Herd Behavior in the Japanese Bank Lending Market since the 1980s [1]

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Abstract

This paper empirically investigates whether Japanese banks had followed herd behavior since the financial liberalization in the 1980s, and whether observed herd behavior, if any, had a potential of inefficient outcomes that could cause macroeconomic fluctuations. Using the data of loan portfolios of Japanese banks, the paper examines Granger-causalities between the lending behaviors of different types of banks. The results suggest: First, Japanese banks inefficiently herded from the early to mid-1980s immediately after the opening of the financial liberalization. Second, this inefficient herd behavior was more intensive in lending to new borrowers that banks had not been familiar with than in lending to their traditional borrowers. Third, banks were inclined to follow other banks that are more informed in lending to a specific industry, or that were larger enough to adjust themselves more effectively to the new environment created by the financial liberalization. These results are fully consistent with theoretical predictions of the past literature and illuminate the possibility that the inefficient herd behavior by Japanese banks created the subsequent asset price bubble in the late 1980s.

Keywords: herd behavior; inefficiency; Japanese banks; bank lending market

JEL classification number: G11; G14; G21; E44

1 Introduction

Japanese banks have been pointed out as following *herd behavior*. Until the late 1970s, the Japanese financial system had been strictly directed by the Ministry of Finance to protect any financial institution from bankruptcy. Capital markets had remained underdeveloped, and bank loans or bond issues underwritten by banks had been the only financing sources for firms. Above all, banking business itself had been the most strictly regulated so that loan amounts, rates, borrowers, fees and so on had been set *uniformly* across banks (Aoki and Patrick[2], Hoshi and Patrick[26]). This regulated financial system has been called the "convoy system." The herd behavior was hence criticized as to symbolize the inefficiency of the Japanese bank lending market.

Accordingly, banks were gradually released from the convoy system and allowed to decide their lending behavior by themselves, since a series of financial liberalization measures were taken in the 1980s. Capital markets have also developed for major Japanese firms in the 1980s, due to the development of bond markets by the huge issuance of government bonds from the late 1970s. [1] Therefore, the financial liberalization may be considered to have resolved herd behavior and made the Japanese lending market more efficient.

Nevertheless, there has been much anecdotal evidence that Japanese banks followed herd behavior even after the financial liberalization, and their seemingly unreasoning behavior has been blamed for subsequent economic fluctuations. For example, in the 1980s, almost all of banks had *uniformly* raised loan shares to finance or real estate industries (seen in Figure 2 later). A fair amount of non-performing loans in the 1990s has been considered to result from the fact that the *majority* of banks did not monitor their borrowers in the asset price bubble period in the late 1980s (Ueda[37]). Afterwards, most banks had *collectively* contracted loans outstanding, the so-called *credit crunch* (Ogawa and Kitasaka[33]). Consequently, the herd behavior by Japanese banks has been criticized as a crucial factor for past stagnations, as Figure 1 shows that the number of the articles, which refer to the herd be-

[1] Hoshi and Kashyap[23][24, chapter 7] survey the financial liberalization measures mainly in terms of three areas: financing, saving, and bank business lines. The financing liberalization particularly with respect to bond markets was developed earlier than other parts, due to the huge issuance of the government bonds in the late 1970s. This paper refers to the financing liberalization, in particular.

havior in the Nihon Keizai Shinbun (Nikkei), is roughly negatively correlated with the real GDP growth rate.

In addition to the anecdotal evidence, it is theoretically imaginable that the financial liberalization itself has created an uncertain environment under which Japanese banks were inclined to herd. As longstanding borrowers ceased to rely only on banks to raise funds in the 1980s, the so-called *financial disintermediation*, banks had to explore new borrowers that they are unfamiliar with, for example, real estate and finance industries (Hoshi and Kashyap[23]). This environment is similar to that occurred to U.S. banks in the late 1970s, when lending opportunities in the U.S. decreased due to economic recession, and U.S. banks had to find new borrowers in developing countries. Jain and Gupta[28] obtain the empirical evidence that small U.S. banks blindly replicated the lending behavior of large U.S. banks. Accordingly, with the lack of information about new borrowers during the financial liberalization in the 1980s, Japanese banks might have herded by inferring the quality of the borrowers from each other's behavior. [2]

Furthermore, the financial liberalization might have created another ground for undesirable herd behavior from a different dimension. Until then, banks' lending areas had been legally segmented by bank type, and each type of banks had had comparative advantages in their own areas. Since the liberalization, however, their borrowers have gradually overlapped with each other across different types of banks (Packer[34]). As each type of banks explored new borrowers in other banks' areas, they might have blindly followed other types of banks who had already had advantages in the areas.

In spite of these observations, few studies have not empirically examined herd behavior by Japanese banks, and a huge amount of criticism just relies on casual observations of herding, but not on any empirical studies. As is mentioned, however, the herd behavior has been discussed as a factor for macroeconomic fluctuations. It is hence necessary to empirically investigate whether Japanese banks had followed herd behavior after the financial liberalization, and whether the herd behavior was harmful or not for the Japanese economy.

[2]Several theoretical studies explain how imperfect information about an investment opportunity is inclined to cause investors' herding. For example, Calvo and Mendoza[12] prove that the increase in new investment opportunities stimulates investors to herd by inferring from others' investment activities. Menkhoff, Schmidt, and Brozynski[31] show that less experienced investors tend to exhibit a higher degree of herding.

The purpose of this paper is to investigate empirically whether Japanese banks had followed herd behavior since the financial liberalization in the 1980s. In particular, this paper focuses on herd behavior across *different* types of Japanese banks, because the different types tend to possess the disparity of information availability, which causes the herd behavior that uninformed banks infer from lending behavior by informed banks. Our empirical methodology is based on Jain and Gupta[28], which is to examine Granger-causalities between lending decisions by different types of banks as evidence for herding.

More importantly, this paper also examines whether identified herd behavior, if any, had led to any *inefficient* outcomes that contradicted fundamental economic conditions and had a potential of subsequent macroeconomic fluctuations, for example, the asset bubble in the late 1980s, the accumulation of non-performing loans in the 1990s. In theory, it depends upon economic conditions whether herd behavior is socially desirable or not. As is mentioned earlier, there has been much anecdotal evidence for banks' herd behavior since the 1980s, but the behavior does not necessarily mean to have been consistent with fundamental conditions at that time and to have caused undesirable fluctuations. For example, if each of banks responds to the same economic conditions independently and rationally, they would behave similarly, but their behavior is mere *clustering* or *spurious herding* that is socially efficient (Hirshleifer and Teoh[21]). [3] On the other hand, there can also be the case that, even if banks' herding depends on their rational decisions, it can lead to inefficient outcomes under the environment of imperfect information. For example, Bikhchandani, Hirshleifer, and Welch[6][7] establish an *informational cascade* model, in which agents make a similar decision based not only on their own private information, but also on the past record of decisions made by their predecessors. They describe that the herd behavior is fully rational, but can be inefficient as well as efficient. [4] Therefore, we will

[3]Actually, in the asset price bubble in the late 1980s, most Japanese banks expected the surging land prices to be sustained and expanded lending to real estate related industries. See Ueda[37].

[4]Information cascade is also analyzed by Alevy, Haigh, and List[1], Banerjee[3], and Chari and Kehoe[10]. Other theoretical studies on *rational* herding include: (i) herding based on *payoff externalities* (e.g. *bank run* in Diamond and Dybvig[15], *liquidity* in Devenow and Welch[14], and receipt of *correlated private information* in Froot, Scharfstein, and Stein[18] and Hirshleifer, Subrahmanyam, and Titman[20]); (ii) herding stemming from *reputation concerns* of acting differently from other managers (Scharfstein and

examine whether observed causalities can be explained by economic variables that may uniformly affect the lending decisions of individual banks, such as the future profitability of borrowers or structural changes in the Japanese financial market. If any causality is still observed after controlling for those factors, it may be considered as evidence for *inefficient* herd behavior that might have contributed to subsequent economic fluctuations. [5]

Note, however, that this paper focuses merely on investigating whether observed herd behavior was so efficient, but not on identifying any theoretical reasons for herding. Bikhchandani and Sharma[8] point out that there is no direct link between the theoretical discussion of herding behavior and the empirical specifications used to test for herding. Alevy, Haigh, and List[1] also argue that it is difficult to control for underlying fundamentals and distinguish spurious herding and any rational herding.

The empirical results of the paper is supportive of the prediction that Japanese banks followed herd behavior after the financial liberalization as well as during the period of the convoy system until the 1970s. Specifically, the results has a *time-specific* feature that banks had *inefficiently* herded from the early to mid-1980s immediately after the opening of the financial liberalization. Next, as a *borrower-specific* feature of the results, the inefficient herd behavior was more intensive in lending to new borrowers that banks had not been familiar with than in lending to traditional borrowers. Finally, as a *bank-specific* feature, banks were inclined to follow other banks that are more informed in lending to a specific industry, or that were larger enough to adjust themselves more effectively to the new environment created by the financial liberalization. Totally our results suggest that the financial liberalization had created an imperfect information environment that had induced banks' inefficient herd behavior, which might have contributed to the subsequent asset price bubble in the late 1980s.

In addition, these results provide empirical supports for theoretical predictions of the past studies. For example, the time-specific feature, that

Stein[36]; Trueman, 1994; Zwiebel, 1995; Prendergast and Stole, 1996; Avery and Chevalier, 1999; and Effinger and Polborn, 2001), (iii) herding due to a *comparative advantage* in holding securities with certain characteristics (Falkenstein[17]). See Bikhchandani and Sharma[8], Devenow and Welch[14], Hirshleifer and Teoh[21], and Chamley[11], and Welch[39] for survey on herd behavior.

[5]See Bischi, Gallegati, Gardini, Leombruni, and Palestrini[5], and Welch[39] regarding numerical or empirical analysis on the macroeconomic impact of herding on financial markets and real economy.

inefficient herding disappeared in the late 1980s, is consistent with studies based on Bayesian learning frameworks, in which agents learn new investment strategies from the behavior of other agents, and their inefficient herding consequently disappears, as agents get familiar with the new environment. [6] The borrower-specific evidence is similar to that by Jain and Gupta[28], who find herding by U.S. banks in lending to unfamiliar developing countries. The bank-specific feature is also consistent with the theoretical literature which concludes that uninformed agents are inclined to follow informed agents under imperfect information. [7]

This paper is closely related to several empirical studies about herd behavior by U.S. banks. Jain and Gupta[28] apply the Granger-causality test to examine herd behavior and find evidence that U.S. banks followed herd behavior in lending to developing countries since the late 1970s. Barron and Valev[4] also find evidence that smaller U.S. banks rely on the behavior of more informed banks from 1982 to 1994. The advantage of our paper is to examine the efficiency of herd behavior as well as the existence of it, while the above studies focus only on the latter issue.

There is a companion paper (Uchida and Nakagawa[38]) which also investigates herd behavior by Japanese banks. The analysis focuses on herd behavior *among the same types of banks* based on the methodology of Lakonishok, Shleifer, and Vishny[29], while this paper focuses on the behavior *across different types of banks*. The former paper provides empirical evidence that major Japanese banks had followed inefficient herd behavior among the same types of banks in the asset price bubble of the late 1980s. In this sense, both papers are complementary to each other and indicate that inefficient herd behavior occurred across bank types in the early and mid-1980s, and afterwards among the same types in the late 1980s. Those successive herd behaviors might have contributed to the formation of the asset bubble in the late 1980s.

The remainder of this paper is composed as follows. Section 2 describes

[6] See Chamley[11], for example. Nelson[32] also shows that inefficient herding gradually disappears when underlying fundamental market conditions change over time.

[7] For example, Chari and Kehoe[10] establish a cascade model in which investors delay investment in order to gain information and start herding when waiting becomes costly due to discounting. Also, Barron and Valev[4] establish a model that smaller banks endowed with insufficient wealth are more likely to not gather costly information on investment prospects, and to rely on the behavior of more informed banks with some delay to infer information about international investment prospects.

the Japanese bank lending market and its historical transition. Section 3 conducts our basic empirical analysis to examine the existence of herd behavior. Section 4 examines the efficiency of the herd behavior observed in Section 3. Section 5 proceeds to further detailed analysis (*sequential* causality test) to reinforce the previous results. Section 6 checks the robustness of the previous results by doing panel VAR causality tests. Section 7 concludes the paper.

2 Loan Data

This section introduces the data of the types of Japanese banks and their loans outstanding by borrower. The loan data is available from "Loans and Discounts Outstanding by Sector" in the *Financial and Economic Statistics Monthly* by the Bank of Japan. The section also describes the historical transition of borrowers, in order to provide the background for later empirical analysis. Other details and data transformations are summarized in Appendix A.1.

2.1 Bank type

Japanese banks are categorized into four types: city banks, regional banks, long-term credit banks (hereafter LTC banks), and trust banks. [8] City banks are biggest banks in Japan, which have main branch offices in big cities and operate nationwide as well as internationally. Regional banks are smaller banks, which have main branch offices in local cities and operate in local markets. LTC and trust banks have special aims of long-term finance and trust services, respectively. Both types of banks had often been characterized as the main providers of long-term funds in Japan.

In the analysis of this paper, we focus on interaction between city banks and the other three types of banks. Although there has been regulation on the segregation of business areas by the financial industry in Japan, city banks' scope of business has been very broad and likely to overlap with that of other types of banks. It is also reasonable to focus on city banks, since

[8] Regional banks are further categorized into regional banks and second-tier regional banks, both of which have different historical background. We treat them together as "regional banks" because of their similar characteristics. We analyzed each type separately, but results were similar to each other.

they dominate in the Japanese lending market. Table 1 shows that city banks' loans outstanding account for more than 40 percent of total loans outstanding in Japan.

2.2 Type of borrowers

The loan data are classified mainly by the following nine industries: (1) Manufacturing, (2) Construction, (3) Electricity, gas, heat supply and water (hereafter Electricity), (4) Transport and communication (Transport), (5) Wholesale, retail trade, eating and drinking places (Wholesale), (6) Finance and insurance (Finance), (7) Real estate, (8) Services, and (9) Individuals.

Figure 2 represents the transition of the share of loans outstanding to each industry to the total loans outstanding regarding all Japanese banks. We can classify these industries into the following three groups based on their distinct patterns. The first group is *traditional* industries, Manufacturing and Wholesale, which had been traditionally dominant borrowers for Japanese banks until the late 1970s. The second is *emerging* industries, Finance, Real estate, Services, and Individuals, which have emergently taken over the position since the mid-1980s. The third is *status quo* industries, Construction, Electricity, and Transport, which have been stable and marginal during the whole period. There is a jump at the second quarter in 1993, which reflects changes in the definition of the data.

These patterns reflect a variety of structural changes in Japan. Traditional industries had been composed of large corporations, and raising many funds since the World War II. However, the financial liberalization since the end of the 1970s has enabled those borrowers to access different sources of funds. As a result, they have shifted from bank loans to capital market financing. This shift is called the *financial disintermediation*. [9] The loan shares

[9]The liberalization was partly backed by the institutional reform of the Foreign Exchange and Trade Control Act in 1980 and the enforcement of the New Banking Act in 1982. The Japan-US Yen Dollar Committee report in 1984 was also behind the liberalization. Examples of the liberalization measures include the removal of the ban on CPs and impact loans, and the liberalization of the eligible standard of unsecured corporate debentures. It is also the period that the Bank of Japan alleviated the *window guidance*. Before 1981, the Bank of Japan had set a plan of total loans outstanding every quarter and the increase in loans was actually controlled as planned. After 1982, the guidance was reformed to take the form of a voluntary submission of the plan by individual banks and lifted completely in 1992. See Hoshi and Kashyap[23], Ramseyer[35] and Campbell and

of these industries had decreased monotonically from about 30 percent to 15 percent during the 1980s (Panel (a) of Figure 2).

Meanwhile, the financial liberalization contributed to the boost of the loan shares of emerging industries since the early 1980s (Panel (b) of Figure 2). Banks, who gave up relying on lending to traditional industries, had to look for new borrowers. They thus promoted loans to the emerging industries, as their loan demand also expanded in this booming period. The asset price bubble since the mid-1980s contributed to the influx of funds into the emerging industries as well, because the collateral value of land climbed. By the early 1990s, the loan shares of the emerging industries have become comparable to those of the traditional industries.

Compared to the 1980s, the 1990s shows stability in the loan shares. As demonstrated in Table 2, little change is observed after the corruption of the asset price bubble in the early 1990s. This implies that the impact of the financial liberalization had already prevailed by the end of the 1980s. Together with the fact that the 1990s is the period of the long stagnation and the banking crisis, we expect that the behavior of Japanese banks in the 1990s is different from that in the 1980s.

Based on these observations, we separately examine Japanese banks' lending behavior to the traditional industries and that to the emerging industries. The discussion thus far implies that herding is likely to be found in loans to the emerging industries in the 1980s, because, although banks had to increase the loan shares to those industries in this period, they might not have had enough information about these borrowers. On the contrary, it is less likely to find herding in loans to the traditional industries, because the priority of bank loans had been lowered as a source of finance in the industries. Finally, we do not analyze the status quo industries, because their loan shares of these industries had been marginal and stabile.

3 Existence of Herd Behavior

In this section, we examine empirically whether herd behavior existed or not between city banks and other types of banks in the Japanese lending market. In Section 4, we further examine whether observed herd behavior had been efficient or not.

Hamao[13] for more details.

3.1 Methodology

The empirical methodology is to estimate two-variate vector autoregressive (VAR) models using the data of loans outstanding of city banks and the other types of banks, and examine whether we can find a Granger-causality between their lending behavior.

We focus on the following four sample periods because of the historical background explained in Section 2.2 and data availability: (a) 1975:1 – 1984:4, (b) 1980:1 – 1989:4, (c) 1985:1 – 1994:4, (d) 1990:1 – 1999:4. The frequency of data observations is quarterly. The sample periods are serially overlapped by five years, in order to identify the time variation of herd behavior under the sufficient degree of freedom. These samples enable us to examine whether the financial liberalization had triggered banks' herd behavior in the 1980s. [10]

As a loan variable that represents the lending behavior by a specific type of banks to a specific industry group, we use the ratio of loans outstanding of the bank type to the industry group to the total loans outstanding. This is to normalize the loan size so that we can examine whether banks adjusted their portfolio by herding. [11]

Our VAR includes a constant term, seasonal dummies, and the dummy variable for the change in the definition of the data at the second quarter in 1993.

3.2 Results

Table 2 shows the results about causalities between city banks and the other types of banks. The table consists of four parts, each of which represents the

[10] The structure of the banking industry in Japan has been changing dynamically, especially following the financial system reform called the *big-bang* and the period of banking crisis after the mid-1990s. We conducted analysis with dummy variables to control big bank failures, but the results were not very different.

[11] We do not use the level data of loans outstanding directly as a loan variable. The level data of loans outstanding tend to commove more than the ratio data does, because the level data depend on macroeconomic trends. In our analysis, this comovement has a risk to provide a significant causality between two loan variables even if two types of banks behave independently. We therefore use the ratio data for the convenience of analysis. There is a better loan data, "New Loans for Equipment Funds by Industry," that seems to be less subject to macroeconomic trends. However, we do not use this data because the data is not categorized into the bank type.

results for one of the four sample periods. The row of each part represents the type of banks (except city banks). The column represents the industry group. "Lag" represents the optimal lag of a VAR, which is determined based on SBIC. "⇒ City" represents a causality from the relevant type of banks to city banks. "City ⇒" represents the reverse causality. Each value is an estimated sum of the coefficients of the loan ratio of the type of banks that is an explanatory variable in the VAR. Superscripts $***$, $**$, $*$ represent that the positive sum of coefficients is significant at 1%, 5%, 10% levels in an F-test, respectively. [12]

First, we find a *time-specific* feature that the number of significant causalities are observed increasingly from sample (a) to (b) and thereafter decreasingly from sample (c) to (d). This result suggests that Japanese banks had herded together the most in the 1980s when the financial liberalization started off, and that they gradually ceased to herd by the 1990s. This transition in banks' behavior can be interpreted as follows. As is explained in Section 2.2, the financial disintermediation forced most banks to switch their borrowers from traditional to emerging industries in the 1980s. Japanese banks might have thus learned each other's lending strategies in order to explore new (unfamiliar) borrowers. As banks got accustomed to the new borrowers by the 1990s, herd behavior seems to have disappeared.

Second, we also find a *borrower-specific* feature that causalities are observed constantly from sample (a) to (c) in the traditional industries and the most remarkably in sample (b) in the emerging industries. This result indicates that the impact of the financial liberalization was more substantial in lending to emerging industries than to traditional ones. This feature is consistent with not only theoretical predictions, but also the historical background. As it is shown in Section 2.2 that lending to the emerging industries expanded in the 1980s, banks might have herded to learn unfamiliar emerging borrowers by inferring from other banks' lending strategies. Meanwhile, in the traditional industries, causalities might reflect the past institutional herding that took root in the convoy system, not the herd behavior under imperfect information created by the financial liberalization.

Third, we find a *bank-specific* feature that most causalities are observed

[12]There are several significant *negative* estimates of coefficients that are considered to imply that the banks compete with each other and their loans are mutually substitutes. Although we do not examine this evidence in further detail here, it might be an interesting topic in a future work.

from LTC and trust banks to city banks in sample (b) and (c), and from city banks to regional banks in sample (b). The former evidence suggests that city banks might have followed LTC and trust banks because those banks had had the comparative advantage in long-term lending during the rapid-growth era until the late 1970s, similar to the *Cowbell effect* mentioned by Higano[19]. We may call this herding the Cowbell-*like* effect. [13] The latter evidence implies that, in the 1980s, smaller banks had followed bigger banks that had a higher potential to adjust themselves to the new financial environment.

In summary, Table 2 suggests that the financial liberalization created the new environment and might have stimulated herd behavior among Japanese banks in the 1980s. In particular, herd behavior is done more significantly in lending to the emerging industries than to the traditional ones. Banks might have herded toward the banks who seemed to have comparative advantages in lending to a specific industry, or who have an ability to adjust themselves to the new environment.

4 Inefficient Herd Behavior

Next we proceed to test whether the observed causalities reflect *inefficient* herd behavior by Japanese banks. Banks should be considered to follow fundamental information to make lending decisions, which can lead to *clustering* or *efficient* herd behavior, mentioned in Introduction. If evidence for herding is still found after controlling for those fundamental factors, it suggests that Japanese banks might have followed inefficient herd behavior.

[13] Higano[19] first mentioned the existence of the *Cowbell effect*, which means that there had been an inducement effect in loans made by the Japan Development Bank (JDB, presently the Development Bank of Japan), a government financial institution. Higano claimed that loans made by JDB had put out a signal that the JDB's borrowers were better than other borrowers were. The pure Cowbell effect cannot be detected in the present analysis, since loans made by government financial institutions are not included in the sample. However, Packer[34] argued that the LTC banks played a similar role to JDB's to provide long-term funds to those borrowers who were important in the post World War II development in Japan. Then, we may interpret the results here as indicating that LTC and trust banks might have guided city banks in a similar manner.

4.1 Methodology

The test is conducted by introducing into a VAR several macroeconomic variables. We apply the following three variables as proxies for relative profitability or demand for loans from each industry group. The two variables are the ratio of the nominal GDP by industry group to the aggregate nominal GDP, and the ratio of the stock price index by industry group to TOPIX. The detail of two data is in Appendix A.2.1 and A.2.2, respectively. The third variables are the ratio of total private bonds outstanding to the aggregate nominal GDP (for the traditional industries) and the ratio of a nationwide land price index to the aggregate nominal GDP (for the emerging industries). As is mentioned in Section 2.2, the financial liberalization since the 1980s had stimulated the disintermediation by traditional industries and the demand for loans from emerging industries. Then, the relative size of the private bond market in economy is used as a proxy for the disintermediation, and the relative land price in economy is used as a proxy for the variability in the risk of loan to the unfamiliar borrowers because land was highly valued as collateral in the Japanese lending market. Finally, the one and two lags of the control variables are introduced, in order not only to effectively control for efficient herding, but also to solve the endogenous bias problem. [14]

Note that we introduce only these control variables in order to ensure the sufficient degree of freedom of causality tests. In addition, it is not necessary to introduce a variable that equally affects every industry's loan supply or demand, because such a variable would not change a bank's portfolio. For example, the aggregate GDP, TOPIX, call rates, or the amount of non-performing loans in the 1990s would not change the loan ratio of a specific industry. [15] For this reason, the above bond and land variables are not used for both industry groups.

[14] We also conducted the analysis in which estimated *expected* values of macroeconomic variables were used as control variables instead of their *realized* values, because those expected variables could be better proxies for borrowers' future profitability rather than the *realized* ones could. However, the results were similar to what we show in this paper. In addition, we also conducted the tests in which the lag of a VAR is fixed at four. However, the results were not changed at all.

[15] To make sure, we also examined what if common macroeconomic variables were introduced: for example, call rates, Industrial Production Index, or Nikkei Stock Average. As expected, those were mostly insignificant in VAR estimations.

4.2 Results

Table 3 shows the results about inefficient herd behavior between city banks and the other types of banks.

We can observe several significant causalities after the financial liberalization that are also observed in Table 2, but most of them become less significant at 10% level. First, we still observe the same time-specific feature that causalities are observed the most frequently in sample (b) but become insignificant in sample (c). Hence, the impact of the financial liberalization on inefficient herd behavior might have been limited in the early 1980s and negligible small. Second, we cannot clearly find the borrower-specific feature from the observed causalities. Causalities are observed in sample (a) and (b) evenly in both industry groups. Third, the bank-specific feature are partly observed in a similar manner to Table 2. The Cowbell-like effects are observed in any causalities among city, LTC, and trust banks. However, causalities between city and regional banks are seen in both directions. This result contradicts our theoretical prediction that uninformed banks followed informed ones, in contrast to Table 2.

In summary, Table 3 suggests the possibility that there had been not only efficient, but also inefficient herd behavior by Japanese banks since the financial liberalization in the 1980s. That herd behavior might have contributed to subsequent economic fluctuation such as the asset price bubble in the late 1980s. However, most causalities are not so significant that strongly imply such a big impact of inefficient herding.

5 Further Analysis

We proceed to another analysis to gain further consistent empirical results. In the previous section, we focused on the four typical sample periods to examine the herd behavior by Japanese banks, but the evidence for inefficient herd behavior was not confirmed enough as consistent with the literature and the historical background. A possible reason is that banks' lending behavior had been changing over time so that cannot be identified just by inquiring a few specific sample periods. We therefore investigate whether and how banks' behavior had changed by inquiring on other sample periods as well.

We execute the *sequential* causality test, in which we examine Granger-causalities between Japanese banks during all possible ten-year sample peri-

ods. In detail, we select the earliest ten-year sample period from the whole sample period and examine causalities as in the previous sections. We then repeat the same test by sequentially moving the sample period by one quarter until the end of the selected sample period reaches the end of the whole sample period. The advantage of this test is to find robust causalities and its transition over time more specifically by focusing on all possible sample periods. The methodology of the causality test is entirely the same as in Section 3 and 4.

5.1 Existence of Herd Behavior

Figure 3 shows the results for the existence of herd behavior between city banks and the other types of banks. This corresponds to Table 2 in Section 3.2. The row is the type of banks other than city banks. The column is the industry group. The notation "⇒ City" of each graph represents a causality from the other type of banks to city banks, while "City ⇒" is the reverse causality. The horizontal axis of each graph represents the median time of each ten-year sample period. For example, the results at "1982:1" represent the results of the sample period "1977:1 – 1986:4." Here we use the data from 1970:1 to 1999:4, in order to obtain results from 1975:1 ("1970:1 – 1979:4") to 1995:1 ("1990:1 – 1999:4"). Totally we analyze 81 ten-year sample periods. The solid line is the sum of the estimated coefficients of the loan ratio of the banks that are explanatory variables in a VAR. The dark and light shadows represent that the sum of the coefficients is significant at 1% and 5% level in an F-test, respectively. With these depictions, a thicker and darker shadow may be interpreted as more robust and significant causalities in the shadowed periods. Note that the results regarding trust banks are not obtained from 1975:1 to 1981:4, because of the lack of the trust bank data by 1976:4. See Appendix A for more details.

The figure shows that causalities are generally consistent with the features observed in Table 2. First, we find the time-specific feature that causalities appear persistently in the 1980s and disappear until the 1990s. Second, as for the borrower-specific feature, we cannot find any remarkable difference between two industry groups. In Section 3.2, causalities are observed in the traditional industries continuously from the late 1970s to the 1980s, possibly because of the convoy system and the financial liberalization. Here, however, two effects on herd behavior are individually observed, and, as a

result, causalities are similarly observed in the 1980s in both industry groups. Third, the bank-specific feature is found more clearly in the 1980s in both industry groups: the Cowbell-like effects and regional banks' herding toward city banks, which are consistent with that uninformed agents are inclined to herd toward informed agents.

In terms of the existence of herd behavior, therefore, we confirm more clearly the same time- and bank-specific features as those in Section 3.2. We can thus conclude that the financial liberalization stimulated the herd behavior across different types of Japanese banks in the 1980s. However, the borrower-specific feature is not so clear. [16]

5.2 Inefficient Herd Behavior

We turn to the analysis for inefficient herd behavior. Figure 4 corresponds to Table 3 in Section 4.2. The figure shows several persistent causalities that are not identified in Table 3. First, causalities concentrate in the early or mid-1980s and most of them disappear from the late 1980s, while they are observed during the whole 1980s in Figure 3. Second, most of the causalities observed in the 1980s in Figure 3 are still observed in the emerging industries but not in the traditional industries. Third, the bank-specific causalities are observed more specifically than those in Figure 3: from LTC and trust banks to city banks in the early 1980s and from city to regional banks in the mid-1980s.

We can therefore conclude that Japanese banks *inefficiently* herded the most frequently soon after the opening of the financial liberalization. Specifically, the inefficient herding took place particularly in lending to emerging industries, possibly because of the lack of information about those new borrowers. In addition, less informed city banks herded more inefficiently toward more informed LTC and trust banks in lending to emerging industries. Also, least informed regional banks inefficiently herded toward city banks in both industries and delayed to herd, because regional banks seem to have less ability to adjust to the new environment. Therefore, the inefficient herd be-

[16] We can find other persistent causalities. In the late 1970s, they are seen in the traditional industries, implying the convoy system until the late 1970s. Causality is also found in the 1990s from city to LTC banks in the emerging industries. This indicates the possibility that city banks had become more informed than LTC banks so that LTC banks herded towards city banks.

havior created by the financial liberalization might have contributed to the formation of the asset price bubble in the 1980s and subsequent economic fluctuations.

These observed causalities also give an empirical support to the theoretical hypothesis, mentioned in Introduction, that herd behavior is inclined to take place under the environment of imperfect information, such as the financial liberalization or loans to emerging industries. The bank-specific feature, that least informed regional banks delayed to herd compared to city banks' herding, is also consistent with the theory of Chari and Kehoe[10]. In addition, our empirical evidence is similar to those given by Jain and Gupta[28] and Barron and Valev[4] that smaller U.S. banks rely on the behavior of more informed banks in lending to unfamiliar developing countries.

6 Robustness Check

In this section, we check the robustness of the results of the sequential causality tests using another technique. In the previous section, we focused on ten-year sample periods in order to ensure the degree of freedom. However, the sample period might be so long that tend to include a crucial structural change of economy. We thus reexamine causalities under a smaller sample period, by estimating *panel* vector autoregression models (hereafter panel VAR).

6.1 Methodology

The *panel VAR* estimation is literally to estimate a VAR with panel data. In our paper, if we test causalities between loan ratios of two bank types to an industry group, the panel VAR fixed effect model can be expressed as follows:

$$x_{i,t} = \alpha_{1,i} + \sum_{k=1}^{m} \beta_{1,k} x_{i,t-k} + \sum_{k=1}^{m} \gamma_{1,k} y_{i,t-k} + u_{i,t},$$
$$y_{i,t} = \alpha_{2,i} + \sum_{k=1}^{m} \beta_{2,k} x_{i,t-k} + \sum_{k=1}^{m} \gamma_{2,k} y_{i,t-k} + v_{i,t},$$
$$i = 1, \cdots, N, \quad t = 1, \cdots, T.$$

$x_{i,t}$ and $y_{i,t}$ are the loan ratios by bank type x and y to industry i of the industry group in period t. $u_{i,t}$ and $v_{i,t}$ are i.i.d. error terms. $\alpha_{1,i}$ and $\alpha_{2,i}$ are the vectors of deterministic or exogenous components that represent fixed effects in each industry of the group. $\beta_{1,k}, \beta_{2,k}, \gamma_{1,k}$ and $\gamma_{2,k}$ are the coefficients of the loan ratios. m is the number of the lag of the panel VAR. N is the number of industries in the group. T is the number of observations of the loan ratio to each industry.

The panel VAR estimation is different from the standard VAR in the previous sections, in that the number of total observations of the industry group is increased from T to $N \times T$. For example, in the standard causality test for the traditional industries during 1980:1 – 1989:4, the number of observations of the loan ratio is 40 ($T = 4 \times 10$), because the loan ratio is calculated using the *sum* of loans outstanding to Manufacturing and Wholesale industries. On the other hand, in the panel VAR causality test for the same data, the number of observations is 80 ($N \times T = 2 \times 40$), because the loan ratio is calculated using *individually* the loans outstanding to those industries. As a result, we can ensure the sufficient degree of freedom in the test even if we examine a short period of observations.

We focus on the following smaller sample periods: (a) 1975:1 – 1979:4, (b) 1980:1 – 1984:4, (c) 1985:1 – 1989:4, (d) 1990:1 – 1994:4, and (e) 1995:1 – 1999:4. We estimate the panel VAR with the method of the generalized least square, considering heteroscedasticity of the loan ratio by industry. In addition, loan ratios are normalized by dividing them with their own sample means. The other methodology of the panel VAR causality test is entirely the same as the standard test in the previous sections. [17]

6.2 Existence of Herd Behavior

Table 4 shows the results of causality tests for the existence of herd behavior, corresponding Figure 3 in Section 5.1.

The results partly support the previous sequential causality tests. First, causalities are found most frequently in the 1980s. This feature suggests that the financial liberalization stimulated the herding between Japanese banks.

[17] The optimal lag of the panel VAR is determined based on SBIC. Holtz-Eakin, Newey, and Rosen[22] emphasize the importance of the selection of the optimal lag in the panel VAR estimation. SBIC has been commonly used to determine the optimal lag, according to Larsson, Lyhagen, and Lothgren[30] and Ericsson and Irandoust[16].

However, we also find several causalities in other periods, in contrast to the previous results. Second, we no longer find the feature that herd behavior had been more intense in lending to emerging industries than to traditional industries. Third, we partly confirm the bank-specific features in the 1980s, the Cowbell-like effect and the regional banks' herding toward city banks, but we also observe the reverse direction of causalities.

In summary, the panel causality tests support the previous results that each type of Japanese banks had herded together in facing the financial liberalization in the early 1980s. However, we do not make sure the consistent evidence for the borrower-specific or bank-specific features observed in the previous sections. The analysis suggests that banks' herd behavior had been seen not only in the financial liberalization, but also in any other periods.

6.3 Inefficient Herd Behavior

We then proceed to the panel VAR causality tests for the efficiency of the observed herd behavior. The control variables for efficient herd behavior are fundamentally the same as the macroeconomic data used in Section 4.1. Note that, in the panel causality test, control variables are chosen for *an individual industry of* an industry group, in contrast to the standard causality test in which the variables are chosen for an industry group. It is another advantage of the panel causality test that efficient herding can be controlled more effectively in the panel test. The specific application of the data is in Appendix A.2.

Table 5 shows the results for inefficient herd behavior, corresponding to the sequential causality tests in Figure 4 in Section 5.2. The results generally reinforce the results of the sequential causality tests. First, causalities are the most frequently in the early 1980s and disappearing until the 1990s. Second, in the early 1980s, causalities are found in the emerging industries as well as in the traditional industries, although this borrower-specific feature is not confirmed so clearly as the previous tests. [18] Finally, causalities also suggest the bank-specific feature that uninformed banks inefficiently herded toward informed banks, although the reverse causalities of the Cowbell-like effect are also found. Here the regional banks' herding toward city banks is not exactly confirmed in the early 1980s. However, we reexamine another period

[18] Causalities in the traditional industries are found in the late 1980s as well. This might reflect the effect of not only the financial liberalization, but also the convoy system.

around the mid-1980s, 1983:1 – 1987:4, and confirm the same causalities in both industry groups (Panel (f) of Table 5), considering that the herding is seen around the mid-1980s in the previous tests.

In summary, the main results are consistent with the results in Section 5.2 that Japanese banks, uninformed banks in particular, had inefficiently herded in the 1980s since the opening of the financial liberalization. [19]

7 Conclusion

This paper examines empirically whether Japanese banks had followed herd behavior since the financial liberalization started in the early 1980s, and whether observed herd behavior had had a potential of inefficient outcomes that led to subsequent macroeconomic fluctuations. The herd behavior by Japanese banks has been criticized as to symbolize the inefficiency of the Japanese bank lending market. Even though the behavior seems to have disappeared due to the financial liberalization, there has been much anecdotal evidence for banks' herd behavior, which has been blamed for subsequent economic fluctuations. However, few studies have not empirically examined the herd behavior and its efficiency.

The empirical results of the paper are supportive of our prediction that Japanese banks had *inefficiently* herded from the early to mid-1980s immediately after the opening of the financial liberalization, and not in the 1990s. Specifically, the inefficient herd behavior was more intensive in lending to new borrowers that banks had not been familiar with than in lending to their traditional borrowers. In addition, banks were inclined to follow other banks that are more informed in lending to a specific industry. These results are fully consistent with theoretical predictions of the past literature and illuminate the possibility that the inefficient herd behavior created the subsequent asset price bubble in the late 1980s.

Finally, several issues are unchallenged in this paper. One issue is that this paper identifies the herd behavior by Japanese banks and its efficiency in the economy, but does not empirically investigate whether and how the inefficient herd behavior contributed to the formation of the asset price bubble

[19] Other causalities are observed in the late 1990s. These suggest that inefficient herd behavior occurred after the financial crisis from the end of 1997. See Cargill[9], Hoshi and Kashyap[24, chapter 8][25], and Ito[27] about the financial crisis in Japan.

in the late 1980s and the accumulation of non-performing loans in the 1990s. Another issue is that, as is mentioned in Introduction, this paper focuses merely on investigating whether observed herd behavior was so efficient, but not on identifying any theoretical reasons for observed herding. Those issues will be our future works.

A Data Appendix

All the data used in this paper are available from *Nikkei NEEDS Macroeconomic Data File*. Their original data are published by the following institutions.

A.1 Loans Outstanding

The loan data is available from "Loans and Discounts Outstanding by Sector" in the *Financial and Economic Statistics Monthly* by the Bank of Japan. The data includes the amount of loans supplied to different industries by individual types of banks. The loan data of the trust banks to Finance and Insurance industries is available from the first quarter in 1977. No data of LTC and trust banks is available from the fourth quarter in 2000.

The definitions of the type of banks and its loans outstanding are transformed from the original ones to the following ones. First, as is mentioned in footnote 8, regional and second-tier regional banks are treated together as "regional banks." Second, the loans outstanding of trust banks are defined as the sum of (a) "Banking Accounts of Trust Banks" and (b) "Trust Accounts of Domestically Licensed Banks." Data (b) includes the trust accounts of several other types of banks as well as those of trust banks in an inseparable way. However, the former amount is negligible compared with the latter one.

A.2 Macroeconomic Data

A.2.1 GDP

The GDP data is available from the *Annual Report on National Accounts* by the Cabinet Office, the Government of Japan. We utilize the nominal data from 68SNA (original series, at market prices in calendar year of 1990) for the years until 1979, and from 93SNA (original series, at market prices

in calendar year of 1995) for the years from 1980. The data includes the aggregate nominal GDP and the nominal GDP by industry.

The industry classification is almost the same as that of the loan data, but there is no nominal GDP data of Individuals. The Real estate GDP is thus applied as a proxy for the GDP of Individuals. The nominal GDP by industry is available only on annual basis, so we establish its quarterly data by interpolating the original data.

In the analysis of simple and sequential causality tests (Section 4.2, 5.2), the nominal GDP by *industry group* is calculated as the sum of the nominal GDPs of the industries that are included in a relevant industry group. For example, the nominal GDP of the traditional industries is calculated as the sum of the nominal GDPs of Manufacturing and Wholesale industries. In the panel VAR causality tests (Section 6.3), the nominal GDP by *industry* is used directly from the data.

A.2.2 Stock Price Index

The stock price data is available from the *Monthly Statistics Report* from the Tokyo Stock Exchange. The data includes TOPIX and "TOPIX Stock Price Index by Industry".

The industry classification is slightly different from that of the loan data, so a most closely related stock price index by industry is chosen as a proxy for the index for a relevant industry group or industry itself. In the simple and sequential causality tests, "Electric Appliances Index" is applied for the traditional industries, and "Real Estate Index" is for the emerging industries, respectively. In the panel causality tests, "Electric Appliances Index" is used for Manufacturing industry, "Wholesale Trade Index" is for Wholesale, "Banks Index" is for Finance, "Real Estate Index" is for Real estate, and "Services Index" is for Services. There is no index for Individuals, so "Real Estate Index" is applied for Individuals.

"Wholesale Index" and "Banks Index" are not available until 1982. Then, in the analysis which needs those unavailable data, "Machinery Index" and "Real Estate Index" are instead applied for Wholesale and Finance industries, respectively. "Machinery Index" is chosen because the index is the most correlated with "Wholesale Index" of all indices in the traditional industries during 1983 – 1999. "Real Estate Index" is chosen because the index is the most correlated with "Banks Index" of all indices in the emerging industries

during 1983 – 1999.

A.2.3 Other Data

The bond data is available from *Annual Report* by the Japan Securities Dealers Association. The data includes "Total Private Bonds Outstanding," which is used to establish the proxy for the disintermediation in Section 4.1.

The land price data is available from the Japan Real Estate Institute. The data includes "Nationwide Urban Land Price Index," which is used to establish the proxy for the variability of the risk of loan to emerging industries.

Each of the above control variables is applied not only for an industry group in the simple and sequential causality tests, but also for an individual industry of an industry group.

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Table 1 Loan Shares of the Different Types of Japanese Banks

Year	Total loans outstanding (a) (billion yen)	Loan share of each bank type (%)				(a) / Total private bonds outstanding
		City	Regional	LTC	Trust	
1975	112,502	42.0	34.7	9.8	13.5	17.4
1976	125,303	41.6	35.0	9.8	13.6	17.6
1977	137,120	41.2	35.5	9.8	13.5	17.7
1978	151,197	40.9	36.4	9.6	13.1	17.9
1979	161,598	40.6	36.8	9.6	13.0	17.4
1980	173,260	40.5	37.1	9.5	12.9	17.6
1981	190,276	40.5	37.2	9.6	12.7	17.6
1982	208,917	40.5	37.2	9.7	12.6	18.3
1983	228,694	40.7	36.9	9.7	12.7	19.5
1984	250,826	41.0	36.2	9.8	13.0	20.0
1985	275,141	41.5	35.2	10.2	13.1	20.2
1986	298,130	42.4	33.6	10.0	14.0	18.8
1987	326,613	42.8	33.4	10.3	13.4	17.2
1988	350,105	42.8	33.9	10.3	13.0	15.1
1989	384,625	42.6	34.2	10.4	12.8	15.3
1990	408,791	42.4	34.3	10.6	12.7	14.9
1991	421,083	42.0	34.5	10.7	12.8	14.2
1992	427,972	41.8	34.7	10.5	13.0	13.6
1993	511,018	43.9	35.3	9.3	11.5	14.5
1994	508,850	43.5	36.1	9.2	11.3	13.3
1995	512,747	42.5	36.9	9.3	11.3	12.3
1996	512,060	42.4	37.3	9.2	11.1	10.8
1997	513,748	43.0	37.6	8.8	10.6	10.3
1998	502,902	43.5	38.6	8.2	9.7	8.8
1999	482,246	44.5	39.0	7.0	9.5	8.2

Source: Nikkei NEEDS Macroeconomic Data File.

Table 2　Causality Tests about Existence of Herd Behavior

(a) 1975:1 -- 1984:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.154***	-0.096	4	-0.080	-0.095
LTC	2	0.138**	0.078	2	0.008	-0.022
Trust	4	0.312***	0.056		N.A.	

(b) 1980:1 -- 1989:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	-0.365	0.402***	1	-0.612	0.366***
LTC	1	0.067***	-0.066	1	0.085***	-0.052
Trust	1	0.094***	-0.104	3	0.127***	-0.081

(c) 1985:1 -- 1994:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.228	-0.004	1	0.030	0.028
LTC	1	0.353***	-0.044	3	0.336**	0.171
Trust	2	0.123**	-0.049	1	0.249***	-0.199

(d) 1990:1 -- 1999:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	-0.065	-0.027	1	-0.012	0.018
LTC	3	-0.162	0.068	1	-0.096	-0.246
Trust	1	0.059	-0.056	1	0.070	-0.116

Note: The table shows the results about causalities between city banks and the other types of banks without macroeconomic variables. The row of each panel is the type of banks (except for city banks). The column is the industry classification. " Lag " is the optimal lag of a VAR, which is determined based on SBIC. " => City " represents a causality from the relevant type of banks to city banks. " City => " is the reverse causality. Each value is an estimated sum of the coefficients of the loan ratio of the type of banks that is an explanatory variable in the VAR. Superscripts ***, **, * represent that the positive sum of coefficients is significant at 1%, 5%, 10% levels in an F-test, respectively. Note that the results regarding trust banks are omitted in Panel (a) because of the lack of the data.

Table 3　Causality Tests about Inefficient Herd Behavior

(a) 1975:1 -- 1984:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.192**	-0.142	2	-0.106	-0.013
LTC	2	0.147*	0.020	1	0.197***	-0.511
Trust	2	0.222**	-0.014		N.A.	

(b) 1980:1 -- 1989:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.185	0.292**	1	0.214	0.46***
LTC	1	0.075	-0.074	1	0.079	-0.165
Trust	1	0.108*	-0.215	1	0.233*	-0.340

(c) 1985:1 -- 1994:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.105	0.080	2	0.103	-0.017
LTC	1	0.168	0.002	2	0.318**	0.45**
Trust	2	0.004	-0.083	1	0.160	-0.098

(d) 1990:1 -- 1999:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.534*	0.063	3	-0.090	-0.346
LTC	3	-0.356	0.045	1	-0.121	0.131
Trust	2	0.022	0.069	1	0.037	-0.197

Note: The table shows the results about causalities between city banks and the other types of banks with one and two lagged macroeconomic variables. Other detail is seen in Table 2.

Table 4　Panel VAR Causality Tests about Existence of Herd Behavior

(a) 1975:1 -- 1979:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.287***	-0.261	1	-0.079	0.251***
LTC	2	0.013	0.257**	1	-0.021	0.059
Trust	2	0.022	0.183*		N.A.	

(b) 1980:1 -- 1984:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.177	0.131*	1	0.160***	-0.011
LTC	1	0.054*	0.168**	2	-0.012	0.056
Trust	1	0.071**	0.476***	1	0.002	0.028

(c) 1985:1 -- 1989:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.107	0.135**	1	-0.084	-0.001
LTC	1	0.035	-0.041	1	-0.073	0.036**
Trust	1	0.330***	-0.185	2	-0.075	0.006

(Table 4 continued)

(d) 1990:1 -- 1994:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.160	0.112	1	-0.064	0.080*
LTC	1	-0.050	-0.176	1	-0.066	-0.019
Trust	1	-0.086	-0.243	1	-0.165	0.052**

(e) 1995:1 -- 1999:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	-0.077	-0.053	2	-0.090	.073***
LTC	3	-0.040	0.286**	2	0.019	0.043
Trust	1	0.005	-0.189	2	-0.031	-0.045

Note: The table shows the results about panel VAR causality tests between city banks and the other types of banks without macroeconomic variables. Each value is an estimated sum of the fixed effect coefficients of the loan ratio of the type of banks that is an explanatory variable in the panel VAR. The generalized least square estimation is applied, considering heteroscedasticity of the loan ratio by industry. Loan ratios are normaliezed by dividing them with their own sample means. Other detail is seen in Table 2.

Table 5 Panel VAR Causality Tests about Inefficient Herd Behavior

(a) 1975:1 -- 1979:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.273***	-0.463	1	0.060	0.141
LTC	1	0.032	1.168***	1	0.187***	-0.153
Trust	2	0.089**	0.405***		N.A.	

(b) 1980:1 -- 1984:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	2	0.306	0.770***	3	0.516***	0.067
LTC	2	0.064*	0.491***	1	0.120*	0.142
Trust	1	0.116***	0.458*	1	0.130***	0.071

(c) 1985:1 -- 1989:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.355	0.254*	1	0.082	-0.013
LTC	1	0.226*	0.100	1	0.006	0.163***
Trust	1	0.468***	-0.207	1	-0.042	0.023

(Table 5 continued)

(d) 1990:1 -- 1994:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	-0.471	-0.013	1	-0.237	0.268**
LTC	1	-0.246	-0.022	1	-0.158	-0.439
Trust	1	-0.089	-0.334	1	-0.172	-0.063

(e) 1995:1 -- 1999:4

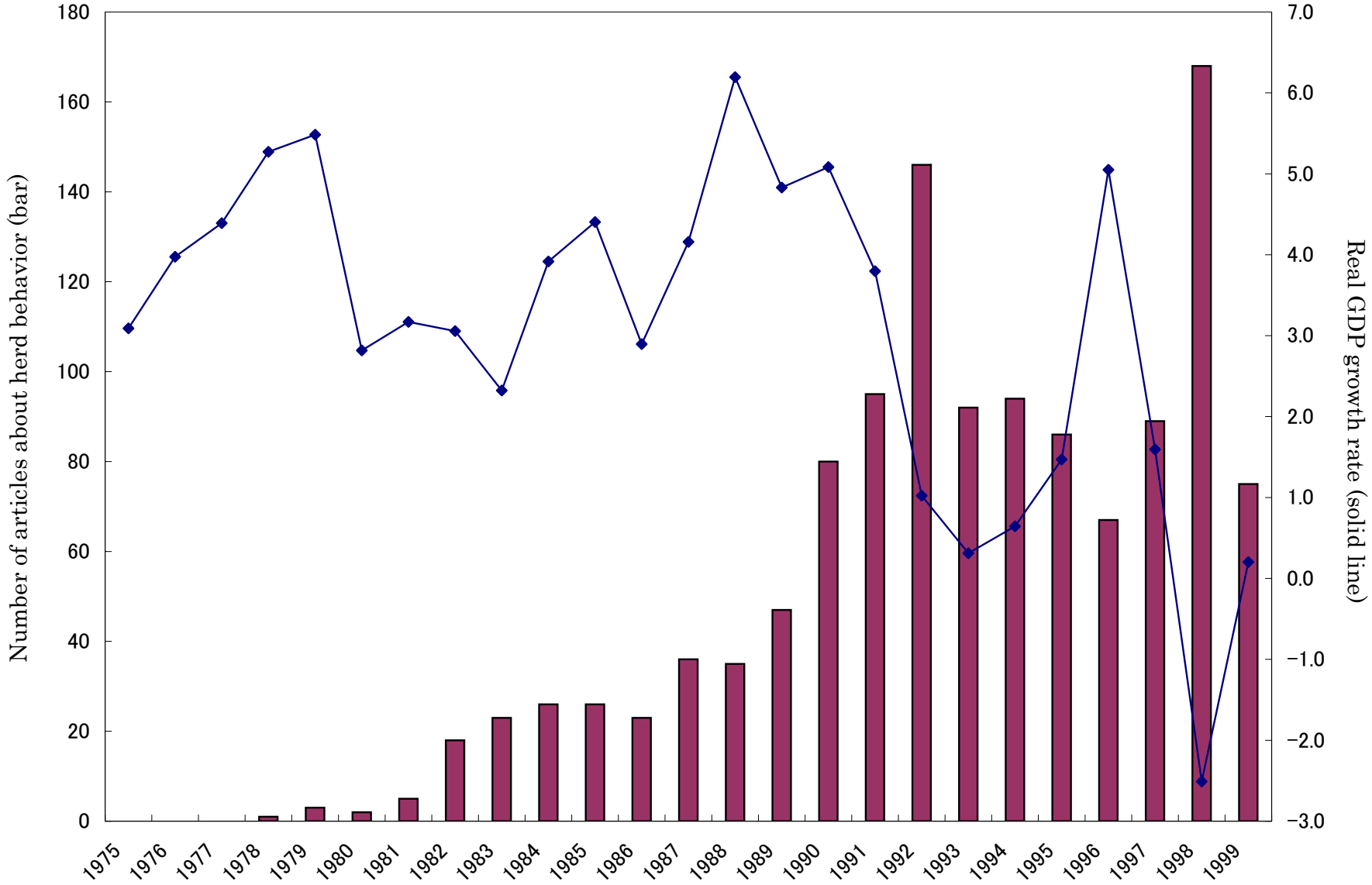
	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	2	0.082	-0.082	1	0.178	0.095
LTC	3	0.005	1.374***	2	0.960	-0.368
Trust	2	-0.125	0.526***	2	0.030	-0.179

(f) 1983:1 -- 1987:4

	Traditional			Emerging		
	Lag	=> City	City =>	Lag	=> City	City =>
Regional	1	0.098	0.284**	3	0.211	0.383***
LTC	1	0.029	0.373*	1	0.046	0.036
Trust	1	0.103*	0.349**	1	0.145	0.057

Note: The table shows the results about panel VAR causality tests between city banks and the other types of banks with one and two lagged macroeconomic variables. Loan ratios and macro variables are normaliezed by dividing them with their own sample means. Other detail is seen in Table 4.

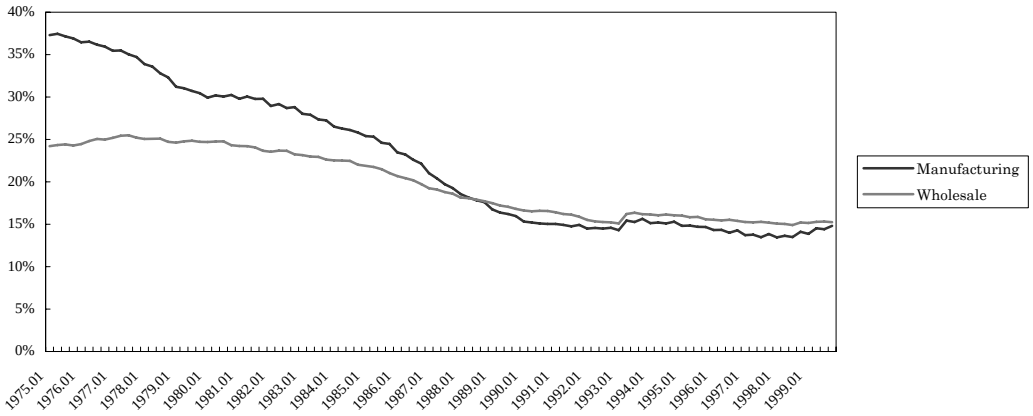
Figure 1　Articles about herd behavior by Japanese banks



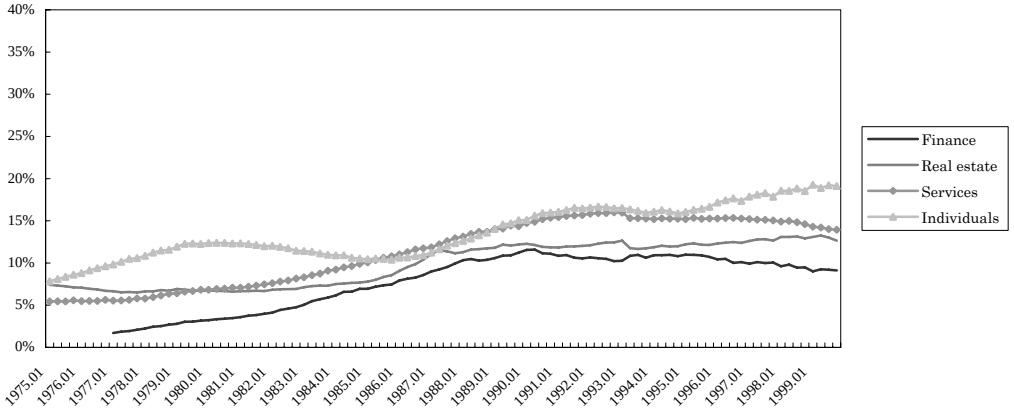
Source: Nihon Keizai Shimbun.

Figure 2 Loan Shares of Individual Industries by Japanese Banks

(a) Traditional industries



(b) Emerging industries



(c) Status quo industries

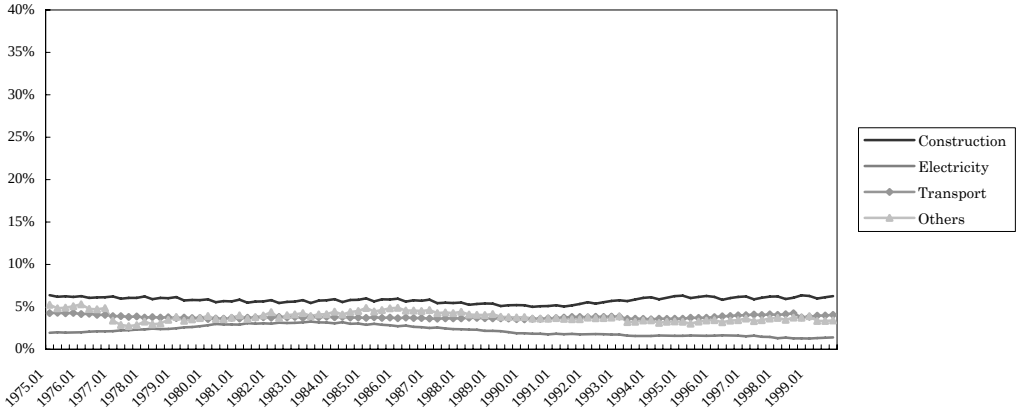
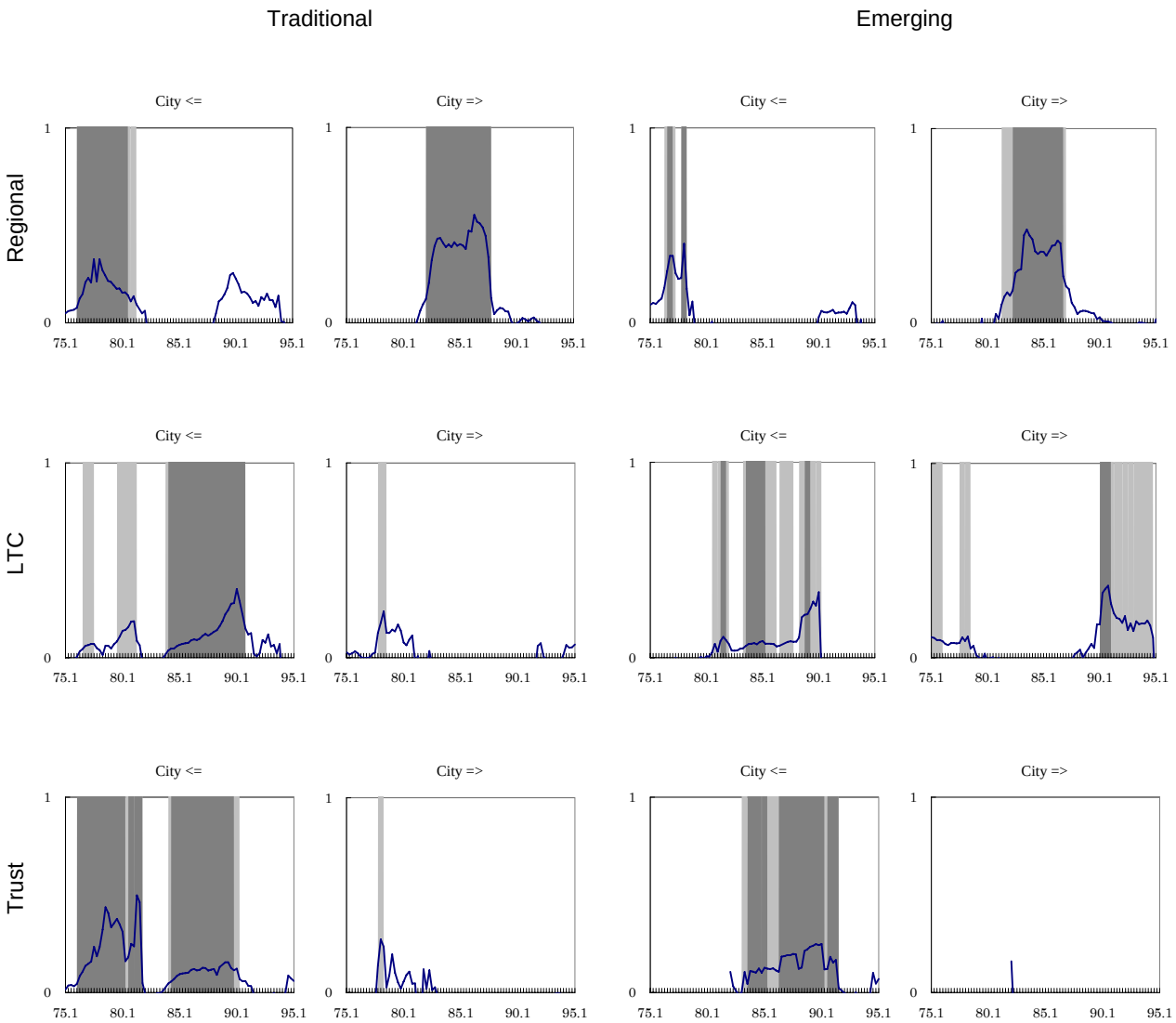
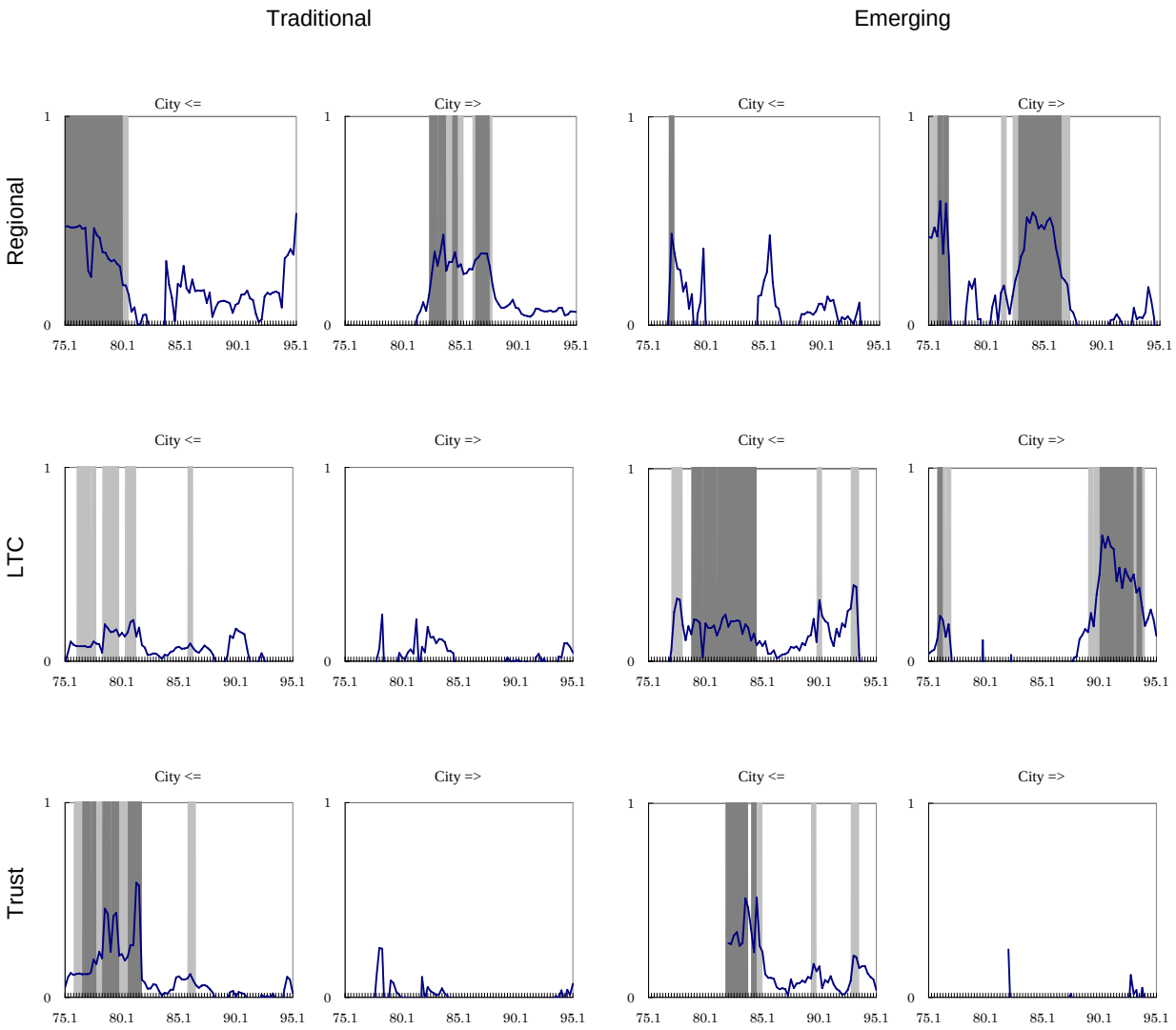


Figure 3 Sequential Causality Tests about Existence of Herd Behavior



Note: The figure shows the results about sequential causality tests between city banks and the other types of banks without macroeconomic variables. The row is the type of banks (except for city banks). The column is the industry classification. " => City " is a causality from the other type of banks to city banks. " City => " is the reverse causality. The horizontal axis of each figure is the median of each sumple period. The solid line is an estimated sum of the coefficients of the loan ratio of the type of banks that is an explanatory variable in the VAR. The dark and light shadows represent that the sum of the coefficients is significant at 1% and 5% level in an F-test, respectively. The optimal lag of a VAR is determined based on SBIC. Note that the results regarding trust banks are omitted from 1975:1 to 1982:4 because of the lack of the data.

Figure 4 Sequential Causality Tests about Inefficient Herd Behavior



Note: The figure shows the results about sequential causality tests between city banks and the other types of banks with one and two lagged macro variables. The black line is an estimated sum of the coefficients of the loan ratio of the type of banks that is an explanatory variable in the VAR. Other detail is seen in Figure 2.