Wesleyan Economic Working Papers

http://repec.wesleyan.edu/
Nº: 2019-002

The Effects of Lender of Last Resort on Financial Intermediation during the Great Depression in Japan

Masami Imai, Tetsuji Okazaki & Michiru Sawada

November 2019

WESLEYAN
UNIVERSITY

Department of Economics
Public Affairs Center
238 Church Street
Middletown, CT 06459-007

Tel: (860) 685-2340
Fax: (860) 685-2301
http://www.wesleyan.edu/econ

November 21, 2019

The Effects of Lender of Last Resort on Financial Intermediation during the Great Depression in Japan[#]

Masami Imai (Wesleyan University)[*]
Tetsuji Okazaki (University of Tokyo)[**]
Michiru Sawada (Nihon University)[***]

Abstract

During the Great Depression, a series of abrupt bank panics unsettled the Japanese economy from 1931-1932. The Bank of Japan (BOJ) expanded its liquidity provision in response, and yet it restricted access to its liquidity facilities mostly to a select group of banks, with which it had long-term correspondent relationships, rather than making its loans widely available "to merchants, to minor bankers, to this man and to that man" as prescribed by Bagehot (1873). The BOJ's preferential treatment of correspondent banks along with the sudden occurrence of bank panics provides us with a quasi-experimental setting to examine the impact of Lender of Last Resort (LOLR) policies on financial intermediation in a difference-in-differences framework. We find that deposits and loans did not fall as fast for correspondent banks as for other banks during the bank panic phase of the Great Depression. Furthermore, correspondent banks were less likely to be closed. Japan's historical experience suggests that central banks' liquidity provision plays an important backstop role in supporting the essential financial intermediation services in time of financial stringency.

[#] Comments from participants at the 4th Central New York Economic History (Colgate University), the study group at the Canon Institute for Global Studies, the Japanese Economic Association Meeting, Keio University, and the Western Economics Association International Meeting are gratefully acknowledged. All errors are ours.
[*] Professor of Economics, Wesleyan University, 238 Church Street, Middletown, CT 06459-0007. Email: mimai@wesleyan.edu.
[**] Professor of Economics, University of Tokyo. Email: okazaki@e.u-tokyo.ac.jp.
[***] Professor of Economics, Nihon University. Email: sawada.michiru@nihon-u.ac.jp.

1. Introduction

Banks issue liquid liabilities (demand deposits) while holding illiquid assets (loans). This maturity mismatch is of little concern to banks (or bank regulators) as long as deposit withdrawals are not strongly correlated with one another and thus are predictable in aggregate. However, as shown in Diamond and Dybvig (1983), a self-fulfilling bank run can develop as a sunspot equilibrium if depositors fear that other depositors would run on their bank. In this scenario, even with strong fundamentals, banks will be forced to attempt to liquidate illiquid assets at deep discount in order to meet rapid deposit withdrawals. The recent global financial crisis that started in 2008 was a painful reminder that liquidity indeed can dry up quickly in a self-fulfilling fashion. However, this socially inefficient outcome can be avoided if a central bank is committed to supplying liquidity to illiquid banks as the Lender of Last Resort (LOLR).[1] Recent theories further clarify conditions under which the private provision of liquidity fails to prevent a run, thereby necessitating central bank lending (e.g., Flannery, 1996, Freixas, Parigi, and Rochet, 2000, Rochet and Vives, 2004, Acharya, Gromb, and Yorulmazer, 2012, Allen, Carletti, and Gale, 2009).[2]

How well does the LOLR work in practice when banks are threatened with runs? It is an elusive question to tackle because central banks do not lend to banks in a random fashion. More likely than not, its liquidity provision is utilized by weak banks (or weak banking systems) whose asset quality is questioned by investors. Even if we observe a rapid decline in bank loans or

[1] The notion that a central bank should act as the LOLR to accommodate a sharp increase in liquidity demand dates back to the 19th century with the seminal work of Thornton (1802) and Bagehot (1873). Both of them recognize that the central bank's liquidity provision, if credible, can ease depositors' concern about a potential run on their banks and eliminate their incentive to withdraw en masse. See Goodhart (1999), Grossman and Rockoff (2015), Humphrey (1989) for more comprehensive review of the intellectual history of the LOLR.

[2] In a related theoretical literature, Cordella and Yeyati (2003), Repullo (2005), Martin (2006), and Matsuoka and Watanabe (2019) model moral hazard implications of the public provision of liquidity.

deposits in spite of aggressive central bank lending, we cannot infer credibly about the effectiveness of central bank lending, since we do not have a relevant counter-factual of how sharply bank lending would have fallen in the absence of aggressive central bank lending. That is, the efficacy of the LOLR cannot be evaluated based only on the presence of (or the lack thereof) statistical correlation between financial intermediation activities and a central bank's liquidity support.

In the present paper, we examine whether LOLR policies mitigate financial contraction during bank panics using our institutional knowledge of how the Bank of Japan (BOJ) executed its lending policy during the Great Depression. The BOJ frequently injected a large amount of liquidity to stabilize Japan's financial system in the interwar period.[3] In addition to the usual discounting of bills, the BOJ offered two categories of so-called "special loans (or *tokubetsu yuzu*, in Japanese)". The first category of special loans was given to banks according to the three specific laws, i.e. the Loss Compensation due to Earthquake Bill Discount Act (1923), the Bank of Japan Special Loan and Loss Compensation Law (1927), and Loan to the Taiwan Bank Law (1927).[4] The second category was emergency loans provided at the discretion of the BOJ. These special loans gave the BOJ the ability to circumvent the stringent due process and conditions that it would normally have to meet when discounting bills. Various channels were used for special loans,

[3] Even prior to the interwar period, the BOJ shows its willingness to smooth out financial market fluctuations. For example, When Japan's stock market collapsed in 1890 due to bad rice harvest, the BOJ promptly injected liquidity into the banking system in order to prevent a large-scale financial panic (Tamaki, 1995, Shizume, 2018). Interestingly, Fukuda and Shao (1992) show that the BOJ supplied reserves in a manner to smooth seasonal fluctuation in interest rates as far back as in 1885, as done by the Federal Reserve after 1913 (Miron, 1983).

[4] The Loss Compensation due to Earthquake Bill Discount Act (1923), the Bank of Japan Special Loan and Loss Compensation Law (1927), and Loan to the Taiwan Bank Law (1927) prescribed that the government should compensate the loss of the BOJ up to one hundred million yen, five hundred million yen and two hundred million yen, respectively (Bank of Japan 1983, p.87, 249, and 253).

including loans on deeds, fixed term loans and suspense payments, and relaxing the constraint for the acceptable collaterals (Ito 2003, pp.171-172; Okazaki 2007, p.662). In principle, special loans could be provided to any bank; however, it has been widely documented that most were given to banks that had long-standing transaction relationships with the BOJ. According to the Bank of Japan Special Loan and Loss Compensation Law (1927), 95% of these loans were provided to these BOJ "correspondent banks" (Ishii 1980, pp.163-166; Okazaki 2007, p.663). Hence, the pre-existing transaction relationship with the BOJ gave these banks substantially better access to the BOJ's liquidity facilities.

The BOJ's lending policy offers a quasi-experimental setting which we exploit to examine the differential impact of banking panics on financial intermediation activities at the bank-level. To be more specific, we use a difference-in-differences strategy to explore whether loans and deposits of the BOJ correspondent banks (treated group) did not fall as fast as those of other banks (control group) when the Japanese economy began to suffer from a series of bank panics in 1931-32.[5] Three complementary mechanisms might be in play to generate differential effects of banking panics on these two types of banks. First, if depositors were aware of this special arrangement between the BOJ and correspondent banks, then these privileged banks must have been less likely to suffer from large-scale deposit withdrawals during the panic period. As a result,

[5] It is also important to note that the government enacted the 1928 Bank Law after the 1927 Banking Crisis. The new law dramatically tightened prudential regulation and transformed Japan's banking system. Before 1928, Japan's banking system was populated by a large number of small, undiversified banks, who did not manage risk properly. The 1928 law converted all ordinary banks to joint-stock companies and dramatically raised capital requirements, thereby encouraging consolidation to improve portfolio diversification and managerial quality. Moreover, the new law formally prohibited insider or related lending, which turned out to have been rather pernicious at the time (Okazaki and Sawada, 2007). As a result of this newly implemented stringent regulation, banks became much more homogeneous as compared to the pre-1928 period, which provide us with a more suitable setting to implement a difference-in-differences strategy.

these banks must have shown more robust loan growth than other banks. Second, even if both groups of banks experienced large deposit withdrawals, correspondent banks must have been able to borrow vital funds from the BOJ more readily, which, in turn, must have helped them continue lending. Third, loans are the most illiquid assets in bank balance sheets, whose value could plummet during banking panics. When the level of uncertainty surged in 1931, correspondent banks, which could access the BOJ's liquidity facilities more reliably than other banks, might have been less concerned about the illiquidity of their assets and more willing to continue lending. In sum, we expect the deposit growth and loan growth of the BOJ correspondent banks to be faster during the bank panic period, as compared to other banks. Moreover, we expect these banks to be better able to withstand runs and thus to exhibit lower failure rates.

To briefly preview our main results, we find that loans and deposits of banks with privileged access to the BOJ loans (i.e., the BOJ correspondent banks) did not contract as fast as other banks in 1931-1932 when Japan's banking system experienced a series of banking panics. The estimated magnitudes are non-trivial: the growth rate of both loans and deposits of the BOJ correspondent banks was approximately 6% faster than that of other banks. The results suggest that the BOJ's commitment to suppling liquidity to correspondent banks is likely to have stabilized deposit flows into these banks and supported their lending during the panic period. Additionally, we find that correspondent banks were less likely to be closed. Hence, the access to the BOJ's liquidity provisions seems to have mitigated the risk of bank runs and bank failures.

Since we focus on the pre-existing, stable correspondent relationship of banks with the BOJ, our main results are not driven by endogenous, positive, selection of strong banks by the

BOJ in the midst of bank panics. However, a concern about omitted variable bias needs to be addressed. In particular, one might be concerned that banks that had transaction relationships with the BOJ performed more robustly during the panic period, not necessarily because they were better able to draw liquidity from the BOJ, but because they might have been financially stronger or less exposed or vulnerable to macroeconomic shocks. We examine this alternative interpretation in three different ways. First, we note that, as is the case with other countries at the time, Japan endured severe economic downturns in 1930, well before it suffered from a series of bank panics in 1931. If our results are driven by unobserved heterogeneity in banks' ability to withstand negative economic shocks, then we expect the BOJ correspondent banks to have performed better than other banks even before 1931 when macroeconomic conditions deteriorated rather rapidly. Nonetheless, the data show no such pre-trend. That is, correspondent banks were not performing any differently than other banks before 1931. The growth rate of loans and deposits diverged between two groups of banks only when the Japanese economy were unsettled by a series of bank runs in 1931-1932.

Second, we probe whether the overall financial health of banks is positively associated with correspondent relationships with the BOJ in order to test an alternative interpretation that the BOJ correspondent banks performed better perhaps because they were financially sounder. We find that correspondent banks did not necessarily exhibit stronger financial health than other banks; i.e., while correspondent banks were more liquid, they were less profitable and, more importantly, possessed smaller capital buffers. Moreover, in the spirit of Altonji, Elder, and Taber (2005) and also, more recently, Oster (2017), we explicitly control for proxies for bank health, bank size, and a variety of socio-economic characteristics of banks' localities in a series of

robustness checks in order to assess the seriousness of omitted variable bias. We find that the coefficient on transaction relationships with the BOJ is highly robust even when we control for these observable factors.

Third, we make use of the geographical information of each bank in two different ways to derive our estimates from more plausibly exogenous variation across banks. One, we restrict our sample to banks located in the capital city of each prefecture. That is, we remove rural banks as one might suspect that rural banks were much more heterogeneous and exposed to larger idiosyncratic shocks. Our central results are robust to this sub-sample test. Two, Ishii (1980) uncovers, through extensive archival works, that the BOJ was motivated to minimize the transaction cost associated with cash delivery and information collection when deciding whether or not to approve transaction relationship with banks. Building on Ishii (1980)'s historical works, we construct an instrumental variable based on each bank's distance to the nearest BOJ branch or the headquarter. Although the effects of the BOJ correspondent relationship on loan and deposit growth in this instrumental variable specification are less precisely estimated than those of the ordinary least squares, they are qualitatively similar. Taken as a whole, although these robustness checks cannot completely rule out the presence of some omitted variable bias, one would be hard-pressed to conclude that the entirety of our main findings is driven by it.

Following the 2008 global financial crisis, central banks around the world took extraordinary measures to set up emergency liquidity facilities and inject a large sum of liquidity into troubled financial systems. Our paper is related to recent papers which use the disaggregated bank-level data to assess the impact of these emergency liquidity facilities on bank

lending in the United States and Europe.[6] Our paper is also related to a strand of papers which exploits a variety of historical experiences with LOLR policies over time and across geographical boundaries in order to capture meaningful variation in central banks' liquidity provision.[7] Miron (1983) finds that the establishment of the Federal Reserve made the US financial system more resilient to seasonal fluctuations in liquidity demand.[8] Grossman (1994) compiles the data on banking crises across the industrialized countries during the Great Depression and shows that macroeconomic policies and banking structure are more powerful predictors of banking crises than central bank lending. More recently, it has been documented that the Federal Reserve Bank of Atlanta (Atlanta Fed), unlike other Federal Reserve banks, was more decisive in providing much needed liquidity to thwart bank panics in the interwar period (Carlson, Mitchener, and Richardson, 2011, White, 2015).[9] In a seminal work, Richardson and Troost (2009) show that the

[6] For example, Berger, Black, Bouwman, and Dlugosz (2017) use the novel data that identify each individual bank that utilized the Federal Reserve's discount window and Term Auction Facility. They show that these facilities positively affected bank lending in the US and that the results are robust to the inclusion of a variety of control variables which capture bank heterogeneity. Similarly, Andrade, Cahn, Fraisse, and Mesonnier (2019) use the data on banks' uptakes of the Eurosystem's Longer-Term Refinancing Operations (LTROs) and show that the LTROs, too, had the positive effect on bank lending as intended.

[7] The historical progression of LOLR policies around the world is neither smooth nor uniform. Calomiris, Flandreau, and Laeven (2016) underscore the role that politics played in the historical evolution of institutional structures that governs the LOLR in the pre-WWII period. The Bank of England (BOE), which is regarded as the pioneering central bank that made a strong commitment to act as the LOLR, was initially founded to "aid the fiscally embarrassed crown" and "to furnish fiscal assistance to the British Treasury" (Lovell, 1957). According to Hawtrey (1932), it took the BOE almost 100 years to firmly establish itself as the LOLR and actively control liquidity in the British banking system. In the case of the United States, the political consensus on the establishment of a central bank was not consolidated until 1913, which was 77 years after Andrew Jackson decided not to renew the charter of the Second Bank of the United States in 1836. Even then, the Federal Reserve did not live up to its expectation as a stabilizing force for the US financial system during the Great Depression (Friedman and Anna Schwartz, 1963, Bernanke, 1983, Bordo and Wheelock, 2013).

[8] Bernstein, Hughson, and Weidenmier (2010) corroborate Miron's findings and show that the Federal Reserve reduced the volatility in both interest rates and stock returns. Interestingly, Jalil (2015) shows that some of Miron's results turn out to be sensitive to the alternative definition of financial panics.

[9] For example, when the Atlanta Fed saw the price of cotton, the major crop in the Atlanta Fed district, rapidly fall after World War I, it borrowed a large quantity of reserves from the other Federal Reserve banks and aggressively discounted bills to assist its member banks.

bank failure rate in the Atlanta Fed District were significantly lower than those in the nearby districts during the Great Depression.[10]

We also aim to better understand Japan's experience with the Great Depression and the financial contraction that followed. The Great Depression started in Japan with the official announcement by the Minister of Finance, on November 21, 1929, that Japan would return to the gold standard at the pre-WWI parity.[11] As the world economy collapsed in the ensuing years, the demand for Japan's exports declined, rapidly.[12] In particular, Japan's silk reeling industry, which was the major export industry of Japan and depended heavily on the United States market, suffered greatly from the global economic downturn. Consistent with the gold standard view of the Great Depression (Temin,1989, Eichengreen, 1992), Japan's output declined sharply along with those of the other countries whose currencies were tied to gold, and yet it began to turn

[10] See also Ziebarth (2013) and Jalil (2014) who follow Richardson and Troost (2009) and exploit the distinct LOLR policy of the Atlanta Fed to identify the economic effects of the LOLR. Three additional papers that motivate our papers are: Vossmeyer (2016), Anderson, Calomiris, Jaremski, and Richardson (2018) and Carlin and Mann (2017). Vossmeyer (2016) develops a treatment model that explicitly takes into account endogenous selections of banks that receive loans from a central bank and applies this model to the bank-level data from the Great Depression to estimate the effects of the LOLR on bank performance. Anderson, Calomiris, Jaremski, and Richardson (2018) compile the detailed bank-level data on Federal Reserve membership and access to the Federal Reserve's discount windows. They use these data to show that the Federal Reserve helped ease its member banks' financing constraints. Carlin and Mann (2017), too, exploit the fact that most state banks chose not to join the Federal Reserve in order to measure the variation in local economy's exposure to fluctuations in the Federal Reserve's discount rate change. They find that dramatic changes in the discount rate in the post-World War I period had large effects on local credit supply and agricultural outputs, especially in the areas where the Fed member banks dominated the local banking system.

[11] It is important to keep in mind that Japan's macroeconomic condition was rather weak even before the official restoration of gold convertibility. *Rikken Minseito* (Constitutional Party), one of the two major political parties, had long supported the restoration of the gold standard at the prewar parity while *Rikken Seiyukai* (Friends of Constitutional Government Party), the other of the two major political parties, opposed it. When the administration shifted from the *Rikken Seiyukai* to the *Rikken Minseito* in July 1929, the government began to cut the budget and the BOJ kept the interest rate high in order to prepare for the return to the gold standard (Patrick, 1972; Bank of Japan 1983, pp.382-383; Metzler, 2006; Grossman and Imai, 2009, Shizume, 2012).

[12] From 1928 to 1931, the raw silk price declined 55%, while the wholesale price index declined 32% (Bank of Japan (1964), p.64, p.88).

the corner soon after the announcement that Japan would go off gold in December 1931 (Cha, 2003, Shibamoto and Shizume, 2014, Nanto and Takagi, 1985). The Great Depression ended up being relatively brief in Japan compared to the other countries that continued to adhere to the gold standard past 1931.

While Japan's economy turned the corner, its banking system began experiencing a series of bank panics in 1931-1932. Rural banks suffered from deposit outflows as the profitability of their loan portfolio deteriorated. In particular, those in Tohoku area suffered from runs when a severe famine aggravated local economies in the fall of 1931.[13] Shortly thereafter, bank runs in Tohoku spread to the southern part of Japan. A major bank panic struck the city of Nagoya in Aichi prefecture in December 1931, leading to a wave of bank failures in the region until March 1932 (Bank of Japan, 1969).[14] Furthermore, when the world price of raw silk plummeted, banks whose borrowers operated in the silk reeling industry had financial difficulties (Adachi, 2004; Ito, 1975). In the end, 112 ordinary banks (over 12% of ordinary banks) failed from 1931-1932 (Akiyoshi, 2009).

Despite its large scale, this bank panic episode has yet to be extensively examined in the literature.[15] The narrative data on the Depression-era panics that Grossman (1994) puts together for the industrialized countries exclude Japan. More recently, Grossman (2010) updates the

[13] Tohoku is located in the northern part of Japan.

[14]The Aichi Nosho and its affiliates, Nosho Saving banks, closed down in December 1931, which led to a loss of depositor confidence and triggered runs on other banks in Aichi. Furthermore, financial conditions in Aichi worsened in the early 1932 due to the closures of two large banks, Murase Bank and Meiji Bank. The closures of two major local banks fomented anxiety of depositors and triggered contagious runs on other banks in Aichi and neighboring prefectures such as Mie and Sizuoka. The Nagoya branch of the BOJ extended special loans to correspondent banks and in some cases even to non-correspondent banks as an extraordinary measure. The bank panic lasted until the end of March 1932.

[15] There are several papers that examine the microeconomic aspect of banking instability during the 1927 financial crisis in Japan (e.g., Okazaki et al., 2005; ; Yabushita and Inoue, 1993).

narrative data to include Japan. Reinhart and Rogoff (2008) amass the data on banking crises that cover a larger cross-section of countries over a longer time span. Nonetheless, this particular bank panic episode does not appear in either of these two datasets. Moreover, Kamekichi Takahashi, an influential economist at the time, wrote mistakenly, "Japan remained immune to the financial crisis of the 1930s, enjoying the benefits of the policy changes and the depreciation of the yen."[16]

In reflection of this, there are only a limited number of papers that examine the disaggregated bank-level data and perform systematic econometric work to better understand this historical bank panic episode. Adachi (2006a) and Akiyoshi (2009) quantify the extent to which bank health explains the probability of bank closure. Akiyoshi (2006a) use similar econometric frameworks to examine the determinants of deposit growth at bank level.[17] These papers, however, are silent on whether the BOJ's liquidity provision mitigated the negative effects of bank panics on financial intermediation activities in Japan. In a paper closely related to this present paper, Sawada (2010) investigates how banks responded to liquidity shocks during the period of 1928-32 but he does not examine whether correspondent banks performed differently from other banks during bank panic period. Various contemporary accounts indicate that the BOJ took some extraordinary measures to arrest bank panics and that these measures

[16] See Shizume (2004) for the entire translated quote. Kamekichi Takahashi was the ex-editor of *Toyo Keizai Shinpo* (the Oriental Economist) and is widely regarded as one of a few prominent contemporary economists who strenuously advocated that Japan ought to return to the gold standard at the ongoing and thus lower rate as opposed to the pre-WWI rate to avoid deflation (Hamada and Noguchi, 2005, Wakatabe, 2015).

[17] In a related paper, Akiyoshi (2006b) examines the effect of bank runs on output growth during the Great Depression based on prefectural level data. It confirmed that bank runs had a negative effect on loan growth although loan growth had only limited effects on output growth.

appear to be effective.[18] However, narrative evidence is not substitute for systematic econometric evidence. We seek to fill this important gap in the literature.

The rest of the paper is organized as follows. Section 2 describes our difference-in-differences methodologies to identify the effect of the LOLR on loan and deposit growth. Section 3 displays and interprets the results. Section 4 estimates probability models and econometrically examines whether correspondent relationship with the BOJ reduced bank closure rate. Section 5 concludes.

2. Empirical Methodology (Loan and Deposit Growth)

To examine the impact of the BOJ's LOLR policy on financial intermediation activities, we use a difference-in-differences estimation strategy based on the disaggregated bank-level data from 1928-1932. Our basic econometric specification is:

$$\Delta Y_{it} = \beta_i + \beta_t + \gamma(BOJ_i)(Crisis_t) + \varepsilon_{it}$$

where subscript *i* and *t* denote bank and year, respectively, ΔY_{it} is loan growth or deposit growth, β_i and β_t denote bank-fixed effects and year-fixed effects, respectively, BOJ_i is a dummy variable for the BOJ correspondence banks (as of 1928)[19], and $Crisis_t$ is a dummy variable for the banking

[18] See Appendix 1 for an example of contemporary newspaper articles that reported on the BOJ's lending policy as well as its efficacy.

[19] We excluded banks that ended correspondent relationship with the BOJ or started it during the sample periods our samples to make a dummy variable for correspondent relationship with the BOJ time-invariant. See page 15.

crisis period, equaling 1 in 1931-1932 (and zero, otherwise). Standard errors are clustered by bank to adjust for serially correlated disturbances (Bertrand, Duflo, and Mullainathan, 2004).

The key independent variable is the interaction of BOJ_i with $Crisis_t$, which captures the differential impact of bank panics on loan and deposit growth. The coefficient on this interaction term should be positive and statistically significant if the BOJ's liquidity provision helped correspondent banks with credit creation. The year-fixed effects, θ_t, capture economy-wide shocks. The bank-fixed effects, θ_i, are included to control for unobservable bank specific factors that are relevant to loan growth or deposit growth. The crucial identifying assumption in difference-in-differences framework is the parallel trend assumption. In our case, our estimates will be biased if idiosyncratic shocks in the panic period, conditional on year-specific and bank-specific effects, are somehow linked to pre-existing transaction relationship with the BOJ.

We draw the bank-level data on loans and deposits from *Ginkokyoku Nenpo* (*Yearbook of the Bank Bureau*), which reports the balance sheet data on the universe of ordinary banks in Japan, annually. We merge these data with the data from Sawada (2010) on the identity of the BOJ correspondent banks. The data on the BOJ correspondent banks are originally taken from *Nihon Ginko Enkakushi* (*the History of the Bank of Japan*). Appendix gives summary statistics (Table A1).

Ginko-kyoku Nenpo has the total of 3,893 bank-year observations during the sample period (1928-32).[20] We make four adjustments to the data for econometric analyses. First, we select the banks which existed through the end of 1931; as a result, 683 bank-year observations

[20] Our sample does not include the banks in colonies of Japan (Taiwan and Karafuto) at that time.

are dropped from our samples.[21] The primary motivation for dropping these banks is the 1928 Bank Law. Under the new law, banks faced much more stringent prudential regulation. In particular, the 1928 Bank Law converted all ordinary banks to joint-stock companies and dramatically raised capital requirement. As a result, a large number of small, undiversified banks were forced to exit, mostly through consolidations but some in voluntary liquidations during 1928-32.[22] Moreover, the new law imposed a regulation on side jobs of bank directors and managers, which is documented to have led to pernicious insider lending practice (Okazaki and Sawada, 2007). Hence, dropping these small banks produces much more homogeneous sample to be analyzed. Moreover, during the panic period, some banks failed and are thus dropped from the sample for this section. As we show later in section 4, we put these banks back into our sample to estimate the impact of correspondent relationship with the BOJ on bank failure rates during the panic period. We find that failed banks were, on average, weaker than surviving banks and less likely to have correspondent relationship with the BOJ. Hence, we believe that our estimates of the impact of correspondent relationship with the BOJ on loans and deposits are likely to be conservative.

Second, the consolidations that occurred during this period show up as large discrete increases in the balance sheets for acquiring (surviving) banks in the data. Out of concern that

[21] At the end of 1928, the number of banks was reported to be 1,025 and it decreased to 534 at the end of 1932, according to *Ginkokyoku- Nenpo*. According to Goto (1968), there were 539 bank exits during the sample period and 305 of them was through consolidations and 234 was through other type of exits (failures or dissolutions or other voluntary liquidations). We also verify that a majority of these exits occurred before bank panics.

[22] Consolidations are classified into three categories according to *Ginko Jiko Geppo*: (Monthly Bank Affairs) absorption, acquisition, and combination into a new bank. Combination into a new bank is a form of consolidation under which a new bank is established after the dissolution of all participants. When the name of the newly established banks was different from those of the participating banks, we identify it as a new bank.

the acquisition of banks and the ensuing sudden increase in bank balance sheet might not be entirely orthogonal to transaction relationship with the BOJ, we drop bank-year observations that correspond with banking consolidations. By removing these banks, 307 bank-year observations are dropped from the samples.[23] Third, in the original data from *Ginkokyoku Nenpo*, we note that there are some observations in which loan growth, deposit growth and asset growth were recorded to be unrealistically large or small (e.g., two-fold increase in loans in one year in the middle of the Great Depression). We deem these observations to be unreliable and drop them from our sample as well.[24] It requires us to remove 81 bank-year observations. Fourth, banks that ended correspondent relationship with the BOJ or started it during the sample periods are removed from our samples to make a dummy variable for correspondent relationship with the BOJ time-invariant. By removing these banks, we aim to ensure that our results are not driven by the possible cherry-picking of healthy banks (or the abandoning of unhealthy banks) by the BOJ during the Great Depression. 81 bank-year observations (21 BOJ correspondent banks) are dropped due to this adjustment.[25] Our final data consist of 2,741 bank-year observations. [26]

3. **Empirical Results**

[23] We identify banks which were involved in consolidations based on *Ginko Jiko Geppo* (Monthly Bank Affairs) by the Bank of Japan.
[24] To be more specific, we drop those banks whose loan or deposit growth or asset growth is more than 1 or less than -1.
[25] There are 149 BOJ correspondent banks (604 bank-year observations) are left in the sample.
[26] Our samples include 15 banks (33 observations) which were newly established during 1929-1931. These banks were founded through consolidations of existing banks, and their names were different from those of the banks that participated in the consolidations. Even if we exclude those banks, it is confirmed that our estimated results are hardly changed.

The basic results are displayed in Columns 1 and 2 of Table 1. As expected, coefficients on the interaction of *BOJ* with *Crisis* are positive and statistically significant for both loan growth and deposit growth. The results suggest that access to the BOJ's liquidity facilities moderated the adverse effects of bank panics on financial intermediation activities. The magnitude of the estimated impact is economically important as well. If typical banks had had better access to the BOJ loans (as the BOJ correspondent banks did) during the panic period, then their loans and deposits would likely have grown by an additional 6%.

The crucial identifying assumption in difference-in-differences is so-called the "parallel trend assumption." In our case, differences in loan and deposit growth between the BOJ correspondent banks and other banks would have remained the same during the panic period if every bank had had equal access to the BOJ's liquidity provision. This assumption can be violated if correspondent banks were, on average, more resilient in adverse economic environment. To examine this possibility, we check whether correspondent relationship with the BOJ is somehow positively associated with deposit growth and loan growth *before the crisis* when there was no known incident of serious liquidity shortage in Japan's banking system. Recall that the Japanese economy plunged into severe downturns when the government restored the convertibility of the yen to gold in January 1930, immediately after the NY stock exchange crashed in October 1929. Hence, if correspondent banks were less vulnerable to macroeconomic shocks, then we would expect them to have performed more robustly than other banks *even before 1931*. To explore whether there is such pre-crisis trend, we add the interaction of a dummy variable for correspondent banks with a dummy variable for the pre-crisis period as follows:

$$\Delta Y_{it} = \beta_i + \beta_t + \gamma(BOJ_i)(Crisis_t) + \theta(BOJ_i)(PreCrisis_t) + \varepsilon_{it}$$

where *PreCrisis*$_t$ equals 1 for 1930. The parameter θ captures the pre-crisis effect of correspondent relationship with the BOJ on deposit growth and loan growth. Our identification assumption will be less credible if $\theta > 0$ (and $\gamma = 0$), because such results mean that trend in loan and deposit growth started to diverge for two groups of banks even before the panic period.

Columns 3 and 4 display the results of this pre-trend test. Note that coefficients on the interaction of a dummy variable for correspondent banks with a dummy variable for 1930 are small and statistically insignificant for both loan and deposit growth. That is, the growth rate of deposits and loans of correspondent banks remained similar to that of other banks in 1930 when the recession became increasingly more severe. In addition, Columns 5-6 add the interaction of correspondent relationship with a dummy for 1929 in order to further check whether there is any suspicious pre-trend in 1929. We detect no such pre-trend, either. In sum, these tests suggest that negative macroeconomic shocks seem to have affected both groups of banks in a similar fashion. Deposit growth and loan growth of correspondent banks, which enjoyed better access to the BOJ's financial backstop, began to follow different (higher) path only during the bank panic phase of the Great Depression.[27]

While the BOJ correspondent banks do not seem to have performed any differently from other banks when economic conditions deteriorated before 1931, the absence of such pre-trend does not rule out an alternative interpretation: the BOJ correspondent banks fared better from

[27] In addition, in order to check whether our results are not driven by the choice of control periods, we estimate the same regressions removing the samples for 1928 when the economy was booming. We also remove the samples for 1928 and 1929. We find that the results are hardly changed in both cases.

1931-1932, not necessarily because they had access to the BOJ loans, but because they were, on average, stronger financially and thus better able to withstand sudden financial contraction. That is, one might be concerned that the BOJ might have pre-selected a group of financially stronger banks that would have continued to maintain depositors' confidence with or without privileged access to the BOJ's liquidity facilities.[28] In order to examine the plausibility of this alternative interpretation, we inspect whether the BOJ correspondent banks exhibit better financial health than other banks. We calculate return on assets, capital-to-asset ratio, and cash-to-asset ratio to proxy for profitability, the size of capital buffer, and liquidity, respectively.[29] We use these accounting ratios as dependent variables in the following year-by-year cross-section regression to detect any significant differences between the BOJ correspondent banks and other banks in financial health:

$$Bank\ Health_i = \beta_0 + \beta_1 BOJ_i + \varepsilon_i$$

The results of these regressions are displayed in Table 2. As shown in Panel A, the BOJ correspondent banks, on average, were more liquid than other banks. Hence, additional cash holdings might have been useful for correspondent banks in time of liquidity shortage. However, cash-to-asset ratio of the BOJ correspondent banks is merely one percentage point larger than

[28] Of course, selection bias can affect the results in the opposite way if the BOJ loans (or the anticipation of thereof) led to moral hazard problem and weaker fundamentals for BOJ correspondent banks.

[29] Asset is defined as the sum of loans, security holding, cash and due from banks. Capital is defined as the sum of paid-in capital, reserved fund, second-half profits. The profit data on individual banks used to measure ROA are censored at zero by our source (*Ginkokyoku Nenpo*). That is, financial losses (negative profits) are not reported in this source. Hence in the following analyses, the values of ROA in those banks are treated as zero. The data on reserved funds are also censored at zero in *Ginkokyoku Nenpo*. We remove banks whose values of reserved funds are censored from our samples when capital -to-asset ratio is included as an explanatory variable.

other banks. Hence, differences in liquidity might not have been the decisive factor. Moreover, as shown in Panels B and C, the BOJ correspondent banks were less profitable and had smaller capital buffers both before and during the panic period. Hence, when taken as a whole, it is safe to say that correspondent banks did not necessarily have stronger financial health than other banks.

One might be concerned that these financial ratios capture the true financial health of banks rather imperfectly and, more critically, that the BOJ correspondent banks might have possessed some unobservable characteristics which contributed to more robust loan and deposit growth during the panic period. For example, the BOJ might have had proclivity to select banks with better reputation as correspondent banks. If depositors shifted their funds to these well-established banks when they faced more uncertainty about the safety of their deposits, then our results might capture the effects of reputation to some extent. That is to say, since we cannot control for reputation, our estimates might be contaminated by omitted variable bias if reputation is tightly linked with correspondent relationship with the BOJ. While it is difficult to measure with precision the size of omitted variable bias, we can make informed conjecture about its seriousness, based on how sensitively our estimates change when we control for observable and relevant factors that are likely to be strongly correlated with unobserved factors (Altonji, Elder, and Taber, 2005, Oster, 2017). For example, a bank's reputation, which is not observable, is likely to be correlated with other observable characteristics (e.g., reputable banks are likely to be older and larger and located in large cities). If our estimates become substantially smaller when we control for observable correlates, then our original estimates in the baseline specifications might be misleadingly large, and of course, one would have to be concerned about

how small our estimates would become if, hypothetically, unobservable factors were controlled for.

To implement this sensitivity analysis, we control for capital-to-asset ratio, cash-to-asset ratio, return on asset, bank size (measured in natural log of assets) to capture bank-level confounds. We also add the interaction of these variables with a dummy variable for the panic period (1931-1932) because banking crisis might have had differential impacts on banks with different profiles; e.g., depositors might have shifted funds away from small local banks to large and perhaps more reputable large banks during the panic period. In addition, we add a host of socio-economic characteristics of areas where banks operated; namely, we use rice output growth and manufacturing production growth, which account for regional heterogeneity in local economic conditions during the Great Depression. Banks located in a prefecture with weakening economic conditions are more likely to have experienced severe financial contraction. Given that the silk reeling industry was severely affected by the global economic shocks, we also include the ratio of raw silk production to total manufacturing production as of 1928 and interact it with a dummy variable for the panic period. Finally, to differentiate two different types of banks, banks that operated in large cities and the ones that operated in rural towns, we include the population density in the headquarters of each bank at the municipality-level and interact it with the panic dummy.[30]

[30] These data are taken from various sources. The data on rice output are from *Teikoku Toukei Nenkan* (Statistical Yearbook of the Empire of Japan). Manufacturing production data are from *Kogyo Tokei 50 Nen Shi* (50 Year History of Manufacturing Census). The data on raw silk production are drawn from *Kojo Tokei Hyo* (Manufacturing Census), The city/town-level data on population density are computed based on *Kokusei Chosa Hokoku* (Report on the Population Census) and *Zenkoku Shichoson betsu Menseki Shirabe* (Census of Land Area by City-Town- Village).

The results of this sensitivity analysis are displayed in Table 3. To set the benchmark, columns 1 and 2 re-produce the basic results without any additional controls. As we show earlier, the coefficients on the key interaction term are positive and approximately .06 for both the growth rate of loans and deposits. Columns 3 and 4 add bank-level controls. Bank size has negative and significant coefficients for both loan growth and deposit growth. We also detect a positive and significant coefficient on cash-to-asset ratio for loan growth (column 3), which suggests that banks with more liquid assets had faster loan growth. When we include these control variables, the coefficients on the key interaction term become .0719 and .0609 for loan and deposit growth, respectively. They are virtually the same as those reported in Columns 1 and 2. In columns 5 and 6, we add a host of control variables that capture local economic shocks. The coefficient on industrial output growth is positive and statistically significant for loan growth (column 5). The central results remain quantitatively robust to controlling for these prefecture-level variables as well.

Columns 7-10 further add the interaction of a dummy variable for bank panics to bank-level controls, the ratio of raw silk production to total manufacturing production, and population density. The results show that coefficients on the interaction of correspondent banks to a dummy variable for the panic period remain robust to these potential correlates. The coefficient on the ratio of raw silk production to total manufacturing production (interacted with bank panic dummy) turns out to be negative and statistically significant. This is consistent with the historical narrative that a rapid decline in global demand for silk had negative effects on local economic and banking performance in Japan. In sum, the coefficients on our key interaction variable are highly robust to the inclusion of relevant confounds; i.e., the estimated difference in loan growth

and deposit growth between these two groups of banks is unlikely to be driven by variations in financial conditions of banks or conditions in local economies where they operated in. To the extent that unobservable confounds are correlated with these observable and relevant factors, these sensitivity tests indicate that omitted variable bias might be of limited concern.

In addition, we make use of the data on banks' locations to further probe the robustness of our central results. A possible criticism of our empirical approach is that we include both rural and urban banks. The former is likely to be more susceptible to local shocks that are highly heterogeneous and hard to measure. Thus, a concern might be that our main findings are driven by unobservable differences between urban and rural banks. To deal with this issue, we remove rural banks by restricting our sample to banks located in the capital city of each prefecture. Banks in the resultant sub-sample are much less heterogeneous, compared to those in the original sample. The data on banks' locations are retrieved from *Ginko Soran* (*Handbook of Banks*) by the Ministry of Finance. Table 4 display the results. Our central results survive this sub-sample test as coefficients on the interaction of correspondent banks with panic dummy are consistently positive and statistically significant.[31]

We also note that, according to Ishii (1980), one of the BOJ's primary concerns, when approving correspondent relationship with banks, was the cost of cash transportation; as a result, correspondent banks were often located near the BOJ branches. Motivated by Ishii (1980)'s archival works, we calculate each bank's distance to the nearest BOJ branches or headquarter

[31] In a similar robustness check, we use only large banks (top one-third in terms of assets at the end of 1931) to select more homogeneous group of banks. Our central findings are robust to this subsample test as well (Table A2).

and use the interaction of this distance measure with a dummy for bank panics as an instrumental variable.[32] We confirm Ishii's work by producing a geographic view of the locations of the BOJ branches and the headquarters of the BOJ correspondent banks and other banks in Figures 1 and 2, respectively. These figures show that the geographical proximity of banks to the BOJ branches seems to be highly relevant. The headquarters of the BOJ correspondent banks tended to be located in the same city as or near the BOJ branches, whereas other banks look to be more scattered around the country.

Our IV specification basically compares banks that are close to the BOJ branches with those that are distant. However, we emphasize that the BOJ did not establish branches in every major city or every prefecture simply because one of the neighboring prefectures had received a BOJ branch earlier[33]. As a consequence, there were a large number of banks that operated in large cities which did not receive BOJ branches. To the extent that we control for differences between cities and rural areas with disaggregated city/town-level data on population density, our identification is essentially based on differences between banks that were located near a BOJ branch and those that were located in a similar place without a BOJ branch.

[32] Hereafter we use the term BOJ's branches in the sense of the BOJ's branches and/or headquarter, for simplicity. The data on the locations of BOJ's branches are retrieved from *Ginkokyoku Nenpo*. The distance between BOJ's branches and each bank is measured by the information of the longitude and latitude, which is obtained by historical geographic information system (GIS) of Murayama Laboratory at Tsukuba University. The location of 8 banks could not be matched with the GIS data. We update the addresses of these banks in 1931 to what they would be in current city-town-village level, using *Zenkoku Shichousonmei Hensen Soran* (Handbook of the transition of the names of City-Town-Village).

[33] There were 18 cities which had BOJ headquarters or branches, namely, Tokyo, Otaru, Hakodate, Akita, Fukushima, Niigata, Kanazawa, Matsumoto, Nagoya, Kyoto, Osaka, Kobe, Okayama, Hiroshima, Matsue, Matsuyama, Moji and Kumamoto. On the other hand, there were some large cities such as Sendai, Yokohama and Kofu which did not have a BOJ branch although there were five or more commercial banks just as in some of those large cities where BOJ branches were located.

The results of this IV specification are displayed in Table 5.[34] The first stage F-statistics are low in some specifications; i.e., they are well below 10 in columns 1 and 2 and barely above 10 in columns 7-10. Following Andrews, Stock, and Sun (2018), we report Anderson-Rubin confidence sets and p-values for Anderson-Rubin tests to ensure that our statistical inferences are robust to weak instrument problems. Note that unlike those from the OLS, point estimates from the IV specifications have much larger confidence intervals. Moreover, the IV estimates are much more sensitive to the inclusion of control variables, compared to those in the OLS results. Thus, the IV results might not be as informative about quantitative effects of the LOLR. Nonetheless, the results show that our central findings are qualitatively robust as the interaction of the BOJ correspondent banks with panic dummy has positive coefficients. In sum, although we cannot entirely rule out an alternative interpretation that the BOJ correspondent banks share some unobservable characteristics that made them less vulnerable to liquidly shocks, one would be hard-pressed to conclude that the entirety of our main findings is driven by it.

4. **Bank Closure**

This section investigates the role of the LOLR in averting bank closure during the panic period.[35] We use the data on the universe of banks which existed at the end of 1930 to estimate the model of the probability of bank closure during the period of 1931-1932. The econometric specification is as follows:

[34] We also perform pre-trend test with our instrument. The results show that this distance measure is uncorrelated with the growth rate of deposits and loans before the crisis. The absence of pre-trend gives some assurance that it is unlikely to capture unobservable differences in bank performance. The results are reported in Table A3 (Appendix).

[35] The information on a bank closure is taken from Shindo (1987), which conducts detailed historical analyses on bank closures during the Great depression and provides the list of closed banks.

$$Closure_i = \alpha + \lambda BOJ_i + \beta X_i + u_i$$

where *Closure$_i$* is the dummy variable for closed banks during 1931-1932. *X$_i$* is a set of covariates. For bank-level covariates, we use the data on capital-to-asset ratio, cash-to-asset ratio, return on assets, and bank size as of the end of 1930. We use these pre-determined values so as to avoid endogeneity problem. Concerning control variables for local economic conditions (rice output growth and manufacturing production growth), we use their average values during 1931-1932. Again, the key independent variable is *BOJ$_i$* which captures the impact of the LOLR on the probability of bank closure. If the privileged access to the BOJ's liquidity facility helped bank in liquidity shortage in the bank panics, this coefficient should be negative and statistically significant. We estimate this equation with linear probability model and probit.

Table 6 displays the results. Columns 1-4 present the estimated results with linear probability specifications. Coefficients on a dummy variable for correspondent banks are negative and statistically significant. The estimated magnitudes suggest that the average closure rate was lower for the BOJ correspondent banks by 6-9% than for other banks. These results suggest that correspondent relationship with the BOJ has the effect of lowering the probability of bank closure. As for control variables, coefficients of the silk ratio are positive and statistically significant, indicating that banks operated in the prefecture with heavy dependence on the silk reeling industry were more likely to be closed during the panic period. Hence, it appears that a rapid decline in global demand and price for raw silk had negative effects on local economic and banking performance. The variables for local economic condition (rice

output growth and manufacturing production growth) are negative and statistically significant as expected. Banks were more likely to be closed in the area with severe economic conditions. Columns 5-8 present the estimated results with probit specifications, which are qualitatively similar. [36]The estimated marginal effects also indicated that the average closure rate was lower for the BOJ correspondent banks by 6-9% than for other banks, although not reported in the table.

5. Concluding Remarks

During the recent global financial crisis that started in 2008, banks suffered from sudden dry-up of liquidity, reminding policy-makers that financial institutions' reliance on short-term funds makes them vulnerable to self-fulfilling runs. In response, central banks around the world promptly lent a large amount of funds to banks which were facing significant rollover risk via emergency liquidity facilities. Similarly, during the Great Depression in the 1930s, the Bank of Japan took extraordinary measures to rescue the banking system, and yet it gave banks with which it had long-established correspondent relationships preferential access to its liquidity provision. This paper uses this unique historical episode in order to identify the impact of LOLR policy on financial intermediation in the disaggregated bank-level data.

[36] We also instrument a dummy variable for correspondent relationship with the BOJ with the distance variable which we employ earlier for loan and deposit growth. The estimated results show that the coefficients of the BOJ correspondence are negative and their magnitudes are quite larger than those of OLS (Columns 1-4). On the other hand, their standard errors are also larger and consequently coefficients become statistically insignificant in some specifications. Chiburis (2012) point out that linear IV estimators could have larger confidence intervals in some conditions such as small observations than Bivariate Probit when the model has an endogenous binary treatment and binary outcome. Then, we complementarily conduct Bivariate probit estimations, which confirms that the coefficients of the BOJ correspondence are negative and statistically significant in all specifications. See in Table A4 for these results.

We find that the access to the BOJ's provision of liquidity indeed made a large difference in terms of mitigating financial contraction. Banks which had long established correspondent relationships with the BOJ exhibited much faster growth in loans and deposits than other banks which did not have such pre-existing relationships with the BOJ. We find this empirical pattern to be highly robust to a series of sensitivity checks. We also find that the BOJ correspondent banks were less likely to be closed in comparison to other banks because of the BOJ's financial support for the former. In sum, our results are consistent with the view that LOLR policies acted as an effective backstop for liquidity shortage and that the financial contraction could have been more severe for the Japanese economy, had it not been for the expansion of BOJ's liquidity provision.

References

Acharya, Viral V., Denis Gromb, and Tanju Yorulmazer. 2012. "Imperfect Competition in the Interbank Market for Liquidity as a Rationale for Central Banking." *American Economic Journal: Macroeconomics*, 4 (2): 184-217.

Adachi, S. 2004. “Showa kyoko-ki niokeru furyo saiken mondai to kin'yu sisutemu no tenkan" (Nonperforming loan problem and transformation of financial system during the Showa Depression) (in Japanese), in K. Iwata (ed.) *Syowa Kyoko no Kenkyu* (Studies on the Showa Depression), Toyo Keizai Shinposha, Tokyo pp.219-48.

Akiyoshi,F. 2006a. Ginko Hatan gaoyobosu Densenkoka no Bunseki (The analyses of the effect of contagion caused by bank failures) *Nihon Keizai Kenkyu* Vol.54, 109-25.

Akiyoshi,F. 2006b. “Ginko Toritsuke Seisankatudou niataeru Eikyonituite” (The analyses of the effect of bank runs on production activities) *Nihon Keizai Kenkyu* Vol.55, 43-58.

Akiyoshi, F. 2009. “Banking panics, bank failures, and the lender of last resort: the Showa Depression of 1930–1932,” *Oxford Economic Papers* October: 776–800.

Andrade, Philippe, Christophe Cahn, Henri Fraisse, and Jean-Stephane Mesonnier, 2019, “Can the provision of long-term liquidity help to avoid a credit crunch? Evidence from the Eurosystems LTRO,” *Journal of the European Economic Association* 17(4): pp. 1070–1106.

Bagehot, Walter, 1873. *Lombard Street: A Description of the Money Market*. New York: Scribner, Armstong & Co.

Allen, Franklin, Elena Carletti, and Douglas Gale, 2009, “Interbank Market Liquidity and Central Bank Intervention,” *Journal of Monetary Economics*, 56, pp. 639–652.

Altonji, J. G., Elder, T. E., & Taber, C. R. (2005). Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools. *Journal of Political Economy*, 113(1), 151–184.

Anderson, Haelim, Charles Calomiris, Matthew Jaremski, and Gary Richardson, 2018, “Liquidity Risk, Bank Networks, and the Value of Joining the Fed,” *Journal of Money, Credit, and Banking*, 50, pp. 173-201.

Andrews, Isaiah, James Stock, and Liyang Sun, “Weak Instruments in IV Regres- sion: Theory and Practice,” MIT Working Paper, 2018.

Bank of Japan (1964) *Meiji 20-nen – Showa 37-nen Oroshiuri Bukka Shisu (Wholesale Price Index, 1887-1962)*, Tokyo: Bank of Japan.

Bank of Japan (1983) *Nihon Ginko Hyakunenshi (100 Year History of the Bank of Japan)* vol.3, Tokyo; Bank of Japan.

Berger, Allen N., Lamont K. Black, Christa H.S. Bouwman, and Jennifer Dlugosz, 2017, "Bank loan supply responses to federal reserve emergency liquidity facilities," *Journal of Financial Intermediation* 32, 1–15.

Bernanke, Ben S. (1983). "Nonmonetary Effects of the Financial Crisis in Propagation of the Great Depression." *American Economic Review* 73 (no. 3), June, pp. 257-76.

Bernstein, Asaf, Eric Hughson, and Marc Weidenmier. (2010) "Identifying the Effects of a Lender of Last Resort on Financial Markets: Lessons from the Founding of the Fed." *Journal of Financial Economics*, 98, 40–53.

Bertrand, M., E. Duflo, and S. Mullainathan (2004). "How much should we trust differences- in-differences estimates?" *Quarterly Journal of Economics 119*, 249–275.

Bordo, Michael D. (1990). "The Lender of Last Resort: Alternative Views and Historical Experience." *Federal Reserve Bank of Richmond Economic Review* January/February.

Bordo, Michael D., Wheelock, David C., 2013. "The promise and performance of the federal reserve as lender of last resort 1914-1933." In: Bordo, Michael D., Roberds, William (Eds.), *The Origins, History, and Future of the Federal Reserve: A Return to Jekyll Island*. Cambridge University Press, pp. 59–98.

Calomiris, Charles W., Marc Flandreau and Luc Laeven, 2016, "Political Foundations of the Lender of Last Resort: A Global Historical Narrative," *Journal of Financial Intermediation*, 28, pp. 48-65.

Carlin, Bruce, and William Mann. 2017. "Finance, farms, and the Fed's early years," NBER Working Paper No. 23511.

Carlson, Mark, Mitchener, Kris, J., Richardson, Gary, 2011. "Arresting banking panics: fed liquidity provision and the forgotten panic of 1929." *Journal of Political Economy*. 119 (5), 889–924.

Cha, M.S., 2003. "Did Takahashi Korekiyo rescue Japan from the great depression?" *Journal of Economic History* 63, 127–144.

Chiburis, R. C., Das, J., and Lokshin, M. (2012). "A practical comparison of the bivariate probit and linear IV estimators." *Economics Letters*, 117(3), 762-766.

Diamond, D., Dybvig, P., 1983. "Bank runs, deposit insurance, and liquidity," *Journal of Political Economy* 91 (3), 401–419.

Cordella, T., Yeyati, E.L., 2003. “Bank bailouts: Moral hazard vs. value effect,” *Journal of Financial Intermediation* 12 (4), 300–330.

Eichengreen, Barry (1992). *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939*. New York: Oxford University Press.

Flannery, Mark J. 1996. "Financial Crises, Payment System Problems, and Discount Window Lending." *Journal of Money, Credit, and Banking* 28, 805-24.

Freixas, Xavier, Bruno M. Parigi, and Jean-Charles Rochet. 2000. “Systemic Risk, Interbank Relations, and Liquidity Provision by the Central Bank.” *Journal of Money, Credit, and Banking* 32 (3): 611–38

Friedman, Milton, and Anna Jacobson Schwartz. 1963. *A Monetary History of the 7–1960.* Princeton University Press.

Fukuda, Shin-ichi and Shao, Chin-Shen, 1992. “Seasonality of interest rates in Japan,” *Japan and the World Economy*, Elsevier, vol. 4(3), pp. 201-213.

Grossman, Richard. 1994. “The Shoe that Didn’t Drop: Explaining Banking Stability in the Great Depression” *Journal of Economic History*. Vol 54, pp 654-682.

Grossman, Richard. 2010. *Unsettled Account: The Evolution of Banking in the Industrialized World Since 1800*. Princeton: Princeton University Press.

Grossman, R. S. and Imai, M., 2009, “Japan's return to gold: turning points in the value of the yen during the 1920s,” *Explorations in Economic History*, 46, pp. 314–323.

Grossman, Richard, and Hugh Rockoff. 2015. “Fighting the last war: economists on the lender of last resort,” NBER working paper 20832.

Goodhart, C. A. E. 1999. “Myths about the lender of last resort.” *International Finance* 2(11): 339-60.

Goto, S. 1968. *Honnpou-Ginko Goudou-Shi* (The History of Bank Consolidation in Japan), Kinyu-Zaisei Jijyo Kenkyuukai

Hawtrey, Ralph G., 1932, *The Art of Central Banking*, Longmans, Greens, Company.

Humphrey, T., 1989. “Lender of last resort: The concept in history.” *Federal Reserve Bank of Richmond Economic Review* 75 (2) (March): 8-16.

Ishii, K., 1980. “Chiho ginko to nihon ginko” (Regional banks and the Bank of Japan). In: Asakura, K. (Ed.)., *Ryotaisenkanki niokeru Kin’yu Kozo: Chiho Ginko wo Chushin toshite* (Financial Structure between the Two World Wars: Focusing on Regional Banks). Ochanomizu Shobo, Tokyo.

Ito, Masanao. “Seishi Yosan-gyo no Doyo to Chiho Ginko-gun no Sonzai Keitai: 1920-nendai no Nagano Ken wo Chushi toshite” (Crisis of the Silk Reeking and Sericulture Industries and Features of Regional Banks: The Case of Nagano Prefecture in the 1920s), *Tochi Seido Shigaku* 67: 1-26, 1975.

Ito, M., 2003, “Showa shonen no kin’yu shisutem kiki: sono kozo to taio (risis of the financial system in early Showa era: its structure and countermeasures). In: Abe E. (Ed.), Kin’yu Kisei ha Naze Hajimatta ka (Why did the Financial Regulation Begin ?). Nihon Keizai Hyoronsha, Tokyo.

Hamada, Koichi, and Asahi Noguchi. 2005. “Preconceived Ideas in Macroeconomic Policy: Japan’s Experience in Two Deflationary Episodes.” *International Economy and Economic Policy* 2:101– 126.

Jalil, Andrew J. 2014. “Monetary Intervention Really Did Mitigate Banking Panics During the Great Depression: Evidence Along the Atlanta Federal Reserve District Border.” *Journal of Economic History* 74 (1): 259–73.

Jalil, Andrew J. 2015. “A New History of Banking Panics in the United States, 1825–1929: Construction and Implications.” *American Economic Journal: Macroeconomics*.

Lovell, Michael C., 1957. "The Role of the Bank of England as Lender of Last Resort in the Crises of the Eighteenth Century," *Explorations in Economic History*, 10, pp. 8-21.

Martin, A. 2006. “Liquidity provision vs. deposit insurance: preventing bank panics without moral hazard.” *Economic Theory*, 28, 197-211.

Matsuoka, Tarishi, Makoto Watanabe. 2019. “Banking Panics and the Lender of Last Resort in a Monetary Economy,” Unpublished paper.

Metzler, M., 2006. *Lever of Empire: The International Gold Standard and the Crisis of Liberalism in Prewar Japan*. University of California Press, Berkeley.

Miron, Jeffrey A. (1986). “Financial Panics, the Seasonality of the Nominal Interest Rate, and the Founding of the Fed.” *American Economic Review* 76 (no. 1), March, pp. 125-40.

Nanto, D.K., Takagi, S., 1985. Korekiyo Takahashi and Japan's recovery from the Great Depression. *American Economic Review* 75, 369–374.

Okazaki, T., 2007. “Micro-aspects of monetary policy: lender of last resort and selection of banks in pre-war Japan.” *Explorations in Economic History.* 44 (4), 657–679.

Okazaki, T., M. Sawada and K. Yokoyama, 2005, “Measuring the extent and implications of director interlocking in the pre-war Japanese banking industry,” *Journal of Economic History,* 65(4), pp.1082–1115.

Okazaki, T., & Sawada, M. (2007). “Effect of bank consolidation promotion policy; evaluating the Bank Law in 1927 Japan,” *Financial History Review*,14,29−61.

Oster, E. (2017). Unobservable Selection and Coefficient Stability: Theory and Evidence. *Journal of Business and Economic Statistics*, 1–18.

Patrick, H., ‘The economic muddle of the 1920s’, in J. W. Morley, ed., *Dilemmas of growth in prewar Japan* (Princeton, 1971), pp. 211–66.

Reinhart, C., Rogoff, K., 2008. “This time is different: a panoramic view of eight centuries of financial crises,” NBER Working Papers 13882, National Bureau of Economic Research.

Repullo, R. (2004).” Capital requirements, market power, and risk-taking in banking,” *Journal of Financial Intermediation*, 13(2), 156-182.

Richardson, G., Troost, W., 2009. “Monetary Intervention Mitigated Banking Panics during the Great Depression: Quasi Experimental Evidence from a Federal Reserve District Border, 1929–1933” *Journal of Political Economy*. 117 (6), 1031-1073.

Rochet, J. C., and X. Vives, 2004. “Coordination failures and the lender of last resort: Was Bagehot right after all?” *Journal of the European Economic Association*, 2(6), 1116-1147.

Sawada, M. (2010). “Liquidity risk and bank portfolio management in a financial system without deposit insurance: Empirical evidence from prewar Japan,” *International Review of Economics and Finance*, 19(3), 392–406.

Shibamoto, Masahiko, Shizume, Masato, 2014. "Exchange rate adjustment, monetary policy and fiscal stimulus in Japan's escape from the Great Depression," *Explorations in Economic History*, 53, pages 1-18.

Shindo,H. (1987) “Showa Kyoko niokeru Gyugo-Ginko /Hitein-Ginko no Jittai to Eikyo” (Situation and Effect of Closed Banks in the Showa Financial Crisis of 1927) Chiho Kinyushi Kenkyu 18 101-126.

Shiratori, K., 2003. “1920 nendai niokeru Nippon Ginko no kyusai yushi” (Rescue loans by the Bank of Japan in the 1920s). Shakai Keizai Shigaku 69 (2), 145–167.

Shizume, Masato. (2012) "The Japanese economy during the interwar period: instability in the financial system and the impact of the world depression." In *The Gold Standard Peripheries*. Palgrave Macmillan: 211-228.

Shizume, Masato. (2018a). "Working of the Banking Networks and Central Bank in Late 19th Century Japan," Working Paper.

Shizume, Masato (2018b). "Financial Crises and the Central Bank: Lessons from Japan Duringthe1920s," In *Coping with Financial Crises Some Lessons from Economic History*, pp. 131-148.

Tamaki, N., 1995. *Japanese Banking.* Cambridge University Press, Cambridge

Temin, Peter (1989). *Lessons from the Great Depression*. Cambridge, MA: MIT Press.

Thornton, Henry. 1802. *An Enquiry into the Nature and Effects of the Paper Credit of Great Britain*. New York: Rinehart and Company.

Vossmeyer, A. (2016), "Sample Selection and Treatment Effect Estimation of Lender of Last Resort Policies," *Journal of Business and Economic Statistics*, 34, 197–212.

Wakatabe, Masazumi. 2015. *Japan's Great Stagnation and Abenomics: Lessons for the World*, Palgrave Macmillan, 209 pp.

White, Eugene N. "Protecting Financial Stability in the Aftermath of World War I: The Federal Reserve Bank of Atlanta's Dissenting Policy". National Bureau of Economic Research Working Paper No. w21341, 2015.

Yabushita, S., Inoue, A., 1993. "The stability of the Japanese banking system: A historical Perspective," *Journal of the Japanese and International Economies* 7, 387–407.

Ziebarth, Nicolas L., 2013. "Identifying the effects of bank failures from a natural experiment in Mississippi during the great depression." *American Economic Journal: Macroeconomics*. 5, pp. 81–101.

Appendix 1: Newspaper reports on the Bank of Japan's effort to prevent bank panics in Nagoya

新愛知 (Shin-Aichi Newspaper)

1932.3.5
紙幣の大洪水
今朝東京から貸切列車で日銀名古屋支店へ莫大な紙幣

Flood of banknotes
This morning, a large quantity of banknotes is to be transported from Tokyo to the Bank of Japan's Nagoya branch by a reserved train.

1932.3.6
自動車六台に積み紙幣の大行進　けさ日銀名支店へ到着
五日午前六時十二分名古屋駅到着の鳥羽行直行列車で中部日本金融界に一大福音をモタらした、これは日本銀行本店から託送の紙幣金額にして一億円八トン百九十五箱（一尺五寸、三尺の木箱に筵包みをされた）が到着した
「この紙幣こそ、数日来の預金者たちが醸出したあらゆる悲喜劇の幕を閉ちる偉大な力をもつものにして、且つ生活権を擁護するところの救世主の御来迎でなくてなんであらうか、かくて日銀名古屋支店に搬入された紙幣の山は地方銀行の要求により何時にても貸出の準備がととのへられた」

Banknotes Stacked on Six Cars Arrived at the Bank of Japan's Nagoya Branch
At 6:12 a.m. a train bound for Toba arrived at the Nagoya Station on the 5th, delivering the gospel to the financial industry in the central Japan in the form of one hundred million yen in 195 boxes from the head office of Bank of Japan.
"These banknotes have great power to end all tragedies that panicked depositors have produced for several days. It is indeed the savior's visit to protect their livelihood. A mountain of paper money which was brought to the Bank of Japan Nagoya branch was ready for lending at any time at the request of local banks."

1932.3.6
日銀理事清水賢一郎は 4 日、午後 5 時 57 分名古屋駅着。
記者に対する車中談
「日本銀行としてはどこ迄も貸出しをする方針である、事実、名古屋の銀行は支払ひ得る能力を持って居るのだから・・・・・単なる声明で、人心を安定せしむることは容易でない。要は空鉄砲よりも実弾でなくちゃいけないのだ。そして人心を冷静に立ち帰らしむべく極力対策を講ずる覚悟で居る」

Kenji Shimizu, the BOJ director, arrived at Nagoya Station on the 4th at 5:57 pm and talked to reporters. "The Bank of Japan's policy is to lending money to any extent since banks in Nagoya have the ability to make payments. It is not easy to assure people with mere statements. Metaphorically, we must use 'loaded guns.' I am prepared to take any measures to calm down depositors."

1932.3.8

五日土曜日に於ける名古屋地方の金融界は朝来静穏に帰し一斉に安定した。即ち四日日本銀行名古屋支店の貸出残高一億五千余万円に増加し、如実に各銀行の資金豊富を思はするに至った。一方日本銀行では応急策として迅速便宜の方法を講じ更に兌換券一億円を五日朝までに取寄せる等金融情勢の安定に努めたので人気は頓に冷静となり漸次落着きを見せるに至り、既に一部の預金者は資金の預け戻しに来るなど極めて楽観すべき情態となった

On Saturday the 5th, the financial community in the Nagoya region returned to the tranquility in the morning. The loan balance of the Bank of Japan Nagoya Branch increased to more than 150 million yen, and banks appeared rich in cash. The Bank of Japan's expedient, prompt measure to deliver 100 million yen to the region by the morning of the 5th further stabilized the financial situation. Some depositors have already become so optimistic that they have come back to deposit cash in their banks.

Figure 1: Locations of BOJ branches and the headquarters of BOJ correspondent banks

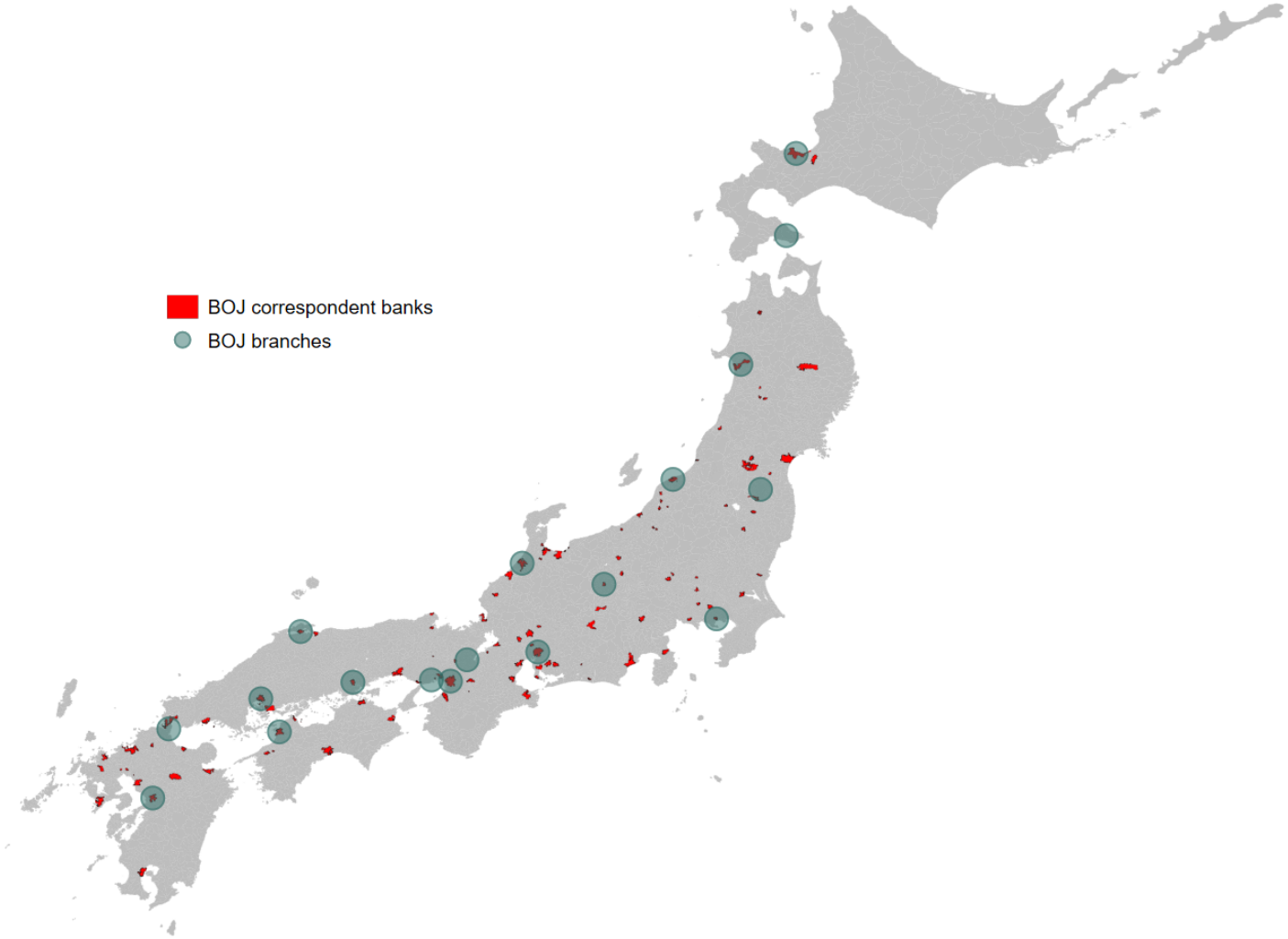

Figure 2: Locations of BOJ branches and the headquarters of non-correspondent banks

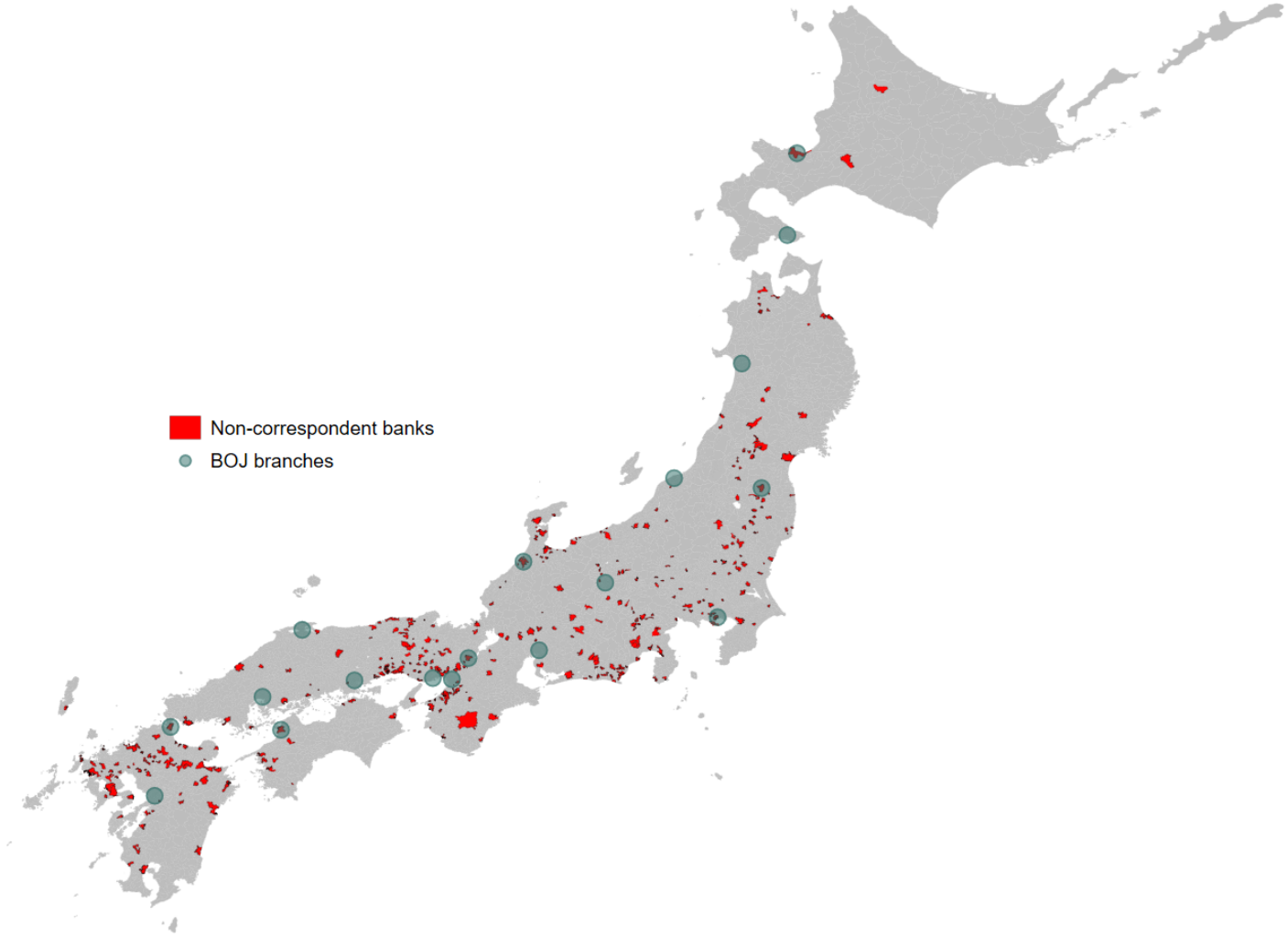

Table 1 Impacts of Lender of Last Resort on Loan and Deposit Growth (Baseline regressions)

VARIABLES	(1) Loan Growth	(2) Deposit Growth	(3) Loan Growth	(4) Deposit Growth	(5) Loan Growth	(6) Deposit Growth
(Banking Crisis)*(BOJ Correspondence)	0.0637***	0.0627***	0.0623***	0.0669***	0.0569***	0.0693***
	(0.0120)	(0.0152)	(0.0142)	(0.0168)	(0.0185)	(0.0197)
(Precrisis(Year=1930))*(BOJ Correspodence)			-0.00380	0.0111	-0.00911	0.0135
			(0.0164)	(0.0179)	(0.0195)	(0.0227)
(Precrisis(Year=1929))*(BOJ Correspodence)					-0.00960	0.00423
					(0.0207)	(0.0204)
Constant	-0.0439***	0.0350***	-0.0438***	0.0348***	-0.0436***	0.0347***
	(0.00583)	(0.00612)	(0.00583)	(0.00611)	(0.00579)	(0.00612)
Observations	2,741	2,741	2,741	2,741	2,741	2,741
R-squared	0.027	0.187	0.027	0.187	0.027	0.187
Number of bank	655	655	655	655	655	655

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2:Test of difference of bank characteristics between BOJ correspondent and non-correspondent banks

Panel A: Cash-asset ratio

	(1)	(2)	(3)	(4)	(5)
VARIABLES	year=28	year=29	year=30	year=31	year=32
BOJ Correspondence	0.00904***	0.0106***	0.0106***	0.00943***	0.00909***
	(0.00256)	(0.00236)	(0.00260)	(0.00237)	(0.00244)
Constant	0.0419***	0.0420***	0.0406***	0.0380***	0.0368***
	(0.00206)	(0.00191)	(0.00203)	(0.00185)	(0.00248)
Observations	523	561	595	599	463
R-squared	0.017	0.029	0.018	0.020	0.015

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Panel B: Capital-asset ratio

	(1)	(2)	(3)	(4)	(5)
VARIABLES	year=28	year=29	year=30	year=31	year=32
BOJ Correspondence	-0.0814***	-0.0947***	-0.110***	-0.128***	-0.130***
	(0.0273)	(0.0231)	(0.0194)	(0.0194)	(0.0239)
Constant	0.356***	0.345***	0.352***	0.373***	0.377***
	(0.0152)	(0.0142)	(0.0114)	(0.0126)	(0.0181)
Observations	505	531	565	574	439
R-squared	0.024	0.039	0.065	0.075	0.085

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Panel C: Return on assets

	(1)	(2)	(3)	(4)	(5)
VARIABLES	year=28	year=29	year=30	year=31	year=32
BOJ Correspondence	-0.0124***	-0.0118***	-0.00953***	-0.00721***	-0.00636***
	(0.00355)	(0.00238)	(0.00203)	(0.00201)	(0.00219)
Constant	0.0467***	0.0367***	0.0329***	0.0276***	0.0249***
	(0.00314)	(0.00213)	(0.00200)	(0.00153)	(0.00184)
Observations	523	561	595	599	463
R-squared	0.014	0.034	0.016	0.015	0.016

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Impacts of Lender of Last Resort on Loan and Deposit Growth (Controlling for observable variables)

VARIABLES	(1) Loan Growth	(2) Deposit Growth	(3) Loan Growth	(4) Deposit Growth	(5) Loan Growth	(6) Deposit Growth	(7) Loan Growth	(8) Deposit Growth	(9) Loan Growth	(10) Deposit Growth
(Banking Crisis)*(BOJ Correspondence)	0.0637***	0.0627***	0.0719***	0.0609***	0.0715***	0.0608***	0.0729***	0.0446**	0.0752***	0.0511**
	(0.0120)	(0.0152)	(0.0124)	(0.0148)	(0.0124)	(0.0149)	(0.0190)	(0.0215)	(0.0189)	(0.0210)
ln(Assets)			-0.146***	-0.134***	-0.148***	-0.135***	-0.151***	-0.139***	-0.150***	-0.136***
			(0.0379)	(0.0409)	(0.0383)	(0.0409)	(0.0393)	(0.0416)	(0.0408)	(0.0432)
Return on Assets			0.0678	0.364	0.0690	0.365	0.0399	0.366	0.00887	0.296
			(0.157)	(0.304)	(0.154)	(0.301)	(0.161)	(0.300)	(0.161)	(0.286)
Capital-to-Asset Ratio			0.0532	-0.0378	0.0542	-0.0375	0.0531	-0.0498	0.0522	-0.0524
			(0.0730)	(0.119)	(0.0731)	(0.119)	(0.0774)	(0.129)	(0.0791)	(0.126)
Cash-to-Asset Ratio			0.858***	0.0578	0.862***	0.0657	0.878***	-0.0448	0.892***	-0.0161
			(0.226)	(0.252)	(0.227)	(0.250)	(0.244)	(0.269)	(0.243)	(0.266)
Industrial Output Growth					0.0445*	0.0196	0.0457*	0.0248	0.0466*	0.0277
					(0.0266)	(0.0320)	(0.0267)	(0.0321)	(0.0270)	(0.0322)
Rice Output Growth					-0.0487	-0.0474	-0.0489	-0.0431	-0.0451	-0.0340
					(0.0351)	(0.0464)	(0.0350)	(0.0465)	(0.0351)	(0.0473)
(Banking Crisis)*(ln(Assets))							0.000965	0.00895	-0.00388	-0.00158
							(0.00638)	(0.00746)	(0.00703)	(0.00804)
(Banking Crisis)*(Return on Assets)							0.311	0.229	0.270	0.122
							(0.274)	(0.335)	(0.276)	(0.331)
(Banking Crisis)*(Capital-to-Asset Ratio)							0.00519	0.0483	0.00605	0.0530
							(0.0422)	(0.0651)	(0.0432)	(0.0645)
(Banking Crisis)*(Cash-to-Asset Ratio)							-0.0549	0.304	-0.110	0.181
							(0.374)	(0.229)	(0.376)	(0.233)
(Banking Crisis)(silk / total manufacturing in 1928)									-0.0605**	-0.147***
									(0.0283)	(0.0390)
(Banking Crisis)*(Population density)									0.00215	0.00406*
									(0.00217)	(0.00243)
Constant	-0.0439***	0.0350***	2.059***	2.011***	2.071***	2.024***	2.124***	2.080***	2.107***	2.047***
	(0.00583)	(0.00612)	(0.570)	(0.626)	(0.576)	(0.626)	(0.592)	(0.637)	(0.613)	(0.660)
Observations	2,741	2,741	2,614	2,614	2,614	2,614	2,614	2,614	2,614	2,614
R-squared	0.027	0.187	0.075	0.209	0.077	0.210	0.078	0.212	0.082	0.223
Number of bank	655	655	647	647	647	647	647	647	647	647

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Impacts of Lender of Last Resort on Loan and Deposit Growth (Banks in the capital cities)

VARIABLES	(1) Loan Growth	(2) Deposit Growth	(3) Loan Growth	(4) Deposit Growth	(5) Loan Growth	(6) Deposit Growth	(7) Loan Growth	(8) Deposit Growth	(9) Loan Growth	(10) Deposit Growth
(Banking Crisis)*(BOJ Correspondence)	0.106***	0.0947**	0.126***	0.102***	0.125***	0.106***	0.126***	0.140***	0.123***	0.127***
	(0.0281)	(0.0372)	(0.0322)	(0.0367)	(0.0322)	(0.0369)	(0.0444)	(0.0469)	(0.0456)	(0.0483)
ln(Assets)			-0.241***	-0.293***	-0.242***	-0.289***	-0.231***	-0.277**	-0.225***	-0.268**
			(0.0679)	(0.111)	(0.0680)	(0.110)	(0.0693)	(0.115)	(0.0709)	(0.113)
Return on Assets			-0.583	1.809	-0.595	1.853	-0.919	1.875	-0.968	1.776
			(0.669)	(1.180)	(0.667)	(1.236)	(0.699)	(1.471)	(0.700)	(1.429)
Capital-to-Asset Ratio			0.0806	0.381	0.0844	0.368	0.211	0.401	0.217	0.409
			(0.231)	(0.304)	(0.234)	(0.311)	(0.304)	(0.362)	(0.302)	(0.358)
Cash-to-Asset Ratio			0.684***	-0.169	0.683***	-0.165	0.762**	-0.258	0.804**	-0.219
			(0.217)	(0.281)	(0.218)	(0.288)	(0.327)	(0.334)	(0.316)	(0.324)
Industrial Output Growth					0.00832	-0.0975	0.00252	-0.100	-0.0157	-0.121
					(0.133)	(0.115)	(0.135)	(0.115)	(0.133)	(0.109)
Rice Output Growth					-0.0390	0.109	-0.0348	0.103	-0.0437	0.0936
					(0.0983)	(0.122)	(0.0985)	(0.123)	(0.0983)	(0.128)
(Banking Crisis)*(ln(Assets))							-0.00349	-0.0160	-0.00853	-0.0216
							(0.0127)	(0.0146)	(0.0135)	(0.0151)
(Banking Crisis)*(Return on Assets)							0.619	-0.0990	0.641	-0.0325
							(0.501)	(0.892)	(0.491)	(0.789)
(Banking Crisis)*(Capital-to-Asset Ratio)							-0.132	-0.0574	-0.162	-0.102
							(0.128)	(0.153)	(0.128)	(0.157)
(Banking Crisis)*(Cash-to-Asset Ratio)							-0.229	0.153	-0.310	0.0792
							(0.516)	(0.192)	(0.531)	(0.189)
(Banking Crisis)(silk / total manufacturing in 1928)									-0.0469	-0.165
									(0.0666)	(0.105)
(Banking Crisis)*(Population density)									0.00668*	0.00373
									(0.00352)	(0.00390)
Constant	-0.0591***	0.0120	3.839***	4.654**	3.851***	4.611**	3.648***	4.402**	3.546***	4.253**
	(0.0170)	(0.0183)	(1.133)	(1.856)	(1.135)	(1.851)	(1.168)	(1.939)	(1.194)	(1.904)
Observations	483	483	451	451	451	451	451	451	451	451
R-squared	0.039	0.101	0.100	0.212	0.101	0.217	0.106	0.220	0.118	0.233
Number of bank	123	123	120	120	120	120	120	120	120	120

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5:Impacts of Lender of Last Resort on Loan and Deposit Growth (IV Specification)

VARIABLES	(1) Loan Growth	(2) Deposit Growth	(3) Loan Growth	(4) Deposit Growth	(5) Loan Growth	(6) Deposit Growth	(7) Loan Growth	(8) Deposit Growth	(9) Loan Growth	(10) Deposit Growth
(Banking Crisis)*(BOJ Correspondence)	0.239***	0.213**	0.201***	0.283***	0.201***	0.286***	0.453***	0.674***	0.411**	0.563***
	(0.0557)	(0.108)	(0.0495)	(0.0624)	(0.0497)	(0.0640)	(0.167)	(0.230)	(0.162)	(0.217)
ln(Assets)			-0.144***	-0.130***	-0.145***	-0.131***	-0.126***	-0.0977**	-0.130***	-0.106**
			(0.0406)	(0.0422)	(0.0410)	(0.0422)	(0.0412)	(0.0461)	(0.0432)	(0.0468)
Return on Assets			-0.0817	0.107	-0.0803	0.105	-0.0719	0.182	-0.0938	0.139
			(0.159)	(0.300)	(0.158)	(0.298)	(0.178)	(0.348)	(0.174)	(0.316)
Capital-to-Asset Ratio			0.0890	0.0236	0.0897	0.0243	0.108	0.0408	0.0970	0.0160
			(0.0791)	(0.119)	(0.0793)	(0.119)	(0.0833)	(0.137)	(0.0847)	(0.130)
Cash-to-Asset Ratio			0.923***	0.171	0.930***	0.184	1.075***	0.280	1.055***	0.233
			(0.228)	(0.256)	(0.229)	(0.256)	(0.262)	(0.308)	(0.260)	(0.297)
Industrial Output Growth					0.0377	0.00768	0.0276	-0.00518	0.0349	0.00980
					(0.0259)	(0.0305)	(0.0282)	(0.0364)	(0.0280)	(0.0348)
Rice Output Growth					-0.0537	-0.0560	-0.0985**	-0.125*	-0.0851**	-0.0949
					(0.0350)	(0.0497)	(0.0412)	(0.0651)	(0.0394)	(0.0615)
(Banking Crisis)*(ln(Assets))							-0.0789**	-0.123**	-0.0715**	-0.104**
							(0.0360)	(0.0494)	(0.0342)	(0.0447)
(Banking Crisis)*(Return on Assets)							0.153	-0.0323	0.0700	-0.183
							(0.359)	(0.423)	(0.355)	(0.406)
(Banking Crisis)*(Capital-to-Asset Ratio)							-0.107	-0.137	-0.0786	-0.0759
							(0.0729)	(0.102)	(0.0673)	(0.0903)
(Banking Crisis)*(Cash-to-Asset Ratio)							-0.254	-0.0260	-0.271	-0.0633
							(0.304)	(0.365)	(0.302)	(0.321)
(Banking Crisis)(silk / total manufacturing in 1928)									-0.112**	-0.226***
									(0.0434)	(0.0600)
(Banking Crisis)*(Population density)									-0.00130	-0.00119
									(0.00301)	(0.00395)
Observations	2,732	2,732	2,593	2,593	2,593	2,593	2,593	2,593	2,593	2,593
R-squared	-0.055	0.150	0.028	0.125	0.031	0.123	-0.145	-0.161	-0.089	-0.019
Number of bank	646	646	626	626	626	626	626	626	626	626
First Stage F Statistic	6.054	6.054	57.03	57.03	56.37	56.37	13.04	13.04	12.41	12.41
Anderson-Rubin chi-sqared test	0.0002	0.0261	0.0001	0.00000	0.0001	0.0000	0.0009	0.0000	0.0023	0.0005
Confidence sets	[.131034, .356046]	[.028346, .473813]	[.109038, .308843]	[.171608, .428387]	[.108176, .308782]	[.176938, .435279]	[.195843, 1.02782]	[.336851, 1.53967]	[.160624, .983538]	[.245251, 1.37896]

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Impacts of Lender of Last Resort on bank closure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	Probit	Probit	Probit	Probit
VARIABLES	Closure	Closure	Closure	Closure	Closure	Closure	Closure	Closure
BOJ Correspondence	-0.0629*	-0.0874**	-0.0844**	-0.0708*	-0.342*	-0.531**	-0.465**	-0.410*
	(0.0363)	(0.0351)	(0.0367)	(0.0368)	(0.206)	(0.213)	(0.213)	(0.215)
ln(Assets)	0.0160**	0.0278***	0.0215**	0.0269***	0.0883*	0.174***	0.102*	0.158**
	(0.00807)	(0.00780)	(0.00938)	(0.00969)	(0.0452)	(0.0472)	(0.0559)	(0.0619)
Return on Assets			-0.556*	-0.532*			-3.918	-3.893
			(0.292)	(0.298)			(2.971)	(3.122)
Capital-to-Asset Ratio			-0.0374	-0.0268			-0.602	-0.532
			(0.0276)	(0.0280)			(0.422)	(0.441)
Cash-to-Asset Ratio			0.164	0.154			1.077	1.221
			(0.321)	(0.320)			(1.847)	(2.002)
Population density per 1000				-0.00724***				-0.0635**
				(0.00279)				(0.0265)
(Silk/total manufacturing)		0.335***	0.326***	0.322***		1.535***	1.520***	1.565***
		(0.0653)	(0.0669)	(0.0687)		(0.245)	(0.261)	(0.296)
Industrial Output Grwoth				0.0110				0.267
				(0.194)				(1.226)
Rice Output Grwoth				-0.609**				-3.157***
				(0.271)				(1.195)
Constant	-0.110	-0.338***	-0.222	-0.276**	-2.451***	-4.013***	-2.699***	-3.371***
	(0.111)	(0.107)	(0.138)	(0.140)	(0.638)	(0.684)	(0.876)	(0.949)
Observations	777	777	726	726	777	777	726	726
R-squared	0.005	0.062	0.061	0.072				
pseudo-R-squared					0.00739	0.0796	0.0825	0.104

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix Table1: Summary statistics

VARIABLES	N	mean	sd	min	max
Loan growth	2,741	-0.0584	0.142	-0.908	0.897
Deposit growth	2,741	-0.0683	0.189	-0.999	0.906
BOJ Correspondence	2,741	0.22	0.415	0	1
ln(Assets)	2,741	14.73	1.501	10.62	20.52
Return on Assets	2,741	0.0318	0.0306	0	0.53
Capital-to-Asset Ratio	2,614	0.336	0.195	0.0146	2.809
Cash-to-Asset Ratio	2,741	0.0421	0.0292	0	0.48
Silk/total manufacturing	2,741	17.89	22.56	0	81.23
Population density per 1000	2,741	2.79	3.447	0.018	16.15
Industrial Output Grwoth	2,741	-0.0449	0.189	-0.82	0.589
Rice Output Grwoth	2,741	-0.0884	0.189	-0.685	0.517

Appendix Table2: Impacts of Lender of Last Resort on Loan and Deposit Growth (Large banks)

VARIABLES	(1) Loan Growth	(2) Deposit Growth	(3) Loan Growth	(4) Deposit Growth	(5) Loan Growth	(6) Deposit Growth	(7) Loan Growth	(8) Deposit Growth	(9) Loan Growth	(10) Deposit Growth
(Banking Crisis)*(BOJ Correspondence)	0.0960***	0.0697***	0.0942***	0.0538**	0.0940***	0.0544**	0.0912***	0.0392	0.0916***	0.0406
	(0.0208)	(0.0243)	(0.0222)	(0.0232)	(0.0224)	(0.0236)	(0.0236)	(0.0268)	(0.0229)	(0.0259)
ln(Assets)			-0.269***	-0.287***	-0.269***	-0.288***	-0.287***	-0.327***	-0.285***	-0.325***
			(0.0490)	(0.0842)	(0.0490)	(0.0837)	(0.0488)	(0.0879)	(0.0510)	(0.0870)
Return on Assets			0.463	0.579	0.472	0.579	-0.0460	0.282	-0.0717	0.252
			(0.375)	(0.676)	(0.375)	(0.670)	(0.274)	(0.526)	(0.261)	(0.507)
Capital-to-Asset Ratio			-0.340	-0.240	-0.339	-0.233	0.0955	-0.0496	0.0743	-0.0798
			(0.271)	(0.382)	(0.271)	(0.375)	(0.342)	(0.370)	(0.343)	(0.368)
Cash-to-Asset Ratio			0.402	0.0389	0.400	0.0289	0.471	-0.0794	0.532	0.00523
			(0.278)	(0.257)	(0.278)	(0.258)	(0.389)	(0.284)	(0.367)	(0.248)
Industrial Output Growth					0.0105	-0.0101	0.00267	-0.00429	-0.00343	-0.0118
					(0.0485)	(0.0532)	(0.0498)	(0.0536)	(0.0501)	(0.0532)
Rice Output Growth					-0.0235	-0.0879	0.0101	-0.0555	0.0203	-0.0411
					(0.0697)	(0.0851)	(0.0684)	(0.0798)	(0.0687)	(0.0834)
(Banking Crisis)*(ln(Assets))							0.00106	0.00889	-0.0132	-0.0103
							(0.00923)	(0.0100)	(0.00984)	(0.0111)
(Banking Crisis)*(Return on Assets)							4.130***	3.849***	4.069***	3.754***
							(1.243)	(1.447)	(1.253)	(1.423)
(Banking Crisis)*(Capital-to-Asset Ratio)							-0.540***	-0.298*	-0.562***	-0.317*
							(0.162)	(0.169)	(0.161)	(0.165)
(Banking Crisis)*(Cash-to-Asset Ratio)							-0.253	0.126	-0.380	-0.0489
							(0.461)	(0.212)	(0.486)	(0.198)
(Banking Crisis)(silk / total manufacturing in 1928)									-0.0908*	-0.146**
									(0.0540)	(0.0699)
(Banking Crisis)*(Population density)									0.00678**	0.00863***
									(0.00303)	(0.00288)
Constant	-0.0374***	0.0445***	4.400***	4.781***	4.404***	4.783***	4.613***	5.397***	4.587***	5.380***
	(0.0121)	(0.0130)	(0.823)	(1.427)	(0.822)	(1.419)	(0.826)	(1.496)	(0.862)	(1.479)
Observations	830	830	797	797	797	797	797	797	797	797
R-squared	0.047	0.146	0.087	0.194	0.087	0.196	0.122	0.217	0.137	0.242
Number of bank	199	199	198	198	198	198	198	198	198	198

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix Table3: Test for correlation between IV and bank perfomance before the crisis

VARIABLES	(1) Loan Growth	(2) Deposit Growth	(3) Loan Growth	(4) Deposit Growth	(5) Loan Growth	(6) Deposit Growth
(Banking Crisis)*(Distance to the nearest BOJ)	-0.0497***	-0.0442	-0.0481***	-0.0392	-0.0437***	-0.0573*
	(0.0160)	(0.0381)	(0.0164)	(0.0414)	(0.0153)	(0.0305)
(Precrisis(Year=30))*(Distance to the nearest BOJ)			0.00474	0.0143	0.00912	-0.00380
			(0.0121)	(0.0162)	(0.0145)	(0.0177)
(Precrisis(Year=29))*(Distance to the nearest BOJ)					0.00851	-0.0352
					(0.0162)	(0.0306)
Constant	-0.0431***	0.0357***	-0.0431***	0.0358***	-0.0430***	0.0356***
	(0.00582)	(0.00615)	(0.00582)	(0.00617)	(0.00583)	(0.00614)
Observations	2,741	2,741	2,741	2,741	2,741	2,741
R-squared	0.024	0.184	0.024	0.185	0.024	0.186
Number of bank	655	655	655	655	655	655

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix table 4: Impacts of Lender of Last Resort on bank closures: IVLPM and Bivariate probit estimations

	(1)	(2)	(3)	(4)	(5)		(6)		(7)		(8)	
	IVLPM	IVLPM	IVLPM	IVLPM	Bivariate probit		Bivariate probit		Bivariate probit		Bivariate probit	
VARIABLES	Closure	Closure	Closure	Closure	Closure	BOJ	Closure	BOJ	Closure	BOJ	Closure	BOJ
BOJ Correspondence	-0.361*	-0.224	-0.351	-0.236	-1.141***		-1.261***		-1.344***		-1.412***	
	(0.215)	(0.180)	(0.215)	(0.258)	(0.296)		(0.314)		(0.351)		(0.400)	
ln(Assets)	0.0645*	0.0505*	0.0732*	0.0565	0.238***	0.910***	0.316***	0.952***	0.292***	1.087***	0.364***	1.068***
	(0.0362)	(0.0307)	(0.0428)	(0.0470)	(0.0639)	(0.0650)	(0.0651)	(0.0679)	(0.0813)	(0.0818)	(0.0908)	(0.0826)
Return on Assets			-0.451	-0.462					-3.573	6.798***	-3.599	6.944***
			(0.309)	(0.320)					(3.141)	(2.363)	(3.248)	(2.340)
Capital-to-Asset Ratio			0.00932	-0.00102					-0.442	1.019***	-0.335	0.959***
			(0.0467)	(0.0495)					(0.414)	(0.173)	(0.428)	(0.169)
Cash-to-Asset Ratio			0.227	0.190					1.589	1.232	1.797	0.972
			(0.352)	(0.335)					(1.941)	(2.492)	(2.054)	(2.464)
Population density per 1000				-0.00511							-0.0495*	0.0422**
				(0.00451)							(0.0259)	(0.0198)
(Silk/total manufacturing)		0.355***	0.374***	0.352***			1.634***	1.077***	1.649***	1.107***	1.688***	0.986***
		(0.0652)	(0.0693)	(0.0741)			(0.238)	(0.323)	(0.252)	(0.328)	(0.284)	(0.380)
Industrial Output Grwoth				0.000658							0.140	-0.721
				(0.199)							(1.189)	(1.304)
Rice Output Grwoth				-0.536**							-2.351*	2.931*
				(0.255)							(1.233)	(1.708)
Distance to Nearest BOJ						0.00997**		-0.0109***		-0.0129***		-0.0112***
						(0.00193)		(0.00199)		(0.00208)		(0.00220)
Constant	-0.752	-0.643	-0.948	-0.697	-4.418***	-14.04***	-5.912***	-14.82***	-5.331***	-17.26***	-6.272***	-17.23***
	(0.480)	(0.410)	(0.598)	(0.665)	(0.866)	(1.011)	(0.889)	(1.064)	(1.168)	(1.296)	(1.301)	(1.308)
Observations	777	777	726	726	777	777	777	777	726	726	726	726
R-squared	-0.086	0.043	-0.009	0.046								
First Stage F Statistic	16.18	15	25.86	16.97								
Rho					0.576		0.540		0.658		0.737	
p-value					(0.0047)		(0.0134)		(0.0254)		(0.0492)	

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1