2, …, k) be explanatory attributes (such as attributes of a customer *i* which affect deposit withdrawal behavior) and a_m the weight of B_{mi}. Then, the probability P_{ei} that customer *i* withdrawals the entire deposit from his account under an event *e* causing a financial crisis can be modeled by the following equation (1).

$$P_{ei} = \frac{\exp\left(a_1 B_{1i} + a_2 B_{2i} + \Lambda + a_m B_{mi}\right)}{1 + \exp\left(a_1 B_{1i} + a_2 B_{2i} + \Lambda + a_m B_{mi}\right)} \qquad \textbf{(1)}$$

where

P_{ei} : Probability that a customer *i* will withdraw its entire deposit when an event *e* occurs,

B_m : An explanatory attribute of deposit withdrawal behavior of a customer *i* (*m* = 1, 2, … k), and

a_m : An weight of attribute B_m

3.2.3. Estimation of deposit outflow from a branch

By applying the above model to estimate the probability P_{ei} that each customer withdrawal his entire deposit when an event *e* occurs, we can easily forecast the deposit outflow amount. Given customer *i*'s deposit amount d_{is} (*i*=1,2,…,n) in a branch *s*, the expectation of the deposit outflow amount D_s from *n* accounts in the branch *s* is provided by the following equation (2).

$$D_{se} = \sum P_{ei} d_{is} \qquad \textbf{(2)}$$

where

d_{is} : Deposit amount of a customer *i* (*i* = 1, 2, … *n*) in the branch *s*, and

D_{se} : Total amount of deposit outflow from *n* accounts in the branch *s* when the event *e* occurs.

3.2.4. Modeling performance evaluation

In order to confirm the good performance of our proposed modeling method, we compared its accuracy with these of several classification methods by applying them to the aforementioned data. In this paper, we used some popular methods in machine learning, i.e., C4.5, neural network (NN), and Naïve Bayes. The parameters of C4.5 (Quinlan 1993) are cf=0.25 and minimum instances per leaf= 20. A popular data-mining platform WEKA (Witten and Frank 2000) was used for the computation.

Table 1. Some Key Indices for Modeling Performance Evaluation.

		Predicted class	
		Positive	Negative
Actual class	Positive	P_T	N_F
	Negative	P_F	N_T

We used Overall Accuracy and Matthews Correlation to evaluate the performance of these models. These measures are evaluated based on a Confusion Matrix depicted in table 1 which shows whether samples are correctly classified by the model. When a target variable takes binary values Positive (P) or Negative (N), the number of correctly classified true Positives is P_T, the number of true Negatives is N_T, the number of incorrectly classified false Positives is P_F, and the number of false Negatives is under the classification by the constructed model. Overall Accuracy (Witten and Frank 2000) is defined according to the following equation (3).

$$OverallAccuracy = \frac{P_T + N_T}{P_T + P_F + N_T + N_F} \quad \textbf{(3)}$$

The Matthews Correlation Coefficient (C) is defined according to the following equation (4) (Witten and Frank 2000). This is a measure of the quality of a binary classification.

$$C = \frac{P_T \times N_T - P_F \times N_F}{\sqrt{(P_T + N_F)(N_T + P_F)(P_T + P_F)(N_T + N_F)}} \quad \textbf{(4)}$$

4 Experiment

4.1 Comparison of Classification Accuracy

We applied each method to build a model of consumer behavior under computer system failure. 10-fold cross validation was used to calculate the averages of the evaluation measures described in the previous section, and obtained the results shown in Figure 1. The classification by the logistic model is the best accuracy among the representative machine learning techniques (C4.5, neural network, Naive Bayes). Similar results were also obtained when they applied to the scandal and natural disaster data sets. Therefore in this paper, we adopt the logistic model to forecast customer deposit withdrawal behavior during financial crises.

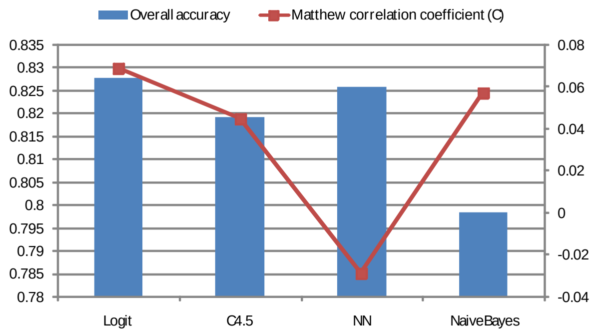


Fig. 1. Comparison of each method's classification accuracy.

4.2 Estimated Deposit Withdrawal Probability Model

Equations (5), (6), and (7) are the deposit withdrawal models for the cases of system failure, bank scandal, and natural disaster, and statistical significance was obtained for each model. Table 2 explains the attributes used in each model. Some attributes appear in all the models such as "Age", "Number of phone calls per day", "Number of people spoken with in person per day", etc. The computer system failure model uses "Awareness of deposit insurance" and "education", the scandal model uses "Total deposits", and the natural disaster model uses "Degree of trust in information sources".

P_{ci}: Probability of deposit withdrawal by a customer i when computer system failure occurs

P_{fi} : Probability of deposit withdrawal by a customer i when scandal disaster occurs

P_{gi}: Probability of deposit withdrawal by a customer i when natural disaster occurs

$$P_{ci} = \frac{\exp\left(-.016B_{AGEi} + .299B_{Q7i} + .162B_{Q9i} - .431B_{Q20i} - .148B_{Q21i} - .131B_{Q33\_2i} + .087B_{Q35i} - .894\right)}{1 + \exp\left(-.016B_{AGEi} + .299B_{Q7i} + .162B_{Q9i} - .431B_{Q20i} - .148B_{Q21i} - .131B_{Q33\_2i} + .087B_{Q35i} - .894\right)} \quad \textbf{(5)}$$

$$P_{fi} = \frac{\exp\left(-.020B_{AGEi} + .277B_{Q1\_2i} + .306B_{Q7i} - .177B_{Q9i} - .667B_{Q16(1)i} + 1.029B_{Q16(2)i} - .083B_{Q34i} - 3.542\right)}{1 + \exp\left(-.020B_{AGEi} + .277B_{Q1\_2i} + .306B_{Q7i} - .177B_{Q9i} - .667B_{Q16(1)i} + 1.029B_{Q16(2)i} - .083B_{Q34i} - 3.542\right)} \quad \textbf{(6)}$$

$$P_{gi} = \frac{\exp\left(-.030B_{AGEi} - .139B_{Q1\_1i} + .162B_{Q1\_3i} + .170B_{Q1\_5i} - .171B_{Q1\_6i} + .162B_{Q7i} + .092B_{Q9i} + .053B_{Q35i} - .749\right)}{1 + \exp\left(-.030B_{AGEi} - .139B_{Q1\_1i} + .162B_{Q1\_3i} + .170B_{Q1\_5i} - .171B_{Q1\_6i} + .162B_{Q7i} + .092B_{Q9i} + .053B_{Q35i} - .749\right)} \quad \textbf{(7)}$$

Table 2. Attributes used in the Models.

Attribute name	Description
AGE	Age
Q1_1	Degree of trust in TV as an information source
Q1_2	Degree of trust in newspaper as an information source
Q1_3	Degree of trust in weekly magazine as an information source
Q1_5	Degree of trust in email as an information source
Q1_6	Degree of trust in neighbor as an information source
Q7	Number of phone calls per day
Q9	Number of people spoken with in person per day
Q16(1)	Under ¥5 million total deposits
Q16(2)	¥5-¥10 million total deposits
Q20	Awareness of deposit insurance
Q21	Education
Q33_2	Degree of trust in other people
Q34	Form of employment
Q35	Annual income

4.3 Deposit Withdrawal Behavior and Customer Attributes

Based on the models and their parameters obtained in the previous section, we now investigate the relationships between customer attributes and deposit withdrawal behavior.

4.3.1. Model for deposit withdrawal probability under computer system failure

Figure 2 shows the relationship of deposit withdrawal behavior with awareness of deposit insurance and education under computer system failure. It shows deposit withdrawal probabilities for a) a group where the customer do not know deposit insurance, and b) another groups where the customers know deposit insurance. Each colored bar corresponds to the education level of customers. When a computer system failure has occurred, the customers who do not know deposit insurance tend to withdraw their deposits in a high probability regardless of their education. On the other hand, the customers who know deposit insurance tend to withdraw their deposits in lower deposit withdrawal probabilities as their education increases. This may be because computer system failure is temporary, and they understand that the situation is not so serious as to make it urgent to withdraw their entire deposit.

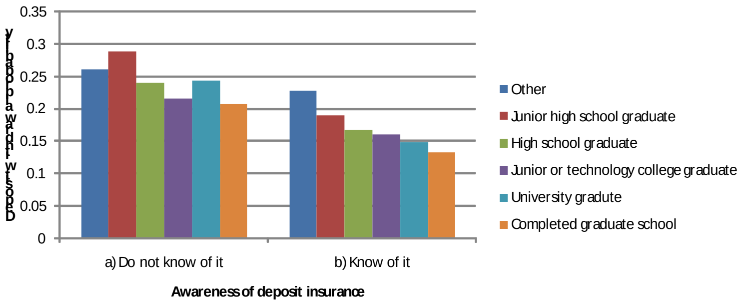


Fig. 2. Deposit withdrawal probability under a computer system failure.

4.3.2. Model for deposit withdrawal probability under a bank scandal

Figure 3 shows the relationship between deposit withdrawal behavior and types of employment (a customer attribute) under a bank scandal. We see from the graph that a few people without permanent jobs (not employed or part time employee) respond by withdrawing deposits from the bank which caused a scandal. But we see that customers with permanent jobs, (especially self-employed and family employees) react more strongly to scandals. We conjecture that people working in permanent jobs have stronger moral views, and thus are more sensitive to the scandals in their reaction.

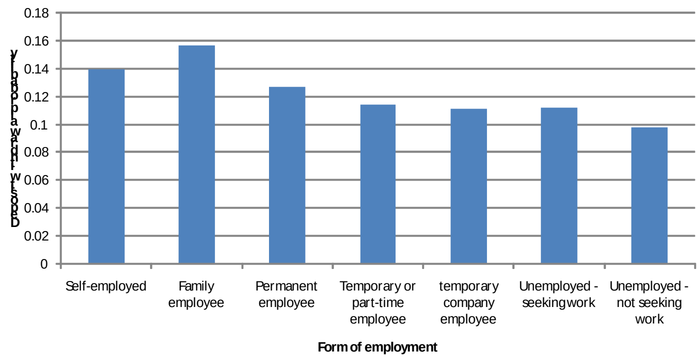


Fig. 3. Deposit withdrawal probability under a scandal.

4.3.3. Model for deposit withdrawal probability under natural disaster

Figure 4 shows the relationship between deposit withdrawal behavior and region of residence under a natural disaster. The graph shows in Japan's south regions (Kyushu and Okinawa regions) and north regions (Tohoku, Kanto, Hokuriku, Koshinetsu), there are high probabilities of deposit withdrawals when a natural disaster occurs. As Japan's Kyushu and Okinawa regions are frequently damaged by typhoons, we conjecture that people living in these regions understand well that their short-term cash in the bank is needed during disasters, and show a strong response to natural disasters.

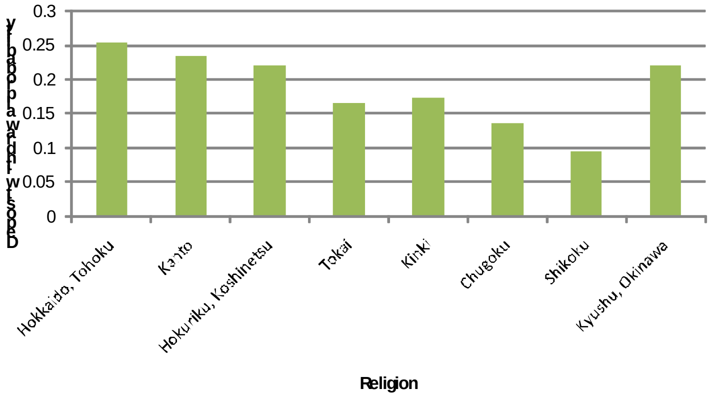


Fig. 4. Deposit withdrawal probability under a natural disaster.

5. Deposit Outflow Simulation for Branch Management and Customer Relationship Management

Based on the deposit withdrawal probability models for the diverse financial crises, we are able to estimate the withdraw amounts of customer groups in simulations under various scenarios which may arise in the future, and can obtain knowledge necessary to create strategies in response to crises. In this section, we demonstrate this knowledge derivation process.

5.1 Deposit Outflow Simulation for Bank Branch Management

Bank branches are located in a multitude of locations in Japan, and each branch maintains accounts of various customer groups in its area. As these customer groups are diverse, banks must establish appropriate branch strategies which match to each branch's environment. In order to run deposit outflow simulations for the bank branch management, we consider a typical bank branch follow. We assume that the branch locates in a dense residential area within walking distance of many residences, corporate employees comprise a large percentage of customers, and it maintains 10,000 accounts. We also assume that each individual has one account in the branch, and can withdraw his entire deposit at any time. In this section, we perform simulations of total deposit withdrawals under the two scenarios indicated in Table 3.

Table 3. Two scenarios of deposit withdrawal from a bank branch.

	Trigger of deposit withdrawals	Differences of branch environments
Scenario 1	Natural disaster	Regions: Shikoku, Hokkaido/Tohoku
Scenario 2	Bank scandal	Location: dense commercial area/ dense residential area

5.1.1. The effects on deposit outflow in its region under natural disaster

Simulation of scenario 1 in Table 3 is that a financial crisis arises under a natural disaster. In this case, inter-regional differences of consumer behavior are supposed to be significant. Figure 5 shows average deposit amount per customer in Shikoku region and Hokkaido/Tohoku regions under a natural disaster. As seen in the graph, the average deposit amount per person in Hokkaido/Tohoku region is lower than that in Shikoku. Assuming that an average branch holds 10,000 accounts, a Shikoku branch has larger deposits than a branch in Hokkaido/Tohoku. However, when a natural disaster occurs, a customer in Hokkaido/Tohoku region has around 25% probability to withdraw his deposit, while the probability is 10% for a Shikoku region customer. Hokkaido/Tohoku region customers are more likely to withdraw deposits. Therefore, even if branches have the same number of customers, a branch in Hokkaido/Tohoku region would experience more severe deposit outflows (deposit outflow per person: ¥856,000) which are about 2.2 times as large as that from a Shikoku region branch (deposit outflow per person: ¥389,000). From this finding, if the bank branch management is established by focusing on the Shikoku region simply because of the size of its deposits, it may overlook the actual greater risk of large deposit outflows in Hokkaido/Tohoku region.

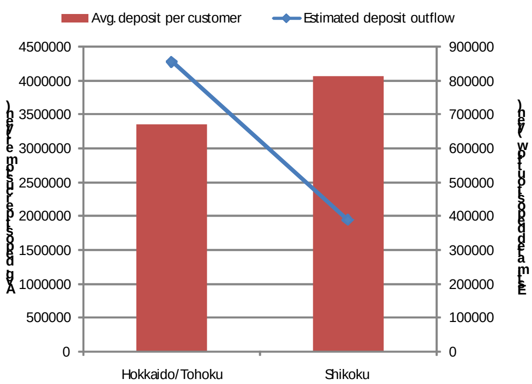


Fig. 5. Differences between two regions in deposit withdrawal behavior under a natural disaster.

5.1.2. Customer's sensitivity to bank scandal

In scenario 2 in Table 3, the deposit outflows from branches in a dense commercial area and in a dense residential area are estimated, when a bank scandal occurs. Figure 6 shows the average deposit amount per person in each branch location, and the estimated deposit withdrawals under a bank scandal. From this figure, we see that average deposits per person in dense commercial areas are higher than these in dense residential areas. When a bank scandal occurs, 14% of customers in dense commercial areas withdraw deposits which is more than the 12.2% in dense residential areas. Therefore when a scandal occurs, deposit outflow from a dense commercial area is 26% greater than that from a dense residential area, and deposit outflow risk of commercial area which is greater than branch size alone would indicate. This also shows that in order to evaluate deposit outflow risk, it is important to understand the relationship between branch characteristics and deposit withdrawal behavior in addition to the total amount of branch deposits.

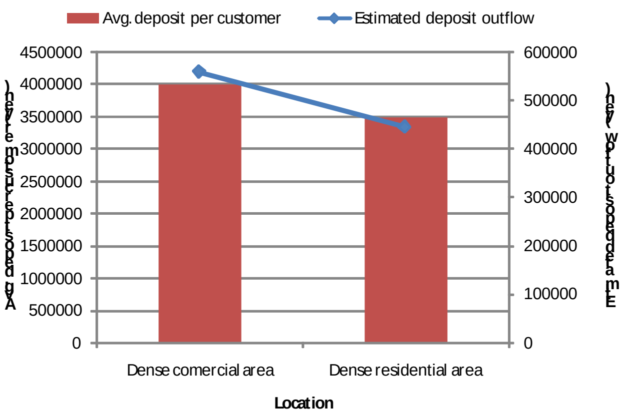
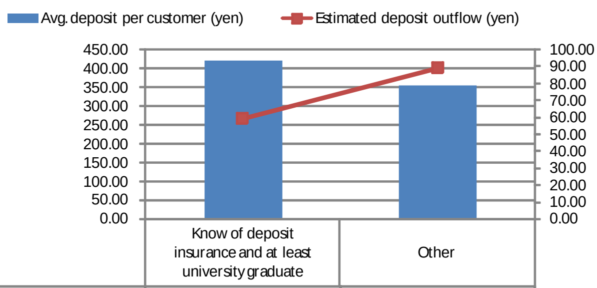


Fig. 6. Differences between locations in deposit withdrawal behavior under a bank scandal.

5.2 Deposit Outflow Simulation for Customer Relationship Management

A bank branch maintains accounts of various customer groups which live in the surrounding area. Therefore, a bank can efficiently maintain or even acquire customers by adopting a response strategy suitable for each customer during a financial crisis. In this section, we discuss who should be approached in order to halt deposit outflows during a financial crisis, or to gain deposits of customers from other banks.

Figure 7 shows average deposit balance and deposit outflow when computer system failure occurs. It indicates these values for people who know deposit insurance and are at least university graduates and for the other people. We see from this graph that the former customers have larger average deposits than other customers. But when a computer system failure occurs, customers who know deposit insurance and are at least university graduates have 14% probability of deposit withdrawal which is much lower than 25.2% of the other customers, and thus the former has an average ¥594,000 deposit outflow, while the latter has ¥895,000. The customers without a high education level and knowledge of deposit insurance are excessively affected by computer system failures, and start a bank-run like in a panic. For a competitor of the bank having a computer system failure, this is a business opportunity to gain customers. If some appropriate approaches are applied to these customer groups, the customers are effectively gained from the rival bank.



	Know of deposit insurance and at least university graduate	Other
Avg. deposit per customer (yen)	423.08	354.81
Estimated deposit outflow (yen)	59.40	89.45

Fig. 7. Effects of deposit insurance awareness and education on deposit outflow.

Deposit withdrawal behavior of customers is also greatly affected by their psychological characteristics. One psychological characteristic is communication frequency, where information is shared with other people through various media under the frequency. For example, one can measure the frequency of conversations in person, use of phone and email, etc. Here we measure communication frequency according to the number of phone calls per day and the number of people with whom the respondent has conversations in person per day. Figure 8 shows the deposit outflow percentage when a bank scandal occurs for the frequently communicating customer group where each customer has at least 6 phone calls per day and conversations in person with at least 4 people per day. The percentage for the other customers is also indicated. From the figure, we see that frequently communicating customers are almost 3 times as likely as the others to withdraw their deposit. When a bank scandal occurs, these customers seem to actively gather the information by phone, conversations in person, etc., and have a strong tendency to take the withdraw action in their response. If a bank knows this customer group, it can take an appropriate customer strategy when a bank scandal occurs.

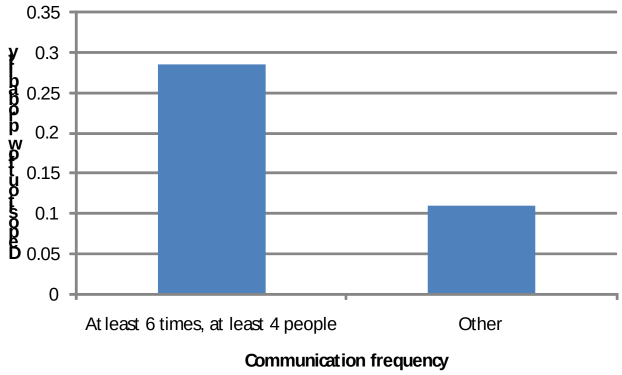


Fig. 8. Effect of communication frequency on deposit outflow.

6. Conclusions

The deposit outflow models in this paper present important implications for bank management during a financial crisis. Japan’s banks have the experience of responding to the financial crisis after the bubble collapsed. Thus they have more insights than many other countries on the strategy in response to financial crisis. However, the banks in Japan do not consider that these customers have different individual responses to the crises, nor do they have a framework to create branch strategy and/or customer strategy based on this fact.

In this paper, we proposed deposit withdrawal models which consider differences in deposit withdrawal behavior of customers due to various causes of financial crises. This paper’s experiment clarified that the deposit withdrawal behavior of customers is affected by the region where a branch is located, customer characteristics, type of event which caused the financial crisis, etc. Then from these obtained models, we were able to gain important suggestions for the strategies of branch management and customer management during financial crises.

However, many issues remain to be solved. People make decisions based on information of financial crises acquired from various media. Differences between these information sources may induce different deposit withdrawal behaviors. If the relationships between these information sources and deposit withdrawal behavior are investigated in more details, we become to obtain important suggestions on the media which banks should pay attention to depending on the type of financial crisis.

Moreover, this paper limited to its focus on deposit outflows from a bank, but does not pay attention to the destinations of those deposits (banks where they are re-deposited). The proposed models cannot address the flow of deposits from a bank to the other banks. Accordingly, they cannot forecast changes in market shares. Also, our models cannot address important economic indices (financial situation, economy, etc.). In the future, expansion of the models to address these indices should be explored.

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