No. DP22-3

RCESR Discussion Paper Series

Interregional Flow of Funds in Japan via Loans and Deposits of Financial Institutions, and its Determinants

March 2022

UESUGI Iichiro, Hitotsubashi University

HIRAGA Kazuki, Nagoya-City University

MANABE Masashi, Kaetsu University

YOSHINO Naoyuki, Keio University

RCESR

The Research Center for Economic and Social Risks
Institute of Economic Research
Hitotsubashi University

2-1 Naka, Kunitachi, Tokyo, 186-8603 JAPAN
http://risk.ier.hit-u.ac.jp/

Interregional Flow of Funds in Japan via Loans and Deposits of Financial Institutions, and its Determinants

UESUGI Iichiro* HIRAGA Kazuki** MANABE Masashi*** YOSHINO Naoyuki****

Abstract

Using data on loan and deposit balances at the bank branch level, we, for the first time, develop indicators of the interregional flow of funds in Japan for the period 2005-2019 and analyze their determinants. Making use of the fact that the regions in which a bank receives deposits and those in which it extends loans are different, we calculate the extent to which deposits in a region are transformed into loans in various regions within a bank. We then aggregate the extent of transformation for all banks to create indicators of the interregional flow of funds in a country. Regarding the characteristics of these indicators, there are several salient features. First, while the majority of deposits goes to lending within the same prefecture, there is also a substantial amount of deposits used for loans in other prefectures. And second, the extent of interregional flow of funds between remote prefectures has declined over time, but the extent between neighboring prefectures has somewhat increased. Regarding the determinants of the interregional flow of funds, we also find several features. First, deposits received in prefectures with lower land prices are used for loans in prefectures with higher land values, indicating that loans related to real estate businesses remain to be an integral part of bank lending. Second, interregional flow of funds is sometimes inefficient in that deposits collected in productive/profitable prefectures are used for loans in less productive/profitable prefectures in some econometric specifications. And third, deposits in concentrated loan markets are transformed into loans in markets that are less concentrated.

Keywords: loan and deposit market; financial intermediation; efficiency of credit allocation; interregional fund flows.

---

* Professor, Institute of Economic Research, Hitotsubashi University (Special Research Fellow, Financial Research Center, Financial Services Agency), Corresponding author
** Associate Professor, Faculty of Economics, Nagoya-City University (Special Research Fellow, Financial Research Center, Financial Services Agency)
*** Professor, Faculty of Business Innovation, Kaetsu University (Special Research Fellow, Financial Research Center, Financial Services Agency)
**** Professor Emeritus, Keio University; Director, Financial Research Center, Financial Services Agency
Original version of the working paper is posted at the webpage of the Research Center of Financial Services Agency as DP 2020-10. The authors would like to express their sincere gratitude to OHGO Naoki, advisor to the Financial Research Center and Financial Services Agency, FUKUDA Shin-ichi, HINO Masashi, Si-Yeon Lee, MORITA Hiroshi, ONO Arito, SHIOJI Etsuro, Gregory Udell, and participants at the seminar in the Financial Services Agency for their valuable comments. Views expressed in this paper are of the authors' and do not necessarily represent those of the Financial Services Agency or the Financial Research Center.

1. Introduction

Banks accept deposits from savers and provide loans to borrowers. Asset transformation, the process in which banks transform liabilities including deposits into assets such as loans with different maturities and interest rates, is one of the major functions of financial intermediaries. Through asset transformation, deposit-taking financial intermediaries play an important role in eliminating mismatches between the supply of and the demand for funds in the economy. For this reason, each country's central bank compiles statistics on the flow of funds in order to quantify the extent banks and other financial intermediaries, households, non-financial institutions and the government, hold assets and liabilities of various types on their balance sheets. In recent years, central banks not only aggregate balance sheets of the financial institutions; they also keep track of the flow of some of the instruments (deposits, loans, and bonds) between institutional sectors including financial institutions.[1]

Despite efforts by the central banks, however, what is less understood is the state of asset transformation across regions within the country. In other words, we do not know much about the behavior of financial institutions that accept deposits and extend loans across regional boundaries. If the scope of a financial institution's activities is limited to a single region, then the institution invests all the deposits it collects in loans to the same region. In reality, however, many financial institutions engage in interregional financial intermediation, collecting deposits and issuing loans across multiple regions. In the United States, many banks began operating across state lines following a series of deregulations on interstate banking operations in the 1980s and 1990s. In Japan, too, where restrictions on the location of bank branches have been lifted for several decades, many cases of cross-boundary lending beyond the scope of the traditional market have been reported (Ozaki et al., 2019), as competition among financial institutions intensifies due to the declining demand for loans. These suggest that financial institutions channel their deposits to lending in a wider geographic area than they did in the past, increasing the need to understand the current state of financial intermediation across regions. Nevertheless, neither economists, policymakers, nor banking practitioners possess a comprehensive understanding of the current state of interregional financial intermediation, namely, how deposits are transformed into loans across regions.[2] Moreover, no assessment has been made as to whether such interregional flows

[1] See Konno (2014) on the developments of these "from-whom-to-whom" statistics by central banks of Japan and several other countries. Manabe (2010) discusses the accuracy of these statistics in detail.

[2] The study that is most closely related to our interest is Aguirregabiria et al. (2020) that measure the gap between geographical distribution of deposits and that of loans in the United States. However, their study does not identify how deposits made in a region are channeled into loans in different regions due to data

of deposits and loans within the country are being carried out efficiently, nor whether they contribute to eliminating mismatches between supply of and demand for funds.

Against this background, in this study, we develop an indicator of interregional flow of funds via deposits and loans of financial intermediaries within a country for the first time. Using the indicators, we then analyze the determinants of the fund allocation between regions. More specifically, we use information on the amount outstanding of deposits and loans held by a financial institution at each branch to calculate the extent to which deposits collected by the institution in a region are used for loans not only to the originating region but to other regions. Having aggregated its extent for all financial institutions in Japan, we create indicators of the interregional flow of funds within the country. We regard this as an attempt to extend the current flow of funds statistics reported by the central banks in various countries beyond what they have done. Further, we estimate coefficients on the determinants of these indicators of the interregional flow of funds. We employ variables for productivity, firms' profitability and stability, market concentration, and real estate market conditions at the regional level and examine whether financial institutions' deposits are transformed into loans according to regional differences in these variables.

The results obtained are twofold: those concerning the characteristics of the interregional flow of funds indicators and those concerning their determinants. Regarding the former on the attributes of the interregional fund flows, there are two major findings. First, the majority of deposits goes to lending within the same prefecture. However, this ratio differs substantially between prefectures (the minimum being over 30%, while the maximum being more than 90%), and there is a substantial amount of funds flows between prefectures. Second, regarding the development of interregional flows during the period of analysis (2005-2019), the proportion of funds transferred between remote areas has decreased, while the proportion of flows between neighboring prefectures has slightly increased. As a result, the weighted average geographic distance between prefectures where deposits are made and those where loans are issued tends to decrease rather than increase over the course of the period of analysis.

Regarding the latter, the determinants of flows of funds, there are three major findings. First, deposits from prefectures with low land prices are used for loans in prefectures with high land prices. Moreover, variations in land prices contribute to the development in the flow of funds more than those in any other explanatory variables. These underline the importance of loans to real estate related businesses in the country. Second, productivity and firms' profitability in a

limitations.

prefecture are not necessarily positively correlated with flows of funds between prefectures. That is, deposits collected in prefectures with higher productivity are sometimes used for loans in prefectures with lower productivity. This indicates that the flow of funds is sometimes inefficient. Third, deposits in concentrated loan markets are transformed into loans in markets that are less concentrated.

The rest of the paper is structured as follows. Section 2 describes our empirical approach. Together with our method to construct indicators of interregional flows of funds, we explain a framework for analyzing the determinants. Section 3 introduces the data used in our analysis. Section 4 presents the results of our analysis. After providing details of the characteristics of the indicators of interregional flows of funds, we explain the estimation results as they pertain to the determinants of flows of funds. In Section 5, we present our conclusions.

2. Empirical Approach

In this section, we first explain the method by which we calculate indicators of the interregional flows of funds via deposits and loans by deposit-taking financial institutions. Next, we introduce our empirical approach for examining the determinants of interregional flows of funds.

2.1 Constructing Indicators of Interregional Flows of Funds

A financial intermediary (hereinafter referred to as bank) i collects deposits D_{ij} from region j and lends $L_{ij'}$ to region j'. Within bank i, the sum of total lending plus non-lending operations in all regions is equal to the sum of total deposits plus non-deposit funding in all regions. To reflect non-deposit funding a non-lending operations, we add the categories “other financing” and “other operations” to regions j and j', respectively, and enter non-negative numbers for these items such that total deposits and total lending match:[3]

$$D_i = \sum_j D_{ij},\ L_i = \sum_{j'} L_{ij'},\ D_i = L_i \qquad (1)$$

The value of j and j' may be the same or different. When a bank opens branches in a different region and collects deposits and extends loans in the region, the amount of collected deposits does not need to match the amount of extended loans in the same region. To that end, banks move

[3] Specifically, if bank i’s “total loans by region” is smaller than “total deposits by region,” the difference between the two (the amount by which deposits exceed loans) is recorded in “other assets.” On the other hand, if total deposits are smaller than total loans, the difference between the two (the amount by which loans exceed deposits) is recorded in “other financing.”

funds across regions to adjust differences in deposits and loans within the region. That is to say, within a bank, deposits in a region are transformed into loans not only in the region where the bank receives deposits but also in other regions where the bank extends loans. To put it another way, the bank collects deposits from various regions in order to finance the loans it extends in one region.

The amount of bank i's loans issued in region j' that is financed by bank i's deposits in region j is:

$$\frac{D_{ij}}{D_i} \times L_{ij'} \tag{2}$$

This expresses the amount of deposits that bank i channels from region j to region j' to finance its lending in region j'. The assumptions underlying the calculations here are: (1) even if there are loans and deposits within regions j and j', respectively, loans and deposits are not offset within regions; and (2) deposits in both regions j and j' are used to finance lending in region j' in proportion to their share of bank i's total deposits. Based on these assumptions, bank i may finance its lending in region j' with deposits in region j at the same time that it finances the lending it does in region j with deposits in region j'.[4]

The deposits in region j used for lending in region j' can be formulated similarly for other banks. Summing up the amount shown in the formula (2) across all the banks, the amount of loans extended by all banks in region j' that is financed by deposits in region j is as follows:

$$\sum_i \frac{D_{ij}}{D_i} \times L_{ij'} = L_{j'} \times \sum_i \frac{D_{ij}}{D_i} \times \frac{L_{ij'}}{L_{j'}} \tag{3}$$

We will use the left-hand side of equation (3) for the amount of interregional flow of funds and employ it to construct a flow matrix for the interregional flow of funds. Each element in the matrix represents the amount of deposits that flow from region j to region j'. We will also use the latter

[4] An alternative approach is to drop assumption (1) and use deposits made in the region primarily for lending in the same region. Appendix provides example of tables for flow of funds indicators in which loans and deposits are offset by a financial institution in the same region. It also shows the results of calculations based on actual data. However, banks do not usually distinguish deposits that are made across different regions because the value of one unit of deposits are exactly the same across regions. Hence, we keep assuming (1) and (2) in the following analysis.

part on the right-hand side of (3), $\sum_i \frac{D_{ij}}{D_i} \times \frac{L_{ij'}}{L_{j'}}$, for the ratio of interregional flow of funds and employ it to construct a coefficient matrix for the interregional funds flow. Each element in the matrix represents the ratio of deposits that flow from region j to region j' for loans to the total amount of loans extended in region j'.

In this analysis, we define regions at the prefecture level. While prefectures are administrative regions and do not necessarily coincide with the scope of the loan and deposit markets, we use this definition as it has been adopted in previous studies on the interbank competition in the Japanese loan market (e.g., Uchida and Tsutsui, 2005, Hiraga, Manabe, and Yoshino, 2018). Note, however, that we use granular information on loans and deposits at the bank branch level and that we are able to construct matrices for interregional flows of funds across geographical areas that are smaller than prefectures.

2.2 A Numerical Example

To illustrate what the two interregional flow of funds matrices represent, the one for the flow amount and the one for flow coefficients, we set up a simple example in which four banks (Bank A to D) have deposit and loan balances in four regions (Region 1 to 4), as shown in Table 1.

$$\sum_i \frac{D_{ij}}{D_i} \times L_{ij'} \tag{4}$$

and

$$\sum_i \frac{D_{ij}}{D_i} \times \frac{L_{ij'}}{L_{j'}} \tag{5}$$

Equations (4) and (5) are included in the matrices that we respectively present in Table 2. The share of deposits received in a region by a bank among the total deposits at the bank, $\frac{D_{ij}}{D_i}$, is shown in a matrix we present in the black box in Table 2. The share of loans extended by a bank in a region among the total loans extended in the region, $\frac{L_{ij'}}{L_{j'}}$, is shown in a matrix that we indicate in the red box. $\sum_i \frac{D_{ij}}{D_i} \times \frac{L_{ij'}}{L_{j'}}$, which is the sum of the multiples between $\frac{D_{ij}}{D_i}$ and $\frac{L_{ij'}}{L_{j'}}$ for all the banks, is shown in the matrix we indicate in the blue box. Finally, multiplying each element in the blue

matrix by L_j, yields $\sum_i \frac{D_{ij}}{D_i} \times L_{ij'}$, which we show in the matrix in the yellow box. This matrix represents the amount of interregional flow of funds.

Table 1: A hypothetical example of deposits and loans by banks and regions

Loans	Bank A	Bank B	Bank C	Bank D
Region1	800	100	200	100
Region2	200	700	400	100
Region3	200	300	800	100
Region4	200	100	200	700
Other assets	800	600	1000	500
Sum	2200	1800	2600	1500

Deposits	Bank A	Bank B	Bank C	Bank D
Region1	2000	0	0	0
Region2	200	1700	600	0
Region3	0	100	2000	0
Region4	0	0	0	1500
Other financing	0	0	0	0
Sum	2200	1800	2600	1500

Table 2: Interregional flow of funds matrices based on the hypothetical example

					Bank A	800	200	200	200	800	2200
					Bank B	100	700	300	100	600	1800
					Bank C	200	400	800	200	1000	2600
					Bank D	100	100	100	700	500	1500
					Sum	1200	1400	1400	1200	2900	
Bank A	Bank B	Bank C	Bank D	Sum		Region 1	Region 2	Region 3	Region 4	Other assets	
2000	0	0	0	2000	Region 1	727.2727	181.8182	181.8182	181.8182	727.2727	2000
200	1700	600	0	2500	Region 2	213.3256	771.6006	486.1305	158.7801	870.1632	2500
0	100	2000	0	2100	Region 3	159.4017	346.5812	632.0513	159.4017	802.5641	2100
0	0	0	1500	1500	Region 4	100	100	100	700	500	1500
0	0	0	0	0	Other financing	0	0	0	0	0	0
2200	1800	2600	1500		Sum	1200	1400	1400	1200	2900	

Bank A	0.666667	0.142857	0.142857	0.166667	0.275862
Bank B	0.083333	0.5	0.214286	0.083333	0.206897
Bank C	0.166667	0.285714	0.571429	0.166667	0.344828
Bank D	0.083333	0.071429	0.071429	0.583333	0.172414
Sum					

Bank A	Bank B	Bank C	Bank D	Sum
0.909091	0	0	0	
0.090909	0.944444	0.230769	0	
0	0.055556	0.769231	0	
0	0	0	1	
0	0	0	0	

	Region 1	Region 2	Region 3	Region 4	Other assets
Region 1	0.606061	0.12987	0.12987	0.151515	0.250784
Region 2	0.177771	0.551143	0.347236	0.132317	0.300056
Region 3	0.132835	0.247558	0.451465	0.132835	0.276746
Region 4	0.083333	0.071429	0.071429	0.583333	0.172414
Other financing	0	0	0	0	0

By looking at each row of the yellow matrix (the matrix for the amount of interregional flow

of funds), which shows $\sum_i \frac{D_{ij}}{D_i} \times L_{ij'}$, we see how the deposits collected in each region are used for loans in different regions and for other assets. In the example, among the 2000 units of deposits collected in region one, 727 are directed to lending within the same region, 182 are employed for loans to each of the three other regions, and 727 are used for other assets.[5] Looking at the column of the same matrix, we see how loans provided in a region are funded by deposits from all the regions. In this example, in order to finance 1200 units of loans made in region one, 727 units of deposits from the same region are used, together with 213, 159, and 100 from deposits in regions two, three and four, respectively.

2.3 Examining Determinants of Interregional Flows of Funds

In this subsection, we present an empirical approach for analyzing determinants of the interregional flow of funds via loans and deposits. Financial institutions collect deposits and other financing sources and invest them in loans and other assets. Their decision is affected not only by the supply side factors but also by the factors on the demand side. Factors considered in making such choices include performance (*Performance*) and stability (*Stability*) of the regional economy, the extent of concentration in the loan and deposit market (*HHI_L* and *HHI_D*), and other regional characteristics (*Others*). We control for macroeconomic factors that may uniformly affect the interregional flow of funds. In some specifications we also control for region-pair fixed effects.

The following two specifications are used for estimation: the one that takes differences of explanatory variables between regions j' and j as presented in Specification (6) and the one that respectively uses the variables in the region where banks receive deposits (Region j) and the variables in the region where banks extend loans (Region j') as presented in Specification (7).

$$Flow_{jj't} = \alpha + \beta_1 Diff\_Performance_{jj't} + \beta_2 Diff\_Stability_{jj't} + \beta_3 Diff\_HHI^L_{jj't} + \beta_4 Diff\_HHI^D_{jj't} + \beta_5 Diff\_Others_{jj't} + \delta_{jj'} + \varepsilon_{jj't} \quad (6)$$

$$Flow_{jj't} = \alpha + \beta_1 Performance_{j't} + \beta_2 Performance_{jt} + \beta_3 Stability_{j't} + \beta_4 Stability_{jt} + \beta_5 HHI^L_{j't} + \beta_6 HHI^L_{jt} + \beta_7 HHI^D_{j't} + \beta_8 HHI^D_{jt} + \beta_9 Others_{j't} +$$

[5] In this example, Bank A is the only bank with deposits in region one, and the first row of the flow matrix shows that Bank A's deposits in the region are assigned to loans extended by Bank A in the four regions and to other assets. Similarly, in region four where only Bank D receives deposits, the fourth row shows how the bank's deposits are transformed into lending to the four regions and other assets. In contrast, Bank A, B, and C collects deposits in region two, and Banks B and C do so in region three. Therefore, in the second and third rows, each element represents the flow of funds by multiple banks.

$$\beta_{10} Others_{jt} + \delta_{jj'} + \varepsilon_{jj't} \quad (7)$$

The dependent variable, *Flow*, which represents the interregional flow of funds, is defined as follows:

$$Flow_{jj't} \equiv \left(\sum_i \frac{D_{ijt}}{D_{it}} \times L_{ij't} - \sum_i \frac{D_{ij't}}{D_{it}} \times L_{ijt}\right) \frac{1}{\sum_i D_{ijt}} \quad (8)$$

We first take the difference between the amount of deposits directed from region j to region j' for loans and the amount of deposits directed in the opposite way from j' to j. We then divide the difference by the amount of deposits in region j. The variable indicates the proportion of the net flow of deposits from region j to region j' relative to the amount of deposits in the region where deposits are originated.

One important point to note is that in this estimation we only focus on how deposits are used for loans across different regions without considering the choice in the use of deposits, that is, whether deposits are employed for loans or for other assets. In a similar vein, we solely focus on how loans extended in a region are financed by deposits from various regions without considering possible non-depository financing sources. Thus, by employing the above specifications of (6) and (7) we implicitly assume the choice between loans and other assets is independent of the locational choice of loans banks extend. In a similar manner, we assume that the choice between deposits and other financing sources is independent of the choice between regions where banks receive deposits.

Turning to the details on the explanatory variables, the first explanatory variable is the productivity of the region and the profitability of firms located in the region. The unit of analysis is the relationship between region j and region j'. We compare firms' productivity and profitability between regions j and j' by subtracting the level of productivity and profitability in region j from the level for region j' to define the following variable:

$$Diff\_Performance_{jj't} \equiv Performance_{j't} - Performance_{jt} \quad (9)$$

This explanatory variable increases as the productivity and profitability of region j' exceeds that of region j more. If the flow of funds between regions is efficient, the sign of the coefficient should

be positive. An alternative explanatory variable would be to use variables related to productivity and profitability for regions j and j' independently, rather than taking the difference between them. In such a case, if the coefficients of the productivity and profitability variables in region j' are positive and those in region j are negative, then the flow of funds is efficient.

Productivity is an important factor in assessing the efficiency of the flow of funds. If lending is allocated according to the level of productivity, that is, if the deposits collected from regions with low productivity are transformed into loans to regions with high productivity, then the flow of funds can be regarded as efficient. Many previous studies on the (in)efficient resource allocation, beginning with Hsieh and Klenow (2009), examine the extent of efficiency by comparing labor and capital productivity across regions and sectors. Our study is based on the same idea and reveals the efficiency of interregional flow of funds by examining the signs of coefficients on productivity.[6]

The second important explanatory variable concerns risks in the region. Even if the productivity and profitability of firms located in the region are lower than others, bank deposits may flow into the region if many of the firms are stable and the likelihood of bankruptcy is low. Thus, employing the difference in business stability between regions j' and j or by using the variable on business stability in regions j and j' independently, we can test whether funds are channeled into regions with high business stability. Similar to the variables for productivity and profitability, the variable comparing business stability is defined as:

$$\boldsymbol{Diff\_Stability_{jj't} \equiv Stability_{j't} - Stability_{jt}} \qquad (10)$$

If funds are flowing into regions with stable business conditions, then there will be a positive coefficient on this difference variable. If the stability variables for regions j' and j are introduced separately in the estimation, we expect a positive coefficient on the stability variable for region j' and a negative coefficient for region j.

The third set of explanatory variables in the estimation measures the extent of competition in the loan and deposit market. Since intense competition in the loan market lowers the lenders' profit margin, banks are likely to search for opportunities to gain higher profit margins and

[6] Restuccia and Rogerson (2017) survey a number of studies on the efficiency in the resource allocation. In their review, many studies in the various fields of economics have examined this issue including development economics, industrial organization, international economics, and labor economics. Regarding the field of finance, they refer to Caballero, Hoshi, and Kashyap (2008) as an example that evidences for the inefficient resource allocation by the presence of so-called zombie firms.

increase flows of funds into less competitive loan markets. We assume here that the extent of competition in the loan market is measured by the size of market concentration, that is, the Herfindahl and Hirschman Index (HHI). When the HHI becomes large, we expect a less competitive environment in the loan market. We employ the difference in HHI in the loan market between region j' and region j:

$$\boldsymbol{Diff\_HHI^{L}_{jj't} \equiv HHI^{L}_{j't} - HHI^{L}_{jt}} \quad (11)$$

We expect a positive coefficient on the variable in the estimation. As the loan market becomes less competitive relative to others, banks tend to channel a larger amount of deposits to the region.

A similar argument may apply to the deposit market. Since more competition raises deposit interest rates and lowers banks' profit margins, banks are likely to collect more deposits in less competitive deposit markets and increase flows of funds from them. We define the difference in HHI in the deposit market as:

$$\boldsymbol{Diff\_HHI^{D}_{jj't} \equiv HHI^{D}_{j't} - HHI^{D}_{jt}} \quad (12)$$

We expect a negative coefficient on the difference variable in the estimation. Suppose that the extent of concentration in the deposit market in region j' becomes larger than before and therefore banks receive a larger amount of deposits in the region. This results in a larger amount of deposit flow from region j' to region j, reducing the amount of net inflow of funds into region j'. By a similar argument, in the estimation in which we include the extent of deposit market concentration in regions j and j' separately, we expect a negative coefficient on the deposit HHI in region j' and a positive coefficient on the deposit HHI in region j.

Other explanatory variables include the level of appraised land prices in a region and the diffusion index of business conditions in Japan. During the asset price bubble in the late 1980s, financial institutions not only increased their lending to firms involved in the real estate businesses, such as firms in the construction and real estate industries and non-bank lenders, but also extended loans against real estate collateral. The emphasis on real estate-related lending led to further increases in real estate prices and in the size of the asset price bubble. Following the collapse of the bubble, the proportion of companies providing collateral, especially in the form of real estate, to financial institutions declined as a result of the protracted decline in real estate prices.[7] It was

[7] According to the Small and Medium Enterprise Agency's Basic Survey on Small and Medium Enterprises,

also because the government authorities encouraged financial institutions to promote lending that did not rely on such collateral. However, financial institutions in recent years have relied on lending to real estate related businesses such as mortgage to rental houses (Bank of Japan, 2016). In light of these background, it is still useful to include the variable on land prices and examine its impact on the interregional flow of funds. Lastly, we also add the Bank of Japan's diffusion index of business conditions, considering the possibility that macroeconomic environment affects the extent of interregional flows of funds over time.

3. Data

In this section, we describe the data used for the analyses. There are three types of data. First and most important, we use data on the outstanding amount of loans and deposits at each head office and branch office of all financial institutions in Japan. The data have been recorded annually at the end of each fiscal year, that is, March 31. Each financial institution reports the data to the Financial Services Agency (hereinafter, FSA) and the agency has stored the data for the years from 2005 to 2019. Financial institutions included in this analysis are major banks, trust banks, other banks, regional banks, shinkin banks, and credit cooperatives.[8] Although the original data include information at the head office and branch office level, for the purpose of this analysis, we aggregate the loan and deposit amount outstanding for each bank at the prefecture level.

We also employ the data to calculate HHI in the loan and deposit market at the prefecture level. Thus far, it has been impossible to accurately calculate the HHI in the loan and in the deposit market at the prefecture level. This has been due to the unavailability of a substantial portion of necessary information for constructing the HHI statistics. In this study, we overcome this issue by using newly available loan and deposit data provided by the FSA. For further information on the construction of the HHI, see Uesugi et al. 2021 (in Japanese).

Second, we employ the Regional-Level Japan Industrial Productivity Database (hereafter R-JIP) jointly produced by the Research Institute of Economy, Trade and Industry (hereinafter, RIETI) and the Institute of Economic Research at Hitotsubashi University and the METI Basic

which provides population estimates of annual trends for all small and medium enterprises, the percentage of enterprises that provide physical collateral for loans from their main banks has fallen from 54% in the 2005 survey to 29% in 2019.

[8] Financial institutions included in the FSA data but not included in our analysis are credit agricultural cooperatives, credit fishery cooperatives, postal savings, Shoko Chukin Bank, and Norinchukin Bank. Further, government-affiliated financial institutions except for Shoko Chukin Bank are not included in the FSA data. Note, however, that these government-affiliated financial institutions do not receive deposits but finance their loans using other sources, which makes them difficult to include in our analytical framework.

Survey of Japanese Business Structure and Activities (hereinafter, BSBSA). They are used for the analysis on the determinants of interregional flow of funds. R-JIP has been constructed as a basic resource for analyzing regional economies in Japan and includes information on nominal and real value added, real capital stock, and working hours by prefecture and industry. This enables us to measure capital and labor productivity for each prefecture. It should be noted, however, that even the latest version of the 2017 R-JIP covers only the period 1970–2012, and there is no information on the regional productivity in recent years by using R-JIP. Hence, the estimation period using R-JIP is limited to the period of 2005-2012.

With regard to the BSBSA, we employ this statistics to obtain information on firms' operating profits, value added, and net worth at the prefecture level, making it possible to calculate the level of productivity, profitability, and the capital ratio. The first two are important to measure the performance of firms located in a prefecture and the last variable is important for measuring the extent of managerial stability of businesses in a prefecture. The advantage of BSBSA over similar government statistics, which is the Ministry of Finance's Financial Statements Statistics of Corporations by Industry, is that semi-aggregated statistics at the prefecture level are publicly available.

Third, for one of the other explanatory variables, we use the logarithm of the average appraised land prices for all purposes by prefecture, which is reported in the annual Public Notice of Land Prices in Japan assembled by the Ministry of Land, Infrastructure, Transport and Tourism. For the variable on the overall business environment in the country, we employ diffusion index (DI) for business sentiment in the Tankan Survey issued by the Bank of Japan. The DI is for all industries and all sizes, measured as of March each year.

4. Results

4.1 Characteristics of the Interregional Flow of Funds Indicators

In the following two subsections, we show the interregional flow of funds indicators in the first and last years of the period of analysis, 2005 and 2019. We focus on their characteristics and developments over time.

4.1.1 Matrix of Coefficients for the Interregional Flow of Funds

Table 3 is a matrix for years 2005 and 2019 showing the ratio of deposits in region j that are used for loans in region j' to the total amount of loans in region j'. Rows add up to 1 in each column. Elements that belong to the top 10% of the ratio size are masked in red, while elements belonging

to the bottom 50% are masked in green.

We start by looking at the matrix for the year 2005 and point out several findings. First, diagonal elements are the largest within each column, indicating that the majority of deposits in a prefecture are transformed into loans in the same prefecture. However, there are variations in size between prefectures. The ratio is larger in remote prefectures (e.g., Okinawa and Hokkaido) and in prefectures which are large in area size (e.g., Hokkaido, prefectures in the Tohoku region, Niigata, and Nagano). In contrast, the ratio is smaller in prefectures at the core of an economic agglomeration (Tokyo and Osaka) and in prefectures adjacent to such cores (Kanagawa and Hyogo). Second, as one of the features about off-diagonal elements, we observe higher ratios between neighboring prefectures. A group of Gunma, Tochigi and Saitama, a group of Toyama, Ishikawa and Fukui, a group of Tottori and Shimane, and a group of prefectures on the Shikoku island are such examples. The ratios between the prefectures are fairly high, indicating the presence of active flows of funds within the groups. Third, the rows for Tokyo and Osaka record higher ratios than others, along which a large number of elements are masked in red. This indicates that a large amount of deposits collected in these prefectures is used for loans extended in the other prefectures. The tendency is more pronounced for Tokyo than for Osaka as almost all the elements in the row for Tokyo are masked in red. Fourth, we look at the bottom row, which represents the shares of other non-deposit financing sources that are used for loans in a prefecture. They are zero for most prefectures or very small even in case they are positive. This indicates that the deposit amount outweighs that of loans in most financial institutions. We also look at the rightmost column, which represents the extent deposits from each prefecture contributes to "asset management other than loans." The ratio is the highest for deposits from Tokyo, indicating that financial institutions headquartered in metropolitan areas such as those in Tokyo contribute to finance the purchases of non-loan assets.

We next compare the matrices in years 2005 to 2019 and examine developments in the interregional flow of funds to note several findings. First, diagonal elements tend to become somewhat larger in the past 15 years, indicating the greater extent that loans in a prefecture are financed by deposits collected in the same prefecture. The prefectures in which the ratios in the diagonal elements increased during the period outnumber the prefectures in which the ratio decreased. The tendency is more pronounced in the prefectures within Tokyo and Osaka metropolitan areas. Second, the relative importance of the flow of funds between neighboring prefectures increased in several regions, including the Kinki and Kyushu regions. The ratios in the off-diagonal elements in these regions has increased during the period and many elements

turned into red in 2019. Third, the ratios in the row for Tokyo declined to some extent as a smaller number of elements are masked in red in 2019 than in 2005. This indicates that the tendency of deposits being channeled to loans in remote regions has somewhat dwindled over the years. Fourth, Tokyo increased its share in other asset management than lending from 28% in2005 to 37% in 2019.

4.1.2. Matrix of Flow Amount for the Interregional Flow of Funds

Table 4 is a matrix showing the amount of deposits collected in prefecture j that are used for loans in prefecture j'. We calculate the amount by multiplying the ratios in Table 3 by the total amount of loans in each prefecture. This matrix is useful when we compare the sheer size of fund flows between regions. There are two points that we would like to highlight. First, the diagonal element is the largest in each row and each column, indicating that the flow of funds is the largest within the same prefecture than it is in any other different prefecture pairs. Second, there is a large influx and outflow of funds in prefectures that belong to metropolitan areas. For example, for Tokyo a large number of elements are masked in red not only along the row but also along the column the prefecture is involved. For Osaka, we observe a similar tendency but to a lesser extent. However, elements along the column tend to be larger than those along the row, indicating that the amount of deposits these metropolitan prefectures receive for loans from other prefectures outweighs the amount of deposits they provide to other prefectures for loans.

4.1.3 Physical Distance between Deposit Collecting Regions and Loan Issuing Regions

In the previous subsections, we explained the characteristics of the interregional flow of funds and the changes during the period of analysis. We did so by focusing on individual elements of the matrix. In this subsection, we attempt to identify the characteristics of the interregional flow of funds by aggregating the data in the matrix into a single value and observing its evolution over time.

Several methods of aggregation can be considered, but here, we measure the physical distance from prefectures where deposits are made to those where loans are issued. We then examine whether these distances have increased or decreased over the period. On the one hand, if banks extend loans in remote prefectures from those they receive deposits, the distance between deposits and loans tends to be larger. We may say that the distance for banks' asset transformation becomes larger than before. On the other hand, if the flow of funds between neighboring prefectures has increased more rapidly than between other pairs of prefectures, as we saw in the

previous subsection, and the relative importance of capital flows from Tokyo has declined, then the distances between deposit collecting prefectures and loan issuing prefectures may have become shorter.

Figure 1 shows changes in the physical distance between deposit-taking prefectures and loan-making prefectures. We employ locational (latitude and longitude) information on each prefectural capital city in Japan and calculate pairwise distances between 47 prefecture capitals in the country. The distances are weighted by the amount of funds in the interregional flow of funds. Looking at the figure, we see that the distance has declined overall during the period, despite a temporal increase following 2011. This is partly consistent with the trend identified by Ozaki et al. (2019) in which financial institutions increased their local lending after 2014 at the same time they increased their lending in neighboring regions. However, our results are inconsistent with them in that we find that the decline in distance between deposits and loans has continued since 2005.

4.2 Determinants of Interregional Flows of Funds

We implement estimations to examine the factors that determine the interregional flow of funds we described in the previous subsections. Specifically, we use panel data to estimate Equations (6) and (7). Table 5 shows the definitions and descriptive statistics of the variables employed for estimations. It should be noted that due to the fact that R-JIP spans only up to the year 2012 and that the variables constructed from the R-JIP database are limited in their observation period and in the number of observations.

Tables 6 presents the results for Equation (6). It comprises two panels: Panel A for estimations without lags in the explanatory variables and Panel B for those taking one period lag for the explanatory variables. In each panel, the left-hand side shows the results of estimation using ordinary least squares (OLS), while the right-hand side shows the results of fixed effect estimation. Table 7 presents the results Equation (7). Other than this, the composition of the table is the same as in Table 6.

In the above tables, as there are seven variables that represent the productivity and profitability of firms in a region, expressed as $Diff\_Performance_{jj'}$ and $Performance_{jj'}$ in these equations, these are used as explanatory variables in separate estimations. Other than these variables, the capital ratio, which is an indicator of business stability expressed as $Diff\_Stability_{jj'}$ and $Stability_{jj'}$, HHI, which is the degree of lending and deposit market concentrations, expressed as $Diff\_HHI_{jj'}$ and $HHI_{jj'}$, the logarithm of land prices, expressed as

$Diff\_Others_{jj'}$ and $Others_{jj'}$, and the business sentiment DI in the Bank of Japan's Tankan Survey, which expresses the state of the economy as a whole, are included as explanatory variables in all estimations.

4.2.1 Results Using Differences between Regions as Explanatory Variables

We start from Table 6 by looking at the OLS estimation results in Columns (1)–(7) of Panel A. Four notable features are observed. First, the signs of significant coefficients on the variables for productivity and profitability are all positive. Positive signs are obtained when we employ the ratio of operating income to total assets, the ratio of operating income to sales, value added per employee, real capital productivity, and real labor productivity. Based on the results of the OLS estimations, we infer that deposits collected in low productivity/profitability prefectures are channeled to loans extended in high productivity/profitability prefectures. Second, for the variable on the business stability of firms located in the region, coefficients are all negative and significant, indicating that the lower the firms' capital ratio becomes and the higher their leverage becomes, greater the amount of funds flowing into the region becomes. Third, for the variables on concentration in the loan and deposit markets, coefficients are negative for all the loan market HHIs and positive for all the deposit market HHIs. This implies that a larger amount of funds flows into regions with low loan market concentration and high deposit market concentration. Fourth, coefficients on land prices are all positive, indicating that flow of funds becomes more sizable from prefectures with low land prices to those with high land prices.

Next, we explain the results of the fixed effects estimation using Columns (8)–(14) on the right-hand side of the same panel. There are several differences on the signs and significance of estimated coefficients obtained from the pooled OLS. There are four notable points. First, with regard to variables on productivity and profitability, while the coefficient on the ratio of operating income to sales remains positive and marginally significant, the coefficients on the ratio of total assets to value added, value added per employee, real capital productivity, and real labor productivity turn negative. Controlling for interregional fixed effects yields estimation results, we identify the impact of changes in the differences in productivity between the respective regions, rather than focus on cross-sectional productivity differences. In such cases, contrary to the OLS estimation results, deposits collected in high productivity prefectures tend to be used for loans in low productivity prefectures.

Second, the coefficients on the variable on business stability among firms in the regions are not significant. Third, for the concentration variables in the loan and deposit markets, all

coefficients for the loan HHI are, like in the results of the OLS, significant and negative. By contrast, the deposit HHI does not have significant coefficients except in Columns (13) and (14), where the estimation period is limited up to 2012. If increased concentration in the loan market raises markups, then increases in HHI should bring about an increase in lending by financial institutions in that region. Contrary to these expectations, however, the results here show that there are fewer flows of funds into regions with high lending market concentrations. This may be due to the declining demand for loans in those regions affecting both the choice of destination for lending by financial institutions and the flow of funds between regions. In this case, financial institutions refrain from entering the market where demand is low and only a limited amount of funds flows into the region, which leads to increased concentration in the loan market and to the lower influx of funds to the region. Fourth, coefficients on land prices are all positive.

Finally, we look at results in Columns (15)–(28) of Panel B. The signs of coefficients are the same as those in Panel A for almost all variables. The exceptions are the positive and significant coefficient on the ratio of operating income to total assets in Column (22) and the insignificant coefficient on the ratio of value added to total assets in Column (24).

4.2.2 Results of Estimation Using the Level of Each Region as Explanatory Variables

This subsection explains the results in Table 7. We first detail the results of the OLS estimation in Columns (29)–(35) on the left-hand side of Panel A. The results are consistent with those in the left-hand side of Panel A in Table 6. That is, signs of coefficients on the variables measuring the difference between regions in Table 6 are the same as signs of coefficients on the variables for region j' in Table 7. And they are mostly opposite of signs of coefficients on the variables for region j in the table. Exceptions are the ratio of operating income to sales (the sign of the coefficient for region j and that for region j' are both positive), the ratio of value added to total assets (not significant in Table 6, but positive for region j' and negative for region j), and value added to sales revenue (not significant in Table 6, but positive for region j'). Moreover, in many estimations, absolute values of coefficients on variables in the destination prefecture (region j') exceed those of the origination prefecture (region j). This suggests that variables in the destination region are more important than those in the origination region as determinants of the interregional flow of funds.

Next, in Columns (36)–(42) on the right-hand side of Panel A we explain the results of estimations controlling for fixed effects between regions. The results are mostly consistent with those in the right-hand side of Panel A in Table 6. That is, signs of coefficients on many variables

measuring the difference between regions in Table 6 are the same as signs of the coefficients on variables for region j' in Table 7. They are opposite to the signs of coefficients on many variables region j. Real capital productivity, real labor productivity, loan market concentration, and land prices are the variables whose coefficients are consistent between Tables 6 and 7.

On the other hand, there are some other variables for which the results do not align between Tables 6 and 7. For productivity and profitability, while the coefficients on the difference variables in Table 6 are insignificant or positive, the coefficients for region j' in Table 7 are negative in some cases (the ratio of operating income to total assets and the ratio of operating income to sales revenue). Some of the coefficients on the difference variables in Table 6 are negative but become insignificant as coefficients for region j' in Table 7 (ratio of added value to total assets). To summarize, the variables related to productivity and profitability in region j' often take negative coefficients. Similar to the results we obtain for the fixed effect estimations in Section 4.2.1, funds flow from regions with high productivity to those with low productivity.

Looking at the deposit market HHI, the coefficients of difference in Table 6 are generally insignificant. In contrast, in Table 7 all coefficients for region j' are both positive and significant and those for region j are also marginally positive in some cases. This implies that the higher the deposit market HHI in region j' and the more moderate its competition, the greater the inflow of funds from region j becomes When we look at firms' capital adequacy ratios, which indicate business stability, the sign of the coefficient in region j' is, as in Table 6, insignificant; however, the sign of the coefficient for region j is significantly positive in several cases.

Finally, looking at Columns (43)–(56) of the estimate results in Panel B of Table 7, the coefficient signs are consistent for almost all variables in Panel A. However, exceptions could be observed for some variables. Some coefficients that are insignificant in Panel A become significant (capital ratio and deposit market concentration in region j), and some other coefficients that are significant turn insignificant (the ratio of operating income to total assets, the ratio of operating income to sales revenue, loan and deposit market concentration in region j'). As for the concentration of the loan and deposit markets, Panel A shows opposite signs of coefficients to those that are predicted. But in Panel B, which uses lagged explanatory variables, there is a substantial decline in the significance level in the estimated coefficients, diminishing the extent to which the results are opposite to those predicted.

4.3 Economic Significance of Estimated Coefficients

In the previous subsections, we look at Tables 6 and 7 and show that there are a number of

variables that are statistically significant, including productivity and profitability, business stability, market concentration, and land prices. The next question is which of these variables has the greatest impact on the interregional flows of funds. In this subsection, we multiply estimated coefficients on explanatory variables and their one-standard deviation to measure the size of impact of these variables on the fund flows.

Table 8 presents the results of the multiplication. A panel in the left corresponds to the estimation results of Equation (6) and a panel in the right corresponds to the results of Equation (7). In each panel, we show one-standard deviation of the explanatory variables in the first column. It is multiplied with the coefficients on each explanatory variable obtained from either OLS estimations or fixed effect estimations. The center column of each panel shows the result of multiplication based on OLS estimations and the right column shows the result based on the fixed effect estimations. We see two notable features.

First, changes in land prices have the greatest influence on the flow of funds. When we employ the estimated coefficients using Equation (6) and apply the OLS method, a one-standard deviation increase in the difference in land prices results in an increase in the flow of funds ratio by 0.47 percentage points. The impact is the largest among the explanatory variables used in Equation (6). Considering that the mean value of the dependent variable is 0.13% and that its standard deviation is 1.1%, the impact is economically quite sizable. Even in the fixed effect estimation, the impact of a change in the difference in land prices on the flow of funds ratio amounts to 0.15 percentage points, again the largest among the explanatory variables.

When we look at the multiplication results in the right panel, the results are more or less consistent with those in the left panel. A panel in the right corresponds to the estimation results of Equation (7). For a one-standard deviation increase in land prices in region j', the dependent variable increases by 0.69 percentage points in the OLS estimate and by 0.13 percentage points in the fixed effect estimate. Land prices in the region from which the flow of funds originates have a relatively smaller negative effect. A one-standard deviation increase in land prices in region j results in a 0.08 percentage point decrease in the OLS and a 0.05 percentage point decrease in the fixed effect estimation.

Second, other variables that have a quantitatively substantial impact on flows of funds include the loan and deposit HHI and real capital productivity. For example, using the OLS estimation results in Equation (6), the variables whose variation causes the greatest impact on the flow of funds are, in the order of the magnitude of the effect, concentration of the deposit market, real capital productivity, and concentration of the lending market, while using the fixed effect

estimation results, the variables are concentration in the loan market and real capital productivity. Compared to these variables, the impact of real labor productivity, the ratio of operating income to total assets, and the ratio of operating income to sales revenue are minor.

5. Conclusion

In this study, we develop indicators of the interregional flow of funds via loans and deposits held by financial institutions. For this purpose we use data reported to FSA on loans and deposits amount outstanding at each branch of financial institutions. We also examine determinants of these flows. Regarding the characteristics of these indicators, there are two salient features: (1) while the majority of deposits goes to lending within the same prefecture, there is also a substantial amount of deposits used for loans in other prefectures; and (2) the extent of interregional flow of funds between remote prefectures has declined over time, but the extent between neighboring prefectures has somewhat increased. Regarding the determinants of the interregional flow of funds, we also find several features. First, deposits received in prefectures with lower land prices are used for loans in prefectures with higher land values, indicating that loans related to real estate businesses remain to be an integral part of bank lending. Second, Interregional flow of funds is sometimes inefficient in that deposits collected in productive/profitable prefectures are used for loans in less productive/profitable prefectures in some econometric specifications. And third, deposits in concentrated loan markets are transformed into loans in markets that are less concentrated.

To the best of the authors' knowledge, there has been no such indicators of interregional flows of funds through the banks' loans and deposits in a single country. Particularly in countries like Japan, where deposit-taking financial institutions play an important role in the flow of funds in the economy, it is important to understand how the flow of funds works and how it is determined.

A particularly interesting finding concerning the determinants of flows of funds is that land prices have a strong impact on fund allocations. Real estate prices have been on a long-term downward trend since the collapse of the bubble economy, and the share of lending secured by real estate has substantially declined. Nonetheless, the results show that conditions in the real estate market continue to play a major role in interregional flows of funds.

There are number of topics for future analysis. First, in relation to the determinants of interregional flows of funds, it is important to analyze to whom financial institutions extend loans among firms located in the region. When a financial institution enters a loan market where firms

and incumbent banks have established close relationships, the quality of firms which the new entrant bank can extend loans to may be much worse than the average quality of firms in the region. Thus, it is important to identify the quality of firms in a region using firm-level information and to scrutinize these data. The second important issue is on the choice between loans and other types of assets. In recent years, the ratio of loans to deposits has continued to drop in Japan due to sluggish demand for loans, increasing the importance of investments in assets such as bonds. We need to incorporate the choice between loans and other asset investment into the examination on the determinants of interregional funds flow. The third is an analysis of the impact of various shocks on the interregional flow of funds. The fiscal stimulus after financial crises, natural disasters, and pandemic may cause major shocks to the interregional flow of funds. Notably, many are concerned about how a massive government expenditure in response to a surge in the Covid-19 infections affects the interregional flow of funds. These are the issues the researchers and policymakers will be interested.

References

Aguirregabiria, V., R. Clark, and H. Wang (2020) "The Geographic Flow of Bank Funding and Access to Credit: Branch Networks, Local Synergies and Competition," *working paper*.

Alessandrini, P., A.F. Presbitero, and A. Zazzaro (2010) "Bank Size or Distance: What Hampers Innovation Adoption by SMEs?," *Journal of Economic Geography*, 10(6), 845–881.

Bank of Japan (2016) "Regional Financial Institutions Lending to Home Owners and Challenges in Credit Management - Results of the Questionnaire Survey," financial system report annex series. (in Japanese).

Caballero, R.J., T. Hoshi, and A.K. Kashyap (2008) "Zombie Lending and Depressed Restructuring in Japan," *American Economic Review*, 98(5), 1943–1977.

Degryse, H. and S. Ongena (2005) "Distance, Lending Relationships, and Competition," *Journal of Finance*, 60(1), 231–266.

Hsieh, C.-T. and P.J. (2009) "Misallocation and Manufacturing TFP in China and India," Klenow,

Quarterly Journal of Economics, 75(4), 1403–1448.

Konno, S. (2014) "The Development and Expansion of Flow of Funds Statistics in Response to International Demands Following the Financial Crisis," *Bank of Japan Review*, 2014-J-6. (in Japanese).

Manabe, M. (2010) "Estimated Flow of Fund Statistics between Institutional Sectors," *Japanese Journal of Monetary and Financial Economics*, 30, 42–62. (in Japanese).

Mester, L.J., L.I. Nakamura, and M. Renault (2007) "Transactions Accounts and Loan Monitoring," *Review of Financial Studies*, 20(3), 529–556.

Ono, A., Y. Saito, K. Sakai. and I. Uesugi (2016) "Does geographical proximity matter in small business *lending*? Evidence from changes in main bank Relationships," HIT-REFINED working paper series 40, Institute of Economic Research, Hitotsubashi University.

Ozaki, M., T. Konno, H. Hiroyama, and Z. Tsuchiya (2019) "Trends in Cross-Border Lending by Regional Banks," *Bank of Japan Review*, 2019-J-4. (in Japanese).

Petersen, M.A. and R.G. Rajan (2002) "Does Distance Still Matter? The Information Revolution in Small *Business* Lending," *Journal of Finance*, 57(6), 2533–2570.

Restuccia, D. and R. Rogerson (2017) "The Causes and Costs of Misallocation," *Journal of Economic Perspectives*, 31(3), 151–174.

Table 3: Matrix of Coefficients for Interregional Flow of Funds

(cells colored red are top 10%, those in green are bottom 50%)

Table for 2005

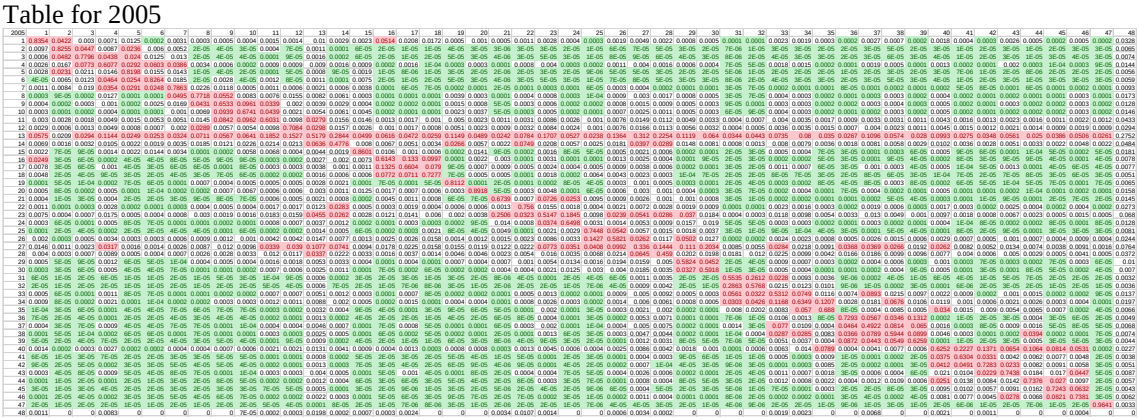


Table for 2019

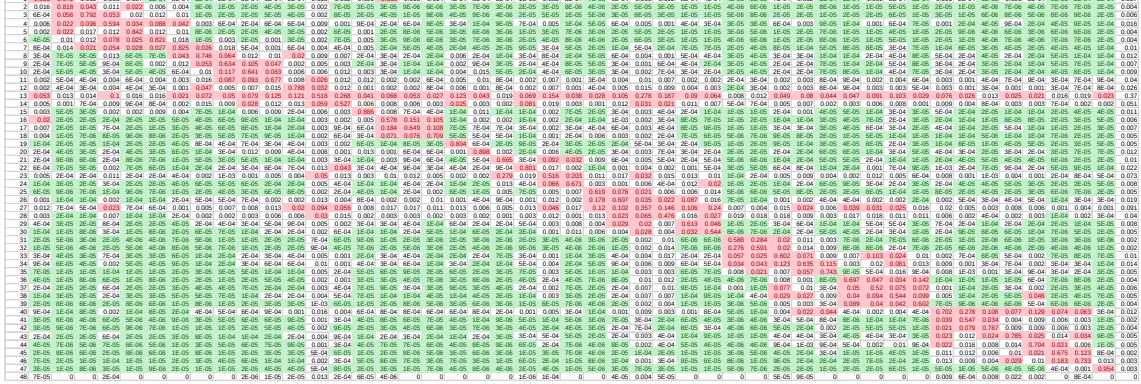


Table 4: Matrix of Flow Amount for Intergenerational Flow of Funds

(cells colored red are top 10%, those in green are bottom 50%)

Table for 2005

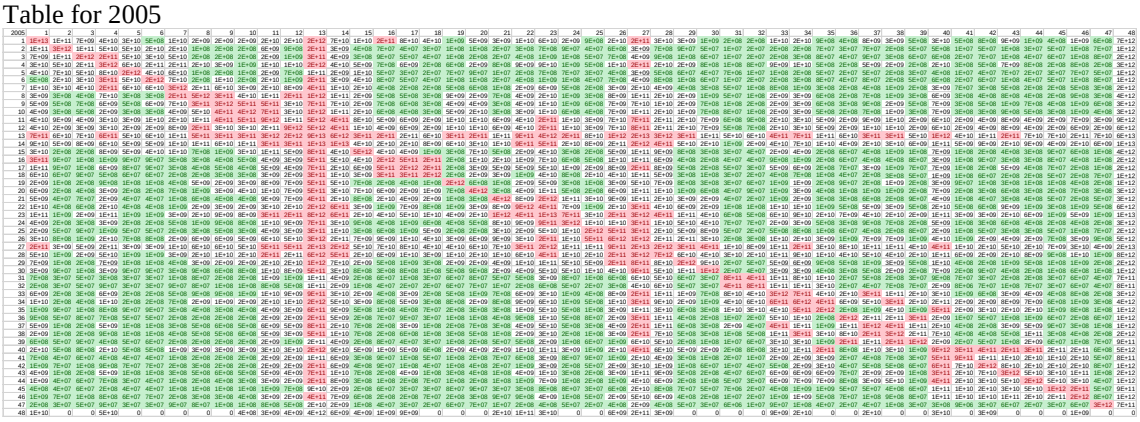


Table for 2019

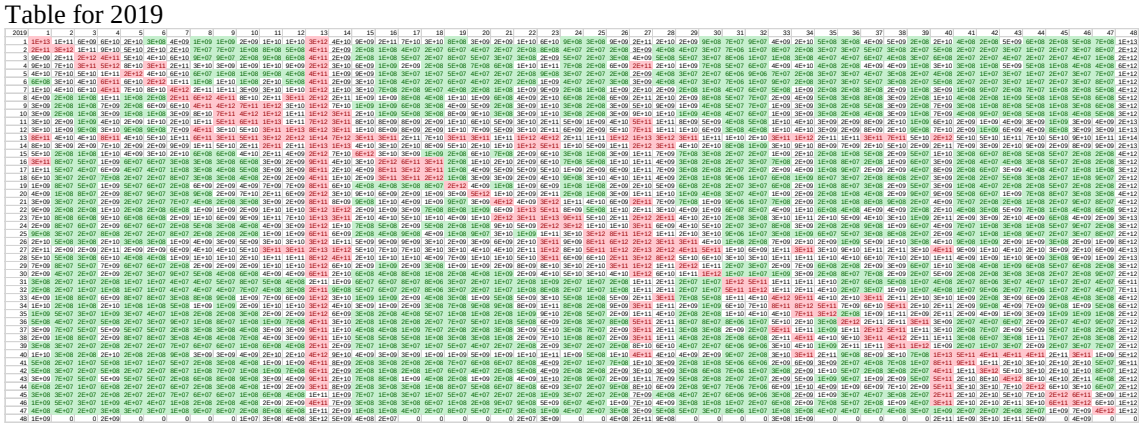


Table 5: Definitions and summary statistics of the variables used in estimations

Definitions

Variable names	Definitions	Source
flow	Flow of funds from prefecture j to prefecture j'	FSA
diff_profit_bus_asset	Difference of profit_bus_asset between j' and j	BSBSA
diff_va_asset	Difference of va_asset between j' and j	BSBSA
diff_profit_bus_sales	Difference of profit_bus_sales between j' and j	BSBSA
diff_va_sales	Difference of va_sales between j' and j	BSBSA
diff_va_emp	Difference of va_emp between j' and j	BSBSA
diff_realVA_capital	Difference of realVA_capital between j' and j	R-JIP
diff_realVA_labor	Difference of realVA_labor between j' and j	R-JIP
diff_cap_ratio	Difference of cap_ratio between j' and j	BSBSA
diff_hhi_loan_pref	Difference of hhi_loan_pref between j' and j	BSBSA
diff_hhi_deposit_pref	Difference of hhi_deposit_pref between j' and j	BSBSA
diff_ln_lp_all	Difference of ln_lp_all between j' and j	BSBSA
profit_bus_asset_j	Business profit/ total asset	BSBSA
va_asset_j	Value added/ total asset	BSBSA
profit_bus_sales_j	Business profit/ sales	BSBSA
va_sales_j	Value added/ sales	BSBSA
va_emp_j	Value added/ number of employees	BSBSA
realVA_capital_j	Real value added/ real capital stock	R-JIP
realVA_labor_j	Real value added/ total number of working hours. Total number of working hours = number of workers at work*number of working hours for a year per person/1000	R-JIP
cap_ratio_j	Net worth/ total asset	BSBSA
hhi_loan_pref_j	Herfindahl-Hirschman Index in the prefecture loan market	FSA, Uesugi et al. (2021)
hhi_deposit_pref_j	Herfindahl-Hirschman Index in the prefecture deposit market	FSA, Uesugi et al. (2021)
ln_lp_all_j	log (average land prices) Land used for residential, industrial, and commercial use	PNLP
boj_di_march	Diffusion index of business conditions	BOJ Tankan

Summary statistics

Variable names	N	mean	sd	min	p1	p5	p10	p25	p50	p75	p90	p95	p99	max
flow	16215	0.0013	0.0110	-0.0453	-0.0110	-0.0021	-0.0007	0.0000	0.0000	0.0001	0.0007	0.0043	0.0583	0.1929
diff_profit_bus_asset	16215	0.0021	0.0224	-0.1124	-0.0629	-0.0333	-0.0215	-0.0093	0.0009	0.0137	0.0297	0.0404	0.0627	0.1051
diff_va_asset	16215	-0.0077	0.0653	-0.2028	-0.1470	-0.1099	-0.0888	-0.0530	-0.0114	0.0354	0.0794	0.1049	0.1533	0.2361
diff_profit_bus_sales	16215	0.0016	0.0256	-0.1621	-0.0848	-0.0332	-0.0214	-0.0090	0.0017	0.0125	0.0253	0.0381	0.0792	0.1531
diff_va_sales	16215	-0.0065	0.0461	-0.2155	-0.1329	-0.0825	-0.0611	-0.0317	-0.0058	0.0188	0.0446	0.0716	0.1178	0.2183
diff_va_emp	16215	-0.1985	2.3615	-9.9059	-5.9135	-4.1771	-3.2312	-1.6380	-0.1375	1.2732	2.6818	3.6374	5.5674	9.5384
diff_realVA_capital	8648	-0.0045	0.0884	-0.4228	-0.2856	-0.1546	-0.1065	-0.0486	0.0006	0.0473	0.0903	0.1198	0.2246	0.3899
diff_realVA_labor	8648	-0.1602	0.8171	-3.5692	-2.2184	-1.5189	-1.1766	-0.6636	-0.1430	0.3535	0.8442	1.1739	1.9031	3.3874
diff_cap_ratio	16215	0.0045	0.1324	-0.6448	-0.3381	-0.2104	-0.1450	-0.0751	-0.0002	0.0822	0.1745	0.2353	0.3269	0.5119
diff_hhi_loan_pref	16215	0.0160	0.0992	-0.3028	-0.2137	-0.1516	-0.1160	-0.0513	0.0171	0.0873	0.1388	0.1758	0.2364	0.3213
diff_hhi_deposit_pref	16215	0.0288	0.1147	-0.3173	-0.2438	-0.1601	-0.1269	-0.0489	0.0308	0.1094	0.1816	0.2084	0.2734	0.3657
diff_ln_lp_all	16215	0.0600	0.8707	-3.4504	-2.7222	-1.4018	-1.0185	-0.3565	0.1512	0.5165	1.0346	1.3766	2.1698	3.7840
profit_bus_asset_j	16215	0.0402	0.0180	-0.0469	0.0002	0.0164	0.0222	0.0301	0.0383	0.0465	0.0651	0.0730	0.0960	0.1180
va_asset_j	16215	0.2414	0.0401	0.0803	0.1585	0.1754	0.1868	0.2129	0.2378	0.2715	0.2966	0.3058	0.3340	0.3646
profit_bus_sales_j	16215	0.0347	0.0192	-0.0286	0.0002	0.0117	0.0163	0.0243	0.0320	0.0409	0.0523	0.0651	0.1104	0.1759
va_sales_j	16215	0.2010	0.0346	0.0653	0.1309	0.1528	0.1633	0.1813	0.1988	0.2158	0.2359	0.2673	0.3144	0.3580
va_emp_j	16215	7.1839	1.5920	4.5402	4.8532	5.2324	5.4652	5.9368	6.8322	8.0953	9.2341	10.5052	12.0383	14.8233
realVA_capital_j	8648	0.4078	0.0586	0.2713	0.2716	0.3069	0.3454	0.3773	0.4037	0.4395	0.4750	0.4978	0.6067	0.7162
realVA_labor_j	8648	4.2462	0.6270	3.2082	3.2813	3.4111	3.4977	3.8474	4.1428	4.5463	5.0050	5.5039	6.2763	6.9995
cap_ratio_j	16215	0.3932	0.1022	-0.0072	0.1847	0.2573	0.2846	0.3262	0.3832	0.4433	0.5192	0.6113	0.6876	0.7145
hhi_loan_pref_j	16215	0.2296	0.0710	0.0486	0.0512	0.0845	0.1408	0.1787	0.2459	0.2874	0.3088	0.3153	0.3366	0.3700
hhi_deposit_pref_j	16215	0.2547	0.0825	0.0869	0.0964	0.1042	0.1269	0.1959	0.2779	0.3113	0.3418	0.3582	0.4569	0.4684
ln_lp_all_j	16215	11.2231	0.5190	10.1266	10.4688	10.5866	10.6690	10.8893	11.1184	11.4295	11.9029	12.2342	13.4202	13.9106
boj_di_march	16215	-1.4	15.7646	-46	-46	-46	-24	-8	5	10	12	17	17	17

Table 6: Panel A estimation results for equation (1), explanatory variables not lagged

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Dependent variable: Flow_jj'							Dependent variable: Flow_jj'						
	Estimation method: Pooled OLS							Estimation method: Fixed effect model (pair of prefectures j and j')						
	Lags for explanatory variables: No							Lags for explanatory variables: No						
Performance														
diff_profit_bus_asse	0.0133***							0.00161						
	(0.00433)							(0.00110)						
diff_profit_bus_sales		0.0170***							0.00227*					
		(0.00396)							(0.00119)					
diff_va_asset			-0.00158							-0.00162**				
			(0.00141)							(0.000729)				
diff_va_sales				0.00122							0.000714			
				(0.00203)							(0.000780)			
diff_va_emp					0.000365***							-8.85e-05***		
					(3.99e-05)							(1.93e-05)		
diff_realVA_capital						0.0236***							-0.00719***	
						(0.00134)							(0.000645)	
diff_realVA_labor							0.00168***							-0.000409***
							(0.000136)							(6.76e-05)
Stability														
diff_cap_ratio	-0.00661***	-0.00736***	-0.00529***	-0.00555***	-0.00738***	-0.00828***	-0.00952***	-0.000300	-0.000350	-0.000109	-0.000272	-5.27e-05	-0.000540	-0.000630
	(0.000729)	(0.000763)	(0.000607)	(0.000687)	(0.000642)	(0.000760)	(0.000804)	(0.000345)	(0.000347)	(0.000337)	(0.000349)	(0.000337)	(0.000421)	(0.000424)
HHI_loan														
diff_hhi_loan_pref	-0.0197***	-0.0198***	-0.0197***	-0.0201***	-0.0162***	-0.0142***	-0.0195***	-0.00783***	-0.00783***	-0.00762***	-0.00779***	-0.00779***	-0.0117***	-0.0115***
	(0.00175)	(0.00174)	(0.00175)	(0.00177)	(0.00179)	(0.00237)	(0.00236)	(0.00114)	(0.00114)	(0.00114)	(0.00114)	(0.00114)	(0.00164)	(0.00165)
HHI_deposit														
diff_hhi_deposit_pre	0.0238***	0.0236***	0.0243***	0.0245***	0.0214***	0.0170***	0.0220***	0.000409	0.000343	0.000292	0.000540	0.000890	0.00719***	0.00666***
	(0.00155)	(0.00155)	(0.00154)	(0.00155)	(0.00157)	(0.00207)	(0.00206)	(0.00149)	(0.00149)	(0.00149)	(0.00149)	(0.00149)	(0.00227)	(0.00228)
Other factors														
diff_ln_lp_all	0.00538***	0.00532***	0.00531***	0.00538***	0.00502***	0.00412***	0.00507***	0.00169***	0.00168***	0.00168***	0.00170***	0.00161***	0.00267***	0.00314***
	(0.000126)	(0.000126)	(0.000136)	(0.000128)	(0.000131)	(0.000181)	(0.000169)	(0.000137)	(0.000137)	(0.000137)	(0.000137)	(0.000138)	(0.000245)	(0.000242)
boj_di_march	2.66e-06	3.02e-06	1.78e-06	1.93e-06	3.64e-06	-2.42e-06	-3.10e-06	-4.45e-07	-4.10e-07	-5.77e-07	-4.63e-07	-8.11e-07	-4.87e-06***	-4.50e-06***
	(5.05e-06)	(5.05e-06)	(5.04e-06)	(5.05e-06)	(5.04e-06)	(6.00e-06)	(6.05e-06)	(1.05e-06)	(1.05e-06)	(1.05e-06)	(1.05e-06)	(1.05e-06)	(1.12e-06)	(1.12e-06)
Constant	0.000565***	0.000582***	0.000567***	0.000583***	0.000706***	0.000756***	0.000797***	0.00126***	0.00127***	0.00125***	0.00127***	0.00124***	0.000937***	0.000892***
	(8.64e-05)	(8.63e-05)	(8.67e-05)	(8.74e-05)	(8.73e-05)	(0.000123)	(0.000125)	(4.19e-05)	(4.19e-05)	(4.21e-05)	(4.20e-05)	(4.22e-05)	(6.35e-05)	(6.44e-05)
Observations	16,215	16,215	16,215	16,215	16,215	8,648	8,648	16,215	16,215	16,215	16,215	16,215	8,648	8,648
R-squared	0.151	0.151	0.150	0.150	0.155	0.184	0.169	0.018	0.018	0.018	0.017	0.019	0.052	0.041
Number of id								1,081	1,081	1,081	1,081	1,081	1,081	1,081

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6: Panel B estimation results for equation (1), explanatory variables lagged by one period

	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
	Dependent variable: Flow_jj'							Dependent variable: Flow_jj'						
	Estimation method: Pooled OLS							Estimation method: Fixed effect model (pair of prefectures j and j')						
	Lags for explanatory variables: One year							Lags for explanatory variables: One year						
Performance														
diff_profit_bus_asse	0.0164***							0.00236**						
	(0.00448)							(0.00105)						
diff_profit_bus_sales		0.0193***							0.00282**					
		(0.00410)							(0.00113)					
diff_va_asset			-0.00105							-0.000631				
			(0.00148)							(0.000698)				
diff_va_sales				0.00187							0.00105			
				(0.00211)							(0.000747)			
diff_va_emp					0.000413***							-4.42e-05**		
					(4.18e-05)							(1.87e-05)		
diff_realVA_capital						0.0247***							-0.00524***	
						(0.00139)							(0.000643)	
diff_realVA_labor							0.00178***							-0.000313***
							(0.000141)							(6.72e-05)
Stability														
diff_cap_ratio	-0.00727***	-0.00799***	-0.00565***	-0.00600***	-0.00798***	-0.00852***	-0.00987***	-0.000453	-0.000494	-0.000233	-0.000410	-0.000178	-0.000510	-0.000572
	(0.000766)	(0.000799)	(0.000637)	(0.000720)	(0.000673)	(0.000785)	(0.000831)	(0.000333)	(0.000335)	(0.000326)	(0.000338)	(0.000325)	(0.000420)	(0.000421)
HHI_loan														
diff_hhi_loan_pref	-0.0202***	-0.0203***	-0.0203***	-0.0207***	-0.0163***	-0.0147***	-0.0201***	-0.00633***	-0.00631***	-0.00616***	-0.00628***	-0.00620***	-0.0103***	-0.0102***
	(0.00184)	(0.00184)	(0.00184)	(0.00186)	(0.00188)	(0.00245)	(0.00244)	(0.00114)	(0.00114)	(0.00114)	(0.00114)	(0.00114)	(0.00163)	(0.00164)
HHI_deposit														
diff_hhi_deposit_pre	0.0242***	0.0240***	0.0248***	0.0250***	0.0216***	0.0180***	0.0233***	-6.99e-05	-0.000148	-1.92e-05	0.000147	0.000232	0.00768***	0.00733***
	(0.00163)	(0.00163)	(0.00162)	(0.00162)	(0.00165)	(0.00214)	(0.00212)	(0.00145)	(0.00145)	(0.00145)	(0.00145)	(0.00145)	(0.00226)	(0.00227)
Other factors														
diff_ln_lp_all	0.00560***	0.00553***	0.00553***	0.00559***	0.00519***	0.00435***	0.00533***	0.00168***	0.00168***	0.00167***	0.00169***	0.00162***	0.00291***	0.00324***
	(0.000134)	(0.000134)	(0.000145)	(0.000136)	(0.000139)	(0.000187)	(0.000175)	(0.000141)	(0.000141)	(0.000141)	(0.000141)	(0.000143)	(0.000244)	(0.000240)
boj_di_march	3.07e-06	3.38e-06	1.96e-06	2.19e-06	4.20e-06	-7.03e-07	-1.42e-06	-4.22e-07	-3.96e-07	-5.78e-07	-4.50e-07	-7.31e-07	-3.31e-06***	-3.03e-06***
	(5.25e-06)	(5.24e-06)	(5.24e-06)	(5.24e-06)	(5.23e-06)	(6.19e-06)	(6.25e-06)	(1.00e-06)	(1.00e-06)	(1.00e-06)	(1.00e-06)	(1.00e-06)	(1.11e-06)	(1.12e-06)
Constant	0.000573***	0.000593***	0.000580***	0.000598***	0.000736***	0.000786***	0.000833***	0.00128***	0.00128***	0.00127***	0.00128***	0.00126***	0.000949***	0.000915***
	(9.10e-05)	(9.09e-05)	(9.13e-05)	(9.20e-05)	(9.19e-05)	(0.000127)	(0.000129)	(4.09e-05)	(4.09e-05)	(4.11e-05)	(4.10e-05)	(4.12e-05)	(6.33e-05)	(6.40e-05)
Observations	15,134	15,134	15,134	15,134	15,134	8,648	8,648	15,134	15,134	15,134	15,134	15,134	8,648	8,648
R-squared	0.154	0.154	0.153	0.153	0.158	0.188	0.173	0.016	0.016	0.016	0.016	0.016	0.043	0.038
Number of id								1,081	1,081	1,081	1,081	1,081	1,081	1,081

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7: Panel A estimation results for Equation (2), explanatory variables not lagged

	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)
	Dependent variable: Flow_jj'							Dependent variable: Flow_jj'						
	Estimation method: Pooled OLS							Estimation method: Fixed effect model (pair of prefectures j and j')						
	Lags for explanatory variables: No							Lags for explanatory variables: No						
Performance														
profit_bus_asset_j	0.0240***							-0.00234*						
	(0.00499)							(0.00140)						
profit_bus_asset_j	-0.0298***							-0.00658***						
	(0.00566)							(0.00161)						
profit_bus_sales_j		0.0219***							-0.00192**					
		(0.00221)							(0.000923)					
profit_bus_sales_j		0.00415***							0.00105					
		(0.00159)							(0.00102)					
va_asset_j'			0.0120**							-0.00112				
			(0.00502)							(0.00158)				
va_asset_j			-0.0262***							-0.00602***				
			(0.00488)							(0.00168)				
va_sales_j'				0.00809***							0.00234**			
				(0.00269)							(0.00102)			
va_sales_j				0.00198							0.00129			
				(0.00265)							(0.00114)			
va_emp_j'					0.000600***							-0.000227***		
					(5.77e-05)							(2.52e-05)		
va_emp_j					-0.000326***							-5.32e-05**		
					(4.80e-05)							(2.62e-05)		
realVA_capital_j'						0.0536***							-0.0102***	
						(0.00171)							(0.000920)	
realVA_capital_j						-0.00902***							0.00554***	
						(0.00155)							(0.000799)	
realVA_labor_j'							0.00451***							-0.000368***
							(0.000165)							(8.95e-05)
realVA_labor_j							-0.000675***							0.000491***
							(0.000161)							(8.04e-05)
Stability														
cap_ratio_j'	-0.00741***	-0.00458***	-0.00680***	-0.00669***	-0.00915***	-0.0130***	-0.0200***	0.000163	0.000191	0.000120	-7.27e-05	8.07e-05	0.000659	-4.45e-05
	(0.000837)	(0.000734)	(0.000929)	(0.000903)	(0.000824)	(0.000902)	(0.000987)	(0.000394)	(0.000387)	(0.000396)	(0.000398)	(0.000386)	(0.000512)	(0.000518)
cap_ratio_j	0.00480***	0.00245***	0.00468***	0.00194**	0.00345***	0.00191*	0.00243**	0.000927*	0.000681	0.00114**	0.000593	0.000826*	0.00232***	0.00180**
	(0.000905)	(0.000783)	(0.000906)	(0.000824)	(0.000781)	(0.00101)	(0.00105)	(0.000495)	(0.000492)	(0.000502)	(0.000522)	(0.000491)	(0.000702)	(0.000713)
HHI_loan														
hhi_loan_pref_j'	-0.0281***	-0.0313***	-0.0289***	-0.0303***	-0.0246***	-0.0168***	-0.0240***	-0.00359**	-0.00369**	-0.00376**	-0.00414**	-0.00434***	-0.00690***	-0.00607***
	(0.00218)	(0.00218)	(0.00218)	(0.00223)	(0.00221)	(0.00275)	(0.00276)	(0.00168)	(0.00168)	(0.00168)	(0.00168)	(0.00167)	(0.00233)	(0.00235)
hhi_loan_pref_j	0.0180***	0.0179***	0.0176***	0.0176***	0.0138***	0.0131***	0.0156***	0.0110***	0.0104***	0.0108***	0.0102***	0.0103***	0.0170***	0.0164***
	(0.00241)	(0.00241)	(0.00242)	(0.00244)	(0.00248)	(0.00322)	(0.00322)	(0.00159)	(0.00159)	(0.00159)	(0.00159)	(0.00158)	(0.00228)	(0.00231)
HHI_deposit														
hhi_deposit_pref_	0.0492***	0.0527***	0.0502***	0.0520***	0.0495***	0.0467***	0.0547***	0.00453**	0.00490**	0.00468**	0.00554**	0.00612***	0.00920***	0.00762**
	(0.00199)	(0.00198)	(0.00198)	(0.00204)	(0.00197)	(0.00246)	(0.00250)	(0.00220)	(0.00220)	(0.00220)	(0.00220)	(0.00220)	(0.00316)	(0.00323)
hhi_deposit_pref_	-0.0133***	-0.0139***	-0.0124***	-0.0138***	-0.00912***	-0.00794***	-0.00921***	0.00212	0.00332*	0.00283	0.00351*	0.00214	-0.00397	-0.00345
	(0.00201)	(0.00201)	(0.00203)	(0.00201)	(0.00210)	(0.00270)	(0.00267)	(0.00190)	(0.00189)	(0.00189)	(0.00188)	(0.00188)	(0.00323)	(0.00324)
Other factors														
ln_lp_all_j'	0.0133***	0.0142***	0.0133***	0.0134***	0.0129***	0.0123***	0.0146***	0.00243***	0.00234***	0.00241***	0.00239***	0.00240***	0.00337***	0.00427***
	(0.000191)	(0.000213)	(0.000191)	(0.000196)	(0.000193)	(0.000251)	(0.000252)	(0.000182)	(0.000182)	(0.000182)	(0.000182)	(0.000183)	(0.000330)	(0.000337)
ln_lp_all_j	-0.00146***	-0.00128***	-0.00135***	-0.00144***	-0.00108***	-0.000694***	-0.000941***	-0.000942***	-0.000995***	-0.000923***	-0.000987***	-0.000750***	-0.00216***	-0.00229***
	(0.000146)	(0.000156)	(0.000148)	(0.000147)	(0.000157)	(0.000202)	(0.000188)	(0.000172)	(0.000172)	(0.000173)	(0.000172)	(0.000173)	(0.000297)	(0.000295)
boj_di_march	1.79e-05***	1.70e-05***	1.95e-05***	1.45e-05***	1.59e-05***	-3.10e-05***	-1.76e-05***	1.48e-06	-2.50e-06**	2.52e-07	-2.71e-06**	8.40e-07	-1.25e-06	-3.83e-06***
	(5.29e-06)	(4.78e-06)	(5.08e-06)	(4.79e-06)	(4.79e-06)	(5.37e-06)	(5.37e-06)	(1.46e-06)	(1.17e-06)	(1.42e-06)	(1.17e-06)	(1.25e-06)	(1.36e-06)	(1.22e-06)
Constant	-0.138***	-0.156***	-0.138***	-0.140***	-0.139***	-0.153***	-0.173***	-0.0187***	-0.0174***	-0.0190***	-0.0190***	-0.0189***	-0.0152***	-0.0257***
	(0.00299)	(0.00354)	(0.00301)	(0.00318)	(0.00300)	(0.00375)	(0.00394)	(0.00276)	(0.00282)	(0.00277)	(0.00279)	(0.00275)	(0.00499)	(0.00510)
Observations	16,215	16,215	16,215	16,215	16,215	8,648	8,648	16,215	16,215	16,215	16,215	16,215	8,648	8,648
R-squared	0.288	0.290	0.287	0.286	0.292	0.372	0.356	0.023	0.022	0.023	0.022	0.028	0.059	0.046
Number of id								1,081	1,081	1,081	1,081	1,081	1,081	1,081

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7: Panel B estimation results for equation (2), explanatory variables lagged by one period

	(43)	(44)	(45)	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)	(55)	(56)
	Dependent variable: Flow_jj'							Dependent variable: Flow_jj'						
	Estimation method: Pooled OLS							Estimation method: Fixed effect model (pair of prefectures j and j')						
	Lags for explanatory variables: One year							Lags for explanatory variables: One year						
Performance														
profit_bus_asset_j	0.0270***							-0.00192						
	(0.00517)							(0.00133)						
profit_bus_asset_j	-0.0346***							-0.00797***						
	(0.00586)							(0.00153)						
profit_bus_sales_j		0.0237***							-0.00117					
		(0.00230)							(0.000880)					
profit_bus_sales_j		0.00372**							-0.000394					
		(0.00166)							(0.000977)					
va_asset_j'			0.0147***							-0.000923				
			(0.00521)							(0.00150)				
va_asset_j			-0.0290***							-0.00726***				
			(0.00504)							(0.00159)				
va_sales_j'				0.00958***							0.00221**			
				(0.00281)							(0.000973)			
va_sales_j				0.00152							0.000226			
				(0.00273)							(0.00110)			
va_emp_j'					0.000685***							-0.000162***		
					(6.08e-05)							(2.44e-05)		
va_emp_j					-0.000358***							-8.16e-05***		
					(4.98e-05)							(2.50e-05)		
realVA_capital_j'						0.0562***							-0.00681***	
						(0.00176)							(0.000916)	
realVA_capital_j						-0.00932***							0.00490***	
						(0.00159)							(0.000796)	
realVA_labor_j'							0.00476***							-0.000163*
							(0.000169)							(8.88e-05)
realVA_labor_j							-0.000723***							0.000482***
							(0.000165)							(7.97e-05)
Stability														
cap_ratio_j'	-0.00827***	-0.00515***	-0.00763***	-0.00752***	-0.0102***	-0.0135***	-0.0209***	0.000342	0.000354	0.000304	9.04e-05	0.000314	0.00101**	0.000380
	(0.000883)	(0.000769)	(0.000977)	(0.000952)	(0.000866)	(0.000927)	(0.00102)	(0.000386)	(0.000378)	(0.000388)	(0.000390)	(0.000376)	(0.000510)	(0.000514)
cap_ratio_j	0.00566***	0.00290***	0.00539***	0.00237***	0.00397***	0.00181*	0.00241**	0.00155***	0.00124**	0.00178***	0.00125**	0.00138***	0.00308***	0.00254***
	(0.000955)	(0.000824)	(0.000952)	(0.000865)	(0.000820)	(0.00104)	(0.00108)	(0.000485)	(0.000483)	(0.000494)	(0.000517)	(0.000483)	(0.000699)	(0.000707)
HHI_loan														
hhi_loan_pref_j'	-0.0284***	-0.0317***	-0.0293***	-0.0309***	-0.0243***	-0.0173***	-0.0248***	-0.00244	-0.00260	-0.00259	-0.00289*	-0.00293*	-0.00620***	-0.00549**
	(0.00229)	(0.00229)	(0.00229)	(0.00233)	(0.00232)	(0.00283)	(0.00284)	(0.00168)	(0.00168)	(0.00168)	(0.00168)	(0.00168)	(0.00232)	(0.00233)
hhi_loan_pref_j	0.0184***	0.0184***	0.0180***	0.0181***	0.0139***	0.0136***	0.0162***	0.00971***	0.00907***	0.00948***	0.00896***	0.00900***	0.0148***	0.0144***
	(0.00253)	(0.00253)	(0.00254)	(0.00256)	(0.00259)	(0.00331)	(0.00331)	(0.00158)	(0.00158)	(0.00158)	(0.00158)	(0.00158)	(0.00227)	(0.00229)
HHI_deposit														
hhi_deposit_pref_	0.0501***	0.0539***	0.0512***	0.0534***	0.0505***	0.0490***	0.0574***	0.00341	0.00393*	0.00356	0.00441**	0.00426*	0.00986***	0.00782**
	(0.00209)	(0.00207)	(0.00208)	(0.00213)	(0.00206)	(0.00253)	(0.00257)	(0.00217)	(0.00217)	(0.00217)	(0.00217)	(0.00217)	(0.00315)	(0.00320)
hhi_deposit_pref_	-0.0135***	-0.0143***	-0.0125***	-0.0141***	-0.00906***	-0.00873***	-0.00996***	0.00246	0.00354*	0.00327*	0.00381**	0.00265	-0.00296	-0.00272
	(0.00211)	(0.00210)	(0.00213)	(0.00211)	(0.00219)	(0.00278)	(0.00274)	(0.00184)	(0.00183)	(0.00183)	(0.00183)	(0.00183)	(0.00321)	(0.00322)
Other factors														
ln_lp_all_j'	0.0140***	0.0149***	0.0138***	0.0140***	0.0134***	0.0129***	0.0153***	0.00265***	0.00252***	0.00262***	0.00255***	0.00263***	0.00435***	0.00515***
	(0.000203)	(0.000226)	(0.000202)	(0.000208)	(0.000205)	(0.000258)	(0.000259)	(0.000188)	(0.000188)	(0.000188)	(0.000188)	(0.000190)	(0.000329)	(0.000335)
ln_lp_all_j	-0.00155***	-0.00137***	-0.00143***	-0.00152***	-0.00113***	-0.000766***	-0.00101***	-0.000772***	-0.000849***	-0.000746***	-0.000841***	-0.000642***	-0.00183***	-0.00185***
	(0.000154)	(0.000164)	(0.000155)	(0.000155)	(0.000164)	(0.000207)	(0.000193)	(0.000177)	(0.000178)	(0.000178)	(0.000177)	(0.000179)	(0.000296)	(0.000293)
boj_di_march	2.05e-05***	1.84e-05***	2.17e-05***	1.62e-05***	1.73e-05***	-3.07e-05***	-1.66e-05***	2.61e-06*	-1.91e-06*	1.31e-06	-1.98e-06*	1.16e-06	-1.58e-06	-3.21e-06***
	(5.51e-06)	(4.90e-06)	(5.27e-06)	(4.92e-06)	(4.91e-06)	(5.52e-06)	(5.52e-06)	(1.37e-06)	(1.09e-06)	(1.33e-06)	(1.09e-06)	(1.17e-06)	(1.35e-06)	(1.21e-06)
Constant	-0.144***	-0.163***	-0.144***	-0.146***	-0.144***	-0.160***	-0.181***	-0.0231***	-0.0209***	-0.0234***	-0.0222***	-0.0229***	-0.0315***	-0.0417***
	(0.00316)	(0.00373)	(0.00317)	(0.00335)	(0.00316)	(0.00386)	(0.00405)	(0.00289)	(0.00292)	(0.00290)	(0.00290)	(0.00288)	(0.00497)	(0.00506)
Observations	15,134	15,134	15,134	15,134	15,134	8,648	8,648	15,134	15,134	15,134	15,134	15,134	8,648	8,648
R-squared	0.295	0.297	0.294	0.293	0.300	0.380	0.365	0.023	0.021	0.022	0.021	0.025	0.053	0.047
Number of id								1,081	1,081	1,081	1,081	1,081	1,081	1,081

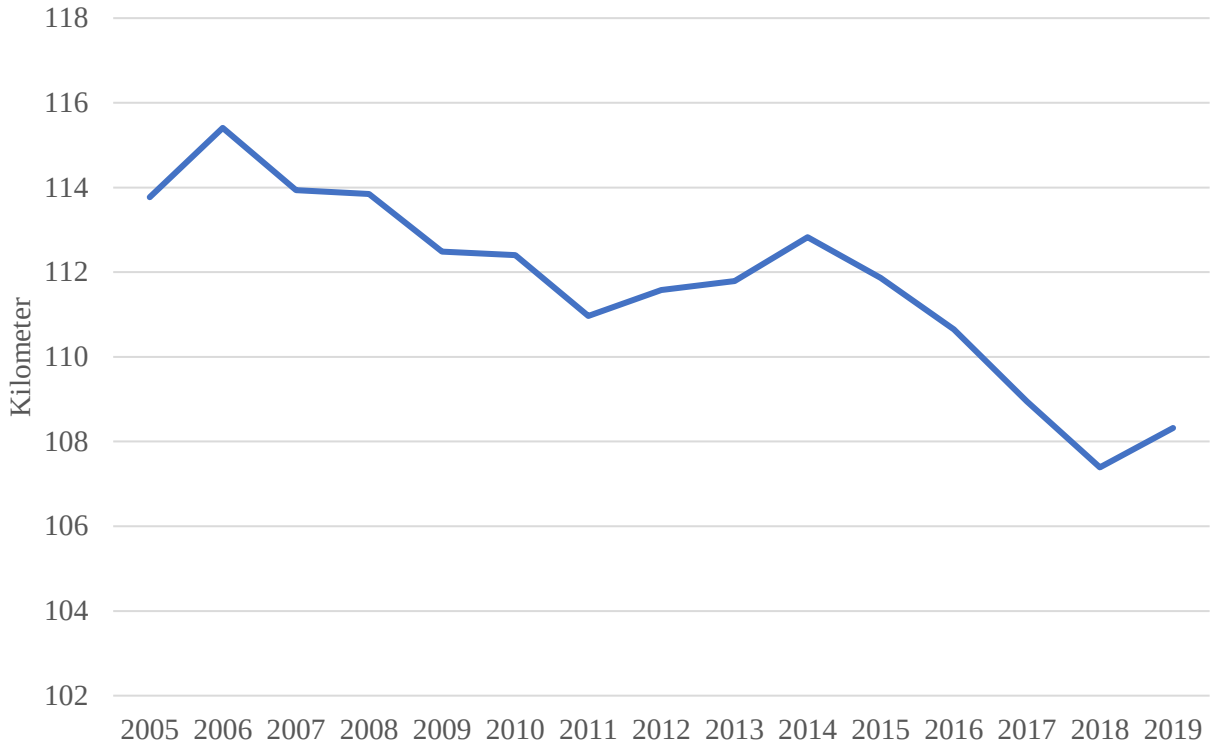
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 8: Effect of a change of one-standard deviation in the explanatory variable on the dependent variable

	one std in	Change in Flow	
	exp. var.	OLS	FE
diff_profit_bus_asset	0.0224	0.0003	0.0000
diff_profit_bus_sales	0.0256	0.0004	0.0001
diff_va_asset	0.0653	0.0000	-0.0001
diff_va_sales	0.0461	0.0000	0.0000
diff_va_emp	2.3615	0.0009	-0.0002
diff_realVA_capital	0.0884	0.0021	-0.0006
diff_realVA_labor	0.8171	0.0014	-0.0003
diff_cap_ratio	0.1324	-0.0009	0.0000
diff_hhi_loan_pref	0.0992	-0.0020	-0.0008
diff_hhi_deposit_pref	0.1147	0.0027	0.0000
diff_ln_lp_all	0.8707	0.0047	0.0015

	one std in	Change in Flow	
	exp. var.	OLS	FE
profit_bus_asset_j'	0.0180	0.0004	0.0000
profit_bus_asset_j	0.0180	-0.0005	-0.0001
profit_bus_sales_j'	0.0192	0.0004	0.0000
profit_bus_sales_j	0.0192	0.0001	0.0000
va_asset_j'	0.0401	0.0005	0.0000
va_asset_j	0.0401	-0.0011	-0.0002
va_sales_j'	0.0346	0.0003	0.0001
va_sales_j	0.0346	0.0000	0.0000
va_emp_j'	1.5920	0.0010	-0.0004
va_emp_j	1.5920	-0.0005	-0.0001
realVA_capital_j'	0.0586	0.0031	-0.0006
realVA_capital_j	0.0586	-0.0005	0.0003
realVA_labor_j'	0.6270	0.0028	-0.0002
realVA_labor_j	0.6270	-0.0004	0.0003
cap_ratio_j'	0.1022	-0.0008	0.0000
cap_ratio_j	0.1022	0.0005	0.0001
hhi_loan_pref_j'	0.0710	-0.0020	-0.0003
hhi_loan_pref_j	0.0710	0.0013	0.0008
hhi_deposit_pref_j'	0.0825	0.0041	0.0004
hhi_deposit_pref_j	0.0825	-0.0011	0.0000
ln_lp_all_j'	0.5190	0.0069	0.0013
ln_lp_all_j	0.5190	-0.0008	-0.0005
boj_di_march	15.7646	0.0003	0.0000

Figure 1: Physical distance between prefectures where deposits are collected and prefectures where loans are extended



Appendix: Indicators of the interregional flow of funds when loans and deposits at the bank prefecture level cancels out

In the analysis presented in the main text, the indicators of interregional flows of funds are calculated based on the idea that "banks lend in each region proportionally to the value of deposits obtained in each region, after aggregating deposits in each region." Conversely, depending on the reason a bank holds both loans and deposits, it may be that deposits in one location are important for loans offered in the same location, while deposits in other locations are not.[9)]

In this Appendix, we define the flow of funds indicators based on the concept that deposits in a region are used first for lending in the same region. In this case, bank i's deposits and loans in each region are, respectively:

$$D_{ij}^{N} = \max(D_{ij} - L_{ij}, 0), \quad L_{ij'}^{N} = \max(L_{ij'} - D_{ij'}, 0) \qquad \text{(A1)}$$

Bank i's total deposits and total loans are, respectively, defined as:

$$D_{i}^{N} = \sum_{j} D_{ij}^{N},\ L_{i}^{N} = \sum_{j} L_{ij'}^{N},\ D_{i}^{N} = L_{i}^{N} \qquad \text{(A2)}$$

The share of bank i's lending in region j' that is financed by bank i's deposits in region j is newly defined as:

$$\frac{D_{ij}^{N}}{D_{i}^{N}} \times L_{ij'}^{N} \qquad \text{(A3)}$$

Under this approach, banks in each region either have zero loans or zero deposits, and thus transfers of deposits to finance loans between bank branches in any two regions are not made in either direction. Below, we examine the extent to which interregional flows of funds differ from the baseline case when loans and deposits are offset at the institutional and prefectural level, using the same examples presented in the main text.

By offsetting loans and deposits, only outstanding deposits and loans are recorded for each bank and region, as shown in Table 9 below.

[9] For example, Mester, Nakamura and Renault (2007) focused on deposit accounts that firms which obtain loans from banks open at those banks and showed that the transactions in those accounts provide important information for determining firms' credit risk. Firms that obtain loans from banks are expected to open deposit accounts at the same branch from which the loan is obtained. In order to handle deposits, which have strong ties to lending, separately, it is desirable that we change our assumption (1) in the main text and consider lending to use deposits made at the same branch and the remainder, after offsetting lending and deposits, is used to exchange funds with others.

$$\sum_i \frac{D_{ij}^N}{D_i^N} \times L_{ij'}^N \quad \text{(A4)}$$

$$\sum_i \frac{D_{ij}^N}{D_i^N} \times \frac{L_{ij'}^N}{L_{j'}^N} \quad \text{(A5)}$$

show how the matrix notation is used. Each region's share of total bank deposits, $\frac{D_{ij}^N}{D_i^N}$, is shown in the black box in Table 10. Each bank's share of total lending within the region, $\frac{L_{ij'}^N}{L_{j'}^N}$, is shown in the red box. Multiplying both and summing for all banks yields $\sum_i \frac{D_{ij}^N}{D_i^N} \times \frac{L_{ij'}^N}{L_{j'}^N}$, shown in the blue box, and multiplying this by $L_{j'}$ yields $\sum_i \frac{D_{ij}^N}{D_i^N} \times L_{ij'}^N$ shown in the yellow box.

Looking across the matrix in the yellow box, which expresses $\sum_i \frac{D_{ij}^N}{D_i^N} \times L_{ij'}^N$, we can see how the deposits collected in each region are used for lending and investment in each region, and how this differs from the baseline. In this example, of the 1200 deposits collected in Region one, after offsetting against loans, Regions three and four each use 200 for lending, and 800 are used for asset management. Compared to the baseline, we see that as a result of Bank A no longer lending to Kagawa due to offsetting, the flow of deposits from Tokushima to Kagawa became zero, and the flow of deposits to the rest of the region increased. Looking at the same matrix vertically, we could also see from which region's deposits the loans offered in each region are provided. In this example, to finance the 400 in loans made in Tokushima, 129, 171, and 100 were used from deposits in Kagawa, Ehime, and Kochi, respectively. The flow of deposits from Kagawa to Tokushima declined because Bank A, which does a lot of lending to Tokushima by offsetting, no longer has deposits in Kagawa.

Table A1: A hypothetical example of deposits and loans by bank and by region (after offsetting deposits and liabilities)

Loans	Bank A	Bank B	Bank C	Bank D	Deposits	Bank A	Bank B	Bank C	Bank D
Region 1	0	100	200	100	Region 1	1200	0	0	0
Region 2	0	0	0	100	Region 2	0	1000	200	0
Region 3	200	200	0	100	Region 3	0	0	1200	0
Region 4	200	100	200	0	Region 4	0	0	0	800
Others	800	600	1000	500	Others	0	0	0	0
Sum	1200	1000	1400	800	Sum	1200	1000	1400	800

Table A2: The interregional flow of funds matrix based on the hypothetical example

				Bank A	0.00	0.00	200.00	200.00	800.00	1200.00
				Bank B	100.00	0.00	200.00	100.00	600.00	1000.00
				Bank C	200.00	0.00	0.00	200.00	1000.00	1400.00
				Bank D	100.00	100.00	100.00	0.00	500.00	800.00
Bank A	Bank B	Bank C	Bank D		Region 1	Region 2	Region 3	Region 4	Others	Sum
1200.00	0.00	0.00	0.00	Region 1	0.00	0.00	200.00	200.00	800.00	1200.00
0.00	1000.00	200.00	0.00	Region 2	128.57	0.00	200.00	128.57	742.86	1200.00
0.00	0.00	1200.00	0.00	Region 3	171.43	0.00	0.00	171.43	857.14	1200.00
0.00	0.00	0.00	800.00	Region 4	100.00	100.00	100.00	0.00	500.00	800.00
0.00	0.00	0.00	0.00	Others	0.00	0.00	0.00	0.00	0.00	0.00
1200.00	1000.00	1400.00	800.00	Sum	400.00	100.00	500.00	500.00	2900.00	4400.00

				Bank A	0.0000	0.0000	0.4000	0.4000	0.2759
				Bank B	0.2500	0.0000	0.4000	0.2000	0.2069
				Bank C	0.5000	0.0000	0.0000	0.4000	0.3448
				Bank D	0.2500	1.0000	0.2000	0.0000	0.1724
Bank A	Bank B	Bank C	Bank D		Region 1	Region 2	Region 3	Region 4	Others
1.0000	0.0000	0.0000	0.0000	Region 1	0.0000	0.0000	0.4000	0.4000	0.2759
0.0000	1.0000	0.1429	0.0000	Region 2	0.3214	0.0000	0.4000	0.2571	0.2562
0.0000	0.0000	0.8571	0.0000	Region 3	0.4286	0.0000	0.0000	0.3429	0.2956
0.0000	0.0000	0.0000	1.0000	Region 4	0.2500	1.0000	0.2000	0.0000	0.1724
0.0000	0.0000	0.0000	0.0000	Others	0.0000	0.0000	0.0000	0.0000	0.0000

Next, we present the results of calculating the interregional flows of funds indicators with loans and deposits offset for each financial institution and prefecture based on actual data. As in the main text, focusing on 2005 and 2019, the beginning and the end of the data period, we present matrices of the ratios of the volume of deposits moved between prefectures for lending divided by the value of loans at the destination, and the volume of deposits transferred between prefectures, as shown in Tables 11 and 12, respectively. In both tables, the diagonal elements of the matrices are zero, that is, the circulation of funds within the same prefecture is shown as zero. Offsetting has significantly reduced the volume of funds transferred, and the zero elements have also increased.

Table A3: Matrix of Coefficients for Interregional Flow of Funds

(cells colored red: Top 10%; cells colored green: Bottom 50%)

Table for 2005

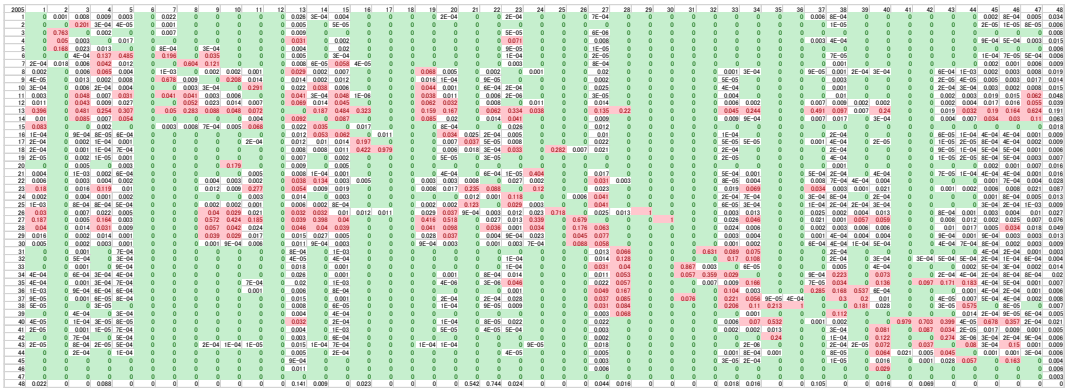


Table for 2019

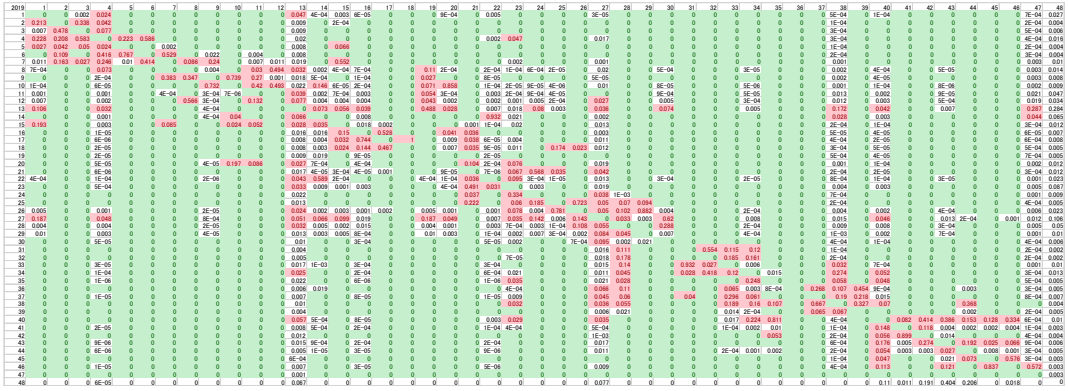


Table A4: Matrix of Flow Amount for Intergenerational Flow of Funds

(cells colored red: Top 10%; cells colored green: Bottom 50%)

Table for 2005

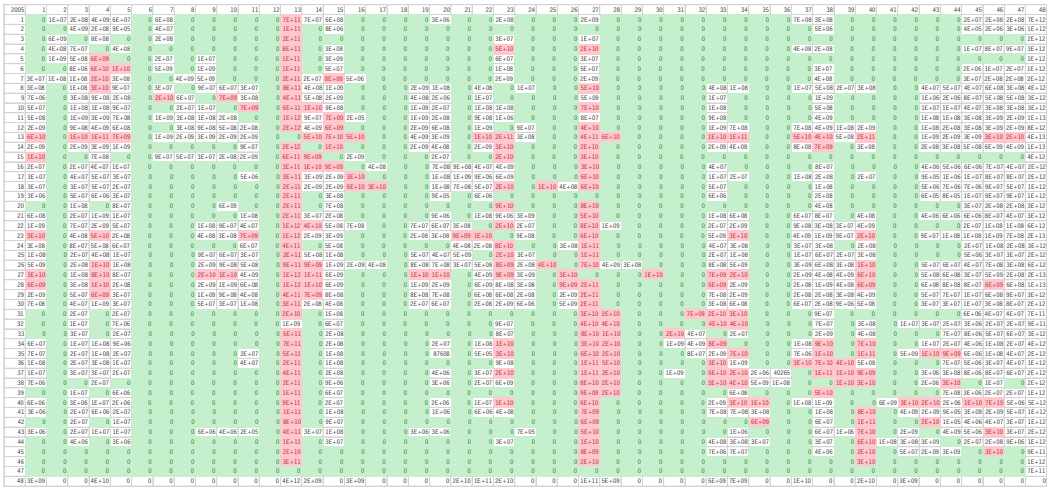
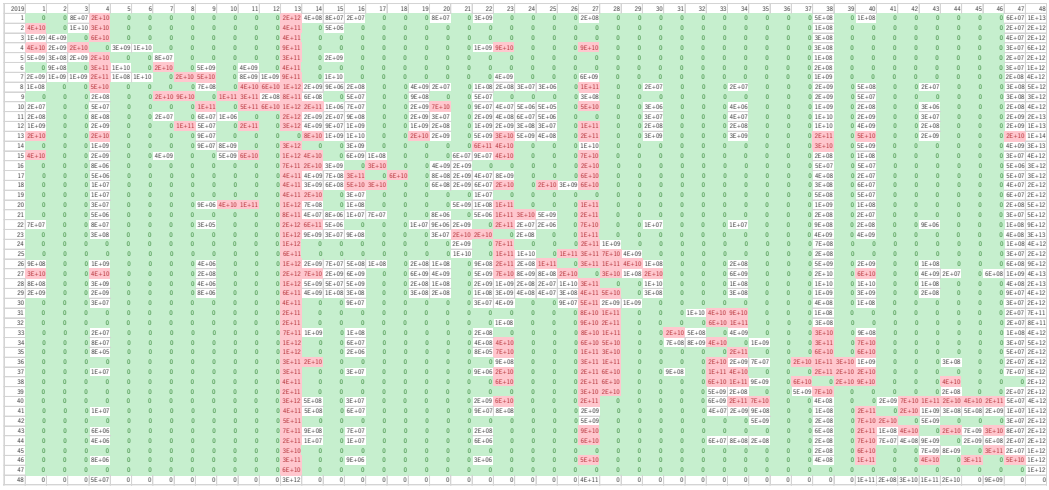


Table for 2019



List of online appendix files (in Japanese)
https://www.fsa.go.jp/frtc/seika/R2.html#13

Appendix file1: Matrix of coefficients for interregional flow of funds: 2005-2019

Appendix file2: Matrix of flow amount for intergenerational flow of funds: 2005-2019
Note: Actual amount of flows are standardized by the amount of deposits collected in Hokkaido that are used for loans extended in Hokkaido in 2005.

Appendix file3: Matrix of coefficients for interregional flow of funds: 2005-2019
Note: Deposits and loans within the same financial institution and prefecture are cancelled out.

Appendix file4: Matrix of flow amount for intergenerational flow of funds: 2005-2019
Note: Actual amount of flows are standardized by the amount of deposits collected in Hokkaido that are used for loans extended in Tokyo in 2005.
Note: Deposits and loans within the same financial institution and prefecture are cancelled out.