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Working of the Banking Networks and Central Bank in Late 19th Century Japan

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We shed new light on the interaction between private banks and the central bank in 19th century Japan by focusing on the formation and working of networks of these banks. We employ a network analysis with branching and correspondence contracts among these banks. We also use bank lending rates at the prefectural level to test the effects of the networks on the integration of the national financial market. We find that private banks had already built a dense network throughout the nation before the establishment of the central bank, which contributed to the integration of the national financial market to some extent; the central bank contributed little or nothing to the integration of the financial market in its early days; and the central bank found another way to contribute, namely, by providing liquidity during the financial crisis of 1890 as a lender of last resort.

1. Introduction

The history of the emergence of central banks has attracted attention in academic and policy arenas for years (Hayek 1976; Goodhart 1988). Furthermore, recent experiences have posed new challenges related to the essential function of central banks, namely, the provision of liquidity to the national economy. The Great Recession of the 2000s renewed interest in central banking under financial instability, low economic growth, and the zero lower bound of interest rates. Also, ongoing developments in the area of cryptocurrencies have called into question the role of a central bank as the sole provider of liquidity (Bordo et.al. 2016, 4-5; Edvinsson et.al. 2018, 21-23).

Central banks are products of the modern age, and the nature of their evolution proves that there is no single theory that can explain the bigger picture of their history across time and space. Predecessors of central banks were established as early as the 17th century either as a hub of the national payment system (as in the case of the Netherlands), or as the bank for managing the national debt (as in the case of England). However, these early banks did not perform at the full capacity of modern central banks. They may not have had monopoly over the issuance of the national currency or the function of the lender of last resort (LOLR), which are perceived as essential elements of central banking today. During the 19th century, some of the predecessors of central banks acquired these functions and became central banks. Central banks established during the second half of the 19th century or the early 20th century were designed to be central banks from the onset, e.g. the Bank of Belgium, established in 1850, the Bank of Italy, established in 1861, the German Reichsbank, established in 1875, the Bank of Japan, established in 1882, and the Federal Reserve System (FRS) in the United States, established in 1913 (Edvinsson et.al. 2018, 11-15).

The establishment of these central banks and their evolution in the early days highlight the essential aspects of central banking, which remained hidden for a long time after the modern monetary system became widespread, by revealing the defects of previously existing systems, the motivations of the founders of central banks, competition and cooperation between the existing banks and the newly-established central bank, and the learning process of each central bank in a new institutional and political setting. These lessons will contribute to any discussion aimed at designing a new monetary system under new conditions in the 21st century.

The motivations for founding central banks varied across countries. In some cases, a central bank was founded in the aftermath of a financial crisis. In other cases, it was established as a part of nation-building (Bordo et.al. 2016, 8; Edvinsson et.al. 2018, 14-16). In the case of Japan, the designers of modern social and economic systems initiated a series of monetary reforms as a vital part of nation-building. They once decided to adopt a monetary system with plural private issuing banks modeled after the national banks in the United States. Later, they switched to a system with a central bank modeled after the monetary system in Europe (Shizume 2018, 332-339). As a result, Japan passed through a period with two coexisting networks, one built solely by private issuing banks and the other built by the Bank of Japan (BOJ), the newly established central bank. In this setting, we can test how the existing network of private banks worked and what the new central

bank added to that network.

Founders of the FRS conducted extensive research on overseas monetary and financial systems as well as on theoretical issues and the history of the banking system in the United States prior to establishing the FRS (the National Monetary Commission, 1911). They invited Masayoshi Matsukata, former Finance Minister who established the BOJ, and other financial experts from Japan to write reports on the Japanese monetary and financial systems. And, O. M. W. Sprague, a prominent monetary economist at Harvard University, contributed the concluding chapter on the Japanese banking system, where he wrote about the inefficiency of national banks in Japan:

> The system of national banks...was not a system favorable to the immediate development of an efficient banking organization throughout the country. Up to a certain point it had indeed accomplished this result and probably more quickly than would have been possible if a central bank had been established at the outset...There was an almost entire absence of arrangements between the banks for transferring idle funds to those sections of the country in which there might be a peculiarly urgent demand for accommodation.[1]

At the same time, Sprague condemned the BOJ's inability to deal with the problem, saying "There has been no attempt by its means to furnish the people generally with banking facilities." Having cited Sprague (1911), Goodhart (1988) rephrases, "Nor did the Bank make much attempt to develop improved payments and transfer facilities throughout Japan: this was left to the private banks."[2] However, empirical studies need to be conducted before reaching such conclusions.

In this paper we shed new light on the interaction between private banks and the central bank during the emergence of central banking in the late 19th century by focusing on the formation and working of networks of these banks.

We will explore three subjects: 1) the structure and working of the existing network built by the private banks, 2) how the newly established central bank changed (or didn't change) the working of the existing network of private banks, and 3) what else the new central bank added to the function of the national monetary system.

We employ a network analysis using two, heretofore unexplored network datasets: branching and correspondence contracts among private banks as of June 1880, two years before the establishment of the BOJ, and between the BOJ and private banks as of December 1884, two years after the establishment of the BOJ.[3] We also use bank lending rates at the prefectural level to test the effects of the networks on the integration of the national financial market. This is the first attempt to apply a network analysis to the emergence of central

[1] Sprague (1911), 184-185.
[2] Sprague (1911), 192; Goodhart (1988), 157.
[3] Ministry of Finance (1881); the Bank of Japan (1885).

banking in Japan.[4] We also study the case of an individual bank with newly-compiled detailed information about its business and balance sheet.

Our key findings are as follows: 1) private banks had already built a dense network throughout the nation before the establishment of the central bank, which contributed to the integration of the national financial market to some extent; 2) although the designer of the national monetary system intended to further integrate the national financial market by establishing the central bank, the central bank contributed little or nothing to that plan in its early days; and 3) the central bank found another way to contribute, namely, by providing liquidity during the financial crisis of 1890 as the LOLR. After the crisis, the central bank intervened in the financial market more actively.

2. Chronology of the Networking of the Private Banks and Central Bank

After the forced opening of the treaty ports in 1859, Japan went through a turbulent but dynamic transition from a feudal society to a modern one. The new Meiji government, which had thrown out the Tokugawa Shogunate, conducted a modernization program under the banner of "rich nation, strong army." It moved to establish a modern monetary and financial system with some trial and error.

After heated debate between advocates of a multiple-issuing-bank system modeled after the United States and proponents of a single-issuing-bank system modeled after Europeans countries, the government, at first, introduced the former system. Under the revised National Bank Act of 1876, 153 national banks were established as issuing banks (Shizume 2018, 333-336). Through the early 1880s they formed a nationwide network in parallel with the trading of commodities such as rice, silk, and tea. The banks had no central clearing mechanism in this system, and payments between distant places had to be settled through correspondent networks. The banks searched for netting partners one by one.

After facing rampant inflation during and after the Satsuma Rebellion of 1877, the government inclined toward the regulation of banknote issuance and the establishment of a central bank. Masayoshi Matsukata, who was to become the Finance Minister in 1881, advocated for the establishment of a central bank as a means of promoting the integration of the national financial market. Later, in explaining why the BOJ was established, he blamed the national banks for not integrating the national payment/financial system.

The BOJ created a correspondent network with private banks in the early days after its founding. Though the BOJ was to remain small at the beginning, consisting of only the Tokyo headquarters and one branch in Osaka until 1890, it held 134 correspondent agreements with private banks in 1884.

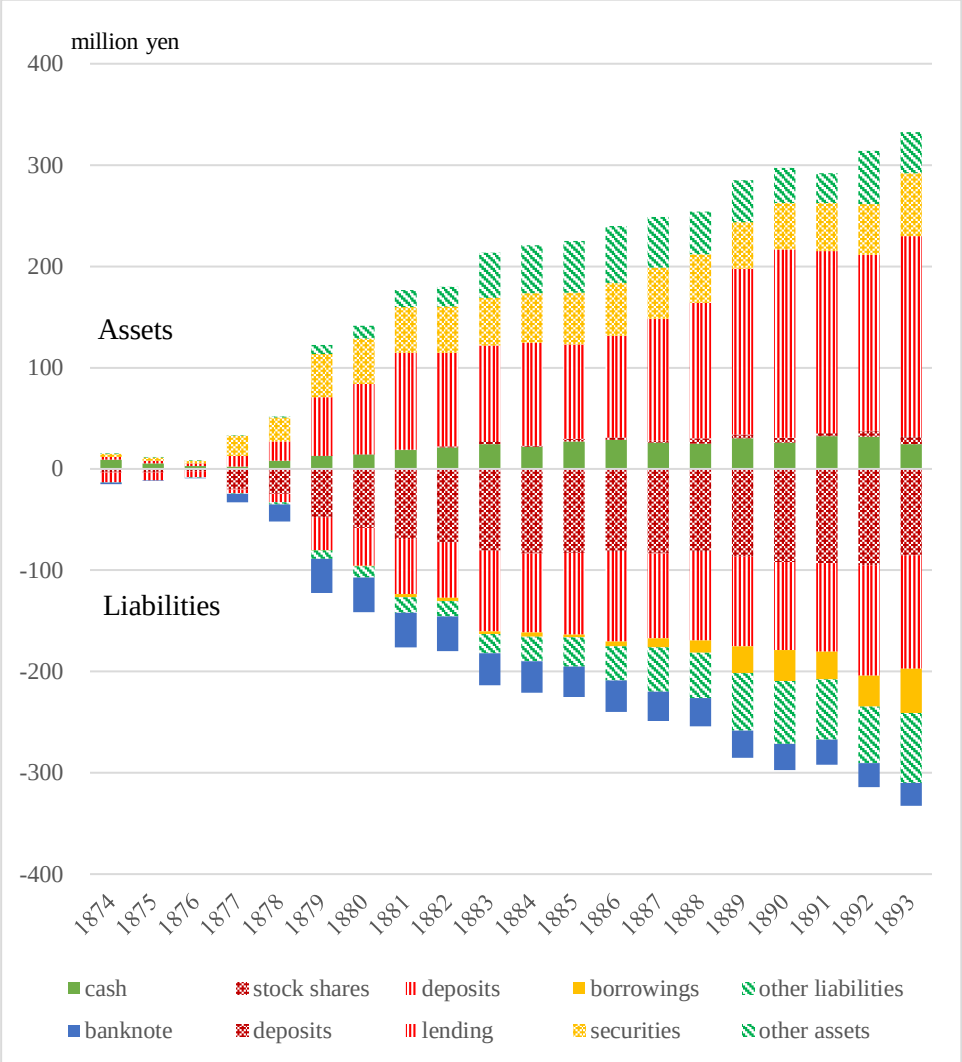
The amended National Bank Act of 1883 declared that the charters of all existing national banks would expire in twenty years from their establishment, that their banknotes had to be redeemed before the expiration of the charters, and that they had to be either closed or converted into private banks without issuance rights once the charter had expired. From 1896 to 1899, the charters of all of the national banks

[4] Jeremski and Wheelock (2016) examine determinants of the location of the Federal Reserve Banks' head offices, branches and district boundaries using a network analysis.

expired and most of the national banks changed into non-issuing banks.

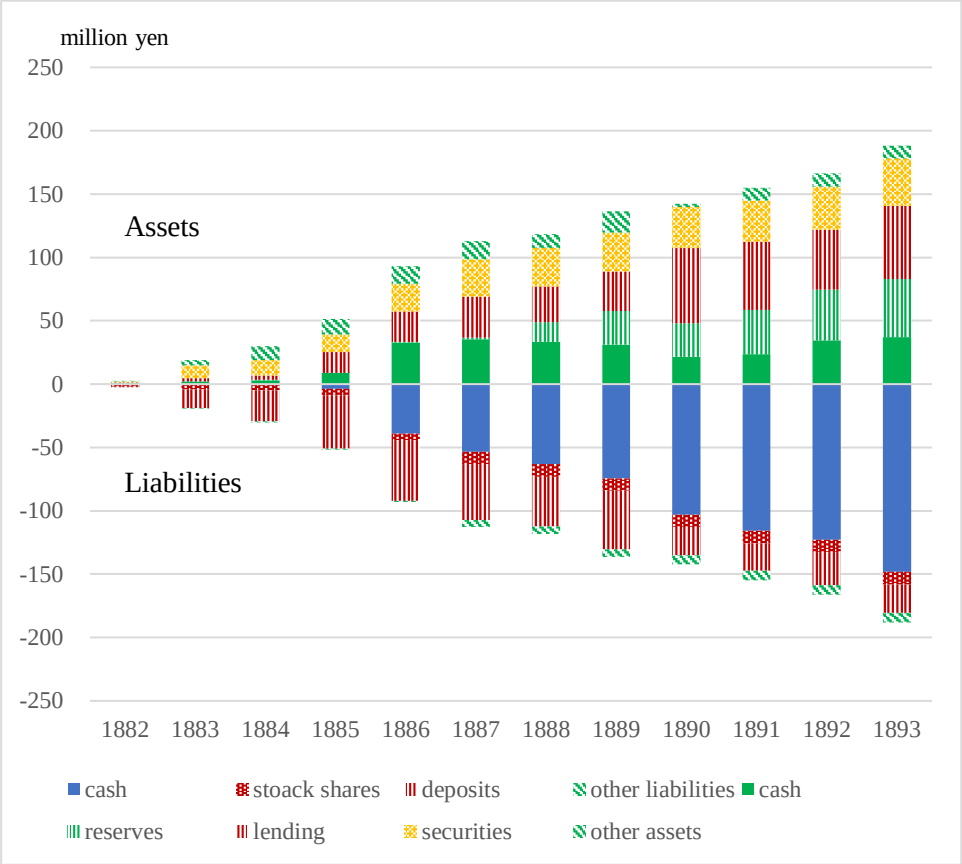
Figure 1 shows the growth of the business of banks excluding the BOJ during the 1880s and early 1890s with some fluctuations. It also reveals that banknotes comprise only a small portion of their liabilities. Figure 2 shows that the BOJ also expanded its operations from the onset. In contrast to other banks, a large part of the BOJ's liabilities was banknotes. Tsurumi (1991) emphasizes the competitive nature of the relationship between the national banks and BOJ in the late 19th century, though no quantitative evidence is given. We need to explore the interaction between existing private banks and the newly established central bank.

Figure 1. Bank's balance sheet excluding the BOJ



Source: Fujino and Teranishi (2000)

Figure 2. The BOJ's balance sheet



Source: Fujino and Teranishi (2000)

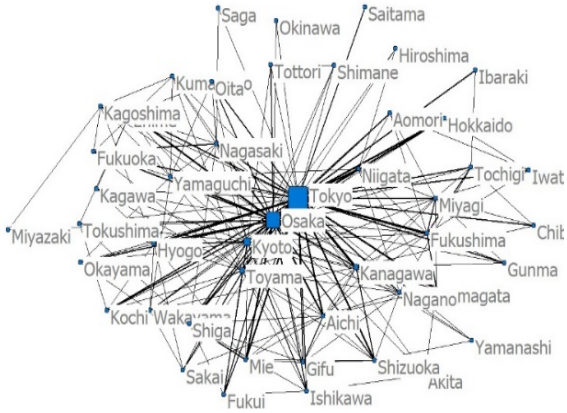
3. Network Analysis of the Private Bank and Central Bank Networks

In this section we employ a network analysis to explore the structures of the networks of the private banks and the BOJ.

First, we map the structure of the network built by the private banks and that built by the central bank with the private banks (Figure 3). Each prefecture is defined as a "node," the basic unit used for the analysis, and the branching and correspondent relationships are "links" connecting pairs of nodes. The maps show a clear difference between the structures of the network built solely by the private banks and the network built by the BOJ. Though without “clusters,” the private bank network as of 1880 had two national centers, Tokyo and Osaka, several regional centers closely connected to the national centers, and many peripheral nodes. In a sense, the private banks had built a hierarchical network before the BOJ was established. In contrast, the network built by the BOJ with the private banks had two "clusters" centered around Tokyo and Osaka, where the headquarters and only branch were placed.

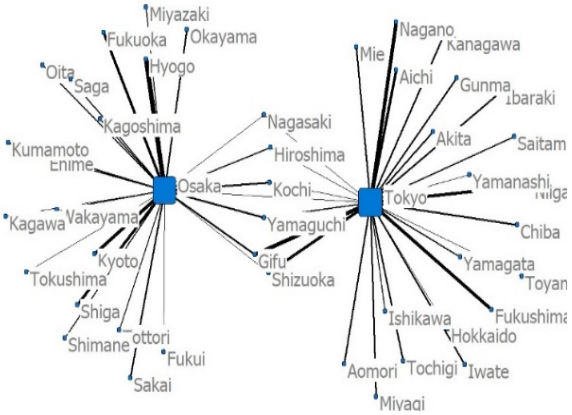
Figure 3. Networks of Private Banks and the Bank of Japan

Within Private Banks



Source: Ministry of Finance (1881).

The Bank of Japan and Private Banks



Source: Bank of Japan (1885).

Second, we compare the density between the network of private banks and the BOJ's network with the private banks. "Density" in the network analysis refers to the ratio of existing links to the maximum number of links to be contained in the network. The density of the private bank network, 438/(47*46)=0.203, is greater than the density of the BOJ network, 100/(46*45)=0.048.[5]

Third, we calculate "centrality measures" of each node in the private bank and BOJ networks. We use several alternative measures of centrality in the network analysis. "Degree" refers to the number of links of a node. "Betweenness" refers to the number of shortest paths between all pairs of nodes that pass through a node adjusted by the total number of shortest paths. "Closeness" is the sum of links on the shortest paths from a node to all of the other nodes. Tokyo and Osaka were the two national centers by all of the aforesaid measures. Prefectures such as Kyoto, Toyama, Kanagawa, Aichi, Hyogo, Yamaguchi, Nagasaki, Niigata, and Fukushima formed regional centers in the private bank network, while no such centers formed in the BOJ network (Table 1).

[5] Only the private bank network has a node in Okinawa Prefecture, so the total number of nodes in that network exceeds that of the BOJ network (47 versus 46).

Table 1. Centrality Measures of Selected Nodes in the Network Analysis

	Network built by private banks/			Number of links		Network built by the Bank of Japan/			Number of links	
Prefecture	Degree	Betweenness	Closeness	PBs-Tokyo	PBs-Osaka	Degree	Betweenness	Closeness	BOJ-Tokyo	BOJ-Osaka
Tokyo	45	398.775	47	-	27	27	697.5	63	-	1
Osaka	41	256.692	51	27	-	25	646.5	65	1	-
Kyoto	28	70.432	64	11	6	1	0	109	0	5
Toyama	19	28.8	73	5	4	1	0	107	1	0
Kanagawa	15	15.294	77	13	5	1	0	107	3	0
Aichi	14	7.782	78	11	8	1	0	107	4	0
Hyogo	13	8.936	79	12	10	1	0	109	0	8
Yamaguchi	13	8.543	79	3	8	2	0	88	2	3
Nagasaki	12	11.051	80	5	6	2	0	88	1	1
Niigata	12	7.151	80	9	3	1	0	107	4	0
Fukushima	12	6.876	80	15	2	1	0	107	5	0
Miyagi	11	8.025	81	6	1	1	0	107	3	0
Nagano	11	4.475	81	7	2	1	0	107	6	0
Shiga	10	3.767	82	6	7	1	0	109	0	4
Gifu	10	1.221	82	7	3	2	0	88	6	3

Source: Author's calculation based on Ministry of Finance (1881) and Bank of Japan (1885) data

4. Effects of the Bank Networks on the Integration of the National Financial Market

In this section we incorporate the results of the network analysis from the previous section into an econometric analysis to examine how the bank networks affected the integration of the national financial market, especially the convergence of prefectural interest rates.

Using prefectural monthly bank lending rates from July 1886 to June 1991, we derive three indexes of market integration into the national financial centers at the prefectural level. Then we relate the structure of the bank networks to the indexes.[6]

First, we derive three indicators of market integration using econometrics. We employ Granger causality tests on the first difference of the prefectural bank lending rates against the two regional centers, Tokyo and Osaka. We confirm that the Tokyo rate was Granger-caused by the Osaka rate while the Osaka rate was not Granger-caused by the Tokyo rate, which suggested that Osaka was superior to Tokyo as the national financial center during the early stage of modern financial development.

Table 2. Granger Causality Tests for Lending Rates between Tokyo and Osaka

	Lag length	Private Banks	
		Tokyo to Osaka	Osaka to Tokyo
July 1886-December 1891	1	Yes	Yes
	2	No	Yes
	3	No	Yes

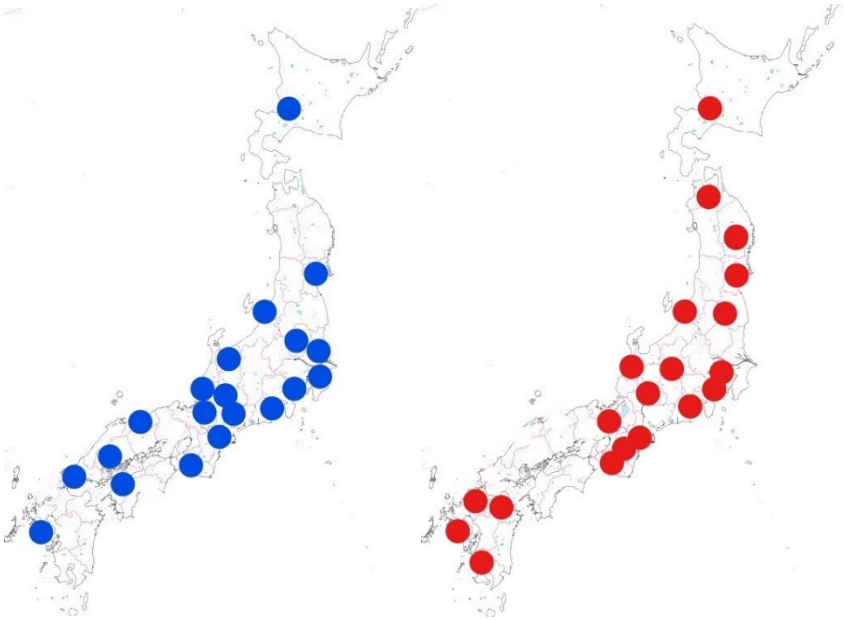
Note: Significant at the 1 percent level.

[6] When Mitchener and Onuki (2007) analyzed prefectural monthly bank lending rates from 1886 to 1922 with the data compiled into the BOJ database, they argued that the Japanese financial market was integrated over time. Mitchener and Ohnuki (2009) attribute the financial market integration to the development of information networks such as the introduction of the telegraph and the establishment of branch offices of commercial banks and the central bank. We focus on the first five years of the data to explore the interaction between existing private banks and the newly established BOJ.

Next, we calculate the statistical significance of the Granger causality tests of other prefectures against Tokyo and Osaka to assess market integration with the national financial centers. Figure 4 summarizes the results of the Granger causality tests for all prefectures. A dot represents that the interest rate in the prefecture was "Granger caused" by the interest rate in a financial center (Tokyo/Osaka), indicating a close link to the financial center. The results suggest that the central-eastern regions near Tokyo (e.g. Kanto and Hokuriku) were closely linked to Tokyo and the north and the western regions (e.g. Tohoku, Kinki and Kyushu) were closely linked to Osaka, while the central region located between Tokyo and Osaka (Tokai) was closely linked to both of the two centers.

Figure 4. Granger Causality Tests on Prefectural Interest rates

Granger-caused by Tokyo Rates Granger-caused by Osaka Rates



Note: Significant at the 1 percent level.

Then we regress an error-correction model following the approach of Obstfeld and Taylor (2004).[7]

$$\Delta R_{i,t} = \alpha + \sum_{j=1}^{p} \beta_j \Delta R_{i,t-j} + \sum_{j=0}^{p} \gamma_j \Delta R_{c,t-j} + \omega\left(\delta + R_{i,t-1} - \theta R_{c,t-1}\right) + \varepsilon_t \quad (1),$$

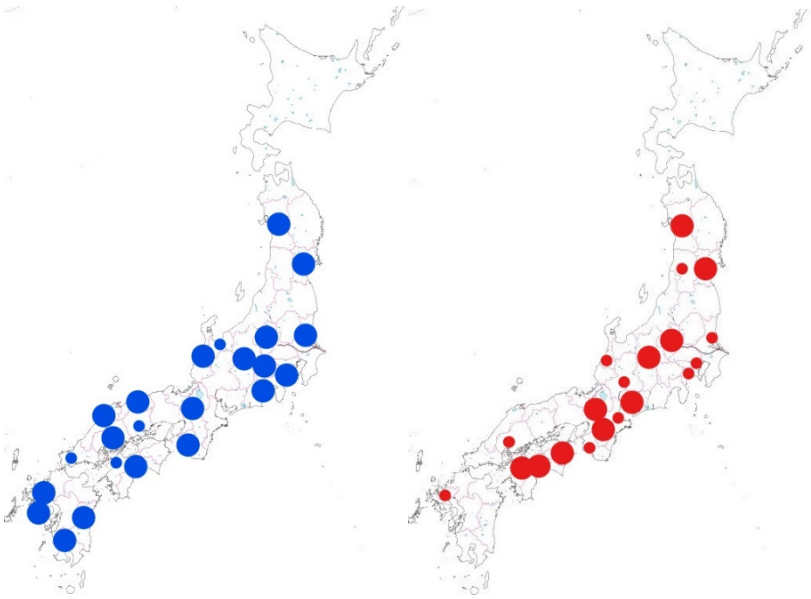
where ω is the "adjustment speed" and θ is a "cointegration coefficient." Interpreting from this approach, we can assess the market integration using three indicators over three time frames: the significance of the Granger causality test in the short-term, the adjustment speed ω in the medium-term, and the cointegration coefficient θ in the long-term. The sign of ω is expected to be negative, and if the absolute value of ω is bigger, the adjustment to the long-run relationship is faster. If θ=1, the local interest rate moved in tandem with the central

[7] Obstfeld and Taylor (2004) explore the degree of integration of national financial markets with the global centers, London and New York, during the gold standard period. We apply their methodology to market integration at the prefectural level in Japan.

rate. The sample period is from July 1886 to December 1891. Figures 5 and 6 report θ and ω of individual prefectures. In many cases, the coefficients have the expected signs and statistically significant, suggesting that the national market integration proceeded in this period as a whole, but with reginal differences.

Figure 5. Convergence of bank lending rates to the rate in the financial center: Adjustment speed (ω)

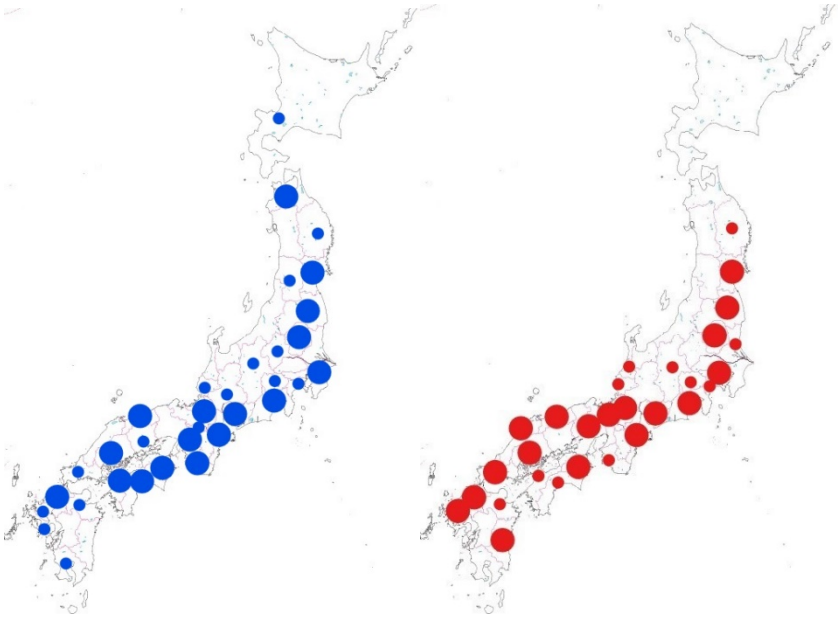
Quickly adjusted to Tokyo rate Quickly adjusted to Osaka rate



Note: Large dots: $\omega \leq -0.5$; small dots: $-0.5 \leq \omega \leq 0$.

Figure 6. Convergence of bank lending rates to the rate in the financial center: Cointegration coefficient (θ)

Cointegrated to Tokyo rate Cointegrated to Osaka rate



Note: Large dots: $0.5 \leq \omega$; small dots: $0 \leq \omega \leq 0.5$.

Second, we employ cross-section regressions to explore how the networks built by the private banks and the BOJ affect the market integration of the prefectures with the national financial centers.

$MI_i = \alpha + \beta NWPBi + \gamma NWCBi + \varepsilon_i$ (2),

where MI_i is an indicator of the market integration of prefecture i, $NWPB_i$ represents the conditions of the private bank network of prefecture i, and $NWCB_i$ represents the conditions of the BOJ network of prefecture i. MI_i is determined using the significance of the Granger causality test, adjustment speed, and cointegration coefficient. $NWPB_i$ and $NWCB_i$ are determined according to the number of links with Tokyo/Osaka, "degree," "betweenness," and "closeness," variables derived from the analysis in the previous section.

The regression results show that coefficients of the private bank network are often statistically significant while those of the BOJ network are not (Table 3). From these results, we conjecture that 1) the network of existing private banks contributed to the convergence of interest rates across prefectures to some extent, and 2) the new central bank added little or nothing to the existing private bank network in terms of interest rate convergence across prefectures.

Table 3. Effects of Bank Networks on Market Integration

1) Dependent variable: Significance of the Granger Causality at 5 per cent level																
Independent variables	Branch/Corres. Relations				Degree				Betweenness				Closeness			
Financial Center	Tokyo	(	robust std.err	)	Tokyo	(	robust std.err	)	Tokyo	(	robust std.err	)	Tokyo	(	robust std.err	)
National Banks	-0.003	(	0.018	)	0.004	(	0.018	)	-0.003	(	0.006	)	0.012	(	0.012	)
BOJ	0.045	(	0.050	)	-0.027	(	0.025	)	0.000	(	0.002	)	-0.012	(	0.007	)
Constant	0.557	(	0.137	***)	0.625	(	0.143	***)	0.641	(	0.084	***)	0.812	(	1.223	)
Number of obs.	44				44				44				44			
R2	0.0233				0.0278				0.0408				0.0403			
F Stat.	0.41				7.42				-				1.70			
Independent variables	Branch/Corres. Relations				Degree				Betweenness				Closeness			
Financial Center	Osaka	(	robust std.err	)	Osaka	(	robust std.err	)	Osaka	(	robust std.err	)	Osaka	(	robust std.err	)
National Banks	0.029	(	0.013	**)	0.034	(	0.016	**)	0.007	(	0.004	)	-0.244	(	0.010	**)
BOJ	-0.021	(	0.038	)	-0.034	(	0.023	)	-0.003	(	0.002	)	0.006	(	0.008	)
Constant	0.563	(	0.109	***)	0.417	(	0.130	***)	0.619	(	0.081	***)	2.091	(	0.710	***)
Number of obs.	44				44				44				44			
R2	0.0645				0.1312				0.0371				0.1183			
F Stat.	2.33				11.23				-				3.52			

2) Dependent variable: Co-integration Coefficient																
Independent variables	Branch/Corres. Relations				Degree				Betweenness				Closeness			
Financial Center	Tokyo	(	robust std.err	)	Tokyo	(	robust std.err	)	Tokyo	(	robust std.err	)	Tokyo	(	robust std.err	)
National Banks	-0.028	(	0.015	*)	-0.018	(	0.014	)	-0.005	(	0.006	)	0.011	(	0.007	)
BOJ	-0.092	(	0.075	)	-0.008	(	0.016	)	0.001	(	0.002	)	0.015	(	0.009	*)
Constant	0.061	(	0.325	)	-0.080	(	0.232	)	-0.213	(	0.184	)	-2.728	(	0.889	***)
Number of obs.	44				44				44				44			
R2	0.0556				0.0215				0.0148				0.0353			
F Stat.	1.85				7.48				-				3.05			
Independent variables	Branch/Corres. Relations				Degree				Betweenness				Closeness			
Financial Center	Osaka	(	robust std.err	)	Osaka	(	robust std.err	)	Osaka	(	robust std.err	)	Osaka	(	robust std.err	)
National Banks	-0.038	(	0.018	**)	-0.007	(	0.020	)	-0.061	(	0.006	)	0.008	(	0.015	)
BOJ	-0.118	(	0.075	)	-0.025	(	0.027	)	0.002	(	0.003	)	0.009	(	0.011	)
Constant	0.125	(	0.280	)	-0.103	(	0.263	)	-0.158	(	0.196	)	-1.853	(	0.999	)
Number of obs.	44				44				44				44			
R2	0.0714				0.016				0.0175				0.0142			
F Stat.	3.11				9.52				-				1.14			

3) Dependent variable: Adjestment Speed																
Independent variables	Branch/Corres. Relations				Degree				Betweenness				Closeness			
Financial Center	Tokyo	(	robust std.err	)	Tokyo	(	robust std.err	)	Tokyo	(	robust std.err	)	Tokyo	(	robust std.err	)
National Banks	0.016	(	0.013	)	-0.011	(	0.021	)	-0.013	(	0.004	***)	0.000	(	0.017	)
BOJ	0.004	(	0.053	)	0.027	(	0.030	)	0.006	(	0.001	***)	0.002	(	0.011	)
Constant	-0.601	(	0.111	***)	-0.450	(	0.155	***)	-0.442	(	0.081	***)	-0.651	(	0.974	)
Number of obs.	44				44				44				44			
R2	0.0256				0.0192				0.1052				0.0008			
F Stat.	1.10				4.10				-				0.02			
Independent variables	Branch/Corres. Relations				Degree				Betweenness				Closeness			
Financial Center	Osaka	(	robust std.err	)	Osaka	(	robust std.err	)	Osaka	(	robust std.err	)	Osaka	(	robust std.err	)
National Banks	-0.010	(	-0.008	)	-0.019	(	0.008	**)	-0.007	(	0.002	***)	0.014	(	0.006	**)
BOJ	0.004	(	0.027	)	0.024	(	0.012	**)	0.004	(	0.001	***)	-0.007	(	0.005	)
Constant	-0.306	(	0.086	***)	-0.219	(	0.076	***)	-0.308	(	0.056	***)	-0.811	(	0.397	**)
Number of obs.	44				44				44				44			
R2	0.0162				0.0751				0.0622				0.0786			
F Stat.	0.73				3.18				-				2.76			

Note: *** represents significance at the 1 percent level; ** at 5 the percent level; * at the 10 percent level.

5. Case Study: The Tenth National Bank

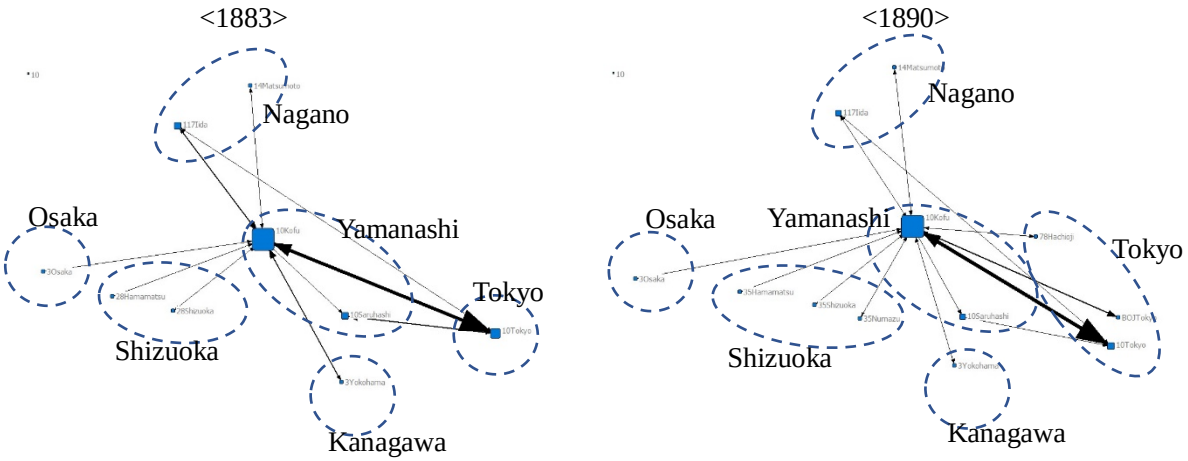
In this section, we look at the working of an individual bank's network as a case study.

We choose the Tenth National Bank headquartered in Kofu, Yamanashi Prefecture. Yamanashi is located west of Tokyo, and produced silk to export through Port of Yokohama in Kanagawa Prefecture. The bank

had brunches in Tokyo and Saruhashi, a town in the eastern Yamanashi. It held correspondence contracts with banks in two financial centers of Tokyo and Osaka as well as neighboring Kanagawa, Shizuoka, and Nagano prefectures. It concluded a correspondence contract with the BOJ in 1884. We have obtained detailed statistics of fund transfer through bills of exchange among its head office, branches and correspondence counterparts from 1877 to 1893.

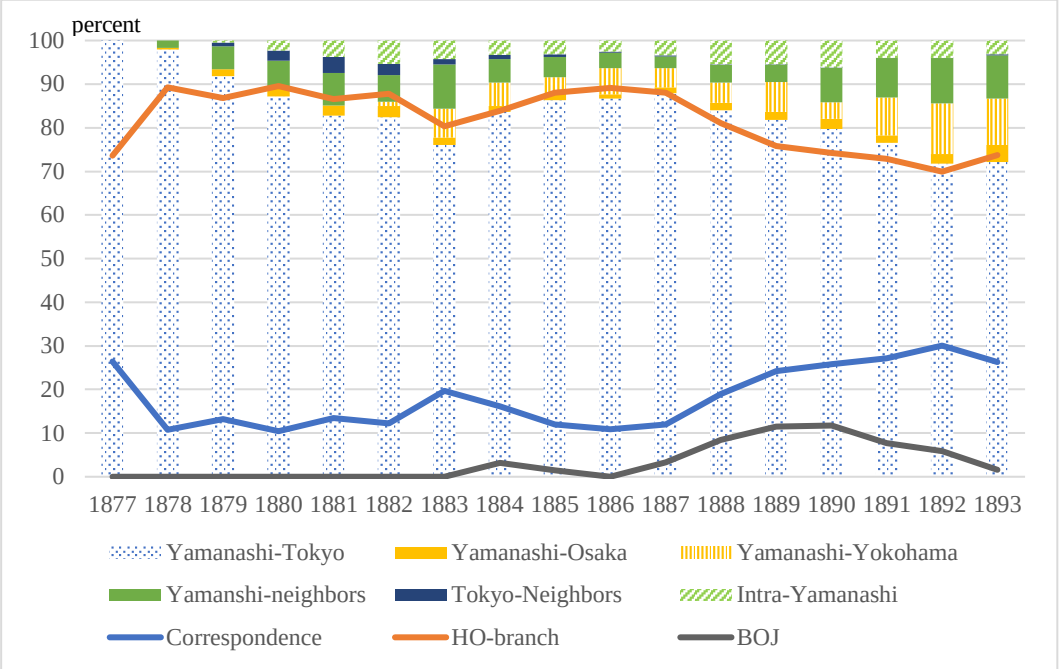
The 10th National Bank's networking strategy and flow of funds did not change after the conclusion of a correspondence agreement with the BOJ. In 1883, it had two branches (one in Yamanashi and one in Tokyo) as well as the head office in Yamanashi, and six correspondence contracts (two in Shizuoka and Nagano, one in Osaka and Kanagawa). It held relationships with banks in neighboring prefectures, financial centers, and the trading port. In 1890, it had its head office and branches in same locations. It held eight correspondence contracts including that with the BOJ (it had opened one more in neighboring Shizuoka). Its networking policy did not change by the opening of a contract with the BOJ (Figure 7). Also, the amount of transactions through bills of exchange, the main instrument for fund transfer, wasn't affected much by the start of business with the BOJ (Figure 8).

Figure 7. The network of the 10th National Bank



Source: Business Report of the 10th National Bank, various issues

Figure 8. Components of flow of funds through bills of exchange within the network of the 10th National Bank



Source: Business Report of the 10th National Bank, various issues

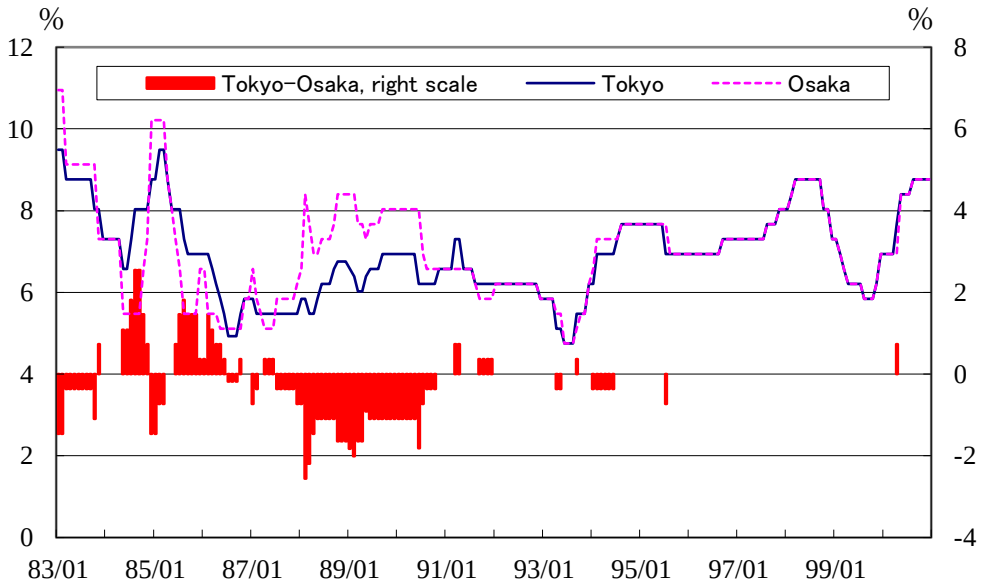
We may, at least partially, attribute the ineffectiveness of the BOJ's correspondence network on the existing network of private banks to the cost structure of fund transfer. In 1890, the 10th National Bank charged its customers a fee of 0.25-0.08 percent for each transaction depending on distance and transportation cost. The BOJ imposed an interest on each correspondence bank's net credit balance at the end of the day at an annual rate of 7.67 percent. This meant that, if the 10th National Bank used its correspondence account with the BOJ and the fund stayed in the BOJ account for five days, the 10th National Bank had to pay as much as 0.105 percent (7.67*5/365) to the BOJ unless an offsetting fund transfer took place. At this price setting, there was little incentive for national banks to use correspondence with the BOJ if they had other alternatives, e.g. inter-branch fund transfers or reciprocal correspondence with other national banks.

These findings are consistent with the results of the previous section, indicating that the founding of the BOJ did not affect the working of existing networks of national banks.

5. Learning by doing to become a central-bank

If the BOJ didn't contribute to the financial market integration in its early days, what did it add to the existing system? The BOJ was going through a process of learning by doing. In the 1880s, the bank set its lending rate in accordance with local financial conditions. Official interest rates differed between the bank's Tokyo Headquarters and Osaka Branch. Different patterns of demand for funds prevented full interest rate convergence even with the presence of the central bank (Figure 9).

Figure 9. Official Discount Rates of the BOJ in Tokyo and Osaka



Source: the BOJ

The BOJ changed its stance toward the financial market for the first time after facing the financial panic of 1890 in Osaka and western Japan. After the panic it expanded its own national branch network and actively extended its lending operations by adding company stocks to eligible collaterals, paving the way to its emergence as the LOLR toward the end of the century. It also started to intervene in local interest rates even during peacetime. The BOJ opened offices in Hakodate, Otaru and Shimonoseki in 1893, Kyoto in 1894, Nagoya in 1897 and Fukushima in 1899.[8]

Table 4 shows a structural change in the relationship between the official discount rate of the BOJ and private lending rate at around the banking panic in 1890. Before the panic, the BOJ's lending didn't necessarily "Granger cause" private lending rate, whereas after the panic, the lending rate of the central bank certainly "Granger caused" private lending rate.

[8] The Bank of Japan (1982), pp.428-438.

Table 4. Granger Causality Tests for Lending Rates of BOJ and Private Banks

	Lag length	Tokyo		Osaka	
		BOJ to PBs	PBs to BOJ	BOJ to PBs	PBs to BOJ
July 1886-December 1891	1	No	No	Yes	No
	2	No	No	No	No
	3	No	No	No	No
January1892-June 1897	1	No	No	Yes	No
	2	No	No	Yes	No
	3	Yes	No	Yes	No

Note: Significant at the 1 percent level.

6. Conclusion

The analyses of this paper reveal that the newly established central bank did no better than private banks in integrating the national financial market in its early days. Mitchener and Ohnuki (2007, 2009) demonstrate an integration of the national financial market over the long run up toward the 1920s for various reasons. This paper shows that the existing private banks had already contributed to the market integration to a certain extent, and that the BOJ needed time to learn to play its role as a central bank. Although the designer of the national monetary system intended to further integrate the national financial market by establishing the central bank, the central bank contributed little or nothing to that plan in its early days. The central bank found another way to contribute, namely, by providing liquidity during the financial crisis of 1890 as the LOLR. After the crisis, the central bank intervened in the financial market more actively.

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