CENTER FOR ADVANCED RESEARCH IN FINANCE

# CARF Working Paper

CARF-F-511

# The Bright and Dark Side of Financial Support from Local and Central Banks after a Natural Disaster: Evidence from the Great Kanto Earthquake, 1923 Japan

Tetsuji Okazaki
Graduate School of Economics, University of Tokyo, Japan

Toshihiro Okubo
Faculty of Economics, Keio University, Japan

Eric Strobl
Department of Economics, Bern University, Switzerland

April 2021

CARF is presently supported by Nomura Holdings, Inc., Sumitomo Mitsui Banking Corporation, The Dai-ichi Life Insurance Company, Limited, The Norinchukin Bank, MUFG Bank, Ltd. and Ernst & Young ShinNihon LLC. This financial support enables us to issue CARF Working Papers.

# The Bright and Dark Side of Financial Support from Local and Central Banks after a Natural Disaster: Evidence from the Great Kanto Earthquake, 1923 Japan

Tetsuji Okazaki, Toshihiro Okubo, Eric Strobl[1]

April 2021

## Abstract

Natural disasters can seriously damage firms as well as the banks that they use independent of their size. However, it is small- and medium-sized firms in particular that will be affected by this because they tend to be financially constrained and thus greatly depend on these potentially damaged local banks for financing. In this paper, we focus on the Great Kanto Earthquake of 1923, which resulted in serious damage to small- and medium-sized firms and banks in Yokohama City, to investigate how effective the provision of loans by local banks, as well as the Earthquake Bills policy implemented by the Bank of Japan, was in helping firms recover. Using linked firm- and bank-level datasets, we find that larger local banks allowed damaged firms to survive and grow. The Earthquake Bills policy mitigated the negative impact of bank damage on firms and prevented credit crunch, although this deteriorated the balance sheet of local banks and resulted in financial instability and a banking crisis as a side effect.

Keywords: Great Kanto Earthquake, Building damage, Firm-bank relationship, Yokohama city, Earthquake bills, Bank of Japan

[1] Okazaki: Graduate School of Economics, University of Tokyo, Japan. Okubo: Faculty of Economics, Keio University, Japan. Strobl: Department of Economics, Bern University, Switzerland.
Corresponding: Okubo, okubo@econ.keio.ac.jp Keio University, Faculty of Economics, 2-15-45 Mita Minato-ku Tokyo, 108-8345, Japan

## 1. Introduction

Small firms generally tend to be financially constrained and to be particularly vulnerable to external negative shocks. Credit sources dry up more quickly for small than for large firms in a crisis (Berger and Udell, 1998; OECD, 2012). In this regard, when natural disasters severely damage firms as well as local banks by causing many casualties, collapsed buildings, and business shutdowns, small- and medium-sized firms face higher probabilities of bankruptcy as a consequence. This arises because they are financially constrained and thus often find it difficult to finance their recovery. On the other hand, a surge of firms' credit demand for financing their survival and recovery deteriorates the balance sheet of their local transaction banks, also potentially damaged, thus resulting in financial crisis and instability. Therefore, the banking system and financial institutional development are arguably crucial in reducing constraints for small- and medium-sized enterprises (SMEs) (Beck et al., 2004; Beck and Demirguc-Kunt, 2006)[2] and reducing the propagation of negative shock impacts on small firms via the firm–bank relationship (Puri et al., 2011; Cotugno et al., 2013; Sette and Gobbi, 2014).

This paper addresses the question as to what extent financial constraints on small firms affect their survival and recovery after negative external shock, how their transaction banks could mitigate their financial constraints through bank lending, and whether central bank policies can help firms and banks survive and grow. The Great Kanto Earthquake in 1923 in Japan is an excellent case to study the potentially detrimental effects on smaller firms. As the most serious earthquake in Japanese history, more than one hundred thousand people died and assets as large as 35.5% of the gross national product (GNP) in 1922 were destroyed (Tokyo City Office, 1925; Ohkawa et al., 1974; Okazaki et al., 2019)[3], where much of the human and physical damage was concentrated in Tokyo City and Yokohama City. Particularly in Yokohama City, many small firms and local banks were affected. In response, the Bank of Japan (BOJ) rediscounted bills issued by firms in the damaged areas from banks, the so-called "Earthquake Bills." This provided liquidity and mitigated financial constraints for small firms. At the same time, the Earthquake Bills also helped insolvent banks and firms to survive, and thereby destabilized the banking system and financial markets, resulting in the financial crisis of 1927.

In addressing the issues at hand, this paper investigates firm survival and growth after the Great Kanto Earthquake with respect to firm–bank relationships and analyzes the pros and cons of the BOJ policy of discounting Earthquake Bills. We focus on Yokohama City for several reasons. At

[2] Around 39% of small firms face lack of financing as the main constraint to their growth (Beck et al., 2004).
[3] Calculated using the amount of damage from Tokyo City Office (1925) and nominal GNP from Ohkawa et al. (1974).

the time, it was a modernized port city and had suffered much more serious damage due to the earthquake than Tokyo City. Compared with Tokyo City, Yokohama City was small and the credit market there was locally limited. Moreover, inside the city, there were many local small banks and many SMEs, and these local banks and SMEs were tightly linked. Furthermore, unlike today, the credit market was geographically segmented in Japan. Because almost all banks in Japan were locally operated, lending by their local transaction banks was crucial for SMEs' business. Under this circumstance, the earthquake damage intensified the negative impact on the financial constraints of the SMEs and local bank lending became a more crucial factor for survival.

Arguably, the case of the 1923 Earthquake and central bank policy is not just an interesting historical event to study, but can also provide timely lessons for today. More specifically, the Earthquake Bill policy implemented at the time is similar to the currently often employed credit easing policy as a nonstandard monetary policy instrument. For example, during the Global Financial Crisis of 2009, many central banks such as the FED (United States) and the ECB (Europe Union) purchased corporate bonds of specific sectors to stabilize the financial market. Such credit easing increased bank lending and promoted liquidity (Wang, 2016; Churm et al., 2018)[4] and may have incentivized banks to lend money to SMEs to mitigate their financial constraints (Havrylchyk, 2016).

Our paper adds to the existing literature on three fronts. First, our study can be related to the banking literature. More specifically, some papers investigate the effect of bank failures on client firms. For instance, Slovin et al. (1993) analyze the stock prices of lending firms by the bank's de facto failure, and was followed by several other related studies (Bae et al., 2002). These all find a significantly negative effect of bank failures on the market values of client firms. Several other papers investigate the effects of bank failures or weak bank health on client firms, such as Fukuda and Koibuchi (2006) and Brewer III et al. (2003) which analyzed the failure of three long-term credit banks in Japan. However, these suffer from an identification problem in that the causality between bank failure and client firms' poor performance is unclear. To deal with the causality problem, the recent literature uses specific events as exogenous liquidity shocks. Khwaja and Mian (2008) is the seminal paper using firm–bank relationship data in this regard and find that firms with lending by banks with higher exposure to a liquidity shock tend to be more affected. Giannetti and Simonov (2013) investigate large listed firms to study the real effects of bank recapitalizations in Japan, while Chava and Purnanandam (2011) and Schnabl (2012), using the 1998 Russian sovereign default as a bank liquidity shock, examine a shock's transmission to the United States and an emerging market (Peru), respectively. In a paper much closer to ours,

[4] Wang (2016) finds that the US credit easing and LSAP1 have a positive impact on lending by large banks.

Hosono et al. (2016) find that bank liquidity shocks after the Kobe earthquake negatively affect client firms' investment even in Japan. However, our study also differs from these studies in an important aspect. While all of the just mentioned studies specifically highlight the bank-lending channel, in reality, less lending due to external negative shocks is not only caused by banks' financial condition ("bank-lending channel") but also by firm size in that smaller firms in particular tend not to have alternative sources of credit ("firm-borrowing channel"). Thus, our value added is to investigate not only the lending channel but also the firm-borrowing channel by focusing on SMEs. More specifically, we explicitly investigate how SMEs were affected by tightened financial constraints as a result of the liquidity shock and how this might have been mitigated by BOJ policy.

Second, related to the above-mentioned firm-borrowing channel, our paper is related to SMEs and their financing. SMEs tend to be financially constrained and highly dependent on their transaction banks (Berger and Udell, 1998; Beck and Demirguc-Kunt, 2006). SMEs are more vulnerable to internal and external risks and disruptive shocks, which increases their dependency on credit demand from their transaction bank (Beck et al., 2005). Within our context, it should be noted that there were several local banks and the relationship between local banks and SMEs was traditionally long and tight in Japan (Boot, 2000; Uchida et al., 2008), which induces financial constraints in SMEs and segments bank market by region (Tsutsui and Kano, 2003). In general, such a setting is likely to have seen strong relationship banking (Petersen and Rajan, 1994, 1995) and caused a hold-up problem (Sharpe, 1990; Rajan, 1992). Thus, in this paper, we consider not only the bank-lending channel but also firm-borrowing channel using unique firm-level data that cover SMEs and their bank relationship in Yokohama City during the 1923 earthquake.

Third, while natural disasters can potentially have devastating impacts on local businesses, much of the existing literature on the economic impact of natural disasters has focused on macroeconomic, regional effects, households, or individuals[5]. In contrast, only a limited number conduct firm-level analysis. In this regard, it has been found that some businesses were permanently closed down if they were sufficiently affected by a natural disaster (Craioveanu and Terrell, 2016; Cole et al., 2019).[6] Surviving firms experience losses (Boarnet, 1998; Tanaka, 2015), but there may be some surviving businesses that subsequently increase their production or boost their productivity (Leiter et al., 2009; Cole et al., 2019; Okazaki et al., 2019; Okubo and Strobl, 2021). A key, largely neglected aspect is whether businesses can survive a natural disaster

[5] See the review by Karim and Noy (2016) and Noy and duPont (2018).
[6] Craioveanu and Terrell (2016) found that firms damaged by Hurricane Katrina were less likely to survive, while Cole et al. (2019) discovered similarly for firms located in buildings damaged by the earthquake in Kobe City, Japan.

and can prevent production losses through access to financial funds, in particular, to loans. More specifically, Collier and Babich (2019) and Collier et al. (2019) showed that bank credit played an important role in financing businesses' recovery. In addition, younger and smaller firms were the most credit constrained after the event (Collier and Babich, 2019) but also benefited most from local lending (Cortes, 2014)[7]. With regard to natural disasters, the substantial demand for credit by damaged firms after such events, in turn, can put a substantial strain on the banking system (Klomp, 2016; Noth and Schuewer, 2017; Cortes and Strahan, 2017)[8]. In this regard, the ability of banks to serve as credit providers for affected firms is limited if they are damaged (Hosono et al., 2016; Koetter et al., 2020; Rehbein, 2018)[9]. Governmental or other financial aid can thus serve to circumvent the credit constraints faced by firms, although this is not always effective (Cole et al., 2017). In this vein, this paper investigates how damaged firms can finance enough in terms of keeping their business afloat, achieving recovery and growth as a consequence of the BOJ policy.

We bring together several unique datasets that allow us to investigate empirically the role of financial constraints and central bank policy in firm survival and ex post growth in Yokohama City after the earthquake. First, we collate damage data at the level of *Chome*, a small unit of an area within the city, as well as for individual firms. It should be noted in this regard that while the earthquake damage to firms and banks was huge, it was fairly heterogeneous across geographical spaces even within damaged areas. Second, we digitize unique data on firms as well as their transaction relationship with banks. More precisely, for Yokohama City, we compiled firm-level data in terms of survival and performance and linked this information to the balance-sheet information of banks with which each firm had a transaction relationship, before (1922) and after (1925) the earthquake. Finally, as noted above, just after the earthquake the government and the BOJ prepared a scheme for promoting the recovery by liquidity supply from the BOJ. Importantly, we collate information on the bank-level amount of the Earthquake Bills and link this to the banks involved in the firm–bank transaction relationship. This, thus, can be used as a measure indicating the extent to which each bank was supported by the BOJ credit. We combine all these data and undertake an econometric analysis of the role of firms' financial constraints, their banking relationships, and central bank policy in response to damage induced by the earthquake.

[7] This is true for household recovery. See Sawada and Shimizutani (2008) regarding household consumption after the Kobe earthquake.
[8] Klomp (2016), using a cross-country study covering 160 nations, found that natural catastrophes significantly affected both the liquidity and solvency of banks. This was confirmed by Noth and Schuewer (2017) and Cortes and Strahan (2017), using bank-level data for the US.
[9] Rehbein (2018) after a large flood event in 2013 in Germany showed that damaged banks can even cause negative spillovers to undamaged firms who are their clients.

The remainder of the paper is organized as follows. Section 2 describes the historical background, focusing on the basic features of the Japanese financial system, the damage by the Great Kanto Earthquake, and its impact on the financial system. Section 3 explains the data and provides some descriptive statistics. Section 4 presents the econometric analyses. Section 5 discusses some implications of the BOJ policy. Section 6 presents the conclusion.

## 2. Background

### 2.1 Financial system in prewar Japan

The modern financial system in Japan dates back to the 1870s, just after the political regime change, the so-called Meiji Restoration. In this period, according to the National Bank Act of 1872, around 150 national banks, that is, private banks privileged to issue their own banknotes, were founded, while the Tokyo and Osaka Stock Exchanges were established in 1878. National banks were reorganized as ordinary banks after the foundation of the BOJ in 1882, and ordinary banks increased sharply in number to form a nationwide network of banking in the 1890s (Okazaki et al., 2005; Okazaki and Sawada, 2012). Although the stock exchanges listed just national bonds and stocks of themselves at first, the number of listed stocks increased in the late 1880s as many large joint-stock companies emerged in various industries, such as railways, marine shipping, and manufacturing (Tokyo Stock Exchange, 1928). In 1900, the ratio of the total paid-in capital of joint-stock companies rose to 24.6% of GNP. Figure 1 illustrates the long-term trends of the liabilities of the nonfinancial sector in Japan. More precisely, although the Japanese financial system is sometimes regarded as "bank-based" (Allen and Gale, 2000), i.e., raising funds from main banks, this view holds just for the postwar period (Okazaki and Okuno-Fujiwara, 1999; Hamao et al., 2009; Okazaki, 2016). In prewar Japan, the volume of funds raised from the stock market was almost as large as that from banks.

It is notable that patterns of corporate finance differed in firm size. Whereas large joint-stock companies with a capital no less than 10 million yen raised around 90% of funds from the stock and the bond markets, smaller firms and individuals relied for 60–70% of their funding from borrowing (Table 1). In addition, sources of borrowing depended upon firm size as well. Although the data are only for the early 1930s, Panels A and B of Table 2 show the sources of borrowing for establishments in Yokohama City by establishment size. Smaller establishments tended to rely on financial sources other than banks, including traders. Yet, even small- and medium-sized firms borrowed money from banks. For instance, factories with an average of 11.7 employees (those with capital from 10,000 to 50,000 yen) borrowed 26.9% of their money from banks, and commercial establishments in the same class of capital depended for 37.9% of their borrowing from banks. Thus, banks played a substantial role in the fund-raising of small- and medium-sized

firms in normal times, which implies that under the natural disaster, when networks of trades and trade credit are damaged, the role of banks is crucial.

Meanwhile, the banking system in prewar Japan had some distinctive features. First, it included numerous small banks. In 1922, just before the Great Kanto Earthquake, there were 1,799 ordinary banks, which had just 2.87 branches on average (Goto, 1970, pp. 86–87). 74.6% of these ordinary banks had capital smaller than one million yen. Later, a lower limit of bank capital was imposed by the Bank Law in 1928. Second, many of these banks had a close relationship with particular industrial firms (Kato, 1957). Okazaki et al. (2005) identified a tight bank–firm relationship by interlocking directors and found that 83.0% of ordinary banks in 1926 shared at least one director or auditor sent from their tightly connected industrial firms. Banks related to industrial firms tended to concentrate their loans on those firms, which would sometimes result in bank failures and bankruptcy (Bank of Japan, 1933; Kato, 1957; Okazaki et al., 2005).

## 2.2 Boom, depression, and damage by the Great Kanto Earthquake

The financial system in Japan with the features described above was vulnerable to fluctuations of the macroeconomy and external shocks, which resulted in the long financial instability after World War I. World War I was a springboard for the development of the Japanese economy. The average annual growth rate of real GNP was as high as 7.90% from 1914 to 1918, which was accompanied by an upgrade of the industrial structure. New industries, such as steel, machinery, and chemical industries developed rapidly, under the condition that imports from the Western countries declined. Whereas the ratio of heavy and chemical industries in the total manufacturing production was just 24.9% in 1914, it became 40.9% in 1918[10]. Meanwhile, commodity and asset prices soared. The wholesale price index increased 2.02 times from 1914 to 1918[11]. In the same period, the average price of the stocks traded at the Tokyo Stock Exchange increased 1.81 times, while the average price of paddy fields went up 1.56 times[12]. However, the expansion of the real economy came to an end when the war ended and international competition in the commodity markets restarted. Nevertheless, in 1919, commodity and asset prices again rose sharply by speculation under the easy financial conditions, but finally, in early 1920, commodity and asset markets collapsed, which was the start of the long depression until the early 1930s. The decline in commodity prices had a negative impact on industries, especially newly developed industries, which in turn made banks collect loans from firms in these industries. The circumstance that stocks and real estate were widely used as collateral for bank loans worsened the negative impact of the boom collapse

[10] Calculated using the data from Shinohara (1972), pp. 142–143.
[11] Calculated using the wholesale price index of the Bank of Japan (1964, p. 76).
[12] Calculated using data from the Bank of Japan (1964, p. 88).

on the financial system because the collateral price declined sharply (Bank of Japan, 1933; Takahashi and Morigaki, 1993; Okazaki, 1997; Flath, 2000)[13].

While the Japanese economy was facing the depression and instability of the financial system, the Great Kanto Earthquake hit Japan in 1923. The Great Kanto Earthquake is the most serious natural disaster that Japan has ever experienced. The number of dead and missing is estimated to be around 105 thousand, and 465 thousand buildings were completely burned or destroyed (Table 3). The total amount of physical damage was as large as 35.5% of Japan's GNP in 1922 (Okazaki et al., 2019)[14]. While it is probably better known that Tokyo City (under Tokyo Prefecture) was seriously damaged by the earthquake, the damage in Yokohama City (under Kanagawa Prefecture) was much more serious in a sense. More precisely, the percentages of deaths and missing relative to the population and the percentage of buildings totally burned or destroyed were both higher for Yokohama City than for Tokyo City (Table 3).

### 2.3 Impact on the financial system

It is well-documented that the Great Kanto Earthquake had a large negative impact on the financial system, not only in the Kanto region but also for Japan as a whole[15]. In addition to the direct damage to banks, burning of collateral, destruction of the equipment of borrowing firms, and deaths of borrowers sharply increased the nonperforming loans. The damage by the earthquake made the financial system even more fragile because it was already unstable due to the collapse of the economic boom during and just after World War I.

The government and BOJ actively intervened in the financial system to stabilize it after the earthquake. In this regard, on September 4, 1923, the government announced a moratorium for 30 days to prevent financial panic. Then, to prepare for the expiration of the moratorium, on September 27, the government legislated an act prescribing that the bill payables issued by firms in the damaged area, and discounted before September 1, would be rediscounted by the BOJ with recourse, and the government would compensate the losses of the BOJ incurred by this operation up to 100 million yen. The bills rediscounted by the BOJ were called "Earthquake Bills." The BOJ rediscounted Earthquake Bills from September 1923 to March 1924, amounting to 431

[13] With respect of ordinary banks, the ratio of the loans with stocks and real estate as collateral was 33.8% and 10.1%, respectively (calculated using the data from Toyo Keizai Shinpo-sha, 1927, p. 13).
[14] Calculated using the amount of damage from Tokyo City Office (1925) and nominal GNP from Ohkawa et al. (1974).
[15] See Research Bureau of the Bank of Japan (1933), Imuta (1980), Bank of Japan (1983), Takahashi and Morigaki (1993).

million yen in total (239 billion yen or 2.72 billion US dollars at 2010 price)[16]. It is notable that the rediscount of Earthquake Bills concentrated on large Tokyo and Yokohama banks, which had already had transaction relationships with the BOJ (Ishii, 1980, p. 142; Bank of Japan, 1983, pp. 70–72, pp. 91–94). It is also well known in the context of Japanese financial history that a substantial part of Earthquake Bills was used for maintaining nonperforming loans generated by the boom during and just after World War I and its collapse in 1920 (Bank of Japan 1933, pp. 876–883; Bank of Japan, 1983, pp. 96–97; Takahashi and Morigaki, 1993, pp. 82–86)[17]. Because of the bad financial conditions of the firms that issued Earthquake Bills, it was difficult for the BOJ to collect loaned money from those firms and as a result, the due date was extended twice, from September 1925 to September 1926 and then to September 1927 (Bank of Japan, 1983, pp. 95–97).

Banks in Yokohama City were seriously damaged. Most of the headquarters and branches of banks in Yokohama City suffered from the earthquake (Yokohama Bank, 1980, pp. 65–66). One of the reasons why the damage to the banking system was serious and persistent in Yokohama City is the local financial market structure. The banking industry in Yokohama shared a basic feature with the whole Japanese banking industry in that it included many small- and medium-sized banks. Figure 2 illustrates the size distribution of ordinary banks for the whole of Japan and Yokohama City, in terms of capital. For all of Japan, 74.6% of ordinary banks had capital smaller than one million yen, where the lower limit of bank capital was imposed by the Bank Law in 1928. The distribution for Yokohama City is a little to the right of that of all of Japan, but still, 58.8% of banks had capital smaller than one million yen.

Table 4 breaks down the deposit and loans of banks in Yokohama City. Here, local banks refer to the banks headquartered in Yokohama City, and deposits and loans are those of bank headquarters and branches located in Yokohama City. Among local banks, Souda Bank, Yokohama Koshin Bank, Watanabe Bank, and Dai-ni Bank had large shares, and there were 11 smaller local banks at the end of 1922. In addition to these local banks, major banks headquartered in other prefectures, mainly in Tokyo City, had branches in Yokohama City. It is notable that there was a difference in the changes over time in the deposits and loans between these groups of banks. Large local banks

[16] Inflated by the wholesale price index of the BOJ. We linked the index benchmarked in 1900 with the index benchmarked in 2005, in 1960.

[17] The Bank of Japan (1933) writes, “The amount of the Earthquake Bills unsettled at the end of 1926 was 268 million yen, and the major reason for this huge amount of unsettled bills was decline in the capacity of repayment and financial difficulty of the borrowers because of the prolonged depression. The assets of large borrowers, such as Suzuki Co., businesses of Kuhara group, Kokusai Marine Shipping, and businesses of Murai group, depreciated extremely not only due to the earthquake damage but also due to the damage of the crisis in 1920. Thus, these firms needed fundamental restructuring, but they just temporized, and it was almost impossible for them to repay the Earthquake Bills.” (p. 883).

were seriously damaged by the earthquake. For example, for Souda Bank, one of the large local banks, the headquarters and eight of nine branches in Yokohama City and Tokyo City were burned down, and what is worse, the damage incurred a run by depositors (Yokohama City Office, 1976, pp. 749–750)[18].

Despite the sharp decline in deposits, the loans of the large local banks increased from 1922 to 1924. This increase in loans was supported by the credit from the BOJ by Earthquake Bills (ibid., pp. 749–750; *Yokohama Maicho Shinbun*, July 23, 1924). The amount of special loans by Earthquake Bills to each bank is reported in the last column of Table 4. As stated above, rediscounting through the Earthquake Bills by the BOJ was concentrated in large banks. The impact of the BOJ credit on bank loans was substantial. Figure 3 illustrates the major items of the balance sheet of Souda Bank and clearly shows how the credit from the BOJ supported loans of Souda Bank when deposits declined.

Arguably, at least a part of the BOJ credit contributed to the recovery of Yokohama City. For example, Yokohama Koshin Bank, the second-largest local bank in Yokohama City, loaned a total of 1,080 thousand yen to small businesses for their recovery without collateral, cooperating with Yokohama City Office (Yokohama Bank, 1980, p. 67). Meanwhile, Yokohama Koshin Bank had Earthquake Bills of 1,152 thousand yen rediscounted by the BOJ. However, it is also true that a substantial amount of credit supplied by the BOJ through rediscount of Earthquake Bills was used for maintaining nonperforming loans. For instance, Souda Bank, the largest local bank in Yokohama City, had 8,018 thousand yen of Earthquake Bills rediscounted by the BOJ, but it had already had a large number of nonperforming loans before the earthquake because of its reckless loans to emerging businesses without secure collateral and to the businesses related to the Souda family (Bank of Japan, 1928, pp. 326–331; Bank of Japan, 1933, p. 906). Souda Bank was facing closure with a bank run during the Showa Financial Crisis in 1927. Table 5 shows the composition of its loans just before the closure. Out of the total loans, 23,667 thousand yen, 2,175 thousand yen (9.2%), and 7,369 thousand yen (31.1%) were to the firms owned by the Souda family and other related firms. Most of these loans were uncollectable (Bank of Japan, 1928, pp. 337–348). The case of Souda Bank indicates that the credit from the BOJ through rediscount of Earthquake Bills likely had a negative side effect in terms of continuing unsound related lending.

For smaller local banks, the damage by the earthquake was critical. Indeed, out of 12 smaller local

[18] Another large local bank, Dai-ni Bank was also seriously damaged. With its office building, national bonds of a dozen million yen and raw silk bills of several million yen were burned, which incurred runs on its branches in other cities (Yokohama City Office, 1976, pp. 776–777).

banks listed in Table 4 for 1922, five banks disappeared from the record by the end of 1924. In this respect, it is notable that these smaller banks did not have or had a very small number of bills discounted by the BOJ (Table 4). The deposits of smaller local banks declined very sharply and did not recover, while the loans stagnated.

## 3. Data and Basic Statistics

### 3.1 Data

Our paper mainly exploits five data sources: (a) firm-level data concerning the firm–bank transaction relationship, (b) firm-level data with information on their damage, age, and asset values, (c) bank-level financial data, (d) bank-level Earthquake Bill data, and (e) a damage index at the *Chome* (small districts within towns) level.

(a) The unique firm-level data include the names of the banks with which each firm had a financial transaction relationship, and was obtained from *Dai Nihon Shoko-roku* (*Records on Commercial and Industrial Firms*) published annually by Dai Nihon Shoko-kai, an association of business firms. The data widely cover small- and medium-sized firms with no less than 30 yen for business tax per year[19], including family firms and private firms in all industries: manufacturing, construction (e.g., carpenters), wholesale, retail shops (e.g., grocery shops, pharmacies, confectionaries), services (e.g., restaurants, cafés, inns), repair (house repair workshops and bicycle repair workshops), and transportation. The data contain each firm's information such as firm name, firm owner name, address, industry, main product, business tax, and the names of the bank(s) that the firm mainly transacted with. The purpose of the business tax was to collect tax on a firm's profits, but, in reality, was a pro forma standard tax. As shown in Table A1, the tax standards depended upon the category of business, i.e., sales and employees for wholesale and retail, capital and employees for manufacturing, transportation, printing, etc., and rental price of building and employees for inns, and so on. The tax was imposed based on these standards in the previous year (Fujisawa, 1923) and depended upon the category of business (Appendix Table A1). The standards and rates were different across business categories, but because the tax rate was fixed and the value of the standard for each firm was inspected every year, we can use the amount of business tax as a measure of firm scale. Our samples consist of all the firms in Yokohama City for which information on a bank transaction relationship is recorded in the 1922 and 1925 issues of *Dai Nihon Shoko-roku*. The sample of *Dai Nihon Shoko-roku* consists of 2,853 firms in Yokohama city in total in 1922 (before the earthquake). We drop all banking and financial companies, public utilities, transportation, land and real estates, stock companies, stock owners,

[19] Compared with the data in the Statistical Yearbook of Tokyo Tax Bureau (1922 issue), we find that our samples account for 25% of all the firms that paid business tax in Yokohama City in 1922.

business conglomerates and individuals, leaving us with a sample size of 568 SMEs in the end. After combining other data sources as mentioned below, our sample size is reduced to 335 firms, which is our main (firm survival) estimation sample.

(b) Another firm-level data source is *Shoko Shinyo-roku* (*Records on Credit Statuses of Commercial and Industrial Firms*), published annually by Tokyo Koshin-jo, one of the major credit bureaus. The data are based on credit investigations and widely cover small- and medium-sized firms, including family firms and private firms in all industries. The data record the owner's name, address, industry/business, founding year, and asset value of each firm[20]. The asset value is recorded by rank category from A (larger than 3 million yen) to W (from 0 yen to 999 yen), as indicated in Appendix Table A2. We use the data for 1922 and 1925. In addition to the annual volumes, a special volume on the damage by the Great Kanto Earthquake was published, titled *Keihin Rinji Shoko Shinyo-roku* (*Special Volume for Tokyo and Yokohama Areas*) in March 1924. This volume provides information on firm-level damage by rank category from 1 (no or minor damage), 2 (small damage), 3 (intermediate level damage), 4 (large damage but able to resume business), 5 (serious damage, inducing bad profit and financial conditions) to 6 (enormous damage, i.e., too serious to quantify the level of damage). The samples in Tokyo and Yokohama are the same as those in the annual volumes (*Shoko Shinyo-roku* (*Records on Credit Statuses of Commercial and Industrial Firms*)). The firm-level data are matched with data (a) by firm owner name, firm address, and industry.

(c) The bank-level data for 1922 are taken from a special issue on banks of *Toyo Keizai Shinpo (Oriental Economist)*, while those for 1925 are taken from the *Yearbook of the Bank Bureau of the Ministry of Finance*. The former source provides the financial data of major ordinary and special banks, and the latter covers all ordinary and special banks[21]. For a few banks not covered by the former source, we supplemented the data from their business reports. For our purpose, we use financial data of those banks that had transaction relationships with firms in Yokohama City. Our bank samples include not only banks headquartered in Yokohama City but also those headquartered in other cities such as Tokyo and Osaka Cities because they had branches in Yokohama and transacted with firms there.

(d) The amount of Earthquake Bills rediscounted by the BOJ at the bank level is taken from the BOJ (1983, pp. 92–94). It captures the extent to which each bank had its damage mitigated by the

[20] Founding years for some firms are missing or approximate. Thus, we supplemented the data from Yokohama-shi Shoko Meikan and Yokohama-shi Kogyou Meikan.
[21] *Yearbook of the Bank Bureau of the Ministry of Finance* started to provide bank-level financial data from the 1925 issue.

credit from the BOJ. A part of the Earthquake Bills was not repaid to the BOJ by the due date, where the ratio of the amount unpaid by the end of 1926 to the total Earthquake Bills of each bank is available in the BOJ (1983, p. 101). We use this ratio as a measure of the deterioration of the asset quality of a bank.

(e) Concerning the damage to firms and banks by the Great Kanto Earthquake, we construct a damage index calculated as the percentage of totally and half-collapsed buildings at the *Chome* level, where *Chome* is the smallest unit of a district in Japan, smaller than ward and town. The *Chome*-level damage index data are taken from Takahama et al. (2001) for Yokohama City, from Takemura (2003) for Tokyo City, and from Moroi and Takemura (2002) for other surrounding areas[22]. We use detailed address information of firms and headquarters/branches of banks to match each firm and bank with the damage index.

### 3.2 Firm–bank relationship

A unique feature of our dataset is that it contains information on the banks with which each firm transacted. Table 6 lists the banks in our dataset and the number of firms with which each bank had transaction relationships. We note that some firms transacted with multiple banks. Souda Bank, the largest local bank in Yokohama, had the largest number of client firms, and Yokohama Koshin Bank, the second-largest local bank, had the second-largest number (Tables 4 and 6). Among the banks headquartered in other cities, banks such as the Daihyaku (Tokyo), Sumitomo (Osaka), and Kawasaki (Tokyo) banks had many client firms in Yokohama. The total number of firm observations for 1925 was much smaller than that for 1922 due to the earthquake, but the shares of the banks in terms of the number of client firms were similar to those of 1922.

Table 6 reports the average size of the firms that each bank transacted with, where we measure the firm size in terms of the business tax. Concerning Yokohama City, it is found that the average firm size was substantially larger for nonlocal than for local banks. In particular, large urban banks, such as Mitsui, Dai-san, and Sumitomo, had bigger client firms. Meanwhile, for local banks, client firms of larger banks were bigger than those of smaller ones, but the difference was not substantial.

To see the relationship between bank size and firm size more comprehensively, Figure 4 plots it for 1922, where bank size (horizontal axis) is measured by its capital. Note that when firms transact with multiple banks, we use the average of their capital. First, bank and firm size are positively correlated, which is consistent with the view of a so-called “stratified financial

[22] We are grateful to Dr. Takahama for providing us with the data.

structure," i.e., transaction relationships between banks and firms were stratified and segregated by their size in prewar Japan, such that larger banks only transacted with larger firms, and vice versa (Imuta, 1980; Okazaki, 1993; Teranishi 2011). Second, however, there was still substantial variation in the size of banks for a firm of a certain size to transact with. This provides us with a good amount of variation to conduct regression analyses using bank size and firm size at the same time. Berger et al. (2005) similarly saw a positive size correlation but explained it by different roles between large and small banks, which is different reasoning from ours.

We also compare the average size of the firms with which each bank had transaction relationships, between the pre-earthquake and post-earthquake periods (Table 6). Overall, the number of firms decreased after the earthquake. However, some banks headquartered in Tokyo increased the average size of client firms. In particular, Dai-hyaku Bank and Dai-san Bank saw a sharp increase. On the other hand, many banks headquartered in Yokohama City slightly decreased or retained the average size of their client firms. This indicates that banks headquartered in Tokyo reduced the number of clients while keeping transaction relationships with large clients. In other words, banks headquartered in Tokyo reduced lending to small and medium enterprises after the earthquake. This is consistent with the evidence in the previous section.

### 3.3 Summary statistics

Summary statistics for the variables are provided in the top panel of Table 7. As can be seen, the rate of survival of firms in Yokohama City from 1922 to 1925 was 61.5%. The firm size, measured by the business tax, is on average around 360 yen, but with considerable variation. Their corresponding banks also vary substantially in terms of size measured by capital, with a mean of 110,275 yen[23]. In terms of the damage in the *Chome* where the firms were located, one finds that the average firm damage rate was close to 67% with a standard deviation of 33%. Their banks, by contrast, were located in areas that were slightly more damaged, i.e., 70% on average, but again with considerable variation. Firm damage, a categorical variable ranging from 1 to 6, is 3.1 on average, i.e., intermediate level damage.

In terms of spatial dimension, the Appendix Figures provide maps of old Yokohama City on damage, number of firms, and number of banks (headquarters and branches) at the *Chome* level.

## 4. Econometric Model and Results

[23] In the data, the asset variable is categorical from 1 to 24. Each category defines the range of asset values.

### 4.1 Firm survival

We first investigate how local earthquake damage affected firm survival, where we measure earthquake damage by direct damage to a firm and damage at the regional level, i.e., *Chome*. The latter can be interpreted as capturing neighborhood infrastructure damage as well as damage to local transaction partners. We estimate the survival of firms by estimating the following linear probability model:

$$\begin{aligned} SURVIVAL_{it} = \\ &\alpha_i + \beta_1 X_{it-1} + \beta_2 FDAMAGE_{it} + \beta_3 CDAMAGE_{it} + \beta_4 BDAMAGE_{it} \\ &+ \beta_5 FSIZE_{it-1} + \beta_6 BSIZE_{it-1} + \beta_7 FSIZE_{it-1} \times FDAMAGE_{it} + \beta_8 FSIZE_{it-1} \times CDAMAGE_{it} \\ &+ \beta_9 BSIZE_{it-1} \times BDAMAGE_{it} + \eta_i + \mu_i + \varepsilon_i, \end{aligned} \quad (1)$$

where *SURVIVAL* is an indicator variable that takes the value of 1 if firm i still exists after the earthquake (t), and **X** is a vector of firm i's basic characteristics, such as firm age and asset values. *FDAMAGE* is the damage index of a firm, while *CDAMAGE* is the damage index in the *Chome* where firm i is located. *FSIZE* denotes the firm size. *BDAMAGE* is the damage index of the *Chome* where a firm's corresponding bank was located. We note that the bank damage index is average of the Chome damage for the corresponding bank's headquarters and branches located in Yokohama City. If the headquarter is outside Yokohama City, the *Chome* damage of the branches in Yokohama and headquarter in other cities are used in calculating mean. *BSIZE* is the size of the corresponding bank in terms of capital. We note that if a firm transacted with multiple banks, we use the average of the bank damage indices as well as bank size. $\eta$ is a vector of sector dummies, and $\mu$ is a vector of ward dummies. Standard errors are clustered at the ward level. Although our smallest geographical unit is the *Chome*, almost all firms have transaction banks outside their *Chome* districts but within their ward. For this reason, we cluster standard errors at the ward level.

The results of estimating Equation (1) are reported in the first column of Table 8, first only using firm-level and *Chome*-level damage, alongside firm age, assets, and size as predictors. As can be seen, only firm size and asset are significant determinants of the probability to survive, where firms with greater size and more assets are less likely to exit. We next also included a firm's bank variables, namely bank size and the damage that the bank suffered from the earthquake (column (2)). While bank damage is significantly positive, bank size is not. Adding bank variables does not change the results on the other explanatory variables qualitatively, and only marginally lowers the significant coefficients on firm size and assets. In column (3), to allow the firm damage variables to depend on firm size, we interact the firm and regional variables with firm sales. Likewise, we let the impact of bank damage depend on bank size by interacting these variables

with each other. Accordingly, while this reverses the direct impact of firm size to be significantly negative, it results in a significant negative coefficient on *Chome* damage and a positive and significant coefficient on its interaction term with firm size. Thus, whereas damage in the *Chome* where the firm operates reduces the probability of firm survival after the earthquake, this negative effect is partially buffered by firm size. A plausible reason for this is that because our sample firms are SMEs, their business likely depends on transactions with local consumers and suppliers. Thus, the negative impact of *Chome* damage on firm survival reflects the damage of transaction partners and consumers in the same area. Firm damage on the other hand does not play a significant role in firm survival, neither directly nor through firm size.

In contrast to the *Chome*-damage variables, the variables representing the attributes of the banks that a firm transacted with are not significant. Thus, although one might expect that a larger bank with less damage could maintain a greater lending capacity to its client firms, this was not crucial for firm survival in Yokohama City just after the Great Kanto Earthquake. This could be because of the policy intervention by the BOJ, stated above, and we, thus, next include the variable representing the Earthquake Bill rediscounted by the BOJ, defined as the value of the Earthquake Bills that each bank had rediscounted by the BOJ, divided by the bank's capital, in column (4) of Table 8. We also include the interaction terms of *BOJ_bill* and *BDAMAGE*. However, neither the bank variables nor the *BOJ_bill* is significant, while the estimated coefficients on the *Chome*-damage variable and its interaction with firm size remain unchanged.

Given the importance of the firm scale effect for *Chome*-level damage found in columns (1)–(3), we explore whether firm size matters for the effects of bank damage and the BOJ bill, by interacting firm size with these variables in column (5). In this case, the bank variables are not significant, but the coefficient on the interaction term of the BOJ bill and firm scale is positive and statistically significant. This implies that the impact of the BOJ bill depends also on firm size. As stated above, although most of our sample firms are small- and medium-sized, even for these the relatively large ones tend to survive thanks to the rediscount policy by the BOJ. Concerning this, it is notable that neither the coefficient on the interaction term of the BOJ bill and bank damage, nor that on the interaction term of the BOJ bill and firm damage is significant. In other words, the positive effect of the BOJ's rediscount policy does not depend on bank damage or firm damage. This result is consistent with the contemporary criticism that nonperforming bills unrelated to the earthquake were included in the Earthquake Bills, and the BOJ used the earthquake as an excuse for rescuing unsound firms (Bank of Japan, 1983, pp. 95–96).

In column (6), we consider not only whether a BOJ bill was issued but also whether it mattered

if it was paid (*BOJ_bill_Paid*). Overall, the precision of the results improved. More specifically, the *BOJ_bill_Paid* is significantly positive and its interaction with bank damage is significantly negative. Hence, the *BOJ_bill_Paid* in itself increased the probability of survival but this is attenuated by bank damage. Furthermore, this attenuated effect is dampened by firm size. In other words, if a firm is larger, the BOJ bill positively affects its survival even if its bank is damaged. These findings suggest that the actual payment of the BOJ bill is an important determinant of whether a firm ceases to operate after an earthquake. In particular, relatively large firms tend to have their financial constraints reduced by BOJ bills.

As a final exercise, we further explore the possible intricacies of the role of the BOJ bill in firm survival. More specifically, we allow the effect to depend on the extent of damage in the *Chome* in which the firm was located because the BOJ bill policy was mainly targeted at firms in damaged areas. To investigate this, we add an interaction of *CDAMAGE* and *BOJ_bill_Paid* and an interaction of *CDAMAGE* and *BOJ_bill_Paid* and firm size to the last estimation. Column (7) reports the result. The interaction of *CDAMAGE* and *BOJ_bill_Paid* is significantly positive, and other variables are almost the same as before. Thus, the bill policy was more effective in seriously damaged areas and positively affected firm survival.

## 4.2 Firm growth

Next, we focus on the firms that survived from 1922 to 1925 to investigate whether the earthquake affected their post-survival growth by estimating the following linear model:

$$\begin{aligned}\Delta\log(Y_{t-1\to t}) = {} & \alpha_i + \beta_1 X_{it-1} + \beta_2 \mathrm{FDAMAGE}_{it} + \beta_3 \mathrm{CDAMAGE}_{it} + \beta_4 \mathrm{BDAMAGE}_{it} \\ & + \beta_5 \mathrm{FSIZE}_{it-1} + \beta_6 \mathrm{BSIZE}_{it-1} + \beta_7 \mathrm{FSIZE}_{it-1} \times \mathrm{FDAMAGE}_{it} + \beta_8 \mathrm{FSIZE}_{it-1} \times \mathrm{CDAMAGE}_{it} \\ & + \beta_9 \mathrm{BSIZE}_{it-1} \times \mathrm{BDAMAGE}_{it} + \eta_i + \mu_i + \varepsilon_i, \qquad (2)\end{aligned}$$

where $\Delta\log(Y_{t-1\to t})$ is the size growth of firm i proxied by its business tax paid, and the independent variables are the same as in Equation (1). The estimation results are reported in Table 9, where standard errors are clustered at the ward level.

Column (1) of Table 9 reports the result without bank terms and shows that only firm size is significant, where smaller firms tend to grow at a higher rate once they survive. Adding bank variables induces no substantial change (column(2)). In column (3), we allowed scale effects, both for firms and their banks, concerning the damage variables. Direct damage to a firm is significantly positive and its interaction with firm size is significantly negative. In other words, once a firm survives, a smaller firm with larger damage tends to experience higher growth. This

can be interpreted as creative destruction (Okazaki et al., 2019). The Bank variables are also significant, where both bank size and bank damage coefficients are significantly positive, while their interaction term coefficient is negative. That is, the direction and magnitude of the effect of bank damage on firm growth depend upon bank size, in that a larger bank tended to hinder the growth of its client firms if it was seriously damaged by the earthquake. Taken in context, this might be because banks needed some time for resuming their business to then provide credits to damaged, but surviving, firms to support their growth.

As in the case of firm survival, the firm scale effect is important for identifying the impact of earthquake damage. More specifically, while we find that firm-level damage is, contrary to not allowing for scale effect, now positive, this crucially depends on firm size. More specifically, the larger the firm the less growth-enhancing firm damage will be. This suggests that creative destruction is more likely to manifest itself in smaller damaged firms. A similar effect is found for bank damage in that while bank damage induces greater firm growth, this also depends on bank size. One may want to note that bank size also has an independent growth-enhancing impact.

Allowing for the bank variables' role in surviving firm growth to depend on the issuance of a BOJ bill does not change the significance of the bank-specific variables, as demonstrated in column (4). Similarly, this does not alter the scale-dependent firm-level damage roles, see column (5). As with firm survival, we next explored whether the impact of the bank covariates might depend on the size of the firm. This leaves only two significant variables, namely the bank size and the interaction term of firm size and the *BOJ_bill* variables. The negative impact of the latter means that firm size attenuates the impact of the BOJ bill, where if a firm is larger the impact of the BOJ bills on firm growth is smaller. Finally, we redefined the *BOJ_bill* in terms of being paid (*BOJ_bill_Paid*) in column (6), while adding interaction terms of *Chome* damage, *BOJ_bill_Paid*, and firm size in column (7) of Table 9. These changes, however, simply render the impact of the interaction term of the *BOJ_bill_Paid* with firm size insignificant, while the bank variables are significantly positive. This implies that the BOJ bill policy did not play a crucial role in firm growth, but bank-lending conditions were more crucial. On the bank side, because larger banks may have only been able to resume supplying lending in the medium term, although they could not help firms survive immediately after the earthquake due to their own damage, they eventually could mitigate the financial constraints of firms and thus promote firm growth through the bank-lending channel. In terms of firm size, smaller firms with serious damage tend to experience growth.

### 4.3 Robustness checks

We conducted several robustness checks. First, we use the subsample of single-bank firms. More specifically, at the time of the earthquake, Yokohama was a local and closed city where many small local banks had local clients with tight long-run relationships, and a substantial number of SMEs had only a single transaction bank. However, some firms had transactions with multiple banks. In this regard, the risk from bank shutdown or credit crunch for multiple-bank firms might be nonlinear in the sense that what matters to the firms is at least one bank is left standing. To explore such nonlinearity, we rerun our estimations only for single-bank firms. As shown in Table 10, results on survival and firm growth for this subsample are almost the same as for our full sample, although some additional bill policy variables now become significant in the survival estimation.

Our next robustness check is conducted on the subsample of firms with at least one bank headquartered in Yokohama City. The branches of major banks headquartered in other cities (Tokyo) were reluctant to loan in Yokohama City because after the earthquake the headquarters became cautious and withdrew funds from the branches in Yokohama City (*Yokohama Maicho Shinbun*, September 8, 1924). On the other hand, banks headquartered in Yokohama City left standing kept on their business in Yokohama City even though some branch offices shut down. In this sense, firms with at least one bank headquartered in Yokohama City tend to survive and grow and enjoy the benefit from the BOJ's rediscounted bill policy. Table 11 reports the results, which is a better result than the main estimation result. The magnitudes of the earthquake bill in survival estimation and bank size in growth estimation are larger.

We have thus far neglected the possibility that after the large-scale earthquake, the exit of some seriously damaged firms might have provided an opportunity for new entrants. However, according to the data, *Shoko Shinyo-roku*, the number of new entrants (all businesses such as manufacturing firms, commercial shops, services, banking, finance, real estate, transportation, private business, entrepreneurs, and individuals) did not sharply increase after the earthquake (Appendix Table A3). Regarding our sample, i.e., SMEs with bank transactions, the number of new entrants was very small (19 firms in our sample). Thus, firm exit caused by the earthquake was not replaced by new entrants. A major reason for the small entry is that the Japanese economy was facing the depression and instability of the financial system after World War I, as shown in Section 2.2, and thus new investment was stagnant even after the earthquake.

## 5. Implications: Lessons for Today

The case of the 1923 Earthquake was not just a unique historical event but can provide timely lessons for today. In particular, the Earthquake Bill policy is similar to the current credit easing

policy as a nonstandard monetary policy instrument. During the Global Financial Crisis of 2009, many central banks around the globe, such as the FED (United States), the ECB (Europe Union), and the BOJ, purchased commercial papers and corporate bonds of specific sectors to reduce credit uncertainty and stabilize the financial market. Such credit easing policy assumes central banks take specific private sectors' risk, and thus is very different from traditional monetary policy[24]. However, as pointed out by some studies (Goodfriend, 2011), the credit easing policy involves some serious problems and concerns. The first concern is that such a credit policy is harmful to keeping the independence of the central bank and invades territories of fiscal authorities (Rajan, 2013). The second is that the credit policy is in danger of destabilizing the financial condition of the central bank by purchasing a risky asset. In particular, the credit policy sometimes involves financially fragile sectors such as SMEs, which negatively affects the policy impact.

One difference between the Earthquake Bill implemented during the 1923 earthquake and current credit easing policies is that the Earthquake Bill policy was more indirect, i.e., it rediscounted bills of private banks rather than purchased assets in the market. However, similar to the current policy, the rediscounted bills were biased toward some specific banks in damaged areas and thus it was specific client firms that particularly benefited from the policy. In particular, the Earthquake Bills helped many insolvent banks and firms to survive due to information asymmetry, and thereby destabilized the banking system and financial markets, resulting in the financial crisis of 1927. Therefore, this kind of policy intervention could be effective in mitigating financial constraints for SMEs in financial crises, but at the same time, there is a risk to distort resource allocation and incur a moral hazard.

## 6. Conclusion

The Great Kanto Earthquake of 1923 resulted in serious damage to firms and banks in Yokohama City. Focusing on this event, we explored the role of banks as well as the role of the central bank in the recovery of firms from the natural disaster. First, we find that a firm that had a transaction relationship with a damaged bank had a lower likelihood of survival and reduced growth, indicating that banks indeed played a role in a firm's post-earthquake performance. As a matter of fact, for the small- and medium-sized firms in our sample, we found that bank credit was

[24] Bernanke (2009) first called the FED's approach to supporting credit market as credit easing to distinguish it from quantitative easing. Goodfriend (2011) divides central bank operations into monetary policy and credit policy. While monetary policy contributes to a broad easing in financial conditions, credit policy facilitates financial conditions of specific sectors and/or regions that have difficulty in accessing credit, in other words, a kind of debt-financed fiscal policy. The credit policy is aimed at easing credit conditions and promoting allocation in the market by changing asset composition of the central bank.

essential for their survival and growth. Second, two factors mitigated the negative impact of bank damage on firms. For one, when the size of a damaged bank was larger, the negative impact was smaller. In terms of the other channel, liquidity supplied by the BOJ to banks also reduced the negative impact of bank damage. In this regard, the BOJ actively supplied liquidity by rediscounting the bills issued by firms in the damaged areas. This policy was effective in preventing the credit crunch from amplifying the damage by the earthquake. It should be noted, however, that this policy also had a negative side effect. A substantial number of the Earthquake Bills rediscounted by the BOJ were not repaid. We found that when a firm had a transaction relationship with a bank that had a larger proportion of rediscounted bills unpaid, the likelihood of firm survival was higher, but its growth rate was lower. This finding suggests that in such a case, the credit from the BOJ was used just to let insolvent firms survive, which is consistent with many anecdotes in Japanese financial history. More generally, our study shows that liquidity supply by the central bank for recovery from a shock like a natural disaster can have both positive and negative impacts. Finally, the case of the 1923 Earthquake was not just a unique historical event but can provide timely lessons for today. The Earthquake Bill policy is similar to the current credit easing policy. This kind of policy intervention could be effective in mitigating financial constraints for SMEs in financial crises, but at the same time, there is a risk to distort resource allocation and incur a moral hazard.

## REFERENCES


Allen, F., & Gale, D. (2000). Financial contagion. *Journal of political economy*, *108*(1), 1-33.

Bank of Japan (1928) “Souda Ginko no Hatan Gen’in to sono Seiri” (The reasons for the bankruptcy of Souda Bank and its liquidation), reprinted in Bank of Japan ed., *Nihon Kin’yushi Shiryo* (*Materials on the Japanese Financial History*), Showa edition, volume 24, Tokyo: Printing Bureau of the Ministry of Finance, 1968 (in Japanese).

Bank of Japan (1933) “Kanto Shinsai yori Showa 2-nen kin’yu kyoko ni itaru waga zaikai,” (The Japanese economy from the Great Kanto Earthquake to the Financial Crisis in 1927), reprinted in Bank of Japan ed., *Nihon Kin’yushi Shiryo* (*Materials on the Japanese Financial History*), Meiji Taisho edition, volume 22, Tokyo: Printing Bureau of the Ministry of Finance, 1958 (in Japanese).

Bank of Japan (1964) *Meiji iko Honpo Shuyo Keizai Tokei (Hundred-Year Statistics of the Japanese Economy)*, Tokyo: Bank of Japan (in Japanese).

Bank of Japan (1983) *Nippon Ginko 100-nen Shi (100 Year History of the Bank of Japan)* vol.3, Tokyo: Bank of Japan (in Japanese).

Bae, K-H., Kang, J.-K., Lim, C.-W., 2002. The Value of Durable Bank Relationships: Evidence

from Korean Banking Shocks. Journal of Financial Economics 64, pp. 181-214.

Berg, G., & Schrader, J. (2012). Access to credit, natural disasters, and relationship lending. *Journal of Financial Intermediation*, *21*(4), 549-568.

Beck, T., Demirgüç-Kunt, A., & Maksimovic, V. (2004). Bank competition and access to finance: International evidence. *Journal of Money, Credit and Banking*, 627-648.

Beck, T., Demirgüç-Kunt, A. S. L. I., & Maksimovic, V. (2005). Financial and legal constraints to growth: does firm size matter?. *The journal of finance*, *60*(1), 137-177.

Beck, T., & Demirguc-Kunt, A. (2006). Small and medium-size enterprises: Access to finance as a growth constraint. *Journal of Banking & finance*, *30*(11), 2931-2943.

Berger, A. N.; N. H. Miller, and M. A. Petersen, R G. Rajan and J C. Stein. (2005). "Does Function Follow Organizational Form? Evidence from the Lending Practices of Large and Small Banks." *Journal of Financial Economics*, 76(2), 237-69.

Berger, A. N., & Udell, G. F. (1998). The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of banking & finance*, *22*(6-8), 613-673.

Berger, A. and G. Udell (2006), "A more complete conceptual framework for SME finance", *Journal of Banking & Finance*, Vol. 301/11, pp. 2945-2966

Berger, A. and G. Udell (2002), "Small business credit availability and relationship lending: The importance of bank organisational structure", *The Economic Journal*, Vol. 112/477, pp. F32-F53

Bernanke, Ben S., (2009) "The Crisis and the Policy Response," speech at the Stamp Lecture, London School of Economics, January 13, 2009 (available at http://www.federalreserve.gov/newsevents/ speech/berake20090113a.htm).

Boarnet, M. G. (1998). Business losses, transportation damage and the Northridge earthquake. *Journal of Transportation and Statistics*, *1*(2), 49-64.

Boot, Arnoud W. A., 2000, "Relationship Banking: What Do We Know?", Journal of Financial Intermediation 9(1), 7–25

Brewer III, E., Genay, H., Hunter, W. C., & Kaufman, G. G. (2003). The value of banking relationships during a financial crisis: Evidence from failures of Japanese banks. *Journal of the Japanese and International Economies*, *17*(3), 233-262.

Chava, S., & Purnanandam, A. (2011). The effect of banking crisis on bank-dependent borrowers. *Journal of financial economics*, *99*(1), 116-135.

Churm, Rohan, Michael Joyce, George Kapetanios, and Konstantinos Thoedoidis. 2015. "Unconventional Monetary Policies and the Macroeconomy: The Impact of the United Kingdom's QE2 and Funding for Lending Scheme." Bank of England Working Paper No.542.

Cole, M. A., Elliott, R. J., Okubo, T., & Strobl, E. (2017). Pre-disaster planning and post-disaster aid:

Examining the impact of the great East Japan Earthquake. *International journal of disaster risk reduction*, *21*, 291-302.

Cole, M. A., Elliott, R. J., Okubo, T., & Strobl, E. (2019). Natural disasters and spatial heterogeneity in damages: the birth, life and death of manufacturing plants. *Journal of Economic Geography*, *19*(2), 373-408.

Collier, B. L., & Babich, V. O. (2019). Financing recovery after disasters: Explaining community credit market responses to severe events. *Journal of Risk and Insurance*, *86*(2), 479-520.

Collier, J., Balakrishnan, S., & Zhang, Z. (2019). *From Hurricane Katrina to Hurricane Harvey: Actions, Issues, and Lessons Learned in Transportation and Logistics Efforts for Emergency Response* (No. 19-05576).

Cortés, K. R. (2014). Rebuilding after disaster strikes: How local lenders aid in the recovery.

Cortés, K. R., & Strahan, P. E. (2017). Tracing out capital flows: How financially integrated banks respond to natural disasters. *Journal of Financial Economics*, *125*(1), 182-199.

Cotugno, M., Monferrà, S., & Sampagnaro, G. (2013). Relationship lending, hierarchical distance and credit tightening: Evidence from the financial crisis. *Journal of Banking & Finance*, *37*(5), 1372-1385.

Craioveanu, M. and D. Terrell D (2016) "The Impact of Storms on Firm Survival: A Bayesian Spatial Econometric Model for Firm Survival," in B.H. Baltagi and J. P. Lesage and P. R. Kelley eds., *Spatial Econometrics: Qualitative and Limited Dependent Variables*, Bineley: Emerald Group Publishing Limited.

Elliott, R. J., Liu, Y., Strobl, E., & Tong, M. (2019). Estimating the direct and indirect impact of typhoons on plant performance: Evidence from Chinese manufacturers. *Journal of Environmental Economics and Management*, *98*, 102252.

Flath, D. (2000) *The Japanese Economy*, New York: Oxford University Press.

Fukuda, S. I., & Koibuchi, S. (2006). The impacts of "shock therapy" under a banking crisis: Experiences from three large bank failures in Japan. *The Japanese Economic Review*, *57*(2), 232-256.

Fujisawa, H. (1923) *Kaisei Eigyozei-ho Seigi (Commentary on the Revised Business Tax Law)*, Tokyo: Osakayago Shorten (in Japanese).

Goodfriend, M. (2011). Central banking in the credit turmoil: An assessment of Federal Reserve practice. *Journal of Monetary Economics*, *58*(1), 1-12.

Goto, S. (1970) *Nihon no Kin'yu Tokei (Financial Statistics on Japan*), Tokyo: Toyo Keizai Shinposha (in Japanese).

Giannetti, M., & Simonov, A. (2013). On the real effects of bank bailouts: Micro evidence from Japan. *American Economic Journal: Macroeconomics*, *5*(1), 135-67.

Hamao, Y., T. Hoshi and T. Okazaki (2009) "Listing Policy and Development of the Tokyo Stock

Exchange in the Prewar Period," in T. Ito and A. Rose eds., *Financial Sector Development in the Pacific Rim*, Chicago: University of Chicago Press.

Hosono, K., Miyakawa, D., Uchino, T., Hazama, M., Ono, A., Uchida, H., & Uesugi, I. (2016). Natural disasters, damage to banks, and firm investment. *International Economic Review*, *57*(4), 1335-1370.

Havrylchyk, Olena. 2016. "Incentivising Lending to SMEs with the Funding for Lending Scheme:Some Evidence from Bank-Level Data in the United Kingdom." OECD Economics Department Working Paper No. 1365.

Imuta, T (1980) "Nihon Kin'yu Kozo no Saihen to Chiho Ginko" (Destructing Japanese Banking Structure and Regional Banks) in T. Asakura ed. Ryotaisen kanni okeru Kin'yu Kozo*(Financial System between the Two World Wars)*, Tokyo: Ochanomizu Shobo (in Japanese).

Ishii, K. (1980) "Chiho Ginko to Nippon Ginko" (Regional Banks and the Bank of Japan) in T. Imuta ed., *Ryotaisenkan-ki no Kin'yu Kozo (Financial System between the Two World Wars)*, Tokyo: Ochanomizu Shobo (in Japanese).

Kanagawa Prefecture ed., (1982) *Kanagawa Ken Shi (History of Kanagawa Prefecture)* vol.7, Yokohama: Kanagawa Prefecture (in Japanese).

Karim, A. and I. Noy (2016). "Poverty and Natural disasters: Qualitative Survey of the Empirical Literature." *The Singapore Economic Review* 61(1): 1-36.

Kano, M., & Tsutsui, Y. (2003). Geographical segmentation in Japanese bank loan markets. *Regional Science and Urban Economics*, *33*(2), 157-174.

Kato, T. (1957) *Honpo Ginko Shi Ron (On the Japanese Banking History)*, Tokyo: University of Tokyo Press

Koetter, M., Noth, F., & Rehbein, O. (2020). Borrowers under water! Rare disasters, regional banks, and recovery lending. *Journal of Financial Intermediation*, *43*, 100811.

Klomp, J. (2016). Economic development and natural disasters: A satellite data analysis. *Global Environmental Change*, *36*, 67-88.

Khwaja, A. I., & Mian, A. (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. *American Economic Review*, *98*(4), 1413-42.

Leiter, A. M., Oberhofer, H., & Raschky, P. A. (2009). Creative disasters? Flooding effects on capital, labour and productivity within European firms. *Environmental and Resource Economics*, *43*(3), 333-350.

Moroi, T and M.Takemura (2002) Kanto Jishin (1923 nen 9 gatsu tuitachi) ni yoru Mokuzo Juuka Higai De-ta no Seiri to Shindo Bunpu no Suitei (Damage Data of Wooden Buildings and Estimation of Seismic Intensity in the Kanto Earthquake (September 1st 1923)), *Journal of*

*Japan Association for Earthquake Engineering*, vol 2 (3) pp.35-71.(in Japanese)

Noth, F., & Schüwer, U. (2018). Natural disaster and bank stability: Evidence from the US financial system.

Noy, I. and W. duPont IV (2018) "The Long-term Consequences of Disasters: What Do We Know, and What We Still Don't," *International Review of Environmental and Resource Economics*, 12(4): 325-354.

OECD (2012), Financing SMEs and Entrepreneurs 2012: An OECD Scoreboard, OECD Publishing, Paris

Ohkawa, K., N. Takamatsu and Y. Yamamoto (1974) *Kokumin Shotoku (National Income)*, Tokyo: Toyo Keizai Shinposha (in Japanese).

Okazaki, T. (1993) Senkan-ki no kin'yu kozo henka to kin'yu kiki" (Change of financial market structure and financial crisis in prewar Japan), *Keizai Kenkyu*, 44(4): 300-310 (in Japanese)

Okazaki, T. (1997) Kogyoka no Kiseki: Keizai Taikoku Zenshi (History of Industrialization: Prologue to the Economic Giant), Tokyo: Yomiuri Shinbun-sha (in Japanese).

Okazaki, T. (2016) "Ginkogyo no Sangyo Soshiki to Sangyo Kigyo Kin'yu" (Industrial Organization of the Banking Sector and Corporate Finance) in K. Fukao, N. Nakamura and M. Nakabayashi eds., *Nihon Keizai no Rekishi (History of the Japanese Economy)* vol.4, Tokyo: Iwanami Shoten: 111-137 (in Japanese).

Okazaki, T., T. Okubo and E. Strobl (2019) "Creative Destruction of Industries: Yokohama City in the Great Kanto Earthquake," *Journal of Economic History* 79(1): 1-31.

Okazaki, T. and M. Okuno-Fujiwara eds. (1999) *The Japanese Economic System and Its Historical Origins*, New York, Oxford University Press, 1999.

Okazaki, T. M. Sawada and K. Yokoyama (2005) "Measuring the Extent and Implications of Director Interlocking in Prewar Japanese Banking Industry," *Journal of Economic History*, 65(4), 1082-1115, 2005

Okazaki, T. and M. Sawada (2012) "Interbank Networks in Prewar Japan: Structure and Implications," *Industrial and Corporate Change*, April: 463-506.

Okubo, T., & Strobl, E. (2021). Natural Disasters, Firm Survival and Growth: Evidence from the Ise Bay Typhoon, Japan. *Journal of Regional Science*, forthcoming.

Petersen, M. A., & Rajan, R. G. (1994). The benefits of lending relationships: Evidence from small business data. *The journal of finance*, *49*(1), 3-37.

Petersen, M. A., & Rajan, R. G. (1995). The effect of credit market competition on lending relationships. *The Quarterly Journal of Economics*, *110*(2), 407-443.

Rajan, R. G. (1992). Insiders and outsiders: The choice between informed and arm's-length debt. *The Journal of finance*, *47*(4), 1367-1400.

Rajan, R. (2013). A step in the dark: unconventional monetary policy after the crisis. *Andrew Crockett*

*Memorial Lecture, Bank for International Settlements*, *23*.

Rehbein, O. (2018). *Flooded through the back door: Firm-level effects of banks' lending shifts* (No. 4/2018). IWH Discussion Papers.

Puri, M., J. Rocholl and S. Steffen (2011), "Global Retail Lending in the Aftermath of the U.S. Financial Crisis: Distinguishing between Supply and Demand Effects", *Journal of Financial Economics,* 100(3): 556-578.

Research Bureau of the Bank of Japan (1933) "Kanto Shinsai yori Showa 2-nen Kin'yu Kyoko ni Itaru Waga Zaikai" (The Japanese Economy from the Great Kanto Earthquake to the Financil Crisis in 1927) in the Research Bureau of the Bank of Japan ed. *Nihon Kin'yu Shi Shiryo (Materials on the Japanese Financial History)* vol.22, Tokyo: Printing Bureau of the Ministry of Finance: 737-1110

Sawada, Y., & Shimizutani, S. (2008). How do people cope with natural disasters? Evidence from the great Hanshin-Awaji (Kobe) earthquake in 1995. *Journal of Money, Credit and Banking*, *40*(2-3), 463-488.

Schnabl, P. (2012). The international transmission of bank liquidity shocks: Evidence from an emerging market. *The Journal of Finance*, *67*(3), 897-932.

Sette, E., & Gobbi, G. (2015). Relationship lending during a financial crisis. *Journal of the European Economic Association*, *13*(3), 453-481.

Sharpe, S. A. (1990). Asymmetric information, bank lending, and implicit contracts: A stylized model of customer relationships. *The journal of finance*, *45*(4), 1069-1087.

Shinohara, M. (1972) *Kokogyo (Mining and Manufacturing Industries)*, Tokyo: Toyo Keizai Shinpo-sha (in Japanese).

Slovin, M. B., Sushka, M. E., Polonchek, J. A., 1993. The Value of Bank Durability: Borrowers as Bank Stakeholders. Journal of Finance 48 (1), pp. 247-266.

Statistical Bureau, Ministry of Internal Affairs and Communication ed. (2006) *Nihon Choki Tokei Soran (Historical Statistics of Japan)* new edition, vol 1, Tokyo: Tokyo: Nihon Tokei Kyokai (in Japanese).

Takahama, T, S. Midorikawa, H. Shinbo and S. Abe (2001). "1923 nen Kanto Jishin niyoru Yokohama-shi deno Mokuzoukaoku no Higaibunpu" (Damage distribution of wooden houses in Yokohama City by the 1923 Kanto earthquake, in *Proceedings of the 26th JSCE Earthquake Engineering Symposium*, 1: 105-108 (in Japanese).

Takahashi, K. and K. Morigaki (1993) *Showa Kin'yu Kyoko Shi (History of Showa Financial Crisis)*, Tokyo: Kodansha (in Japanese).

Takemura, M (2003) 1923 nen Kanto Jishin niyoru Tokyo-to Chushin-bu (Kyu 15 kunai) no Shosai Shindo Bunpu to Hyoso Jiban Kozo (Seismic Intensity and Surface Ground Structure in Central Metropolitan Tokyo (former 15 wards) in the 1923 Kanto Earthquake), *Journal of*

*Japan Association for Earthquake Engineering*, vol 3 (1) pp.1-36.(in Japanese)

Tanaka, A. (2015). The impacts of natural disasters on plants' growth: Evidence from the Great Hanshin-Awaji (Kobe) earthquake. *Regional Science and Urban Economics*, *50*, 31-41.

Teranishi, J. (2011) *Senzenki Nihon no Kin'yu Shisutemu (The Financial System in Prewar Japan)*, Tokyo: Iwanami Shoten (in Japanese).

Tokyo City Office (1925) *Shinsai niyoru Nihon no Sonshitsu (Damage to Japan by the Great Kantō Earthquake)*, Tokyo: Isseisha (in Japanese).

Tokyo Stock Exchange (1928) *Tokyo Kabushiki Torihikijo 50-nen Shi (50 Year History of the Tokyo Stock Exchange)*, Tokyo: Tokyo Stock Exchange (in Japanese).

Toyo Keizai Shinpo-sha (1927) *Meiji Taisho Kokusei Soran (Statistical Handbook of Meiji and Taisho Eras)*, Tokyo: Toyo Keizai Shinpo-sha (in Japanese).

Uchida, H., Udell, G. F., & Watanabe, W. (2008). Bank size and lending relationships in Japan. *Journal of the Japanese and international Economies*, *22*(2), 242-267.

Wang, L. (2016), "Unconventional monetary policy and aggregate bank lending: does financial structure matter?", Journal of Policy Modeling, Vol. 38 No. 6, pp. 1060-1077.

Yokohama Bank (1980) *Yokohama Ginko 60-nen Shi* (60 Year History of Yokohama Bank), Yokohama: Yokohama Bank (in Japanese).

Yokohama City Office (1937a) *Yokohama Shi Kogyo Chosasho* (Survey of Manufacturing Industries in Yokohama City), Yokohama: Yokohama City Office (in Japanese).

Yokohama City Office (1937b) *Yokohama Shi Shogyo Chosasho* (Survey of Commerce in Yokohama City), Yokohama: Yokohama City Office (in Japanese).

Yokohama City Office (1976). *Yokohama Shi Shi (Hisotry of Yokohama City)*, vol. 5-2, Yokohama: Yokohama City Office (in Japanese).

Table 1 Composition of liabilities of non-financial sector by firm scale

| | | Total | | | Joint-stock companies with capital no less than 10 million yen | | | Other firms and individuals | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Capital | Bond | Borrowing | Capital | Bond | Borrowin | Capital | Bond | Borrowing |
| Million yen | 1915 | 1,480 | 278 | 2,728 | … | … | … | … | … | … |
| | 1920 | 6,679 | 542 | 8,332 | … | … | … | … | … | … |
| | 1925 | 9,129 | 1,761 | 11,397 | 5,018 | 1,761 | 609 | 4,111 | 0 | 10,788 |
| | 1930 | 11,847 | 3,013 | 12,434 | 6,863 | 3,013 | 1,124 | 4,983 | 0 | 11,310 |
| | 1935 | 14,089 | 3,442 | 12,683 | 8,320 | 2,900 | 734 | 5,769 | 542 | 11,949 |
| | 1940 | 26,353 | 6,824 | 25,457 | 16,355 | 4,700 | 3,153 | 9,997 | 2,123 | 22,304 |
| % | 1915 | 33.0 | 6.2 | 60.8 | … | … | … | … | … | … |
| | 1920 | 42.9 | 3.5 | 53.6 | … | … | … | … | … | … |
| | 1925 | 41.0 | 7.9 | 51.1 | 67.9 | 23.8 | 8.2 | 27.6 | 0.0 | 72.4 |
| | 1930 | 43.4 | 11.0 | 45.6 | 62.4 | 27.4 | 10.2 | 30.6 | 0.0 | 69.4 |
| | 1935 | 46.6 | 11.4 | 42.0 | 69.6 | 24.3 | 6.1 | 31.6 | 3.0 | 65.4 |
| | 1940 | 44.9 | 11.6 | 43.4 | 67.6 | 19.4 | 13.0 | 29.0 | 6.2 | 64.8 |

Source: Okazaki (2016).

Table 2 Sources of external finance for factories and commercial business offices in Yokohama City in 1933

A. Factories

| Scale in terms of capital | Number of factories | Employees | Employees per factory | Sales | Sales per factory | Borrowing | Bank | | Credit from transaction counterparts | Traditional financial institutions (pawn shop and mutual loan), and individuals |
|---|---|---|---|---|---|---|---|---|---|---|
| | | persons | persons | 1,000 yen | 1,000 yen | 1,000 yen | 1,000 yen | % | 1,000 yen | 1,000 yen |
| Total | 9,313 | 52,146 | 5.6 | 188,424 | 20.2 | 50,568 | 38,534 | 76.2 | 1,261 | 10,773 |
| x<100 yen | 801 | 1,334 | 1.7 | 379 | 0.5 | 38 | 0 | 0.0 | 3 | 35 |
| 100 yen≦x＜500 yen | 2,494 | 5,134 | 2.1 | 2,670 | 1.1 | 185 | 14 | 7.6 | 42 | 129 |
| 500 yen≦x＜1,000 yen | 1,878 | 4,741 | 2.5 | 3,520 | 1.9 | 206 | 25 | 12.3 | 36 | 144 |
| 1,000 yen≦x＜2,000 yen | 1,714 | 4,818 | 2.8 | 5,269 | 3.1 | 336 | 37 | 11.1 | 85 | 214 |
| 2,000 yen≦x＜5,000 yen | 1,430 | 5,433 | 3.8 | 7,749 | 5.4 | 579 | 92 | 15.9 | 120 | 367 |
| 5,000 yen≦x＜10,000 yen | 447 | 2,616 | 5.9 | 4,740 | 10.6 | 368 | 61 | 16.6 | 101 | 206 |
| 10,000 yen≦x＜50,000 yen | 372 | 4,365 | 11.7 | 12,208 | 32.8 | 982 | 264 | 26.9 | 224 | 494 |
| 50,000 yen≦x＜100,000 yen | 72 | 1,833 | 25.5 | 5,434 | 75.5 | 692 | 296 | 42.8 | 106 | 289 |
| 100,000 yen≦x＜500,000 yen | 65 | 2,889 | 44.4 | 17,864 | 274.8 | 2,234 | 1,139 | 51.0 | 224 | 871 |
| 500,000 yen≦x＜1,000,000 yen | 10 | 1,382 | 138.2 | 8,085 | 808.5 | 744 | 534 | 71.8 | 81 | 130 |
| 1,000,000 yen≦x＜5,000,000 ye | 18 | 4,572 | 254.0 | 45,201 | 2,511.2 | 5,211 | 4,993 | 95.8 | 218 | 0 |
| 5,000,000 yen≦x | 12 | 13,029 | 1085.8 | 75,305 | 6,275.5 | 38,994 | 31,078 | 79.7 | 22 | 7,894 |

Source: Yokohama City Office (1937a).

Note: The figures of borrowing are the sum of the borrowing of the factories in each scale bin.

B. Commercial business offices

| Scale in terms of capital | Number of offices | Employees | Employees per office | Sales | Sales per office | Borrowing | Bank | | Other modern financial institutions | Credit from transaction counterparts | Traditional financial institutions (pawn shop and mutual loan), and individuals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | persons | persons | 1,000 yen | 1,000 yen | 1,000 yen | 1,000 yen | % | 1,000 yen | 1,000 yen | 1,000 yen |
| Total | 20,677 | 57,912 | 2.8 | 607,930 | 29.4 | 15,944 | 8,906 | 55.9 | 255 | 2,850 | 3,934 |
| x<100 yen | 2,482 | 3,742 | 1.5 | 1,141 | 0.5 | 63 | 1 | 2.1 | 2 | 12 | 48 |
| 100 yen≦x＜500 yen | 4,937 | 8,804 | 1.8 | 6,572 | 1.3 | 422 | 22 | 5.3 | 13 | 133 | 253 |
| 500 yen≦x＜1,000 yen | 4,170 | 8,380 | 2.0 | 9,765 | 2.3 | 550 | 55 | 10.0 | 17 | 191 | 286 |
| 1,000 yen≦x＜2,000 yen | 3,758 | 8,356 | 2.2 | 13,904 | 3.7 | 832 | 90 | 10.8 | 19 | 344 | 380 |
| 2,000 yen≦x＜5,000 yen | 3,044 | 8,237 | 2.7 | 26,465 | 8.7 | 1,322 | 193 | 14.6 | 56 | 509 | 564 |
| 5,000 yen≦x＜10,000 yen | 1,070 | 3,819 | 3.6 | 18,086 | 16.9 | 922 | 196 | 21.3 | 23 | 314 | 389 |
| 10,000 yen≦x＜50,000 yen | 903 | 5,340 | 5.9 | 61,456 | 68.1 | 2,352 | 891 | 37.9 | 68 | 766 | 628 |
| 50,000 yen≦x＜100,000 yen | 150 | 1,529 | 10.2 | 47,966 | 319.8 | 1,358 | 501 | 36.9 | 3 | 438 | 417 |
| 100,000 yen≦x＜500,000 yen | 124 | 2,728 | 22.0 | 85,649 | 690.7 | 2,302 | 1,539 | 66.8 | 52 | 144 | 568 |
| 500,000 yen≦x | 39 | 6,977 | 178.9 | 336,927 | 8,639.2 | 5,821 | 5,418 | 93.1 | 0 | 0 | 403 |

Source: Yokohama City Office (1937b).

Note: The figures of borrowing are the sum of the borrowing of the business offices in each scale bin.

Table 3 Damage by the Great Kanto Earthquake

| | Human damage | | | Physical damage | | |
|---|---|---|---|---|---|---|
| | Number of death and missing | Population (thousand persons) | Percentage to the population | Number of buildings completely burnt or destroyed | Total number of buildings (thousand buildings) | Percentage to the total buildings |
| Total | 104,619 | 11,743 | 0.89 | 464,909 | 2,284 | 20.4 |
| Tokyo Prefecture | 70,497 | 4,036 | 1.75 | 328,646 | 827 | 39.8 |
| Tokyo City | 68,660 | 2,265 | 3.03 | 305,146 | 483 | 63.2 |
| Kanagawa Prefecture | 31,859 | 1,379 | 2.31 | 115,353 | 274 | 42.1 |
| Yokohama City | 23,335 | 447 | 5.23 | 72,408 | 99 | 73.2 |
| Other five damaged prefectures | 2,263 | 11,315 | 0.02 | 20,910 | 1,162 | 1.8 |

Note: Other five damaged prefectures are Chiba, Saitama, Shizuoka, Yamanashi and Ibaraki.
Source: Tokyo City Office (1925), pp.160-163.

Table 4 Deposit and loan by bank in Yokohama City

1,000 yen

| | Deposit | | | Loan | | | "Earthquake bills" discounted by BOJ |
|---|---|---|---|---|---|---|---|
| | 1922 | 1924 | 1926 | 1922 | 1924 | 1926 | |
| **Total** | **130,208** | **99,111** | **131,581** | **146,477** | **136,886** | **155,958** | **92,759** |
| **Local banks** | **63,970** | **45,024** | **72,562** | **65,313** | **66,995** | **79,248** | **20,953** |
| **Larger banks** | **49,639** | **39,443** | **66,285** | **50,417** | **53,818** | **63,679** | **19,711** |
| Souda | 22,596 | 12,507 | 14,671 | 12,737 | 12,970 | 14,309 | 8,018 |
| Yokohama Koshin | 14,244 | 16,231 | 31,360 | 5,377 | 12,731 | 17,729 | 1,152 |
| Watanabe | 6,408 | 5,826 | 12,036 | 8,638 | 9,186 | 8,385 | - |
| Dai-ni | 6,390 | 4,879 | 8,218 | 23,664 | 18,931 | 23,256 | 9,299 |
| **Smaller banks** | **14,331** | **5,581** | **6,277** | **14,896** | **13,177** | **15,569** | **1,242** |
| Kanagawa | 4,266 | - | - | 3,121 | - | - | - |
| Hiranuma | 3,527 | 1,767 | 2,293 | 2,940 | 2,464 | 2,190 | - |
| Yokohama Wakao | 2,380 | 2,262 | 2,554 | 3,815 | 8,360 | 11,274 | 1,015 |
| Tobe | 1,000 | - | - | 1,060 | - | - | - |
| Toyo | 904 | - | - | 1,343 | - | - | - |
| Yokohama Boeki | 850 | 427 | 340 | 1,024 | 533 | 450 | 80 |
| Motomachi | 678 | 242 | 235 | 560 | 396 | 344 | 32 |
| Yokohama Shogyo | 301 | 334 | 375 | 525 | 590 | 541 | 66 |
| Okamaru | 173 | - | - | 242 | - | - | - |
| Yokohama | 134 | - | - | 188 | - | - | 49 |
| Joshin | 119 | 549 | 480 | 78 | 834 | 770 | - |
| **Branches of non-local banks** | **66,238** | **54,087** | **59,019** | **81,164** | **69,891** | **76,710** | **71,806** |
| Dai-ichi | 14,828 | 8,822 | 9,007 | 15,117 | 13,030 | 13,207 | - |
| Mitsui | 12,432 | 10,970 | 11,786 | 20,122 | 20,644 | 17,546 | - |
| Dai-san | 9,527 | - | - | 9,251 | - | - | - |
| Sumitomo | 9,006 | 6,106 | 7,382 | 10,496 | 7,269 | 7,382 | - |
| Dai-hyaku | 7,955 | 4,153 | 8,262 | 11,924 | 5,387 | 7,754 | 7,926 |
| Kawasaki | 3,554 | 4,102 | 5,116 | 5,816 | 4,600 | 4,397 | 19,373 |
| Shin'yu | 3,289 | 2,123 | 2,029 | 3,036 | 3,067 | 2,852 | - |
| Fujimoto Bill Broker | 2,233 | 3,670 | 51 | 3,626 | 4,295 | 9,433 | 24,510 |
| Jugo | 1,436 | 3,037 | 4,451 | 218 | 750 | 1,122 | 19,704 |
| Yasuda | 977 | 8,526 | 7,478 | 618 | 9,614 | 12,751 | - |
| Nihon Chuya | 557 | 2,176 | 3,251 | 40 | 107 | 135 | - |
| Kyoshin | 241 | 165 | 0 | 690 | 905 | 0 | 293 |
| Totsuka | 205 | 237 | 206 | 211 | 223 | 131 | - |

Source: Monthly Bulletin of Yokohama Chamber of Commerce, various issues; Bank of Japan (1983), pp.92-93.
Note: The figures on Earthquake Bills are the aomounts of the bills discounted by BOJ from September 29, 1923 to March 31, 1924.

Table 5: Composition of loan from Souda Bank as of 1927

1,000 yen

| | Total | Uncollectable | Percentage |
|---|---|---|---|
| Total | 23,667 | 16,263 | 68.7 |
| Firms owned by Souda family | 2,175 | 2,013 | 92.6 |
| Other related firms | 7,369 | 6,193 | 84.0 |
| Others | 14,124 | 8,067 | 57.1 |

Source: Research Bureau of the Bank of Japan (1933), p.340.

**Table 6: Bank list in Yokohama city**

| | | Number of client firms | | Average size of firms (business tax, yen) | |
|---|---|---|---|---|---|
| Bank name | HQ location | 1922 | 1925 | 1922 | 1925 |
| **Local banks** | | **315** | **89** | **171.6** | **172.9** |
| **Larger banks** | | **257** | **75** | **174.5** | **179.9** |
| Souda | Yokohama | 156 | 42 | 170.7 | 168.5 |
| Yokohama Koshin | Yokohama | 56 | 22 | 120.3 | 159.2 |
| Watanabe | Yokohama | 39 | 11 | 257.3 | 265.0 |
| Dai-ni | Yokohama | 6 | | 238.8 | |
| **Smaller banks** | | **58** | **14** | **158.6** | **135.2** |
| Yokohama Boeki | Yokohama | 5 | 1 | 332.0 | 184.0 |
| Motomachi | Yokohama | 8 | 1 | 69.3 | 82.0 |
| Hiranuma | Yokohama | 24 | 5 | 156.3 | 180.2 |
| Okamaru | Yokohama | 1 | | | |
| Yokohama Shogyo | Yokohama | 6 | | 190.8 | |
| Kyoshin | Yokohama | 9 | 3 | 177.7 | 153.7 |
| Tobe | Yokohama | 4 | 2 | 59.0 | 72.5 |
| Totsuka | Yokohama | 1 | 2 | 96.0 | 60.0 |
| | | | | | |
| **Non-local banks** | | **182** | **55** | **274.0** | **360.2** |
| Dai-ichi | Tokyo | 15 | 4 | 233.9 | 217.3 |
| Mitsui | Tokyo | 20 | 10 | 427.6 | 456.7 |
| Dai-san | Tokyo | 17 | 3 | 365.0 | 989.7 |
| Sumitomo | Osaka | 22 | 10 | 453.7 | 567.1 |
| Dai-hyaku | Tokyo | 40 | 9 | 271.5 | 317.7 |
| Kawasaki | Tokyo | 21 | 5 | 183.6 | 133.6 |
| Yasuda | Tokyo | 3 | 1 | 117.7 | 86.0 |
| Hotoku | Tokyo | 2 | 1 | 60.5 | 109.0 |
| Kyoshin | Yokosuka | 29 | 9 | 123.8 | 166.7 |
| Hudo chochiku | Tokyo | 1 | | 67.0 | |
| Teikoku Chozo | Tokyo | 1 | | 24.0 | |
| Tomikura | Tokyo | 2 | | 72.0 | |
| Sanju-hachi | Hyogo | 1 | | 1096.0 | |
| Others | | 8 | 3 | 188.0 | 171.0 |

**Table 7 Summary Statistics**

| variables | definition | mean | sd | min | max | Source |
|---|---|---|---|---|---|---|
| survival | Survival Indicator | 0.614925 | 0.487341 | 0 | 1 | A |
| sales growth | Firm sales growth | −1.03882 | 0.936348 | −5.05306 | 2.116483 | A |
| Age | Firm Age (ln) | 3.097051 | 0.761821 | 0 | 5.402678 | B |
| Asset | Capital Asset value (category 1-24) | 8.955224 | 4.503601 | 1 | 24 | B |
| FDamage | Firm damage (category, 1-6) | 3.110448 | 1.265519 | 1 | 6 | B |
| Cdamage | Chome Damage (share, 0-1) | 0.6692 | 0.329538 | 0 | 1 | C |
| FSize | Firm size: Taxes on Profits (yen)(ln) | 5.149188 | 0.963459 | 2.302585 | 9.625228 | A |
| Bsize | Bank size: Capital asset (yen) | 10.77629 | 1.397029 | 6.659294 | 14.20987 | D |
| Bank Damage | Bank Damage (share, 0-1) | 0.701882 | 0.105629 | 0.137933 | 0.846726 | C |
| BOJ bill | Earthquake Bills normalized by Capital Asset | 0.047341 | 0.045295 | 0 | 0.330309 | E |
| BOJ bill Paid | Paid Earthquake Bills normalized by Capital Asset | 0.067499 | 0.081388 | 0 | 0.970332 | E |

data sources
A: Dai Nihon Shoko-roku (Records on Commercial and Industrial Firms)
B: Shoko Shinyo-roku (Records on Credit Statuses of Commercial and Industrial Firms)
C: Damage index by Takahama et al. (2001)
D: Yearbook of the Bank Bureau of the Ministry of Finance
E: BOJ (1983, pp. 92-94)

**Table 8: Survival**

| | 1 | | | 2 | | | 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coeff | Std err | t | Coeff | Std err | t | Coeff | Std err | t |
| Age | −0.0043 | 0.025 | −0.17 | −0.0046 | 0.026 | −0.18 | −0.0059 | 0.026 | −0.22 |
| Asset | 0.0127 | 0.006 | 2.17 * | 0.0125 | 0.006 | 2.08 * | 0.0155 | 0.007 | 2.17 * |
| FDamage | −0.0111 | 0.014 | −0.77 | −0.0118 | 0.014 | −0.83 | −0.2149 | 0.116 | −1.85 |
| CDamage | 0.0982 | 0.155 | 0.63 | 0.0997 | 0.164 | 0.61 | −0.8504 | 0.336 | −2.53 ** |
| FSize | 0.1347 | 0.027 | 5.01 *** | 0.1316 | 0.026 | 5.15 *** | −0.1033 | 0.012 | −8.6 *** |
| FDamage#Fsize | | | | | | | 0.0407 | 0.022 | 1.85 |
| CDamage#Fsize | | | | | | | 0.1854 | 0.072 | 2.57 ** |
| Bsize | | | | 0.0183 | 0.020 | 0.93 | −0.0417 | 0.062 | −0.67 |
| BDamage | | | | 0.1828 | 0.067 | 2.71 ** | −0.6567 | 0.917 | −0.72 |
| BSize#BDamage | | | | | | | 0.0803 | 0.086 | 0.94 |
| Sector | | yes | | | yes | | | yes | |
| Ward | | yes | | | yes | | | yes | |
| Observation | | 335 | | | 335 | | | 335 | |
| R-sq | | 0.269 | | | 0.272 | | | 0.289 | |

| | 4 | | | 5 | | | 6 | | | 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coeff | Std err | t | Coeff | Std err | t | Coeff | Std err | t | Coeff | Std err | t |
| Age | −0.0024 | 0.027 | −0.09 | 0.0016 | 0.029 | 0.06 | 0.0062 | 0.030 | 0.21 | 0.0066 | 0.035 | 0.19 |
| Asset | 0.0157 | 0.008 | 2.02 * | 0.0153 | 0.007 | 2.11 * | 0.0148 | 0.006 | 2.35 ** | 0.0147 | 0.006 | 2.31 ** |
| FDamage | −0.2170 | 0.116 | −1.87 * | −0.2707 | 0.138 | −1.96 * | −0.2021 | 0.108 | −1.87 | −0.2212 | 0.114 | −1.94 * |
| CDamage | −0.8561 | 0.323 | −2.65 ** | −0.7298 | 0.393 | −1.86 | −0.7731 | 0.329 | −2.35 ** | −1.9503 | 0.481 | −4.05 *** |
| FSize | −0.1063 | 0.013 | −8.06 *** | 0.0771 | 0.158 | 0.49 | 0.2111 | 0.330 | 0.64 ** | −0.0031 | 0.179 | −0.02 |
| FDamage#Fsize | 0.0411 | 0.023 | 1.8 | 0.0517 | 0.028 | 1.87 * | 0.0386 | 0.021 | 1.85 | 0.0421 | 0.023 | 1.82 |
| CDamage#Fsize | 0.1848 | 0.065 | 2.86 ** | 0.1574 | 0.075 | 2.1 * | 0.1690 | 0.064 | 2.65 ** | 0.3829 | 0.148 | 2.58 ** |
| Bsize | −0.0664 | 0.298 | −0.22 | −0.0389 | 0.297 | −0.13 | −0.0346 | 0.164 | −0.21 | −0.0598 | 0.145 | −0.41 |
| BDamage | −1.1410 | 5.223 | −0.22 | 0.0974 | 4.369 | 0.02 | 0.3466 | 2.228 | 0.16 | −1.1511 | 2.791 | −0.41 |
| BSize#BDamage | 0.0928 | 0.418 | 0.22 | 0.1659 | 0.423 | 0.39 | 0.2355 | 0.417 | 0.56 | 0.3390 | 0.406 | 0.84 |
| BOJ_bill | 17.218 | 81.4 | 0.21 | 3.3414 | 55.05 | 0.06 | | | | | | |
| BDamage#BOJ_bill | −29.129 | 111.1 | −0.26 | −57.815 | 94.48 | −0.61 | | | | | | |
| BSize#BOJ bill | −2.1395 | 7.110 | −0.3 | −3.1434 | 5.406 | −0.58 | | | | | | |
| BDamage#BOJ_bill#Bsize | 3.4433 | 9.629 | 0.36 | 8.5533 | 8.839 | 0.97 | | | | | | |
| FSize#BDamage#BOJ_bill | | | | 2.4847 | 7.517 | 0.33 | | | | | | |
| FSize#BOJ_bill | | | | 5.6316 | 1.726 | 3.26 *** | | | | | | |
| Fsize#BDamage#BOJbill#Bsize | | | | −0.8101 | 0.713 | −1.14 | | | | | | |
| Fsize#BDamage | | | | −0.1696 | 0.259 | −0.66 | −0.1515 | 0.124 | −1.22 | 0.0545 | 0.485 | 0.11 |
| Fsize#BDamage#Bsize | | | | −0.0184 | 0.019 | −0.95 | −0.0323 | 0.039 | −0.82 | 0.0830 | 0.251 | 0.33 |
| BOJ_bill_PAID | | | | | | | 27.460 | 8.488 | 3.24 *** | 3.1578 | 10.50 | 0.3 |
| BDamage#BOJ_bill_PAID | | | | | | | −50.181 | 26.450 | −1.9 * | −23.742 | 29.98 | −0.79 |
| Bsize#BOJ bill PAID | | | | | | | −2.3804 | 2.098 | −1.13 | −1.7431 | 1.781 | −0.98 |
| BDamage#BOJ_bill_PAID#Bsize | | | | | | | 3.8915 | 4.783 | 0.81 | 1.8780 | 4.021 | 0.47 |
| Fsize#BDamage#BOJ_bill_PAID | | | | | | | 2.8895 | 0.933 | 3.1 *** | −0.6863 | 3.050 | −0.23 |
| Fsize#BOJ_bill_PAID | | | | | | | 0.0232 | 3.691 | 0.01 | 3.3021 | 1.290 | 2.56 ** |
| Fsize#BDamage#BOJbillPAID#Bsize | | | | | | | −0.1754 | 0.462 | −0.38 | −0.0465 | 0.043 | −1.07 |
| CDamage #BOJ_bill_PAID | | | | | | | | | | 18.933 | 8.602 | 2.2 * |
| Fsize # CDamage # BOJ bill PAID | | | | | | | | | | −3.4452 | 2.054 | −1.68 |
| Sector | | yes | | | yes | | | yes | | | yes | |
| Ward | | yes | | | yes | | | yes | | | yes | |
| Observation | | 335 | | | 335 | | | 335 | | | 333 | |
| R-sq | | 0.293 | | | 0.313 | | | 0.3102 | | | 0.314 | |

Notes: (i) Standard errors clustered by Ward in parentheses, (ii) *** p<0.01, ** p<0.05, * p<0.10

**BOJ_bill=Bill/Asset**

**BOJ_bill_PAID=(Bill*(1-Unpaid))/Asset**

**Table 9: Firm growth**

| | 1 | | | 2 | | | 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coeff | Std err | t | Coeff | Std err | t | Coeff | Std err | t |
| Age | −0.0265 | 0.095 | −0.28 | −0.0286 | 0.089 | −0.32 | −0.0307 | 0.074 | −0.41 |
| Asset | 0.0079 | 0.010 | 0.81 | 0.0065 | 0.007 | 0.9 | −0.0144 | 0.012 | −1.22 |
| FDamage | −0.0839 | 0.049 | −1.73 | −0.0832 | 0.052 | −1.61 | 0.4440 | 0.078 | 5.66 *** |
| CDamage | 0.1667 | 0.176 | 0.95 | 0.1193 | 0.174 | 0.68 | −0.8331 | 0.566 | −1.47 |
| FSize | −0.4164 | 0.052 | −8.04 *** | −0.4193 | 0.047 | −8.84 *** | −0.2647 | 0.089 | −2.96 *** |
| FDamage#Fsize | | | | | | | −0.1080 | 0.021 | −5.04 *** |
| CDamage#Fsize | | | | | | | 0.1638 | 0.107 | 1.53 |
| Bsize | | | | 0.1023 | 0.065 | 1.57 | 0.8945 | 0.188 | 4.76 *** |
| BDamage | | | | 0.1461 | 1.137 | 0.13 | 12.3381 | 3.369 | 3.66 *** |
| BSize#BDamage | | | | | | | −1.1170 | 0.257 | −4.34 *** |
| Sector Dummy | | yes | | | yes | | | yes | |
| Ward Dummy | | yes | | | yes | | | yes | |
| Observation | | 203 | | | 203 | | | 203 | |
| R-sq | | 0.2605 | | | 0.2748 | | | 0.346 | |

| | 4 | | | 5 | | | 6 | | | 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coeff | Std err | t | Coeff | Std err | t | Coeff | Std err | t | Coeff | Std err | t |
| Age | −0.0345 | 0.077 | −0.45 | 0.0182 | 0.096 | 0.19 | 0.0167 | 0.100 | 0.17 | 0.0177 | 0.108 | 0.16 |
| Asset | −0.0153 | 0.013 | −1.16 | −0.0136 | 0.006 | −2.25 * | −0.0138 | 0.011 | −1.3 | −0.0139 | 0.012 | −1.19 |
| FDamage | 0.4507 | 0.104 | 4.33 *** | 0.1611 | 0.265 | 0.61 | 0.3793 | 0.111 | 3.41 *** | 0.3814 | 0.146 | 2.61 ** |
| CDamage | −0.9236 | 0.668 | −1.38 | −0.9946 | 1.077 | −0.92 | −1.7566 | 0.622 | −2.82 ** | −1.2263 | 1.638 | −0.75 |
| FSize | −0.2731 | 0.106 | −2.58 ** | 0.8935 | 0.639 | 1.4 | −0.0612 | 0.840 | −0.07 | 0.0688 | 0.987 | 0.07 |
| FDamage#Fsize | −0.1095 | 0.026 | −4.17 *** | −0.0513 | 0.046 | −1.12 | −0.0942 | 0.027 | −3.43 *** | −0.0946 | 0.036 | −2.65 ** |
| CDamage#Fsize | 0.1851 | 0.127 | 1.46 | 0.2109 | 0.221 | 0.95 | 0.3484 | 0.134 | 2.61 ** | 0.2470 | 0.308 | 0.8 |
| Bsize | 1.3773 | 0.311 | 4.42 *** | 0.9816 | 0.304 | 3.23 *** | 1.0653 | 0.431 | 2.47 ** | 1.0658 | 0.472 | 2.26 * |
| BDamage | 20.0821 | 4.773 | 4.21 *** | 16.8732 | 9.096 | 1.85 | 11.2925 | 4.669 | 2.42 ** | 12.6375 | 7.382 | 1.71 |
| BSize#BDamage | −1.7046 | 0.356 | −4.78 *** | −0.4111 | 0.665 | −0.62 | −0.7737 | 0.639 | −1.21 | −0.8456 | 0.685 | −1.23 |
| BOJ_bill | 65.7895 | 102.7 | 0.64 | 77.2164 | 110.03 | 0.7 | | | | | | |
| BDamage#BOJ_bill | −69.947 | 135.5 | −0.52 | −410.76 | 329.13 | −1.25 | | | | | | |
| BSize#BOJ bill | −4.6803 | 10.389 | −0.45 | 4.8584 | 11.111 | 0.44 | | | | | | |
| BDamage#BOJ_bill#Bsize | 4.5206 | 13.775 | 0.33 | 91.5555 | 75.688 | 1.21 | | | | | | |
| FSize#BDamage#BOJ_bill | | | | 22.3510 | 35.778 | 0.62 | | | | | | |
| FSize#BOJ_bill | | | | −20.279 | 7.093 | −2.86 *** | | | | | | |
| Fsize#BDamage#BOJbill#Bsize | | | | −6.0941 | 7.963 | −0.77 | | | | | | |
| Fsize#BDamage | | | | −0.4599 | 1.793 | −0.26 | 0.7981 | 1.311 | 0.61 | 69.3271 | 85.101 | 0.81 |
| Fsize#BDamage#Bsize | | | | −0.1406 | 0.142 | −0.99 | −0.1042 | 0.041 | −2.51 *** | −245.19 | 209.46 | −1.17 |
| BOJ_bill_PAID | | | | | | | 55.2966 | 55.683 | 0.99 | −3.5370 | 4.458 | −0.79 |
| BDamage#BOJ_bill_PAID | | | | | | | −224.22 | 179.88 | −1.25 | 21.6627 | 17.757 | 1.22 |
| Bsize#BOJ bill PAID | | | | | | | −3.5192 | 3.236 | −1.09 | 35.1997 | 30.897 | 1.14 |
| BDamage#BOJ_bill_PAID#Bsize | | | | | | | 20.8272 | 16.648 | 1.25 | −3.2934 | 13.587 | −0.24 |
| Fsize#BDamage#BOJ_bill_PAID | | | | | | | 30.9039 | 27.526 | 1.12 | −3.4173 | 2.083 | −1.64 |
| Fsize#BOJ_bill_PAID | | | | | | | −0.6753 | 10.988 | −0.06 | 0.5181 | 1.775 | 0.29 |
| Fsize#BDamage#BOJbillPAID#Bsize | | | | | | | −3.2326 | 2.148 | −1.5 | −0.0887 | 0.066 | −1.35 |
| CDamage #BOJ_bill_PAID | | | | | | | | | | −9.4082 | 23.239 | −0.4 |
| Fsize # CDamage # BOJ bill PAID | | | | | | | | | | 1.7766 | 4.072 | 0.44 |
| Sector Dummy | | yes | | | yes | | | yes | | | yes | |
| Ward Dummy | | yes | | | yes | | | yes | | | yes | |
| Observation | | 203 | | | 203 | | | 203 | | | 203 | |
| R-sq | | 0.327 | | | 0.3723 | | | 0.305 | | | 0.372 | |

Notes: (i) Standard errors clustered by Ward in parentheses, (ii) *** p<0.01, ** p<0.05, * p<0.10

**BOJ_bill=Bill/Asset**

**BOJ_bill_PAID=(Bill*(1−Unpaid))/Asset**

**Table 10: Firms with single bank**

| | Survival | | | Firm growth | | |
|---|---|---|---|---|---|---|
| | Coeff | Std err | t | Coeff | Std err | t |
| Age | −0.0291 | 0.0390 | −0.8 | −0.2650 | 0.0706 | −3.75 *** |
| Asset | 0.0201 | 0.0077 | 2.62 ** | −0.0293 | 0.0104 | −2.81 *** |
| FDamage | −0.2584 | 0.1452 | −1.8 | 0.4046 | 0.1892 | 2.14 * |
| CDamage | −2.6251 | 0.6563 | −4 *** | −3.4444 | 1.3796 | −2.5 ** |
| FSize | −0.6052 | 0.3536 | −1.7 | −3.3877 | 1.5732 | −2.15 * |
| FDamage#Fsize | 0.0469 | 0.0317 | 1.48 | −0.0851 | 0.0291 | −2.93 *** |
| CDamage#Fsize | 0.5098 | 0.1544 | 3.3 *** | 0.6557 | 0.2677 | 2.45 ** |
| Bsize | −0.3265 | 0.1571 | −2.1 * | 1.4050 | 1.1545 | 1.22 |
| BDamage | −4.7330 | 3.6914 | −1.3 | −12.3013 | 26.4716 | −0.46 |
| BSize#BDamage | 0.4733 | 0.2663 | 1.78 | −0.6832 | 2.0226 | −0.34 |
| BOJ_bill_PAID | 187.7757 | 50.8560 | 3.69 *** | −231.4822 | 563.25 | −0.41 |
| BDamage#BOJ_bill_PAID | −294.3454 | 64.4917 | −4.6 *** | 73.3553 | 1047.91 | 0.07 |
| Bsize#BOJ bill PAID | −11.3416 | 0.6133 | −18 *** | −25.6749 | 52.7450 | −0.49 |
| BDamage#BOJ_bill_PAID#Bsize | 16.5545 | 3.9029 | 4.24 *** | 60.9772 | 101.6009 | 0.6 |
| Fsize#BDamage#BOJ_bill_PAID | 17.1856 | 14.3061 | 1.2 | −97.2653 | 54.9616 | −1.77 |
| Fsize#BOJ_bill_PAID | −3.7725 | 10.4727 | −0.4 | 106.7340 | 27.4979 | 3.88 *** |
| Fsize#BDamage#BOJbillPAID#Bsiz | −0.6654 | 0.7563 | −0.9 | −5.3173 | 5.9663 | −0.89 |
| Fsize#BDamage | 0.2880 | 0.6029 | 0.48 | 6.8718 | 2.3505 | 2.92 *** |
| Fsize#BDamage#Bsize | 0.0031 | 0.0413 | 0.07 | −0.2362 | 0.1523 | −1.55 |
| CDamage #BOJ_bill_PAID | 29.8954 | 8.2819 | 3.61 *** | 10.8042 | 18.1039 | 0.6 |
| Fsize # CDamage # BOJ bill PAID | −5.6104 | 1.7716 | −3.2 *** | −0.8423 | 3.6133 | −0.23 |
| Sector Dummy | | yes | | | yes | |
| Ward Dummy | | yes | | | yes | |
| Observation | | 217 | | | 130 | |
| R-sq | | 0.3594 | | | 0.5254 | |

Notes: (i) Standard errors clustered by Ward in parentheses, (ii) *** p<0.01, ** p<0.05, * p<0.10
This estimation limits the sample of firms with single transaction bank.

**Table 11: Firms with (at least one) local banks**

| | Survival | | | | Firm growth | | | |
|---|---|---|---|---|---|---|---|---|
| | Coeff | Std err | t | | Coeff | Std err | t | |
| Age | 0.0340 | 0.0471 | 0.72 | | 0.0227 | 0.0447 | 0.51 | |
| Asset | 0.0215 | 0.0095 | 2.26 | * | −0.0223 | 0.0100 | −2.22 | * |
| FDamage | −0.2558 | 0.1556 | −1.64 | | 0.4704 | 0.0338 | 13.93 | *** |
| CDamage | −1.9935 | 0.3598 | −5.54 | *** | −1.2595 | 1.6045 | −0.78 | |
| FSize | −0.6012 | 0.4920 | −1.22 | | −3.5766 | 0.6276 | −5.7 | *** |
| FDamage#Fsize | 0.0515 | 0.0321 | 1.6 | | −0.1100 | 0.0174 | −6.33 | *** |
| CDamage#Fsize | 0.3899 | 0.1383 | 2.82 | *** | 0.2847 | 0.2893 | 0.98 | |
| Bsize | 0.2171 | 0.2600 | 0.84 | | 1.8917 | 0.9229 | 2.05 | * |
| BDamage | 1.0430 | 5.7969 | 0.18 | | 2.5408 | 17.4925 | 0.15 | |
| BSize#BDamage | −0.1712 | 0.8316 | −0.21 | | −2.4702 | 1.7569 | −1.41 | |
| BOJ_bill_PAID | 39.2616 | 14.479 | 2.71 | *** | 66.3991 | 141.43 | 0.47 | |
| BDamage#BOJ_bill_PAID | −72.5028 | 57.833 | −1.25 | | −283.322 | 274.20 | −1.03 | |
| Bsize#BOJ bill PAID | −5.3460 | 2.2329 | −2.39 | ** | −12.9974 | 7.3965 | −1.76 | |
| BDamage#BOJ_bill_PAID#Bsize | 6.2432 | 7.1681 | 0.87 | | 38.3078 | 21.3688 | 1.79 | |
| Fsize#BDamage#BOJ_bill_PAID | −0.8346 | 6.4906 | −0.13 | | 18.5913 | 29.6142 | 0.63 | |
| Fsize#BOJ_bill_PAID | 4.3040 | 2.3383 | 1.84 | | 15.2140 | 10.9995 | 1.38 | |
| Fsize#BDamage#BOJbillPAID#Bsize | 0.0227 | 0.8631 | 0.03 | | −4.1539 | 2.2004 | −1.89 | |
| Fsize#BDamage | 0.3496 | 0.5083 | 0.69 | | 4.3360 | 1.3478 | 3.22 | *** |
| Fsize#BDamage#Bsize | −0.0060 | 0.1004 | −0.06 | | 0.0161 | 0.1261 | 0.13 | |
| CDamage #BOJ_bill_PAID | 18.7627 | 9.5656 | 1.96 | * | −3.5357 | 27.9245 | −0.13 | |
| Fsize # CDamage # BOJ bill PAID | −3.3423 | 2.3176 | −1.44 | | 0.4995 | 4.6596 | 0.11 | |
| Sector Dummy | | yes | | | | yes | | |
| Ward Dummy | | yes | | | | yes | | |
| Observation | | 255 | | | | 159 | | |
| R-sq | | 0.323 | | | | 0.4713 | | |

Notes: (i) Standard errors clustered by Ward in parentheses, (ii) *** p<0.01, ** p<0.05, * p<0.10

Appendix Table A1: Standard and business tax rate

| Business category | Standard | Tax rate |
|---|---|---|
| Wholesale | Sales | 0.08–0.11 % |
| | Employee | 2.0 yen/person |
| Retail | Sales | 0.2–0.3 % |
| | Employee | 2.0 yen/person |
| Bank, insurance | Capital | 0.4 % |
| | Employee | 2.0 yen/person |
| Rental | Working capital | 0.4 % |
| | Employee | 2.0 yen/person |
| Manufacturing, printing | Capital | 0.4 % |
| | Employee | 2.0 yen/person |
| | Manual worker | 0.5 yen/person |
| Transportation | Capital | 0.4 % |
| | Employee | 2.0 yen/person |
| | Manual worker | 0.5 yen/person |
| Warehouse | Rental price | 5.7 % |
| | Employee | 2.0 yen/person |
| | Manual worker | 0.5 yen/person |
| Railways | Revenue | 1.4 % |
| | Employee | 2.0 yen/person |
| | Manual worker | 0.5 |
| Contracting business | Revenue | 0.3 % |
| | Employee | 2.0 yen/person |
| | Manual worker | 0.5 yen/person |
| Rental hall | Rental price | 7.9 % |
| | Employee | 2.0 yen/person |
| Restautant | Rental price | 8.0 % |
| | Employee | 2.0 yen/person |
| Inn | Rental price | 5.0 % |
| | Employee | 2.0 yen/person |
| Agent, brokage, trust | Fee | 2.1 % |
| | Employee | 2.0 yen/person |

Source: Fujisawa (1923), pp.178–180.

Appendix Table A2: Rank category of firm asset

| Asset size | Rank category |
|---|---|
| Larger than 3,000,000 yen | A |
| 2,500,000–3,000,000 | B |
| 2,000,000–2,500,000 | C |
| 1,500,000–2,000,000 | D |
| 1,000,000–1,500,000 | E |
| 750,000–1,000,000 | F |
| 500,000–750,000 | G |
| 400,000–500,000 | H |
| 300,000–400,000 | I |
| 250,000–3,00,000 | J |
| 20,000–300,000 | K |
| 150,000–200,000 | L |
| 100,000–150,000 | M |
| 75,000–100,000 | N |
| 50,000–75,000 | O |
| 35,000–50,000 | P |
| 20,000–35,000 | Q |
| 10,000–20,000 | R |
| 5,000–10,000 | S |
| 3,000–5,000 | T |
| 2,000–3,000 | U |
| 1,000–2,000 | V |
| 0–1,000 | W |

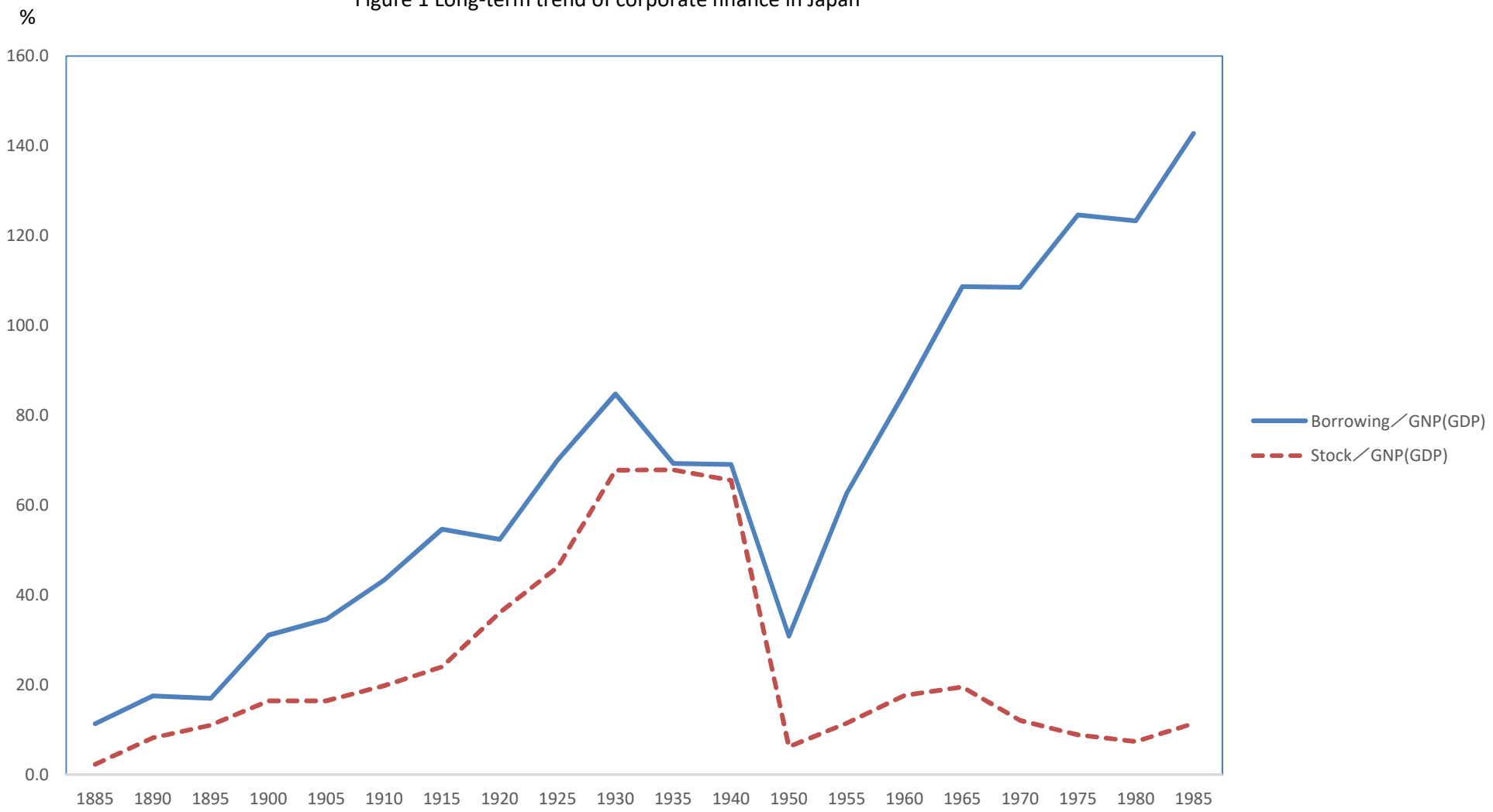
Source: Tokyo Koshinjo (1922, 1926)

Appendix Table A3: Number of new entrant

| year | entrant |
|---|---|
| 1917 | 98 |
| 1918 | 94 |
| 1919 | 73 |
| 1920 | 63 |
| 1921 | 56 |
| 1922 | 40 |
| 1923 | 77 |
| 1924 | 87 |
| 1925 | 48 |

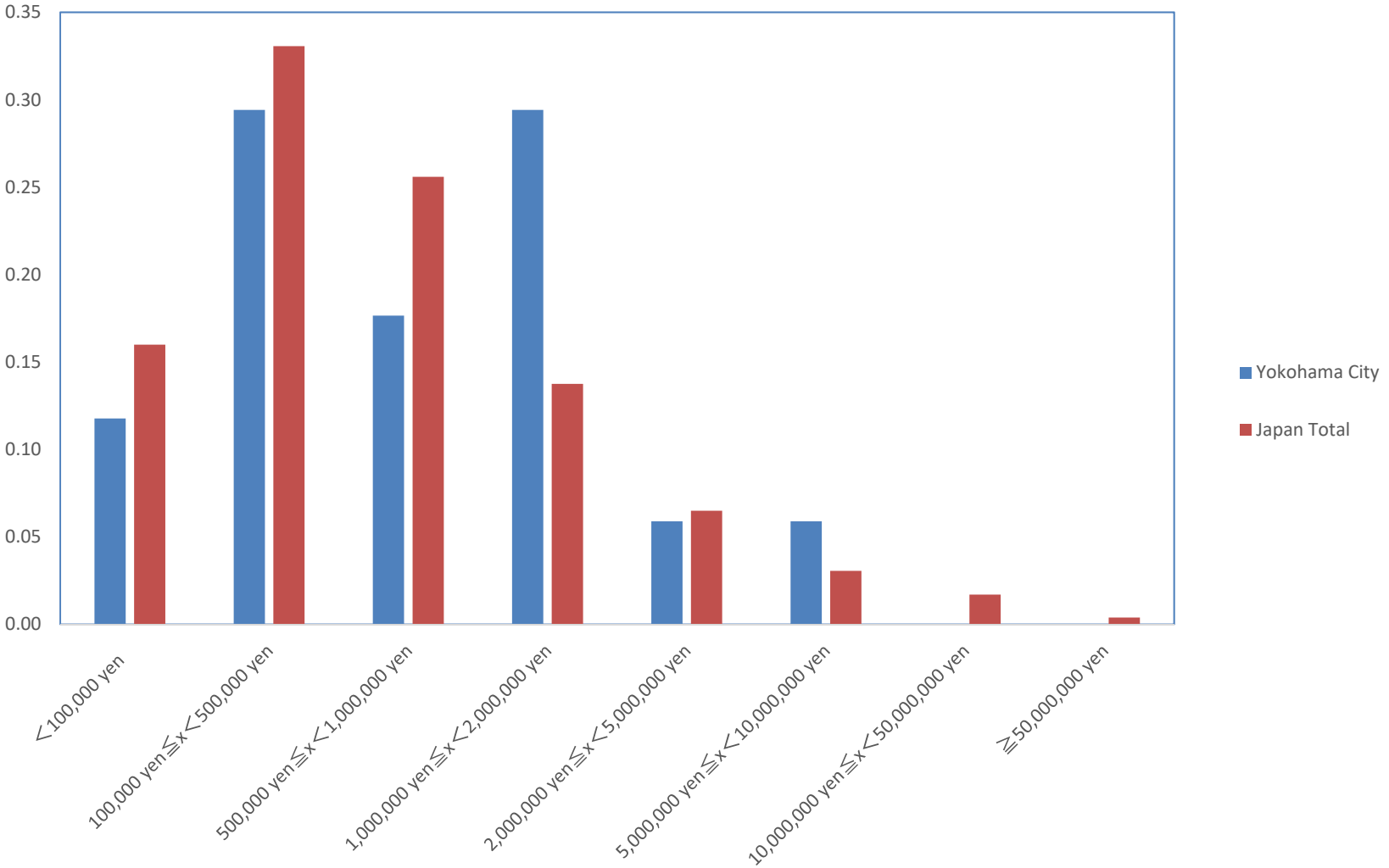
Source: Shoko Shinyo-roku (Records on Credit Statuses of Commercial and Industrial Firms)

Figure 1 Long-term trend of corporate finance in Japan



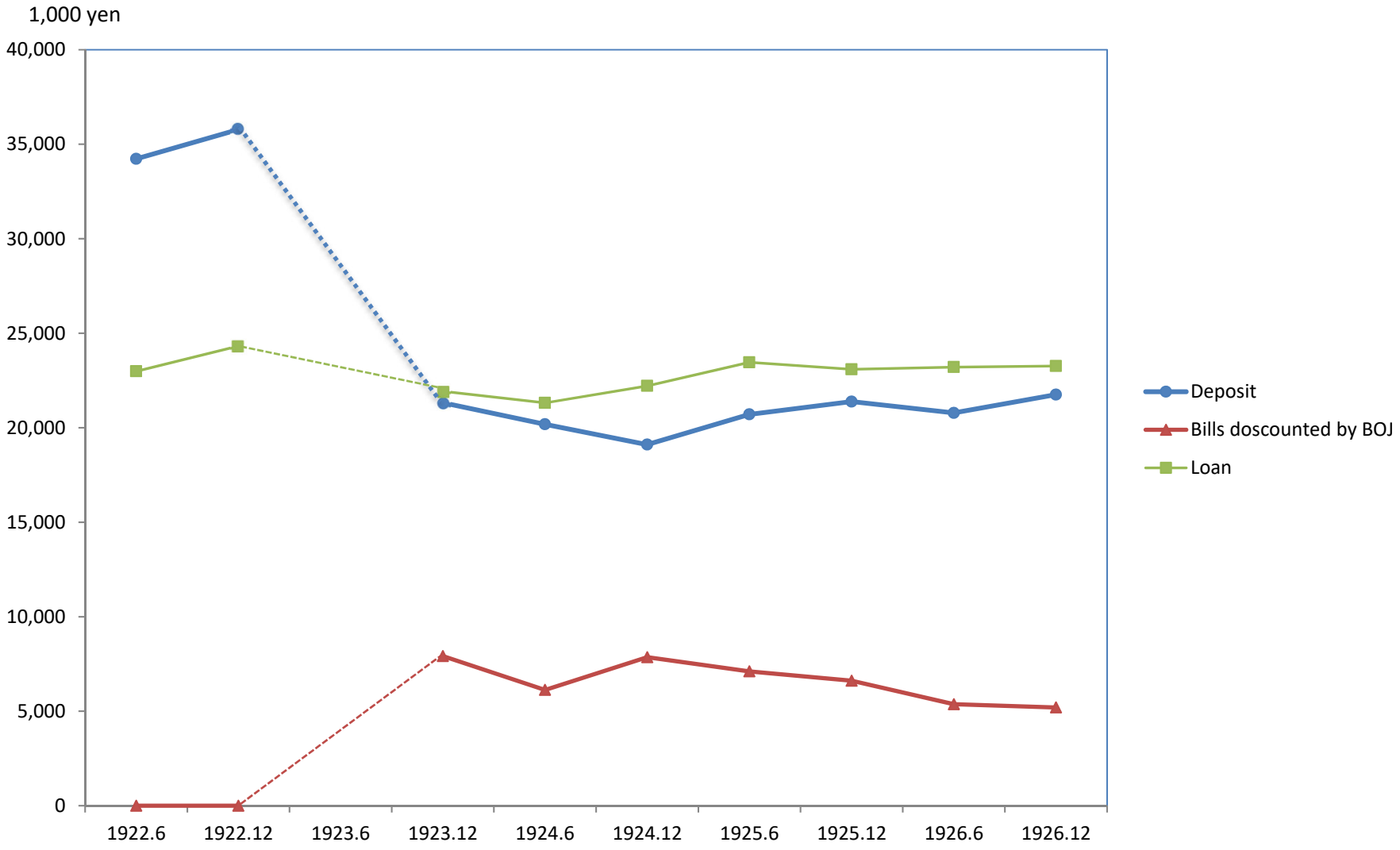

Source: Okazaki (2016).

Figure 2 Size distribution of ordinary banks in terms of capital in 1921




Source: Bank Bureau of Ministry of Finance ed., *Ginko Soran (Handbook of Banks)*, 1921 issue.

Figure 3 Balance sheet of Souda Bank



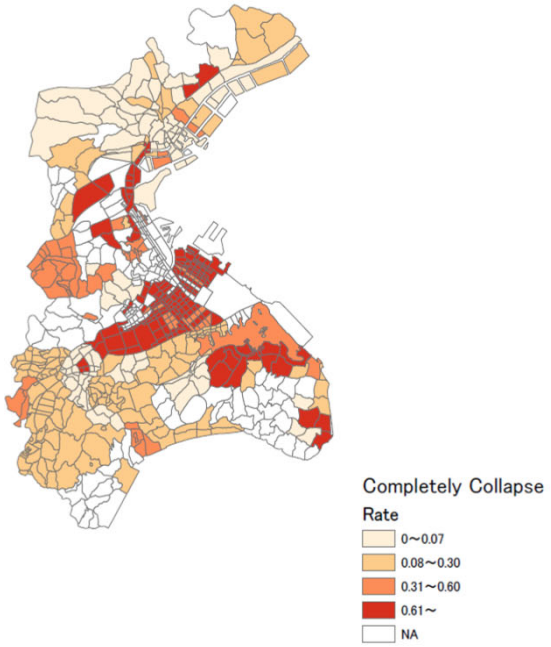

Source: Business Report of Souda Bank, various periods.

Figure 4: Relationship of bank size and firm size

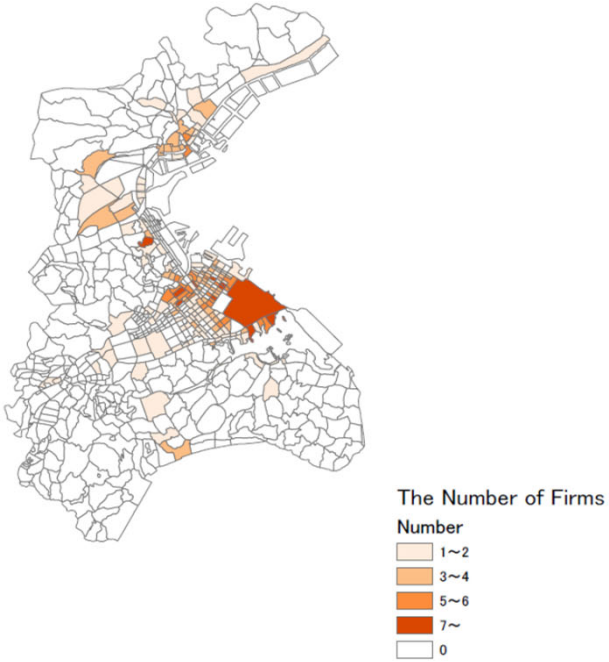

Bank size is measured by capital asset and firm size is measured by business tax (yen)
Both are taken log.
Source: our estimation data

Appendix Figures: Maps on old Yokohama city

Damage map




Number of firms(our sample)




Number of banks (headquaters and branch offices)