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Abstract

In this paper, we explored the structure and implications of interbank networks in pre-war Japan, focusing on director interlocking. It was found that approximately 60% of the banks had at least one connection with another bank through director interlocking. These connections resulted in the construction of complex networks of banks, not to be reduced to core-periphery structures. Based on this finding, the impact of the interbank networks on the financial performance and the survivability of banks was examined. It was revealed that while a bank with a network was not always more profitable compared to a bank without it, a bank which had a network with profitable banks was more profitable. Concerning the probability of failure, it was found that a bank with a network was less likely to fail than a bank without one. In this case as well, the failure probability of a bank was negatively associated with the profitability of the connected banks. In addition, interbank networks affected on bank mergers. Namely, a bank tended to choose a bank in the same network as a counterpart of the merger, which suggests that interbank networks played a role in coordinating bank mergers.

JEL Classification: G21, G34, L14, L22, N25

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1. Introduction

Social network analysis has been developing in the fields of sociology and mathematics for the last fifty years. In economics, as well, the number of studies on networks have rapidly increased over the last decade. These studies, mainly use game-theoretic models, which investigate how networks are formed when each person strategically construct links with others and how stable and efficient such networks are (Jackson 2003; Jackson 2006; Goyal 2007). At the same time, network analysis has been applied to understand various economic phenomena, including mutual insurance among villagers (Fafchamps and Gubert 2007), informal credit among firms (Macmillan and Woodfuff 1999), and welfare participation (Bertland, Luttmer and Mullainathan 2000). These studies focus on the effects of networks on economic behaviours and outcomes.

In particular, financial economists have been interested in the role of networks in interbank markets and financial contagions. They investigate how a shock to a bank contagiously spreads to other banks and how the possibility of a contagion is associated with the structure of interbank networks (Allen and Gale 2000; Frexias et al. 2000; Leinter 2005). Allen and Gale (2000) classified the structures of interbank networks into two types, namely the complete structure of claims, where each bank is symmetrically connected with all other banks, and the incomplete structure of claims, where banks are linked only to neighbouring banks. They theoretically showed that a contagion is less likely in the former structure than in the latter.

Based on Allen and Gale (2000), several studies empirically investigated interbank contagions (Sheldom and Maurer 1998; Furine 2003; Upper and Worms 2004; Boss et al.2004b). Furthermore, research on financial networks has been extended to studies on the relationship between inter-firm networks and contagions (Boissay 2006), as well as to studies on the network topology of the interbank market (Boss et al.2004a;

Cajueiro and Tabak 2007; Iori et al.2008). Boissay (2006) investigated how a financial contagion spreads thorough an inter-firm network of trade credit, and showed how likely a sound firm is to fall into financial distress when its customers are financially distressed, both theoretically and empirically. The literature on the network topology of the interbank market empirically revealed the structure of the inter-bank market, mainly using the methodology of statistical physics applied to complex networks. In particular, they focused on the degree distribution of networks, the clustering coefficient and other measures to characterize the structure of the networks (e.g. random, small world and scale-free).

In addition, there is related literature which focuses on director interlocking, especially its implications on corporate governance. It has been revealed that directors with multiple appointments have difficulties in assuring significant control of management due to a lack of time or specific knowledge (Ferris et al.2003; Perry and Peyer 2005 ect.). Some sociology literature considers director interlocking a communication mechanism, rather than that of control, and argue that director interlocking can be a source of information about business practices and strategy (Useem1982; Palmer et al.,1993; Mizruchi 1996, etc.). Based on case studies and quantitative analyses, they showed that interlocked executives get useful information about business strategy or practice by observing different operations, organizational forms or problems faced by other companies, and apply their experience and knowledge acquired to their own companies.

This paper, focuses on interbank networks in Japan before the Second World War. The banking sector in pre-war Japan is particularly interesting from the standpoint of financial network studies. In pre-war Japan, there were many large investors who held blocks of shares and directorships of multiple banks (Okazaki, Sawada and Yokoyama 2005; Okazaki, Sawada and Wang 2007), and as a result, many banks were connected with other banks through director interlocking and ownership to form complex interbank networks. These interbank networks can be comprehensively identified, using datasets compiled from company directories. The Japanese financial system became unstable and experienced several financial crises in the 1920s. Therefore, by focusing on pre-war Japan, the implications of interbank networks on financial systems can be examined in detail.

The remainder of this paper is organized as follows. Section 2 presents the characteristics of interbank networks based on director interlocking. In Section 3, the effects of interbank networks on the performance and survivability of banks is examined. Section studies how an interbank network affects the choice of counterpart banks in consolidations and how the consolidations based on inter-bank networks differ from other consolidations in terms of post-merger performance. Section 5 concludes the paper.

2. Structure and Quality of Networks

The first task was to identify interbank networks. For this purpose, director interlocking was focused upon, as mentioned in the previous section. The data source is the 1927 issue of the *Directory of Banks and Companies* (*Ginko Kaisha Youroku*), which was also used in Okazaki et al.(2005)[1]. This source covers the names of the directors and auditors of the banks and non-banking firms in 1926 whose paid-in capital was two hundred thousand yen or more[2]. That year was chosen because the market structure of the banking industry drastically changed after that, due to the huge wave of bank mergers and exits that were caused by the financial crisis and the merger

[1] Tokyo Koshinjo, one of the largest private credit bureaus in pre-war Japan, published a directory of corporate directors, *Ginko Kaisha Youroku*, every year from 1897 to 1942.
[2] Conveniently, this source includes a name index. From this name index, a list of all the banks and non-banking companies in which he/she had a director position is listed by the person's name.

promotion policy put forth by the government based on the 1927 Bank Law (Okazaki and Sawada 2007; Okazaki, Sawada and Wang 2007) [3]. The financial data for each bank in 1926 are taken from the 1927 issue of the *Yearbook of the Bank Bureau* (*Ginkokyoku Nenpo*) by the Ministry of Finance, which covers all of the banks in Japan excluding the colonies. The number of banks commonly included in these two sources is 1007[4].

Using the *Directory of Banks and Companies,* a connection was identified between a certain pair of banks, if a person who was a director of a bank was concurrently a director of the other bank. Even if a certain bank (Bank A) had two directors who also held director positions in another bank (Bank B) the number of connections between Bank A and Bank B are counted as one. Table 1 presents the distribution of the numbers of connections found in each bank. As shown, 587 banks out of 1007 banks (58.3%) had at least one connection with another bank through director interlocking.

The number of connections in Table 1 corresponds to the "degree" concept found in social network analysis literature. In this literature, the degree, or the number of relations a certain unit has with other units, is supposed to be a measure of the "centrality" of the former units in the network. That is, the more relations a unit has with other units within a network, the more central or important in the network that unit is considered to be (Wasserman and Faust 1994).

Table 2 summarizes the structure of interbank networks in pre-war Japan. In Panel A, 587 banks which had at least one tie are classified by the number of

[3] The Bank Law set the minimum capital of the bank, which many banks were unable to meet. Those banks were practically obliged to merge with another bank or be liquidated. We will discuss this law in Section4, in more detail.

[4] *Ginkokyoku Nenpo* covers 1,417 ordinary banks in Japan, excluding colonies, at the end of 1926. Financial data are completely available for 1,398 of the 1,417 banks. And, the data on directors and auditors are available in *Ginko Kaisha Youroku* for 1,007 banks.

connections. A bank with four or more connections is defined as a core bank. A bank with less than four connections, but linked with a core bank, is defined as a periphery bank. The rest of the banks, with at least one connection, are defined as independent network banks.

Panel A indicates that the core banks and the periphery banks were a smaller portion of the banks with networks. This implies that the structure of the networks in the banking industry cannot be characterized through a simple core-periphery architecture, or a star-network. The independent network banks, which are dominant in the banks connected to networks, can be classified into two types. One type is the banks indirectly connected to core banks, namely sub-subsidiaries of core banks. The other type is the banks constructing independent small networks, not connected to core banks, either directly or indirectly. As can be seen, interbank networks had a complex structure.

In Panel B, the banks with networks were split into two categories to observe the regional characteristics of interbank networks. On one hand, a bank with an "intra-regional network" was one which was connected only with banks operating in the same prefecture[5]. On the other hand, a bank with an "inter-regional network" is one which had at least one connection with a bank operating in a different prefecture. From Panel B, it is confirmed that the percentage of intra-regional networks is approximately 70%. It can be said that interbank networks were mainly formed within prefectures. This result may have reflected upon the local characteristics of investors and their investment behaviors.

Next, Table 3 shows the basic statistics of financial performance with respect to the banks with networks (Panel A), as well as all the sample banks (Panel B). Comparing these panels, it was found that the performance of the banks with networks

[5] Here, operating in the same prefecture means that the headquarters of two banks were existed in the same prefecture.

was not better than the average performance of all the sample banks, while the scale of the banks with networks was larger in terms of deposit

Finally, the quality of the network of each bank was examined. The quality of the network of a bank (Bank A for example), was measured by the average performance of the banks with which Bank A was connected. Figure1 shows the distribution of the quality of the networks with respect to the 587 banks, which had at least one connection with another bank. As can be seen,, the variance of the network quality was fairly large, in terms of every financial ratio. In other words, there was substantial heterogeneity in the quality of networks. This fact is significant when considering the implications of the interbank networks. For instance, a bank which was connected with the banks performing well, might enjoy management skill transfer and relief during an emergency, whereas a bank which was connected with the banks performing badly might receive a negative impact from them. This issue is explored in the next section.

3. Network and Bank Performance

3.1 The Effects of Networks on Profitability and Survivability

As revealed in the previous section, there were many interbank networks through director interlocking in 1926. This section will investigate how those interbank networks affected bank performance, specifically profitability and survivability. There are a number of papers on the financial performance of banks (Smirlock, 1985; Bourke, 1989; Berger, 1995, Goddard et al. 2001, 2004, etc.) In the context of pre-war Japan, Okazaki et al. (2005) investigated the determinants of bank profitability, focusing on loan quality, economies of scale, extent of market competition and the risk taking attitude. Meanwhile, Okazaki et al. (2007) and Okazaki (2007) investigated the determinants and implications of bank exits in pre-war Japan. Here, their approach is principally followed, adding the variables capturing the interbank network.[6]

The empirical specifications are as follows. These two equations are estimated using the cross-section data of year 1926.

$$ROE_i = \alpha_0 + \alpha_1 * NETWORK_i + \alpha_2 * EQ_i + \alpha_3 * MARKET_i + \alpha_4 * SECURITY_i + \alpha_5 * SIZE_i + \alpha_5 * LEVERAGE_i + \alpha_6 * BOJ_i + \varepsilon_i \quad (1)$$

$$Pr(FAIL_i = 1) = F(\beta_0 + \beta_1 * NETWORK_i + \beta_2 * EQ_i + \beta_3 * SIZE_I + \beta_4 * BOJ_i) \quad (2)$$

ROEi, the dependent variable of Equation (1) denotes the return on equity (ROE) of bank i. $FAIL_i$ in Equation (2) denotes a dummy variable which is equal to 1 if a bank exited due to a failure in the period from 1927 to 1931, and 0, otherwise. As explanatory variables, $NETWORK_i$ is included to capture the effect of the interbank network. $NETWORK_i$ is the dummy variable which is equal to 1, if bank i had at least one connection with another bank, and 0, otherwise.

The interbank network may affect the performance of a bank in several ways. For one thing, a bank which has connections with other banks may be able to share information and useful knowledge, and thereby enhances its profitability and survivability (Useem (1982); Carpenter and Westphal (2001), etc.). For another, a bank with a network may receive relief loans during emergencies from the connected banks[7]. If these are the cases, the expected sign of the coefficient of *NETWORK* is

[6] Since Okazaki et al. (2005), especially focus on the effects of the connections between banks and non-banking companies, variables related with those connections in the estimated model are included. In this paper, the model is altered by replacing it with the variable to capture the effect of interbank networks.

[7] Imuta (1980) cite the history of Shikoku-Ginko and point out the possibility that banks belonged to large networks enjoyed efficient asset portfolio since they expected that they could receive relief loans during a state of emergency from banks in the same networks.

positive in Equation (1), and negative in Equation (2).

A bunch of control variables are included in Equations (1) and (2). EQ is a variable to control for the effect of the Great Kanto Earthquake in 1923. Many banks in the south Kanto district (Tokyo, Kanagawa, Chiba, and Saitama prefectures), suffered from bad loan problems due to the destruction of collateral by the earthquake. EQ is the dummy variable which is equal to 1, if the headquarters of a bank was located in Tokyo, Kanagawa, Chiba, or Saitama prefecture, and 0 otherwise. It is expected that the banks operating in these areas would be less profitable and have a higher probability failure rate. MARKET denotes the market share of the top three banks in a prefecture, in terms of the number of operating units, *i.e.* the headquarters and the branches, in the prefecture[8].

SECURITY is the variable to capture the asset quality of a bank, measured by the ratio of security holdings to loans. The preceding studies on the banking industry in pre-war Japan have regarded securities as relatively safe assets with low risk and low return, because most of them were composed of government bonds and the debentures of major companies (Okazaki et al. 2005, 2007; Nanjo and Kasuya 2005). As they assumed, under normal economic conditions, the expected return of bank loans is higher than that of securities, but the relation can be reversed in a depression, because a portion of bank loans are uncollectible. As a serious depression continued, in Japan in the 1920s, it was quite possible that the ROE of the bank whose portfolio was mainly composed of securities would be higher than that of the bank whose portfolio was mainly composed of loans. In this case, the coefficient of SECURITY is expected to be negative in Equation (2).

SIZE, which is defined as the log of total assets, is the variable to capture the

[8] This variable is common for all of the banks in the same prefecture. Since the data on the amount of deposits or loans of individual banks by prefecture is not available, the number of branch offices was used as a marker share.

economies of scale in Equation (1). If there were economies of scale in the banking industry, the coefficient of SIZE would be positive. In addition to saving the unit cost, it is easier for large banks to diversify assets. Hence, the coefficient of SIZE in Equation (2) is expected to be negative.

The variable BOJ is the dummy variable which is equal to 1 if a bank had a transaction relationship with the Bank of Japan, and 0, otherwise. Okazaki (2007), which investigated the role of the Lender of Last Resort (LLR) in pre-war Japan, revealed that a bank with a transaction relationship with the BOJ enjoyed higher profitability because the transaction relationship loosened the constraint on the asset portfolio, and that the transaction relationship with the BOJ lowered the probability of failures for solvent banks. Therefore, the variable BOJ is included to capture the effect of LLR in both of the equations.

LEVERAGE is the ratio of capital to deposits. This variable is included to control for the effect of the capital structure, following Modigliani and Miller's propositionⅡ. According to the proposition, the expected return on equity increases along with financial leverage. As for Equation (2), several other financial ratios are added. Namely return on equity (ROE) is included, the ratio of capital to deposits (CAPDEPO), and the ratio of bank deposit reserves to total assets (LIQUID), following Okazaki et al. (2007) and Okazaki (2007)[9].

Equation (1) is estimated by the Tobit model, because the profit data of individual banks from *Ginkokyoku Nenpo* were censored at zero. Table 4 presents estimation results of Equation (1). In column 1, the coefficient of NETWORK is

[9] These variables were chosen to capture the components of the CAMEL rating, which has become a standard guideline for the risk of bank failure (Wheelock and Wilson, 2000). CAPDEPO was used to the capture capital adequacy of a bank. Low value for this variable indicates high risk. LIQUID was the variable for liquidity of assets. If a bank has sufficient liquid assets, it is likely to survive against the abrupt withdrawal of deposits. As ROE indicates bank profitability, it can be clearly predicted that ROE will have a negative impact on the probability of bank failures.

positive, but not statistically significant, implying that the benefit of the interbank network on the profitability is not clearly confirmed by this specification. In columns 2-4, the structure and quality of the network are taken into account. To test the effect of the structure of the network, the banks with networks were split by the position in the networks, in Column 2. In column 2, the variable NETWORK is split into three dummy variables, CORE, PERIPHERY and INDEPENDENT, which denote the core banks, the periphery banks and the independent network banks, respectively in the sense of Panel A of Table 2. The coefficients of these three variables are positive, but not statistically significant. In other words, the structure of the network did not have a significant effect on bank profitability[10].

The effect of the quality of the network on bank profitability is now examined. It is hypothesized that a bank which had connections with the banks performing well would have higher profitability than otherwise. To capture the quality of the network, the interaction terms are included. NETWORK*CONROE and NETWORK*CONCAPDEPO, where CONROE and CONCAPDEPO denote the weighted average of the return on equity and the ratio of capital to deposits of the connected banks, respectively. Columns 3 and 4 report the estimation results. In column 3, while the coefficient on NETWORK is no longer positive, the coefficient of NETWORK*CONROE is positive and statistically significant, which is consistent with the hypothesis. In column 4, the coefficient of NETWORK*CONCAPDEPO is also positive, although not statistically significant. In summary, it can be concluded that what mattered was not a network itself but its quality.

Next, Equation (2) is estimated by the Logit model. Table 5 reports the

[10]To examine the effect of the regional characteristics of an interbank network, additional estimations were conducted where NETWORK is split into two variables: INTRAREGION and INTERREGION which denote the banks with intraregional networks and ones with interregional networks, respectively in the sense of Panel B of Table 2. Although not reported in the table, it is confirmed that both of the two network variables are not statistically significant.

estimation results. As shown in columns 1 and 2, the coefficient on NETWORK is negative and statistically significant at the 1% level, which suggests that banks with networks were less likely to fail than those without networks. As for other explanatory variables, the coefficients of SIZE, EQ and ROE are statistically significant and have the expected signs.

In Columns 3-5, the effect of the structure and quality of interbank networks are examined, as in Equation (1). In column 3, NETWORK is replaced by CORE, PERIPHERY and INDEPENDENT. Column 3 shows that the coefficients of these three variables are negative and statistically significant only for INDEPENDENT, which implies that the benefit of the network was observed outside the core-periphery structure. However, the magnitude of the point estimator is not substantially different among these three variables[11].

With respect to the quality of the network, column 4 shows that the coefficient of NETWORK*CONROE is negative and statistically significant. This means that the effect of the network to prevent a bank failure depended upon the profitability of the banks in the network[12]. It can be concluded again that in enhancing the survivability of a bank, what mattered was not the network itself but its quality. Finally, in column 5, the coefficient of NETWORK*CONCAPDEPO is negative but was not statistically significant.

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[11] To examine the effect of geographical feature of networks, an additional estimation was conducted, where NETWORK was replaced by INTRA-REGION and INTER-REGION. It is confirmed that both of the coefficients are negative and statistically significant. Also, the magnitudes of these point estimators are almost the same. Hence, with respect to the effect of interbank networks on the bank survivability, the geographic structure of the networks did not matter.

[12] Column 5 in Table 5 implies that if there were many banks with negative profits in the network, that network would increase the probability of failure. Because the profit data of banks are censored at zero in the dataset, it is difficult to directly check this possibility. However, while the ratio of the banks whose profit data are censored is 4.9% in the banks with networks, it is 8.3% in the banks without networks. Therefore, it is unlikely that interbank networks increased the probability of bank failures.

3.2 Bank Networks and Contagious Withdrawal of Deposits

The effect of the interbank network may not always be positive. As many studies have pointed out, it is possible that financial contagions spread through interbank networks. For instance, when a certain bank is closed due to a bank run, the banks connected with it are more likely to be exposed to contagious runs. This is because depositors suspect that the connected bank become insolvent and illiquid due to default of the interbank loans to the closed banks[13]. In this way, contagious withdrawals of deposits may spread within the same network. Thus, this kind of contagious deposit withdrawals was investigated to determine if this actually occurred in pre-war Japan or not. For this purpose, the following equation on the determinants of deposit growth of each bank is estimated.

$$GDEPO_i = \gamma_0 + \gamma_1 {*} NETWORK_i + \gamma_2 {*} NETWORK_i * CONGDEPO_i + \gamma_5 {*} SIZE_i + \gamma_5 {*} M\&A_i + u_i \qquad (3)$$

,where the dependent variable, GDEPO is the deposit growth rate from the end of 1926 to the end of 1927. This period includes the Showa Financial Crisis of 1927, where nationwide bank runs occurred, and consequently 44 banks were closed. As for explanatory variables, the interaction term NTEWORK*CONDEPO is to capture the contagious effect of the deposit shock of the banks in the same network. Here, CONDEPO indicates the average deposit growth of the banks in the same network. If deposits of a bank decreased due to withdrawals of deposits of the banks in the same network, the coefficient on $NETWORK_i$ * $CONGDEPO_i$ would be positive. In the estimation, both the arithmetic and weighted average of the deposit growth rate of the

[13] In the origin of Showa Financial Crisis of 1927, the bank run against Tokyo Watanabe bank immediately triggered the other run against its family bank, Akaji Saving bank. Consequently, these two banks were closed.

connected banks were used in calculating CONGDEPO of each bank. M&A is the dummy variable which is equal to 1 if a bank experienced mergers or acquisitions in 1927. With respect to the banks which experienced mergers or acquisitions in 1927, in calculating GDEPO, the deposits of the pro-forma banks are used for the end of 1926.[14] In addition, the financial ratios which were used in Equation (2) as the explanatory variables were included. As for sample observations, 183 banks from the 1007 samples were lost in the previous analyses, due to exits of banks. In addition, eight outlier observations were excluded whose deposit growth rate exceeded 100%. Consequently, 816 observations remain.

Table 6 reports the estimation results. Columns 1-3 are the cases including prefecture dummies, while columns 4-6 are the cases excluding them. As indicated in columns 1-3, the coefficients of NETWOK are negative but not statistically significant. In columns 2 and 3, both of the coefficients of NETWORK*CORGDEPO are positive but not statistically significant. Thus strong evidence can not be found for contagious withdrawal of deposits within the network. Then, the prefecture dummies in columns 4-6 are excluded, taking into account the possibility that the prefecture dummies capture the contagious effect of the networks. However, as shown in columns 5 and 6, both of the coefficients of NETWORK*CONGDEPO are still statistically insignificant, although the magnitudes become slightly larger. Furthermore, to correct the selection bias due to bank exits, Equation (3) is re-estimated with a sample selection model by the maximum likelihood (ML) method, where the selection equation consists of the variables explaining the probability of exit. The estimated results are shown in the Appendix. It can also be confirmed that the coefficients on NETWORK*CONGDEPO are positive but not statistically significant. In summary, there is no strong evidence for the contagious effect of interbank networks. The coefficients on ROE and

[14] The value of a pro-forma bank indicates the sum of the balance sheet in participating banks. With respect to other variables, the values of acquiring banks are used.

CAPDEPO are positive and statistically significant, which implies that banks performing well were more likely to collect deposits. In other words, the fundamental factors explain the change of deposits better than contagious factors, which is consistent with Yabushita and Inoue (1993) and Okazaki (2007), which analyzed the factors affecting the probability of bank closures during the Showa Financial Crisis of 1927 to reject contagious bank closures.

4. Bank Networks and Consolidation

As mentioned above, a wave of bank consolidations occurred in the late 1920s and the early 1930s due to the Bank Law of 1927. This law prescribed that a bank should have capital not less than one million yen in principle, and that an existing bank whose capital was smaller than this minimum criterion was required to meet this requirement within five years. While more than half of the ordinary banks did not meet this criterion when the law was enacted in 1928, each of them was principally not allowed to increase their capital by itself. Therefore, these banks were obliged to choose consolidations or liquidations. The question, then, is how interbank networks were related to the process and result of these consolidations. These questions are addressed in this section.

4.1 Bank Networks and Choice of Partner Banks

First, the effects of interbank networks on the process of consolidations are examined. Most of the banks whose capital was smaller than the criterion searched for consolidation counterparts. How did these banks choose the counterparts? And what role did interbank networks play in the process? It is possible that interbank networks affected the choice of counterparts. For instance, a bank may not be sure about the soundness of another bank with which it is supposed to be merged, because it is difficult for the bank to have complete information on the counterpart. In this case, the interbank network based on director interlocking may mitigate such asymmetric information between the two banks. Also, the common directors may coordinate negotiations on the consolidation[15]. Therefore, it is expected that banks were more likely to be consolidated with the banks in the same network than those outside the network.

For the testing of this hypothesis, the events of bank consolidations that occurred in the period from Jan. 1927 to Dec. 1932 were used, as reported in *Ginko Jiko Geppo* (*Monthly Bank Affairs*) edited by the Bank of Japan. Out of the consolidation events reported in the source, the consolidations were selected where the information on the directors is available with respect to all the participating banks. Consequently, 173 events remain. Table 7 shows the number and ratio of the intra-network consolidations, where the participating banks had connected with each other before the consolidation, out of 173 consolidation samples. In cases when the number of participating banks was more than two, it was regarded a consolidation as an intra-network if there had been at least one connection among the participants. In Panel A, consolidations are classified into three categories according to *Ginko Jiko Geppo*, namely, absorption, acquisition and combination into a new bank. Here, combination into a new bank refers to the form of consolidation where a new bank was established after all of the participants were dissolved.

It is confirmed that in more than 30% of the consolidations, networks had already existed among the participating banks. This result suggests that interbank networks played a role in the process of consolidations. Observing the different types of consolidations, it was found that the proportion of intra-network consolidations was

[15] In D'aveni and Kesner (1993), it is shown that target firms are less likely to resist takeover when their managers and the bidder's firm outsiders shared connections to the same prestigious networks.

approximately twice as high in the combination into a new bank as in the other combination categories. In addition, Panel B indicates that this proportion is higher in a “more-than- two consolidation” than in a “one-to one consolidation”.

In interpreting the above findings, Kin’yu Kenkyu-Kai (1934), is a basic reference on bank consolidations in Japan in this period. According to this reference, the participant banks tended to choose to combine into a new bank when the powers of them were almost balanced. On the other hand, in general, negotiations of consolidations are supposed to be more likely to break off, when many equal-power participants are involved. Taking these points into account, it can be interpreted from the results in Table 7 that interbank networks facilitated coordination among merger participants, in particular when the negotiation costs were high.

Panel C classifies consolidations into intraregional consolidations and interregional consolidations. Here, while the former refers to the consolidations where all of the participating banks operated in the same prefecture, the latter refers to other consolidations. Panel C shows that the ratio of intra-network consolidations is higher in the intraregional consolidations than in the interregional ones.

Concerning the results in Panel B, it is possible that the participating banks were more likely to have connections among them in case of a combination into a new bank simply because the number of participants was larger. Also, concerning the results in Panel C, the ratio of intra-network consolidations is higher in case of intraregional consolidations simply because the density of networks was higher within the same prefecture.

Thus, it is necessary to examine the role of the interbank network in choosing merger partners econometrically. Tests were made on whether a connection between a pair of banks had an effect to enhance the probability of consolidation between them, using the data of 320 banks, which participated in 173 consolidations. The equation to be estimated is as follows.

$$\Pr(MERGE_{ij}=1) = F(\beta_0 + \beta_1 NETWORK_{ij} + \beta_2 PREFECTURE_{ij} + \varepsilon_{ij}),\ i \neq j \qquad (3)$$

, where $MERGE_{ij}$ is the dummy variable which is equal to 1, if bank i and bank j were merged in the period from 1927 to 1929, and 0, otherwise. $NETWORK_{ij}$ is the dummy variable which is equal to 1, if there was a director interlocking between bank i and bank j, and 0, otherwise. If a network between the two banks made it easier for them to be merged, the coefficient of $NETWORK_{ij}$ is expected to be positive. $PREFECTURE_{ij}$ is the dummy variable which is equal to 1, if the headquarters of bank i and bank j were located in the same prefecture, and 0, otherwise. Equation (3) is estimated with respect to all the pairs of banks, using the Logit model[16].

The estimation results are reported in Table 8. In column 1, where all of the consolidation samples are used, the coefficient of NETWORK is positive and statistically significant, which suggests that each bank tended to choose the bank with which it had already had a connection, in selecting a merger counterpart. In columns 2-4, the consolidations are classified into abortions, acquisitions and combinations into a new bank, respectively. While the coefficient of NETWORK is positive and statistically significant in all cases, its magnitude is relatively larger for combinations into new banks, which is consistent with the results in Panel B of Table 7. Hence, it can be concluded that interbank networks facilitated coordination among merger participants, in particular when the negotiation costs were high.

In Panel B, consolidations are classified into intraregional and interregional consolidations. Here, $PREFECTURE_{ij}$ is excluded from the explanatory variables. It is confirmed that the coefficient of NETWORK is positive and statistically significant in

[16] Total number of pairs of i bank and j bank is N*(N-1)/2 since removing the pairs of the same bank. Therefore, it amounts to 51040 pairs in the case for 320 banks.

both of intraregional and interregional consolidations. However, the magnitude of the former is larger than that of latter, which is also consistent with the result of Panel C of Table 7.

In summary, it can be safely said that interbank networks affected the choice of merger counterparts, especially in the cases of combinations into new banks.

4.2 Bank Networks and Post-merger Performance

It has been confirmed that the interbank networks facilitated consolidations within them. How, then, were the interbank networks associated with the result of the consolidations? To be more specific, did the intra-network consolidations provide a better effect on bank performance than the other consolidations? It is possible that the pre-merger networks reduced the costs for unifying different organizations. To investigate this point, the effects of intra-network consolidation on post-merger financial performance were estimated. In the analysis, Okazaki and Sawada (2007) was principally followed, which examined the effect of consolidation promoted by the 1927 Bank Law on the financial performance of banks, using data on the event of 1927-32. There, the effects of consolidation were examined on the bank performance by comparing the change in ROA and deposit growth rate from year T-1 to year T+2 and T+3, between the consolidated banks and the non-consolidated banks, where T is the event year when the consolidation occurred[17]. In the following analysis, the events of consolidations in 1927-29 were focused upon.

To begin with, the events of the consolidations need to be selected. In order to identify the consolidation effects clearly, the banks which participated in multiple consolidations in the time-period from beginning of year T-1 to the end of year T+3[18]

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[17] Furthermore, to capture the effect of policy-promoted consolidation, they split the effect of consolidations into that of policy-promoted ones and strategic ones.

[18] For exception, in the case that one bank merged other banks twice within one year,

were excluded. In addition, thc fouus was limited to the consolidation events where the director interlocking data was available for all of the participating banks. Thus, 66 consolidation events remain. Next, the control samples for each event year (1927-29) are chosen to be compared with the consolidated banks. The control sample banks, which correspond to the consolidated banks in the event year T, refer to the banks which were not involved in any consolidations in the period from the beginning of year T-1 to the end of year T+3. For example, the control samples of the event year 1927 are the banks which were not involved in any consolidations during the time-frame from 1926-30. These are compared with the banks which were consolidated in 1927. Event observations for the year 1927 were the consolidated banks in 1927 and their control sample banks. In the same way, event observations were constructed for the years 1928 and 1929, to have unbalanced panel data in three groups of event years 1927-29, which consisted of 1075 bank-event year observations. Table 9 shows the number of consolidations and control samples by event year. The consolidations are classified into intra-network consolidations and other consolidations. Approximately 30% of the consolidations are classified into intra-network consolidations, where the participating banks had a mutual connection.

As to the empirical specification, the model of Okazaki and Sawada (2007) was slightly modified to explicitly capture the effects of intra-network consolidations. The model to be estimated is as follows.

$$\triangle Y_{it} = \beta_0 + \beta_1 NTCONS_{it} + \beta_2 OTHERCONS_{it} + \gamma X_{it} + \varepsilon_{it} \qquad (4)$$

,where i indexes the bank, while t indexes the event year group. The dependent

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These consolidations are dealt with as if they were merged at once. Included are four such cases in sample events: Dai-Hachiju-go Bank (1927), Ju-ni Bank (1928), Ogaki-Kyoritsu Bank (1928) and Goju-roku Bank (1928).

variable, $\triangle Y_{it}$ is the difference of ROA or deposit growth rate in the period from the end of year T-2 to the end of year T+2 or T+3[19]. For the value of consolidated banks in year T-2, pro-forma banks were used, which means this is the sum of the balance sheets of the banks which participated in the consolidations. NTCONS is the dummy variable which is equal to 1, if a bank participated in an intra-network consolidation in year T. OTHERCONS is the dummy variable which is equal to 1, if a bank participated in the consolidations where the participants had no previous connection with each other. If the consolidation had a positive effect on the bank performance, the coefficients of NTCON and OTHERCON are expected to be positive. In particular, of interest are the differences between the coefficients of NTCONS and OTHERCONS. X is a vector of other explanatory variables. Following Okazaki and Sawada (2007), the natural log of the total assets (LN(ASSET) is included, the change in the number of branch offices ($\triangle$ BRANCH), and the dummy variable indicating whether the headquarters of the bank was located in an urban area, namely Tokyo, Kanagawa, Aichi, Kyoto, Osaka and Hyogo prefectures (URBAN)[20]. In addition, the loan-asset ratio (LOAN/ASSET) is included in case the dependent variable is the change of ROA, because this variable is expected to capture the asset risk of banks. Equation (4) is estimated, using pooled OLS with a heteroskedasticity-robust standard error (White 1980).

Table 10 reports the estimation results in the case of the deposit growth rate is used as the dependent variable. While in Columns 1-4, all of the sample banks were used, in Columns 5-8, the outliers were removed whose deposit growth rate exceeded 100%. In Columns 1 and 2, the deposit growth rate from the end of year T-2 to the end

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19 Since consolidations were frequently accompanied by asset reevaluation, the value of the assets of the post-consolidation bank was adjusted in the following way.

$$ASSET^{*}_{T+i} = ASSET_{T-1} + (ASSET_{T+i} - ASSET_{T}), i = 2,3$$

20 Moreover, in actual estimation, the event year dummies are included in explanatory variables to control for the shocks common to the samples of the same event year group, although the estimated results are not shown in the table.

of year T+2 is used as the dependent variable, and in Columns 3 and 4, the deposit growth rate from the end of year T-2 to the end of year T+3 is used. Column 1 shows the case where there is difference distinguished between intra-network consolidations and other consolidations. The coefficient of the consolidation dummy is positive and statistically significant. This suggests that consolidations had an effect on enhancing the banks' ability to collect deposits, which is consistent with Okazaki and Sawada(2007). In Column 2, there is a difference distinguished between intra-network consolidations and other consolidations. It is confirmed that the coefficients of both NTCONS and OTHERCONS are positive and statistically significant, and the magnitudes of these coefficients are almost the same. In Column 4, what is reported are the results concerning the deposit changes from T-2 to T+3, both coefficients are still positive and statistically significant, but the magnitude of NTCONS is larger than that of OTHERCONS. Even if the outliers are excluded, the results are qualitatively the same (Columns 5-8). In summary, both of the intra-network consolidations and other consolidations had a positive effect on deposit growth, and as time went on after the consolidations, the positive effect of the intra-network consolidations seemed to become larger than that of the other consolidations. However, due to the constraints of data, it is difficult to confirm the long-run effect of intra-network consolidations[21].

Finally, Table 11 reports the estimation results of Equation (4), with the change of ROA as the dependent variable. Columns 1 and 2 show the results of the performance changes from the end of year T-2 to year T+2, and Columns 3 and 4 show those from the end of year T-2 to year T+3. In Columns 1 and 3, the coefficient of the consolidation dummy is negative, but not statistically significant. In Columns 2 and 4, both of the coefficients on NTCONS and OTHERCONS are negative, but are also not statistically

[21] If the interval is longer, many consolidation samples may be lost.

significant. While the magnitude of the coefficient of NTCONS is smaller than that of OTHERCONS in Column 2, the result is reversed in Column 4. Therefore, clear evidence can not be confirmed that intra-network consolidations had a better effect on bank profitability than other consolidations.

In Columns 5-8, Equation (4) was estimated with the change of ROA as the dependent variable, taking into account the fact that the profit data are censored at zero. Eliminating the banks whose profit data were zero, Equation (4) is estimated, using the sample selection model with the maximum likelihood method. During selection of the equation, a consolidation dummy was included, SIZE, URBAN, LOAN/ASSET and event year dummies, which are expected to explain the cross sectional differences of bank profit, following Okazaki and Sawada (2007), although the estimated results of the selection of the equation are not shown in Table 11. The estimation results of the second stage are reported in Columns 5-8. It is confirmed that the negative effect of consolidations became slightly smaller, but qualitatively identical.

Summarizing the results obtained in this section, it is concluded that interbank networks made within-network consolidations easier, by reducing the costs of coordination. There is no strong evidence concerning the effects on post-merger performance.

5. Concluding Remarks

In this paper, the structure and implications of interbank networks in pre-war Japan were explored, focusing on director interlocking. It was found that approximately 60% of the banks had at least one connection with another bank through director interlocking. These connections resulted in the construction of complex networks of banks, not to be reduced to core-periphery structures.

Based on this finding, the impact of the interbank networks on the financial performance and the survivability of banks was examined. It was revealed that while a bank with a network was not always more profitable compared to a bank without it, a bank which had a network with profitable banks was more profitable. In other words, concerning profitability, what mattered was not a network *per se* but the quality of network. Concerning the probability of failure, it was found that a bank with a network was less likely to fail than a bank without one. However, the quality of networks mattered also in this case. That is, the failure probability of a bank was negatively associated with the profitability of the connected banks.

These results suggest that inter-bank networks contributed to bank performance and the stability of financial system in some way. However, strong evidence that a financial contagion spread through inter-bank networks as stated in literature on financial networks (Allen and Gale 2000; Frexias et al. 2000; Leinter 2005) could not be found.

In addition, the effect of interbank networks on the bank consolidations which surged in the 1920s and 1930s were examined. It was found that a bank tended to choose a bank in the same network as a counterpart of the consolidation, which suggests that interbank networks played a role in coordinating bank mergers. The post-merger performances were not significantly different between a merger of the banks in the same network and that of a bank in different networks. However, in the sense that bank mergers provided a positive impact on deposits, and that interbank networks played a role in coordinating bank mergers, interbank networks contributed to stabilizing the financial system, which was faced with crisis in the 1920s.

This paper has explored the role of interbank networks from different angles than those points of view found in preceding financial network literature. It was revealed that human networks among banks indeed affected the financial performance and conduct of the banks. However, the exact details of the sources for those effects could not be disclosed. Exploring this issue still remains an opportunity for future research.

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Table1 Distribution of the number of connections through director interlocking

Number of connections	OBS	%
0	420	41.71%
1	297	29.49%
2	146	14.50%
3	63	6.26%
4	40	3.97%
5	16	1.59%
6	10	0.99%
7	4	0.40%
8	1	0.10%
9	5	0.50%
10	2	0.20%
11	2	0.20%
13	1	0.10%

Table2 Structure of interbank networks

Panel A Positions in networks

Types	OBS	%
Core bank	81	8.04%
Periphery bank	142	14.10%
Independent network bank	364	36.15%
Without networks	420	41.71%
Total	1007	100.00%

Panel B Regional characteristics of interbank network.

Types	OBS	%
Intra-regional network	402	39.92%
Inter-regional network	185	18.37%
Without networks	420	41.71%
Total	1007	100.00%

Table3 Basic Statistics

PanelA Basic statistic on banks with networks

Variable	Observations	Mean	Std. Dev.	Min	Max
Number of connections	587	2.068	1.659	1.000	13.000
Capitals/Deposits	587	0.898	4.370	0.036	101.377
Deposits/Loans	587	0.896	0.667	0.003	10.382
Reserves/Total assets	587	0.088	0.081	0.000	0.646
ROE	587	0.135	0.079	0.000	0.732
Amount of deposits (thousand yen)	587	11904.8	46882.6	1.9	609252.4

PanelB Basic statistic on all sample banks

Variable	Observations	Mean	Std. Dev.	Min	Max
Capitals/Deposits	1007	1.043	7.060	0.036	195.1
Deposits/Loans	1007	1.142	7.973	0.003	253.1
Reserves/Total assets	1007	0.089	0.077	0.000	0.6
ROE	1007	0.133	0.079	0.000	0.7
Amount of deposits (thousand yen)	1007	8696.8	38707.7	1.6	609252.4

Table4 Interbank networks and profitability

	Dependent variable: ROE			
Variables	[1]	[2]	[3]	[4]
NETWORK	0.0033		−0.0137	0.0025
	(0.0054)		(0.01)	(0.0055)
CORE		0.0017		
		(0.0082)		
PERIPHERY		0.0113		
		(0.008)		
INDEPENDENT		0.0004		
		(0.0061)		
NETWORK*CONROE			0.1305 b	
			(0.0636)	
NETWORK*CONCAPDEPO				0.0012
				(0.0011)
SIZE	−0.0021	−0.0021	−0.002	−0.0021
	(0.0027)	(0.0027)	(0.0027)	(0.0027)
EQ	−0.0318 a	−0.0326 a	−0.0317 a	−0.0316 a
	(0.0083)	(0.0083)	(0.0084)	(0.0083)
MARKET	0.0001	0.0001	0.0001	0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
SECURITY	0.0154	0.0151	0.015	0.0155
	(0.0107)	(0.0107)	(0.0105)	(0.0107)
LEVARAGE	0.0071 a	0.0072 a	0.007 a	0.0072 a
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
BOJ	0.0046	0.0047	0.0041	0.0047
	(0.0077)	(0.0077)	(0.0077)	(0.0077)
INTERCEPT	0.1372 a	0.1365 a	0.1349 a	0.1362 a
	(0.0364)	(0.0365)	(0.0366)	(0.0363)
Log likelihood	956.10339	957.04466	958.7375	956.2405
Observations	1007	1007	1007	1007
Censored	64	64	64	64

Notes:
Significance at 1%,5% and 10% level are denoted by "a" "b" and "c".
The figures in parentheses are robust standard errors.

Table5 Interbank networks and survivability

Variables	[1]	[2]	[3]	[4]	[5]
NETWORK	−0.5553 a	−0.6393 a		0.4872	−0.6311 a
	(0.213)	(0.2318)		(0.4242)	(0.2421)
CORE			−0.7858		
			(0.5495)		
PERIPHERY			−0.5947		
			(0.3777)		
INDEPENDENT			−0.6301 b		
			(0.2661)		
NETWORK*CONROE				−9.9188 a	
				(3.352)	
NETWORK*CONCAPDEPO					−0.0016
					(0.1039)
SIZE	−0.499 a	−0.2192 c	−0.2138 c	−0.2446 b	−0.2239 c
	(0.1205)	(0.1147)	(0.1193)	(0.1131)	(0.1147)
EQ	1.3276 a	1.0532 a	1.0551 a	1.0401 a	0.9919 a
	(0.2382)	(0.2949)	(0.301)	(0.2935)	(0.29)
BOJ	0.4037	0.2692	0.2683	0.3679	0.2732
	(0.3288)	(0.3495)	(0.3499)	(0.3572)	(0.3515)
CAPDEPO		0.0849	0.0843	0.0885	0.0992 c
		(0.0517)	(0.0517)	(0.0572)	(0.0533)
LIQUID		−4.8702	−4.8862	−2.3722	−2.5879
		(3.4352)	(3.4359)	(2.519)	(2.7194)
ROE		−13.7681 a	−13.7998 a	−13.9059 a	−14.2562 a
		(3.4132)	(3.4191)	(3.3345)	(3.3723)
SECURITY		−0.299	−0.3088	−0.2047	−0.284
		(0.6893)	(0.6973)	(0.5357)	(0.7373)
INTERCEPT	5.023 a	2.8812 c	2.8097 c	3.05 c	2.8278 c
	(1.682)	(1.5767)	(1.643)	(1.5722)	(1.5916)
Pseudo	0.0914	0.223	0.2232	0.2334	0.2169
Observations	1007	1007	1007	1007	1007

Notes:
Significance at 1%,5% and 10% level are denoted by ″a″ ″b″ and ″c″.
The figures in parentheses are standard errors.

Table6 Interbank networks and contagious withdrawal of deposits

	Dependent variable: Deposit Growth Rate					
Variables	[1]	[2]	[3]	[4]	[5]	[6]
NETWORK	−0.0032	−0.0033	−0.0034	0.0143	0.0141	0.014
	(0.0157)	(0.0158)	(0.0158)	(0.0143)	(0.0143)	(0.0143)
NETWORK*CONGDEPO			0.0085			0.0142
(weighted average)			(0.0117)			(0.0112)
NETWORK*CONGDEPO		0.0067			0.0128	
(mean)		(0.0119)			(0.0113)	
M&A	0.0243	0.0249	0.025	0.0494 b	0.0504 b	0.0504 b
	(0.025)	(0.025)	(0.025)	(0.0226)	(0.0226)	(0.0226)
SIZE	−0.0016	−0.0017	−0.0018	−0.0114	−0.0116	−0.0117 c
	(0.0075)	(0.0075)	(0.0075)	(0.0071)	(0.0071)	(0.0071)
ROE	0.2389 c	0.2385 c	0.2381 c	0.3257 a	0.3236 b	0.3232 b
	(0.1243)	(0.1244)	(0.1244)	(0.1251)	(0.1252)	(0.1252)
CAPDEPO	0.0011 a	0.0011 a	0.0011 a	0.0005	0.0005	0.0005
	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)
LIQUID	−0.101	−0.1005	−0.1003	−0.1715	−0.1698	−0.1697
	(0.1222)	(0.1226)	(0.1227)	(0.1178)	(0.1182)	(0.1183)
INTERCEPT	−0.1691	−0.1666	−0.1656	0.0715	0.0743	0.0748
	(0.1234)	(0.1235)	(0.1235)	(0.1056)	(0.1056)	(0.1056)
Prefecture dummies	YES	YES	YES	NO	NO	NO
R−squared	0.1401	0.1403	0.1405	0.0226	0.0234	0.0237
Observations	816	816	816	816	816	816

Notes:
Significance at 1%,5% and 10% level are denoted by "a" "b" and "c".
The figures in parentheses are standard errors.

Table7 Interbank networks and bank consolidation in 1927–29

Panel A: Form of consolidation

Types	Number of events	Number of Intra–network	%
Absorptions	94	27	28.7%
Mergers of equals	25	14	56.0%
Acquisitions	54	14	25.9%
Total	173	55	31.8%

.

Panel B: Number of participants

Types	Number of events	Number of Intra–network	%
One–to–one	154	42	27.3%
More than two	19	13	68.4%
Total	173	55	31.8%

.

Panel C: Regional characteristics

Types	Number of events	Number of Intra–network	%
Intra–regional	146	49	33.6%
Inter–regional	27	6	22.2%
Total	173	55	31.8%

Table8 Interbank networks and choice of partner banks

PanelA: Type of Consolidations

Variables	All consolidations [1]	Absorptions [2]	Acquisitions [3]	Mergers of equals [4]
NETWORK	2.8182 a	1.9435 a	2.0943 a	2.6483 a
	(0.2166)	(0.2504)	(0.3449)	(0.2959)
Prefecture	5.0278 a	5.0553 a	4.254 a	6.236 a
	(0.2012)	(0.2773)	(0.3375)	(0.7302)
INTERCEPT	−7.3869 a	−8.0405 a	−8.2492 a	−10.1263 a
	(0.1797)	(0.25)	(0.2774)	(0.7071)
Pseudo	0.4685	0.3978	0.2995	0.483
Observations	51040	51040	51040	51040

PanelB: Regional characteristics

	Intra−regional [1]	Inter−regional [2]
NETWORK	5.5352 a	4.447 a
	(0.188)	(0.4622)
INTERCEPT	−5.9295 a	−7.6181 a
	(0.0862)	(0.2)
Pseudo	0.1907	0.0767
Observations	51040	51040

Notes:

Significance at 1%,5% and 10% level are denoted by ″a″ ″b″ and ″c″.

The figures in parentheses are standard errors.

Table9 Number of samples by event year

Event Year	Intra-network consolidations	Other consolidations
1927	5	12
1928	9	19
1929	6	15
Total	20	46

Table10 The effect of consolidations on deposit growth rate

	All samples				Excluding outliers			
	Dependent variable: Deposit growth rate from T−2 to T+2 or T+3							
Window	[T−2, T+2]	[T−2, T+2]	[T−2, T+3]	[T−2, T+3]	[T−2, T+2]	[T−2, T+2]	[T−2, T+3]	[T−2, T+3]
Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Consolidation dummy	0.1309 a		0.1019 b		0.1558 a		0.1399 a	
	(0.0396)		(0.044)		(0.0388)		(0.0434)	
NTCONS		0.129 c		0.1374 c		0.1649 b		0.1933 b
		(0.0664)		(0.0809)		(0.0718)		(0.0865)
OTHERCONS		0.1317 a		0.0863 c		0.1518 a		0.1169 b
		(0.0456)		(0.0477)		(0.0439)		(0.0466)
SIZE	−0.0241	−0.0242	−0.0105	−0.0103	−0.0016	−0.0016	0.012	0.0123
	(0.0168)	(0.0169)	(0.0176)	(0.0176)	(0.0097)	(0.0097)	(0.0099)	(0.0099)
URBAN	−0.0073	−0.0073	−0.0245	−0.0244	−0.0499 b	−0.0499 b	−0.0566 b	−0.0565 b
	(0.0479)	(0.0479)	(0.0489)	(0.0489)	(0.0245)	(0.0245)	(0.025)	(0.025)
⊿BRANCH	0.0299 a	0.0299 a	0.0339 a	0.034 a	0.0431 a	0.0432 a	0.0466 a	0.0469 a
	(0.0045)	(0.0045)	(0.0061)	(0.0061)	(0.0056)	(0.0056)	(0.0064)	(0.0063)
d28	−0.0375	−0.0375	−0.039	−0.0391	−0.1041 a	−0.1041 a	−0.1037 a	−0.1039 a
	(0.0484)	(0.0484)	(0.0512)	(0.0512)	(0.0248)	(0.0248)	(0.0266)	(0.0266)
d29	−0.1473 a	−0.1473 a	−0.0893 b	−0.0893 b	−0.158 a	−0.158 a	−0.104 a	−0.1041 a
	(0.0309)	(0.031)	(0.036)	(0.036)	(0.0255)	(0.0255)	(0.0273)	(0.0273)
INTERCEPT	0.3714	0.3715	0.0811	0.0779	0.0421	0.0414	−0.2553 c	−0.2597 c
	(0.2443)	(0.2445)	(0.2571)	(0.2575)	(0.1427)	(0.1425)	(0.146)	(0.146)
Observations	1075	1075	1075	1075	1053	1053	1055	1055
R2	0.0395	0.0395	0.0341	0.0342	0.0832	0.0833	0.0837	0.0843

Notes: Significance at 1%,5% and 10% level are denoted by "a" "b" and "c".
The figures in parentheses are robust standard errors.

Table11 The effect of consolidations on ROA

	OLS				Selection model			
Dependent variable	Dependent variable: Change of ROA from T−2 to T+2 or T+3							
Window	[T−2, T+2]	[T−2, T+2]	[T−2, T+3]	[T−2, T+3]	[T−2, T+2]	[T−2, T+2]	[T−2, T+3]	[T−2, T+3]
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Consolidation dummy	−0.0035		−0.0025		−0.0031		−0.0008	
	(0.0027)		(0.0028)		(0.003)		(0.0033)	
NTCONS		−0.0015		−0.0037		−0.001		−0.0019
		(0.0048)		(0.0058)		(0.0051)		(0.0062)
OTHERCONS		−0.0043		−0.002		−0.0041		−0.0004
		(0.0027)		(0.0028)		(0.003)		(0.0032)
SIZE	0.0015 c	0.0015 c	0.0018 c	0.0017 c	0.0018 c	0.0018 c	0.0017 c	0.0017 c
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.001)	(0.001)
URBAN	0.0037	0.0037	0.0041	0.0041	0.0059 b	0.0059 b	0.0065 a	0.0065 a
	(0.0026)	(0.0026)	(0.0026)	(0.0026)	(0.0023)	(0.0023)	(0.0025)	(0.0025)
⊿BRANCH	0.0004	0.0004	0.0005	0.0005	0.0004	0.0004	0.0005	0.0005
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Loan/assets	−0.0193 c	−0.0193 c	−0.0252 b	−0.0251 b	−0.0076	−0.0077	−0.0099	−0.0098
	(0.0101)	(0.0101)	(0.0115)	(0.0115)	(0.0099)	(0.0099)	(0.0118)	(0.0118)
d28	−0.0037 c	−0.0037 c	−0.0031	−0.0031	−0.0036	−0.0036	−0.0024	−0.0024
	(0.0021)	(0.0021)	(0.0024)	(0.0024)	(0.0022)	(0.0022)	(0.0025)	(0.0025)
d29	−0.004 b	−0.0041 b	−0.0009	−0.0009	−0.0029	−0.0029	−0.0004	−0.0004
	(0.002)	(0.002)	(0.0021)	(0.0021)	(0.0022)	(0.0022)	(0.0023)	(0.0023)
INTERCEPT	−0.0217	−0.0217	−0.0232	−0.0232	−0.0302 c	−0.0302 c	−0.0283	−0.0283
	(0.0181)	(0.0181)	(0.0188)	(0.0188)	(0.0179)	(0.0179)	(0.0191)	(0.019)
pho					−0.6082	−0.6087	−0.6336	−0.6334
P−value					0.002 a	0.002 a	0.0013 a	0.0013 a
Censored					181	181	231	231
Observations	894	894	844	844	894	894	844	844
R2/log likelihood	0.0318	0.032	0.0382	0.0382	1561.071	1561.158	1318.468	1318.484

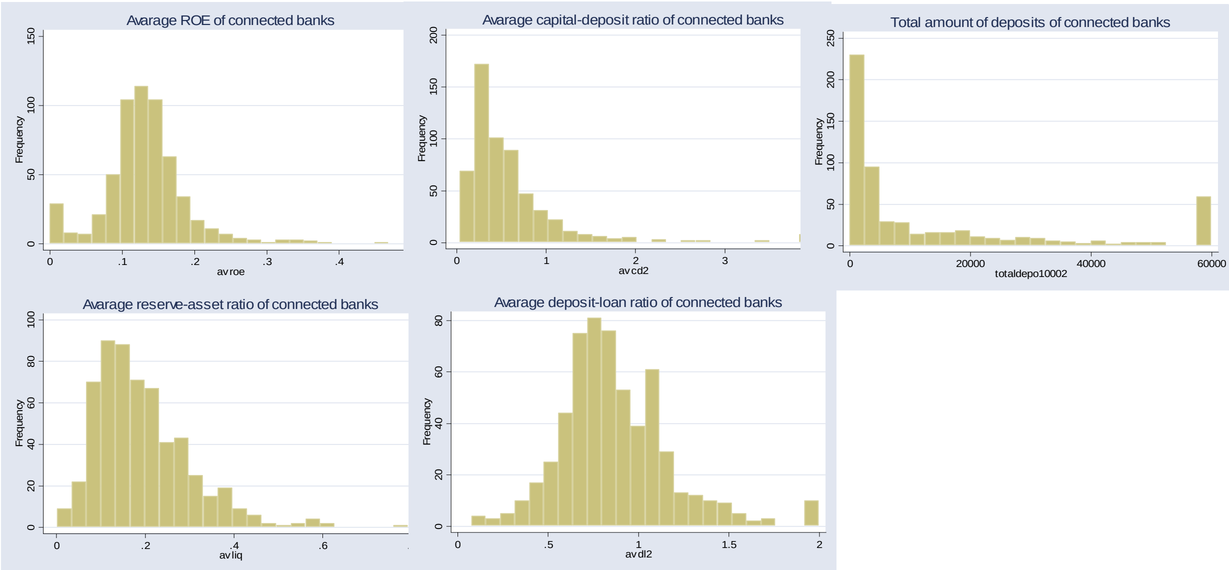
Notes: Significance at 1%,5% and 10% level are denoted by "a" "b" and "c".
The figures in parentheses are robust standard errors.

Appendix Table Interbank networks and contagious withdrawal of deposits (Sample Selection Model)

	Dependent variable: Deposit Growth Rate					
Variables	[1]	[2]	[3]	[4]	[5]	[6]
NETWORK	−0.0033	−0.0034	−0.0034	0.0119	0.0117	0.0117
	(0.0152)	(0.01529	(0.0152)	(0.0144)	(0.0144)	(0.0144)
NETWORK*CONGDEPO			0.0085			0.0134
(weighted average)			(0.0113)			(0.0108)
NETWORK*CONGDEPO		0.0067			0.0116	
(mean)		(0.01159			(0.0109)	
M&A	0.0243	0.0249	0.025	0.0437 c	0.0447 b	0.0447 b
	(0.0242)	(0.02429	(0.0242)	(0.0225)	(0.0225)	(0.0225)
SIZE	−0.0021	−0.0022	−0.0022	−0.0087	−0.0089	−0.0089
	(0.0073)	(0.00739	(0.0073)	(0.0073)	(0.0072)	(0.0072)
ROE	0.2393 b	0.2389 b	0.2386 b	0.3084 b	0.3068 b	0.3064 b
	(0.1199)	(0.1198)	(0.1198)	(0.1304)	(0.1297)	(0.1297)
CAPDEPO	0.001 b	0.001 b	0.001 b	0.0009	0.0009	0.0009
	(0.0004)	(0.00049	(0.0004)	(0.0007)	(0.0007)	(0.0007)
LIQUID	−0.1114	−0.111	−0.1108	−0.0978	−0.0966	−0.0965
	(0.1179)	(0.1181)	(0.1181)	(0.1266)	(0.1248)	(0.1248)
INTERCEPT	−0.1704	−0.168	−0.167	0.0697	0.0725	0.0731
	(0.11989	(0.1197)	(0.1198)	(0.1086)	(0.1071)	(0.1071)
Prefecture dummies	YES	YES	YES	NO	NO	NO
rho	0.120864	0.121521	0.1217022	−0.5962634	−0.5939938	−0.5939471
p-value	0.5205	0.5175	0.5188	0.0013 a	0.0013 a	0.0013 a
Observations	1007	1007	1007	1007	1007	1007
Censored	191	191	191	191	191	191

Notes:
The table reports the results of the second stage in sample selection model.
Significance at 1%,5% and 10% level are denoted by "a" "b" and "c".
The figures in parentheses are standard errors.

Figure1 Quality of interbank networks



Note: These figures indicate distributions on the quality of networks with respect to the 587 banks, which had at least one connection with another bank. The quality of the network of a bank (Bank A for example) is measured by the average performance of the banks with which Bank A was connected.