Columbia Business School

CENTER ON JAPANESE ECONOMY AND BUSINESS

日本経済経営研究所

Working Paper Series

December 2007, No. 257

Herd Behavior by Japanese Banks After Financial Deregulation in the 1980s

Ryuichi Nakagawa and Hirofumi Uchida

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

Herd Behavior by Japanese Banks After Financial Deregulation in the 1980s [1]

Ryuichi Nakagawa [2]
Faculty of Economics
Kansai University

Hirofumi Uchida
Faculty of Economics
Wakayama University

December 20, 2007

[1]This paper was presented at the Center on Japanese Economy and Business (CJEB), Columbia University, and the 2007 Australasian Meeting of the Econometric Society. The authors are grateful to Necmi Avkiran, Ken-ya Fujiwara, Takashi Hatakeda, Keiichi Hori, Fumiharu Mieno, Hugh Patrick, Daniel Smith, Yosuke Takeda, and David Weinstein for helpful comments. However, the authors are solely responsible for any remaining errors. Most of the research was advanced during the first author's sabbatical leave at the CJEB. He thanks Hugh Patrick and David Weinstein, for their great hospitality and encouragement for the publication of this essay in the CJEB Working Paper. The first author also thanks the Financial System Workshop, and the second author thanks the Japan's Ministry of Education, Science, Sports and Culture for a Grant-in-Aid for Scientific Research (C) (No.15530214), and Wakayama University Research Fund for their financial support.

[2]Corresponding author: Faculty of Economics, Kansai University, 3-3-35 Yamate Suita, Osaka 564-0063, Japan. Phone: +81-6-6368-0590. Fax: +81-6-6339-7704. E-mail: ryu-naka@kansai-u.ac.jp.

Herd Behavior by Japanese Banks After Financial Deregulation in the 1980s

Abstract

This paper empirically investigates whether Japanese banks followed herd behavior as a result of financial deregulation in the 1980s, and whether any observed herd behavior brought about inefficiencies that could have caused macroeconomic fluctuations. Using loan-portfolio data, the paper examines Granger-causalities in lending behavior by different types of banks. We find that Japanese banks inefficiently herd from the early through mid-1980s, the period immediately after financial deregulation began. However, contrary to anecdotal evidence, inefficient herd behavior is rarely observed in the 1990s. The herd behavior in the 1980s was more frequently observed in lending to new borrowers than to traditional borrowers. In addition, other banks were inclined to follow those banks that were considered more informed in lending to a specific industry, or that were large enough to adjust more effectively to the environment created by deregulation. These results are consistent with theoretical predictions in the literature and suggest the possibility that the herd behavior contributed to the asset price bubble in the late 1980s.

Keywords: herd behavior; Japanese banks; financial deregulation; inefficiency

JEL classification number: G11; G14; G21; E44

1 Introduction

It is often argued that Japanese banks have engaged in *herd behavior* (*yokonarabi* in Japanese). Until the late 1970s, the Japanese financial system was strictly regulated. Capital markets were prevented to grow, and bank loans and bonds underwritten by banks were the primary external financing source for Japanese firms. Above all, banks were regulated explicitly and implicitly. Loan amounts, interest rates, borrowers, branching, fees, and other business lines were controlled, and banks' competition was discouraged to prevent none to go bankrupt. Thus, banks were often forced to behave *uniformly* to keep the relative sizes of banks stable. As the Japanese economy grew, the herd behavior was criticized as a symbol of the inefficiency of the Japanese financial market. [1]

Since a series of financial deregulation measures began in the 1980s, herd behavior seems to have disappeared. Banks were gradually allowed to decide their strategies by themselves. In addition, capital markets for major Japanese firms developed in the wake of the huge issuance of government bonds from the late 1970s. Deregulation thus seems to have made Japanese financial markets in general, and the lending market in particular, more efficient. [2]

But, it is plausible that Japanese banks were inclined to herd even after deregulation, because deregulation itself created structural shifts in both the demand and supply sides of the lending market. As to the demand side, borrowers that had long-term relationships with banks ceased to rely only on banks when raising funds in the 1980s. This is known as the *financial disintermediation*. As a result, banks had to find new borrowers, such as firms in real estate and finance industries, that they were unfamiliar with (Hoshi and Kashyap[23]). Lacking information about their new borrowers, banks might have herded by inferring the quality of borrowers from each other's behavior. As for the supply side, until deregulation, the areas in which a Japanese bank could lend were legally segmented by type of bank, and each type had comparative advantages in its own areas. As deregulation progressed, banks' borrower bases gradually overlapped (Packer[35]). As each type of bank explored new borrowers in other banks' areas, they might have blindly followed other types of banks that had already had advantages in the areas.

There is also a good deal anecdotal evidence of herd behavior in the lending market

[1] Overviews of the pre-deregulation financial system include Hoshi and Kashyap[chs 4, 5, and 6][24]; Teranishi[38]; and Kitagawa and Kurosawa[30].

[2] Hoshi and Kashyap[23][24, chapter 7] survey financial deregulation measures in terms of three areas: financing, saving, and bank business lines. In particular, the financing deregulation with respect to bond markets was implemented earlier than the other areas, due to the huge issuance of the government bonds in the late 1970s.

after deregulation. For example, in the 1980s, almost all banks uniformly raised the share of their loans going to finance or real estate industries. A large percentage of non-performing loans in the 1990s are considered to be the result of most banks not monitoring their borrowers during the asset price bubble period of the late 1980s (Ueda[39]). Most banks reduced loans outstanding in the 1990s, including a *credit crunch* (Ogawa and Kitasaka[34]).

Consequently, even after the 1980s, there have been arguments that herd behavior by Japanese banks remained a crucial factor that could cause macroeconomic fluctuations. The Nihon Keizai Shimbun (NIKKEI), Japan's leading economic newspaper, frequently wrote about herd behavior by Japanese banks during the stagnation in the 1990s. There was a peak of 146 articles in 1992 when it was clear that the asset bubble had burst and the financial system faced serious consequences, while the 1980s had an average of around 20 articles a year.

However, few studies have empirically examined herd behavior by Japanese banks. In addition, the literature has little investigated whether their behavior, if any, had macroeconomic impacts on the economy.

The purpose of this paper is to rectify this situation in two ways. First, we empirically investigate whether Japanese banks followed herd behavior since the period of financial deregulation. We focus on behavior *across types of banks*. This is important because different types of banks are likely to possess different information about borrowers, which may cause herding by less-informed banks drawing inferences from the behavior of banks considered better-informed. Our empirical methodology is based on Jain and Gupta[29], which examine Granger-causalities between lending decisions by different types of banks as evidence for herding.

Second, we examine whether any herd behavior identified brought about any *inefficient* markets equilibrium that was inconsistent with fundamental economic conditions and could cause macroeconomic fluctuations. We test whether observed causalities can be explained by economic variables, such as the future profitability of borrowers or structural changes in the Japanese financial market, that may uniformly affect the lending decisions of most banks. If any causality is observed even after controlling for those factors, it may be considered as evidence for *inefficient* herd behavior. [3]

[3]We do not investigate theoretical reasons for observed herd behavior and the macroeconomic impact of herding. This is because there is no direct link between a theoretical explanation for herding and an empirically observed herding (Bikhchandani and Sharma[8]). Moreover, it is difficult to control for underlying fundamental conditions and to distinguish spurious herding from rational herding (Alevy, Haigh, and List[1]). For numerical or empirical analysis on the impact of herding on financial markets

In an environment of imperfect information, herd behavior can cause an inefficient outcome. Bikhchandani, Hirshleifer, and Welch[6][7] establish an *informational cascade* model, in which under imperfect information, rational agents infer fundamental conditions based not only on their own private information, but also on the past record of decisions made by their predecessors. If agents learn others that did not have enough information of fundamental conditions, the equilibrium can be inefficient. [4]

However, herd behavior does not always bring about an inefficiency. If banks respond to the same fundamental conditions independently and rationally, they look following herd behavior, known as *clustering* or *spurious herding* (Hirshleifer and Teoh[21]). But the equilibrium is socially efficient. Therefore, if we refer to the macroeconomic impact of herd behavior, it is necessary to examine whether bank herding brought about any inefficiencies. [5]

Our empirical results are supportive of the prediction that Japanese banks followed herd behavior after financial deregulation. The results exhibit a *time-specific* feature of herding. That is, banks followed *inefficient* herd behavior in the early through mid-1980s, which is immediately after the start of deregulation. In that period, the observed herding was *borrower-specific* in the sense that the inefficient herding was more frequently observed in lending to new borrowers than in lending to traditional borrowers. We also find a *bank-specific* feature in bank herding. That is, in the face of the uncertainty, banks were inclined to follow the lead of banks that were considered more informed in lending to a specific industry, or that were larger enough to adjust themselves more effectively to the new environment created by deregulation.

On balance our results suggest that deregulation created an uncertain environment that had induced banks to inefficiently follow herd behavior by inferring from other banks creditworthiness of new borrowers. This might have contributed to the asset bubble in the late 1980s. Such behavior is rarely observed in other periods, in particular in the 1990s.

---

and real economy, see Bischi, Gallegati, Gardini, Leombruni, and Palestrini[5], and Welch[41].

[4]There are a number of theoretical studies of the various types of rational herding. Information cascade is also analyzed by Alevy, Haigh, and List[1], Banerjee[3], and Chari and Kehoe[10]. Other studies include herding based on *pay-off externalities*: *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]. Herding stemming from *reputation concerns* related to acting differently from other managers is studied by Scharfstein and Stein[37]. Herding due to a *comparative advantage* in holding securities with certain characteristics is studied by Falkenstein[17]. For surveys of herd behavior, see Bikhchandani and Sharma[8], Chamley[11], Devenow and Welch[14], Hirshleifer and Teoh[21], and Welch[41].

[5]As an example, in the asset price bubble of the late 1980s, most banks expected the surging land prices to be sustained, so expanded lending to real estate-related industries (Ueda[39]).

Our empirical results are consistent with theoretical predictions of studies based on Bayesian learning frameworks. The time-specific feature of observed herding is consistent with predictions that agents learn investment strategies from the behavior of other agents when there was a significantly new environment, and cease to do so as they become familiar with the environment. [6] The borrower- and bank-specific features are consistent with the literature that shows that agents are inclined to follow informed agents when they make investments into unfamiliar borrowers. [7]

This paper is closely related to a few empirical studies about herd behavior by US banks. Jain and Gupta[29] find that small US banks blindly replicated the lending behavior of large US banks in lending to developing countries from the late 1970s to the early 1980s, when lending opportunities in the United States decreased due to economic recession and they had to find new borrowers in other markets. The situation is quite similar to what occurred in Japan in the 1980s. Barron and Valev[4] also find that smaller US banks also relied on the behavior by more-informed banks from 1982 to 1994. Our contribution compared with these papers is that, while they only examine the existence of herd behavior, we also examine whether the observed behavior created any inefficiency in the lending market.

Uchida and Nakagawa[40] investigate herd behavior by Japanese banks, focusing on behavior *within groups of banks of the same type*, in contrast to our analysis focusing on herding *across types of banks*. The results of these two papers are complementary. Our results indicate that inefficient herd behavior occurred across bank types in the early through mid-1980s, while Uchida and Nakagawa find herding among the same types of banks during the late 1980s. This *successive* herding (of different forms) might have contributed to the formation of the asset price bubble in the late 1980s. [8]

The remainder of this paper is structured as follows. The next section describes the Japanese bank lending market and its historical transition. Section 3 conducts basic Granger-causality tests to examine the existence of herd behavior. Section 4 examines the efficiency of the herd behavior observed in Section 3. Section 5 proceeds with further detailed analysis, *sequential* causality tests, to further analyze the existence and efficiency

[6] See Chamley[11], among others. Nelson[33] also shows that inefficient herding gradually disappears when underlying fundamental market conditions change over time.

[7] Calvo and Mendoza[12] prove that an increase in new investment opportunities stimulates investors to herd by inferring from others' investment activities. Menkhoff, Schmidt, and Brozynski[32] show that less experienced investors tend to exhibit a higher degree of herding.

[8] Note that Uchida and Nakagawa[40] use the term "*irrational* herd behavior." We use the term "*inefficient* herd behavior" because, in our analysis using macroeconomic data, it is difficult to identify whether Japanese banks rationally followed herd behavior.

of herd behavior. Section 6 checks the robustness of the previous results by conducting panel VAR causality tests. Section 7 concludes the paper.

2 Loan Data

This section explains different types of Japanese banks and introduces the data on their loans outstanding by borrower. This section also describes the historical transition of borrowers for banks to provide background for later empirical analysis. Details on data are in the data appendix.

2.1 Bank type

We focus on four types of Japanese banks: city banks, regional banks, long-term credit banks (hereafter LTC banks), and trust banks. City banks are the largest banks in Japan. They have branch offices in major cities and operate nationwide, as well as internationally. Regional banks are smaller and operate in local markets. [9] LTC had the special aim of long-term finance, while trust banks focused on trust services. Both are often characterized as having been the main providers of long-term funds in postwar Japan until the 1990s.

Our analysis focuses on the interaction between city banks and the other three types. Although there was segregation of business areas in the financial industry, the scope of business areas of city banks has been very broad and likely to overlap with the other types of banks. It is also reasonable to focus on city banks, as they have been dominant in the Japanese lending market. Table 1 shows that, for decades, city banks loans outstanding have accounted for more than 40 % of total loans outstanding in Japan.

2.2 Type of borrowers

Loan data by borrower industry are available for the nine industries: Manufacturing; Construction; Electricity, gas, heat supply and water (hereafter Electricity); Transport and communication (Transport); Wholesale, retail trade, eating and drinking places (Wholesale); Finance and insurance (Finance); Real estate; Services; and Individuals.

Figure 1 shows the changing distribution of bank borrowing by various industries from Japanese banks. Panel (a) – (c) show the share of loans outstanding to each borrower industry to the total loans outstanding, and Panel (d) shows loans outstanding to each

[9] Regional banks are categorized into regional banks and second-tier regional banks, each with different historical background. However, we group them together because, when analyzed separately, the results are similar.

industry group. Borrower industries are in three groups based on the distinct pattern of transitions. The first group is *traditional* industries (manufacturing and wholesale), which were the dominant borrowers until the late 1970s. But their outstanding loans have become stable during the 1980s, and their loans shares decreased from about 30% to 15%. The second group is the *emerging* industries (finance, real estate, services, and individuals) that gradually took over as the major borrowers from the mid-1980s in terms of loans outstanding as well as loans share. The third group is *status quo* industries (construction, electricity, and transport), which have marginal and stable shares during the period.

These patterns reflect a variety of structural changes in Japan's economy. Traditional industries were composed of large corporations, and had been borrowing huge sums since the World War II. However, financial deregulation from the end of the 1970s enabled them to access other sources. As a result, their total bank borrowing became largely flat in the mid-1980s. This shift away from direct reliance on banks is known as *financial disintermediation.* [10]

Deregulation helped boost of the loans outstanding and loan shares of emerging industries beginning in the early 1980s. Banks, who had lost the footing of 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 of the mid- to late 1980s also contributed to the influx of funds into the emerging industries. This is because the surge in land values made it easier for banks to lend to unfamiliar borrowers and others using land as collateral.

Compared to the 1980s, the 1990s shows stability in the loan shares. That is, little change is observed after the implosion of the asset price bubble in the early 1990s. In this sense, the structural and strategic consequences of the 1980s deregulation largely played out during the 1980s - although deregulation continued during the 1990s. Together with the fact that the 1990s is a period of stagnation and banking crises, we expect the behavior of Japanese banks in the 1990s to be different from the 1980s.

Based on these observations, we examine the lending behavior of Japanese banks to traditional industries and to emerging industries. The discussion thus far implies a *borrower-specific* feature of herding. That is, herding is likely to be found in loans to emerging industries in the 1980s, because banks needed new customers if they were to

[10]The deregulation includes such institutional reforms as the Foreign Exchange and Trade Control Act (December 1980) and enforcement of the New Banking Act (April 1982). The Japan-US Yen Dollar Committee report (June 1984) was also a factor. See Hoshi and Kashyap[23][24, ch 7], Ramseyer[36] and Campbell and Hamao[13] for more details.

grow, but might not obtain enough information about these borrowers. In contrast, it is less likely to find herding in loans to traditional industries, because the banks knew these customers, and they became relatively less important borrowers. We do not analyze the status quo industries, because the loan shares to these industries were marginal and stabile.

3 Existence of Herd Behavior

In this section, we empirically examine whether herd behavior existed or not between city banks and the other types of banks in the Japanese lending market.

3.1 Methodology

Our empirical methodology is to estimate two-variate vector autoregressive (VAR) models of the loan data of city banks and of the other types of banks. We examine whether Granger-causalities are observed between those loan variables.

We focus on four sample periods based on the historical background explained in Section 2.2 and because of data availability: 1975:1 – 1984:4, 1980:1 – 1989:4, 1985:1 – 1994:4, and 1990:1 – 1999:4. The data observations are quarterly. The periods serially overlap by five years in order to identify the time-variation of herd behavior under sufficient degrees of freedom. The 1980-89 sample period especially enables us to examine whether deregulation triggered herd behavior in the 1980s. [11]

As a loan variable that represents the lending behavior by each type of banks to each industry group, we use the ratio of that type of banks' loans outstanding to the industry group to those banks' total loans outstanding. The size of loans outstanding is thus normalized so that we can examine whether banks adjusted their portfolio composition by herding. [12]

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

[11] We do not analyze the early 1970s, because of data availability. It is also appropriate to focus on the periods after *window guidance* by the Bank of Japan became less important. Until 1981, every quarter the Bank set a plan of total loans outstanding from domestic banks, and the increase in loans was controlled as planned. In 1982, guidance was reformed to take the form of a voluntary submission of planned lending by individual banks, and was lifted completely in July 1991.

[12] We do not investigate the level of loans outstanding. Those data tend to correlate among different banks, and thus to generate spurious causalities more than the ratio data do, because the level data seem to be more subject to macroeconomic trends. There is a series on New Loans for Equipment Funds by Industry, which seems to be less subject to macroeconomic trends. However, the data are not categorized by bank type.

3.2 Results

Table 2 shows the results regarding causalities between loan ratios of city banks and those of the other types of banks. We find three features of observed herding. [13]

First, we find a *time-specific* feature of the results in the sense that the number of significant causalities increases from 1975-84 to 1980-89 and then decreases from 1985-94 to 1990-99. This suggests that Japanese banks followed herd behavior most extensively in the 1980s when deregulation started, and by the 1990s that they gradually ceased to herd. As is explained in Section 2.2, the financial disintermediation forced most banks to switch borrowers from traditional to new industries in the 1980s. There is a possibility that banks followed each other's lending behavior in order to explore new (unfamiliar) borrowers. As banks became accustomed to the new borrowers by the 1990s, herd behavior seems to have disappeared. On the other hand, this finding does not support the anecdotal argument that Japanese banks followed herd behavior during the long stagnation of the 1990s.

Second, in contrast to our prediction, we do not clearly find a *borrower-specific* feature of herding. Causalities are observed not only in loans to emerging industries, but also in loans to traditional industries. This suggests financial deregulation might have induced herding in both industry groups to a similar extent. Alternatively, herding in traditional industries might have reflected the legacy of regulation measures until the late 1970s.

Third, we find, as a *bank-specific* feature of the results, that causalities are observed mostly from LTC and trust banks to city banks in 1980-89 and 1985-94, and from city banks to regional banks in 1980-89. The former finding suggests that city banks followed LTC and trust banks, possibly because those banks had a comparative advantage in long-term lending that was established during the rapid-growth era in the late 1970s. This phenomenon may be called the *Cowbell effect*, because of its similarity to a relationship among Japanese banks noted by Higano[19]. [14] The latter finding implies that, in the 1980s, smaller (regional) banks followed bigger (city) banks deemed likely to have a greater potential to adjust to the new financial environment.

In summary, Table 2 suggests that financial deregulation created a new environment

[13] 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. This might be an interesting topic, but we deter its investigation to a future work.

[14] Higano points out that there might have been an inducement effect in loans made by the Japan Development Bank (JDB, presently the Development Bank of Japan, a government financial institution. He claimed that loans made by JDB signaled that the government was happy with the loans, and that the loans "thus were implicitly guaranteed by the government. Packer[35] argues that the LTC banks played a similar role to JDB's providing long-term funds to borrowers who were important in Japan's postwar development.

that stimulated herd behavior among Japanese banks in the 1980s. In that period, deregulation seemed to have induced bank herding in lending to both traditional and emerging industries, although herding in the traditional industries may also reflect regulation measures until the late 1970s. In addition, banks might have followed those types of banks that seemed to have comparative advantages in lending to a specific industry, or that have an ability to adjust themselves to the new environment. On the other hand, that evidence is rarely observed in the 1990s.

Our findings are consistent with the theoretical prediction that agents tend to learn from the behavior of other informed agents in the existence of information imperfection.

4 Inefficient Herd Behavior

Next we proceed to test whether the observed causalities reflect *inefficient* herd behavior. As mentioned in Introduction, banks should take account of the fundamental conditions of the economy when making lending decisions. This can induce efficient herding that is consistent with the fundamental economy. If evidence for herding is found even after controlling for those fundamental factors, it suggests that Japanese banks might have followed inefficient herd behavior.

4.1 Methodology

The test is conducted by introducing into a VAR several macroeconomic variables.

First, the ratio of nominal GDP by industry group to aggregate nominal GDP and the ratio of the stock price index by industry group to the TOPIX (a broad market stock index) are used to control for changes in the relative size of loans demand by each industry group.

Next, deregulation beginning in the 1980s accelerated disintermediation by traditional industries. Then the ratio of total private bonds outstanding to aggregate nominal GDP is used to control for the structural shift in loans demand by traditional industries.

In addition, the surge in land prices in the 1980s seems to have stimulated loans demand by emerging industries because land could be used as collateral, especially in lending to unfamiliar borrowers. Then the ratio of a nationwide land price index to aggregate nominal GDP is used to control for changes in loans demand by emerging industries.

One and two lags of these control variables are introduced, not only to effectively

control for efficient herding, but also to mitigate the endogenous bias problem. [15]

We ensure sufficient degrees of freedom in the causality test by limiting the number and the lag of control variables. Also, we do not introduce a variable that *equally* affects loan supply or demand of all borrowers, because such a variable is less likely to affect a bank's portfolio composition. For example, the level of aggregate GDP, TOPIX, or call rates do not change the loan ratio of a specific borrower. When those variables were introduced, they were mostly insignificant in VAR estimations. Further, the amount of non-performing loans (NPLs) in the 1990s might have had unequal effects among the loans demand of different borrowers. However, we do not introduce it because its data are not consistently available for our sample period. [16]

4.2 Results

Table 3 shows the results regarding inefficient herd behavior between city banks and the other types of banks. Similarly to Table 2, we can observe several significant causalities after deregulation. However, most of them become less significant.

First, we observe a slight time-specific herding in that causalities are observed most frequently in 1980-89, but this is less remarkable than in Table 2. Hence, after the 1980s, we cannot speculate that herd behavior generated crucial inefficiency in the lending market in any specific period. Second, we do not clearly find the borrower-specific feature since the 1980s. Significant causalities are sparse in both industry groups, except for 1975-84. Third, the bank-specific feature is also obscure, so that the Cowbell effect becomes less significant, although causalities from city to regional banks are observed in 1980-89.

In summary, Table 3 does not indicate any significant evidence for inefficient herd behavior by Japanese banks since financial deregulation in the 1980s. This is because most of the causalities observed in Table 2 become less significant in Table 3. At this point, we can conclude that there might have been bank herd behavior after deregulation, but the behavior might not have caused inefficiency in the lending market.

[15] We also conducted the analysis in which estimated *expected* values of macroeconomic variables were used as control variables instead of their *realized* values, because expected variables can be better proxies for those changes in loans demand than realized ones are. However, it turned out that the results were similar. In addition, we conducted the same tests in which the lag of a VAR is fixed at four. However, the results were not changed.

[16] Another reason for excluding the amount of NPLs is that it is unclear whether the amount to a specific industry had a consistent effect on new loans to that industry. On the one hand, a huge amount of NPLs might discourage new loans; on the other hand, the NPLs might force banks to increase loans to non-performing borrowers to prevent the remaining loans from being declared non-performing. Hoshi and Kashyap[26] discuss this last effect and survey the related literature.

5 Further Analysis: Sequential Causality Test

The previous section looked at four sample periods to examine herd behavior by Japanese banks. Sufficient evidence of inefficient herd behavior was not confirmed. A possible reason is that bank lending behavior had been gradually changing over time, so that herd behavior can not be identified just by testing a few specific sample periods. We therefore investigate whether inefficient herd behavior can be found in other sample periods.

For this purpose, we conduct *sequential* causality tests, which examine Granger-causalities between Japanese banks for all possible ten-year sample periods. Specifically, we select the earliest ten-year sample period from the whole sample period and examine causalities as in the previous sections. This is repeated sequentially, shifting the sample period by one quarter, until the end of the selected sample period reaches the end of the whole period. The advantage of this test is that we can observe the transition of the causalities more stringently.

5.1 Existence of Herd Behavior

Figure 2 shows the results for the existence of herd behavior between city banks and the other types of banks. The shadowed area may indicate the existence of a robust and long-running causality.

The figure shows several features of herding similar to those observed in Table 2. As the time-specific feature, causalities appear most persistently in the 1980s, immediately after deregulation began, and almost disappear by the 1990s. [17] Borrower-specific herding is not distinctly found among observed causalities in loans to either industry group. Interestingly, the bank-specific feature is found more clearly in the 1980s in both industry groups: the Cowbell effects and regional bank herding toward city banks, implying that banks are inclined to follow more-informed banks.

In terms of the existence of herd behavior, therefore, we confirm more clearly the features as those in Section 3.2. We can thus conclude that financial deregulation might have stimulated herd behavior across different types of Japanese banks in the 1980s, while our results seldom support the anecdotal argument that Japanese banks herded in the 1990s.

[17] In the late 1970s, causalities are seen only in the traditional industries, implying the lending patterns of the high growth era until the late 1970s. Causality is also found in the 1990s from city to LTC banks in the emerging industries. This partly supports the possibility of herding in the 1990s.

5.2 Inefficient Herd Behavior

We turn to the analysis of the efficiency of the observed herd behavior. Figure 3 shows several causalities that may more clearly reflect the influence of deregulation.

First, causalities concentrate in the early through mid-1980s, and mostly disappear in the late 1980s. Second, although the borrower-specific feature is not found in Figure 2, in Figure 3 we find that causalities are more intensive in loans to emerging industries after deregulation. On the other hand, most of the causalities in traditional industries are eliminated by control variables. Third, bank-specific causalities are observed more specifically than in Figure 2: from LTC and trust banks to city banks in the early 1980s, and from city to regional banks in the mid-1980s.

Our results generally support our prediction that Japanese banks *inefficiently* followed herd behavior immediately after the beginning of financial deregulation. In that period inefficient herding is observed, particularly in lending to emerging industries, possibly because of the lack of information about those new borrowers. The inefficient behavior in the early 1980s took the form of city banks following more-informed LTC and trust banks, and in the mid-1980s, less-informed regional banks following city banks. [18]

Therefore, considering the rapid growth of loans to emerging industries in the 1980s, herd behavior caused by deregulation might have contributed to subsequent economic fluctuations through emerging loans by less-informed banks. This finding is similar to the results of empirical studies about herd behavior by US banks. Jain and Gupta[29] and Barron and Valev[4] find that small US banks relied on the lending behavior of more-informed US banks in lending to unfamiliar developing countries in the late 1970s and early 1980s.

On the other hand, banks might have behaved efficiently in the 1990s, except for LTC banks following city banks in lending to emerging industries.

6 Robustness Check: Panel VAR Causality Test

In this section, we check the robustness of our results using another technique. In previous sections, we focused on ten-year sample periods in order to ensure sufficient degrees of freedom. However, the sample period might be so long that includes structural changes

[18] As to delayed herding, 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.

in the economy. We thus check causalities under a shorter sample period by estimating *panel* vector autoregression models (panel VAR).

6.1 Methodology

Panel VAR estimation is to estimate a VAR with panel data. Here, in order to test causalities between loan ratios of two bank types in an industry group, the panel VAR fixed-effect model is expressed as:

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

$x_{i,t}$ is the loan ratio of bank type x to industry i in period t, and $y_{i,t}$ is the loan ratio of bank type y to the same in dustry in the same period. $u_{i,t}$ 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.

Panel VAR estimation is different from standard VAR 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. 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 sufficient degrees of freedom in the test even if we examine a short period.

We focus on the following five-year periods: 1975:1 – 1979:4, 1980:1 – 1984:4, 1985:1 – 1989:4, 1990:1 – 1994:4, and 1995:1 – 1999:4. We estimate a panel VAR using generalized least square (GLS), considering the heteroscedasticity of the loan ratio by industry. In addition, loan ratios are normalized by dividing them with their own sample means. Other details of the panel VAR causality test are the same as previous tests. [19]

[19]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

6.2 Existence of Herd Behavior

Table 4 shows the results of panel causality tests for the existence of herd behavior. The table shows that causalities are found most frequently in 1980-84 and 1985-89. This implies that financial deregulation stimulated herd behavior by Japanese banks in the 1980s. A few causalities are also found in the 1990s, although they are not prevalent among Japanese banks.

Again, we do not clearly find the borrower-specific feature. That is, herding was no more intensive in lending to emerging industries. As for the banks-specific feature, we can confirm that regional banks often followed city banks. On the other hand, city, LTC, and trust banks seem to have followed each other. Those banks might have been interdependent in shorter periods.

In summary, the panel causality tests reinforce the previous results that Japanese banks followed herd behavior in facing deregulation in the 1980s. But features regarding borrowers or bank types are not clearly obtained to the extent that is consistent with the results in previous sections.

6.3 Inefficient Herd Behavior

We now proceed to panel VAR causality tests for the efficiency of the observed herd behavior. The variables to control for efficiency are the same as the macroeconomic variables used earlier. Note, however, that in the panel causality test, a different control variable is chosen for each industry of an industry group, while in the standard causality test a control variable is applied for each industry group. In this sense, the efficiency of herd behavior can be controlled more effectively in this panel test.

Table 5 shows the results for inefficient herd behavior. We find the time-specific feature that causalities are most frequently observed in the early 1980s. The borrower-specific feature is not clearly observed in the 1980s, because causalities are found in the traditional industries as well as in the emerging industries. Again, causalities in the traditional industries might reflect not only the effect of deregulation, but also effects of past regulation measures.

Finally, the results in the 1980s suggest the bank-specific feature. The Cowbell effect is often found from LTC and trust banks to city banks, although reverse causalities are partly found. In contrast to the previous analysis, causalities from city banks to regional bank are not clearly observed in the 1980s. However, if we examine the mid-1980s (1983:1

been commonly used to determine the optimal lag, according to Larsson, Lyhagen, and Lothgren[31] and Ericsson and Irandoust[16].

– 1987:4), when those causalities are found in Figure 3, we confirm the same causalities in both industry groups (Panel (f) of Table 5).

In summary, the main results are consistent with the results from sequential causality testing, in that Japanese banks, the less-informed in particular, displayed inefficient herd behavior in the early 1980s, the beginning period of deregulation. [20]

7 Conclusion

This paper has examined empirically whether Japanese banks followed herd behavior after financial deregulation started in the early 1980s, and whether observed herding had brought about inefficient outcomes that could have led to subsequent macroeconomic fluctuations.

The perceived herd behavior of Japanese banks is considered a symbol of inefficient Japanese financial markets. Even though the behavior seems to have disappeared because of deregulation, there has been much anecdotal evidence for herd behavior by banks, which has been blamed for economic problems in the 1990s.

Our empirical results suggest that Japanese banks *inefficiently* herded in the early through mid-1980s, immediately after the beginning of deregulation. In that period, the inefficient behavior seems to have been more significant in lending to new borrowers that banks had not been familiar with than in lending to traditional borrowers. In addition, banks seem to have followed those banks more informed in lending to a specific industry. These results are consistent with theoretical predictions in the literature, and suggest the possibility that inefficient herding might have had contributed to formation of the asset price bubble in the late 1980s. On the other hand, the results do not support anecdotal evidence that Japanese banks followed inefficient herd behavior in the 1990s.

There are two important issues that are unchallenged in this paper. First, we do not empirically investigate whether and how inefficient herding contributed to formation of the asset price bubble in the late 1980s and the accumulation of non-performing loans in the 1990s. Second, we focus sorely on the question of whether observed herd behavior was efficient, not on identifying any theoretical causes of observed herding. Those issues are to be clarified in a separate study.

[20] Other causalities are observed in the late 1990s. This suggests that inefficient herding occurred after the financial crisis from the end of 1997. (See Cargill[9], Hoshi and Kashyap[24, chapter 8][25], and Ito[28] about the crisis.)

A Data Appendix

All the data used in this paper are available from *Nikkei NEEDS Macroeconomic Data File*. The original sources are shown below.

Loans Outstanding

Loan data are available from "Loans and Discounts Outstanding by Sector" in the *Financial and Economic Statistics Monthly* of the Bank of Japan. The data include the amount of loans supplied to different industries by type of bank. Data for trust bank lending to the finance and insurance industries are available only from the first quarter of 1977. No data for LTC and trust banks are available from the fourth quarter of 2000.

The types of banks and their loans outstanding are defined as follows. First, regional and second-tier regional banks are combined as regional banks. Second, the loans outstanding of trust banks are defined as Banking Accounts of Trust Banks + Trust Accounts of Domestically Licensed Banks. The latter includes loans outstanding in the trust accounts of all Domestically Licensed Banks - that is, trust banks and the other types of banks - and the total cannot be separated between trust banks and other banks. However, the amount held by non-trust banks is negligible compared to the amount held by trust banks.

GDP

GDP data are available from the *Annual Report on National Accounts* prepared by the Cabinet Office. We utilize nominal data from 68SNA (original series, at market prices in calendar 1990) for the years until 1979, and from 93SNA (original series, at market prices in calendar 1995) for the years from 1980. The data include aggregate nominal GDP and nominal GDP by industry.

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

In the simple and sequential causality tests, nominal GDP by *industry group* is calculated as the sum of the nominal GDPs of the industries that are included in the 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 directly used.

Stock Price Index

Stock price data are available from the *Monthly Statistics Report* from the Tokyo Stock Exchange. The data include TOPIX and TOPIX Stock Price Index by Industry.

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

The Wholesale and Banks Indexes are not available until 1982. Then in the analysis which uses data prior to 1982, the Machinery and Real Estate Indexes are used for Wholesale and Finance, respectively. The Machinery Index is chosen because it is the most-correlated with the Wholesale Index of all indexes regarding traditional industries during 1983 – 99. The Real Estate Index is the most-correlated with the Banks Index of all indexes regarding emerging industries during 1983 – 99.

Other Data

Bond data are available from the *Annual Report* of the Japan Securities Dealers Association. The data include Total Private Bonds Outstanding, which is used to establish the proxy for disintermediation.

Land price data are available from the Japan Real Estate Institute. The data includes the Nationwide Urban Land Price Index, which is used to establish the proxy for the collateral value of loans to emerging industries.

Each of the above control variables is used not only for an industry group in simple and sequential causality tests, but also for every industry of an industry group in the panel VAR causality tests.

References

[1] J.E. Alevy, M.S. Haigh, and J.A. List. Information Cascades: Evidence from a Field Experiment with Financial Market Professionals. *Journal of Finance*, vol.62, no.1, pp.151–180, 2007.

[2] M. Aoki and H. Patrick, *The Japanese Main Bank System: Its Relevance for Developing and Transforming Economies*, Oxford University Press, 1994.

[3] A. Banerjee. A Simple Model of Herd Behavior. *Quarterly Journal of Economics*, vol.107, no.3, pp.797–817, 1992.

[4] J.M. Barron and N.T. Valev. International Lending by U.S. Banks. *Journal of Money, Credit, and Banking*, vol.32, no.3, pp.357–381, 2000.

[5] G.-I. Bischi, M. Gallegati, L. Gardini, R. Leombruni, and A. Palestrini. Herd Behavior and Nonfundamental Asset Price Fluctuations in Financial Markets. *Macroeconomic Dynamics*, vol.10, no.4, pp.502–528, 2006.

[6] S. Bikhchandani, D. Hirshleifer, and I. Welch. A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades. *Journal of Political Economy*, vol.100, no.5, pp.992–1026, 1992.

[7] S. Bikhchandani, D. Hirshleifer, and I. Welch. Learning from the Behavior of Others: Conformity, Fads, and Informational Cascades. *Journal of Economic Perspectives*, vol.12, no.3, pp.151–170, 1998.

[8] S. Bikhchandani and S. Sharma. Herd Behavior in Financial Markets: A Review. *IMF Working Paper*, no.0048, 2000.

[9] T.F. Cargill. What Caused Japan's Banking Crisis? In T. Hoshi and H. Patrick eds, *Crisis and Change in the Japanese Financial System*, Kluwer Academic Publishers, 2000.

[10] V.V. Chari and P.J. Kehoe. Financial Crises as Herds: Overturning the Critiques. *Journal of Economic Theory*, vol.119, no.1, pp.128–150, 2004.

[11] C.P. Chamley. *Rational Herds: Economic Models of Social Learning*, Cambridge University Press, 2004.

[12] G.A. Calvo and E.G. Mendoza. Mexico's Balance-of-payments Crisis: A Chronicle of a Death Foretold Herding. *Journal of International Economics*, vol.41, no.3, pp.235–264, 1996.

[13] J.Y. Campbell and Y. Hamao. Changing Patterns of Corporate Financing and the Main Bank System in Japan. In M. Aoki and H. Patrick eds, *The Japanese Main Bank System*, Oxford University Press, 1994.

[14] A. Devenow and I. Welch. Rational Herding in Financial Economics. *European Economic Review*, vol.40, no.3-5, pp.603–615, 1996.

[15] D.W. Diamond and P. Dybvig. Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy*, vol.91, no.3, pp.401–419, 1983.

[16] J. Ericsson and M. Irandoust. The Productivity-bias Hypothesis and the PPP Theorem: New Evidence from Panel Vector Autoregressive Models. *Japan and the World Economy*, vol.16, no.2, pp.121–138, 2004.

[17] E.G. Falkenstein. Preferences for Stock Characteristics as Revealed by Mutual Fund Portfolio Holdings. *Journal of Finance*, vol.51, no.1, pp.111–135, 1996.

[18] K. Froot, D.S. Scharfstein, and J.C. Stein. Herd on the Street: Informational Inefficiencies in a Market with Short-term Speculation. *Journal of Finance*, vol.47, no.4, pp.1461–1484, 1992.

[19] M. Higano. *Kinyu Kikan no Shinsa Noryoku (Monitoring Ability of Financial Institutions) (in Japanese)*, University of Tokyo Press, 1986.

[20] D. Hirshleifer, A. Subrahmanyam, and S. Titman. Security Analysis and Trading Patterns when Some Investors Receive Information before Others. *Journal of Finance*, vol.49, no.5, pp.1665–1698, 1994.

[21] D. Hirshleifer and S.H. Teoh. Herd Behavior and Cascading in Capital Markets: A Review and Synthesis. *European Financial Management*, vol.9, no.1, 2003, pp.23–66.

[22] D. Holtz-Eakin, W. Newey, and H.S. Rosen. Estimating Vector Autoregressions with Panel Data. *Econometrica*, vol.56, no.6, pp.1371–1395, 1988.

[23] T. Hoshi and A. Kashyap. The Japanese Banking Crisis: Where Did it Come From and How Will it End? *NBER Macroeconomic Annual 1999*, 2000.

[24] T. Hoshi and A. Kashyap. *Corporate Financing and Governance in Japan*, MIT Press, 2001.

[25] T. Hoshi and A. Kashyap. Japan's Financial Crisis and Economic Stagnation. *Journal of Economic Perspective*, vol.18, no.1, pp.3–26, 2004.

[26] T. Hoshi and A. Kashyap. Solutions to Japan's Banking Problems: What Might Work and What Definitely Will Fail. In T. Ito, H. Patrick, and D. Weinstein eds, *Reviving Japan's Economy: Problems and Prescriptions*, MIT Press, 2005.

[27] T. Hoshi and H. Patrick. The Japanese Financial System: An Introductory Overview. In T. Hoshi and H. Patrick eds, *Crisis and Change in the Japanese Financial System*, Kluwer Academic Publishers, 2000.

[28] T. Ito. The Stagnant Japanese Economy in the 1990s: The Need for Financial Supervision to Restore Sustained Growth. In T. Hoshi and H. Patrick eds, *Crisis and Change in the Japanese Financial System*, Kluwer Academic Publishers, 2000.

[29] A.K. Jain and S. Gupta. Some Evidence on 'Herding' Behavior of U.S. Banks. *Journal of Money, Credit and Banking*, vol.19, no.1, pp.78–89, 1987.

[30] H. Kitagawa and Y. Kurosawa. Japan: Development and Structural Change of the Banking System. In H.T. Patrick and Y.C. Park eds, *The Financial Development of Japan, Korea, and Taiwan*, Oxford University Press, 1994, pp.81–128.

[31] R. Larsson, J. Lyhagen, and M. Lothgren. Likelihood-based Cointegration Tests in Heterogeneous Panels. *Econometrics Journal*, vol.4, no.1, pp.109–142, 2001.

[32] L. Menkhoff, U. Schmidt, and T. Brozynski. The Impact of Experience on Risk Taking, Overconfidence, and Herding of Fund Managers: Complementary Survey Evidence. *European Economic Review*, vol.50, no.7, pp.1753–1766, 2006.

[33] L. Nelson, Persistence and Reversal in Herd Behavior: Theory and Application to the Decision to Go Public. *Review of Financial Studies*, vol.15, no.1, pp.65–95, 2002.

[34] K. Ogawa and S. Kitasaka. Bank Lending in Japan: Its Determinants and Macroeconomic Implications. In T. Hoshi and H. Patrick eds, *Crisis and Change in the Japanese Financial System*, Kluwer Academic Publishers, 2000.

[35] F. Packer. The Role of Long-term Credit Banks within the Main Bank System. In M. Aoki and H. Patrick eds, *The Japanese Main Bank System*, Oxford University Press, 1994.

[36] J.M. Ramseyer. Explicit Reasons for Implicit Contracts: The Legal Logic to the Japanese Main Bank System. In M. Aoki and H. Patrick eds, *The Japanese Main Bank System*, Oxford University Press, 1994.

[37] D.S. Scharfstein and J.C. Stein. Herd Behavior and Investment. *American Economic Review*, vol.80, no.3, pp.465–479, 1990.

[38] J. Teranishi. Japan: Development and Structural Change of the Financial System. In H.T. Patrick and Y.C. Park eds, *The Financial Developmentj of Japan, Korea, and Taiwan*, Oxford University Press, 1994, pp.27–80.

[39] K. Ueda. Causes of Japan's Banking Problems in the 1990s. In T. Hoshi and H. Patrick eds, *Crisis and Change in the Japanese Financial System*, Kluwer Academic Publishers, 2000.

[40] H. Uchida and R. Nakagawa. Herd Behavior in the Japanese Loan Market: Evidence from Bank Panel Data. *Journal of Financial Intermediation*, vol.16, no.4, pp.555–583, 2007.

[41] I. Welch. Herding among Security Analysts Herding. *Journal of Financial Economics*, vol.58, no.3, pp.369–396, 2000.

Table 1 Loan Shares of Different Types of Japanese Banks

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

Source: Nikkei NEEDS Macroeconomic Data File.

Table 2 Causality Tests regarding 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: This table shows the results regarding causalities between loan ratios of city banks and those of the other types of banks in individual industry groups. The rows of each panel show the types of banks whose relationships with city banks are being investigated. Two columns show the industry groups as borrowers. " 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 => " 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. The superscript *** means that the sum of coefficients is positive and significant at 1% level in an F-test; ** at 5%; * at 10%. Results regarding trust banks for 1975-84 are not available because of a lack of data.

Table 3　Causality Tests regarding 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: This table shows the results regarding causalities between loan ratios of city banks and those of the other types of banks in individual industry groups, with one and two lagged macroeconomic variables. Other detail is seen in Table 2.

Table 4　Panel VAR Causality Tests regarding 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: This table shows the results of panel VAR causality tests between loan ratios of city banks and those of the other types of banks in individual industry groups, 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 regarding 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

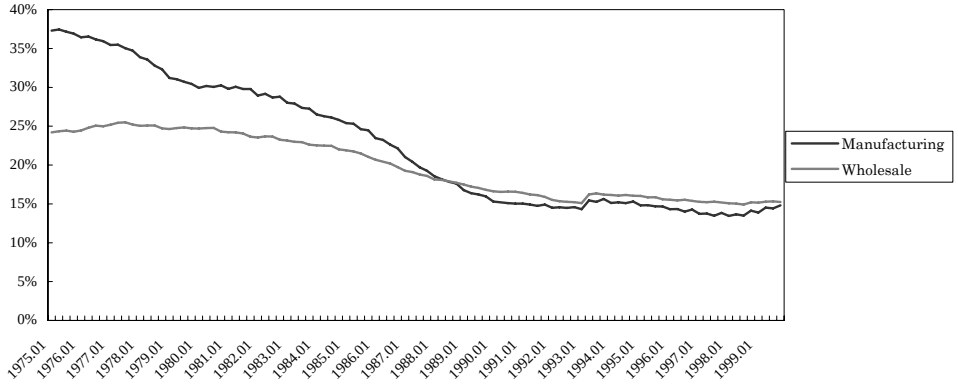
(f) 1983:1 -- 1987:4

	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

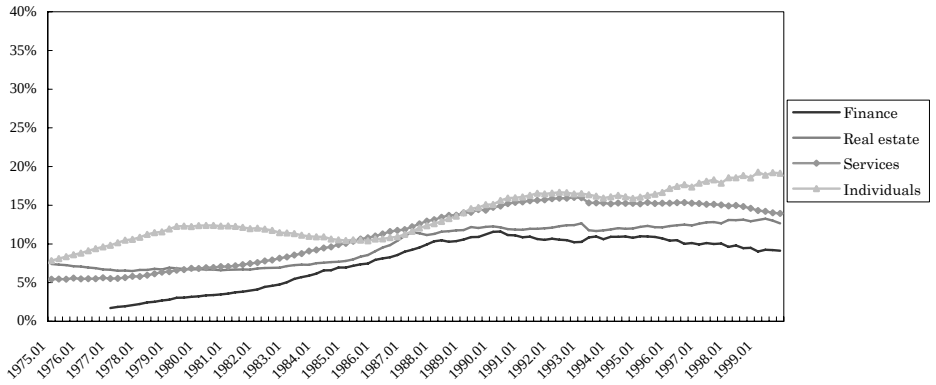
Note: This table shows the results of panel VAR causality tests between loan ratios of city banks and those of the other types of banks in individual industry groups, with one and two lagged macroeconomic variables. Loan ratios and macro variables are normaliezed by dividing them with their own sample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

Figure 1 Loan Shares of Individual Industries by Japanese Banks

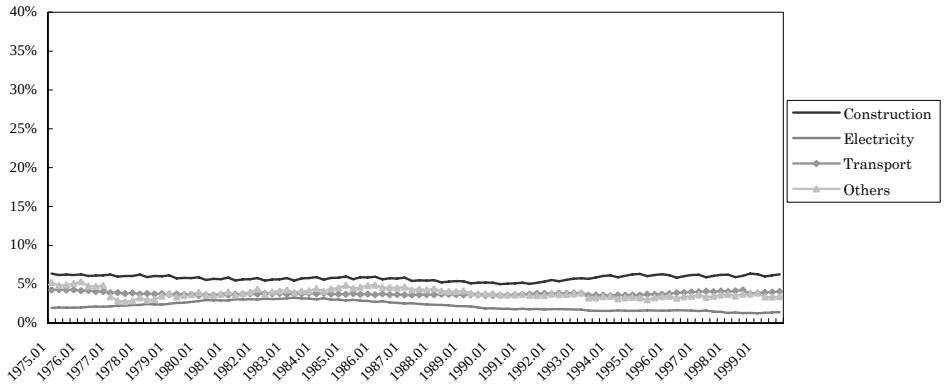
(a) Traditional industries



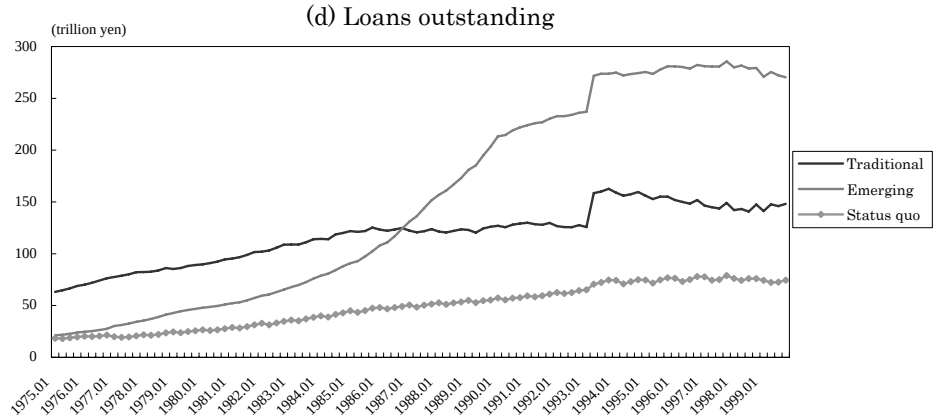
(b) Emerging industries



(c) Status quo industries

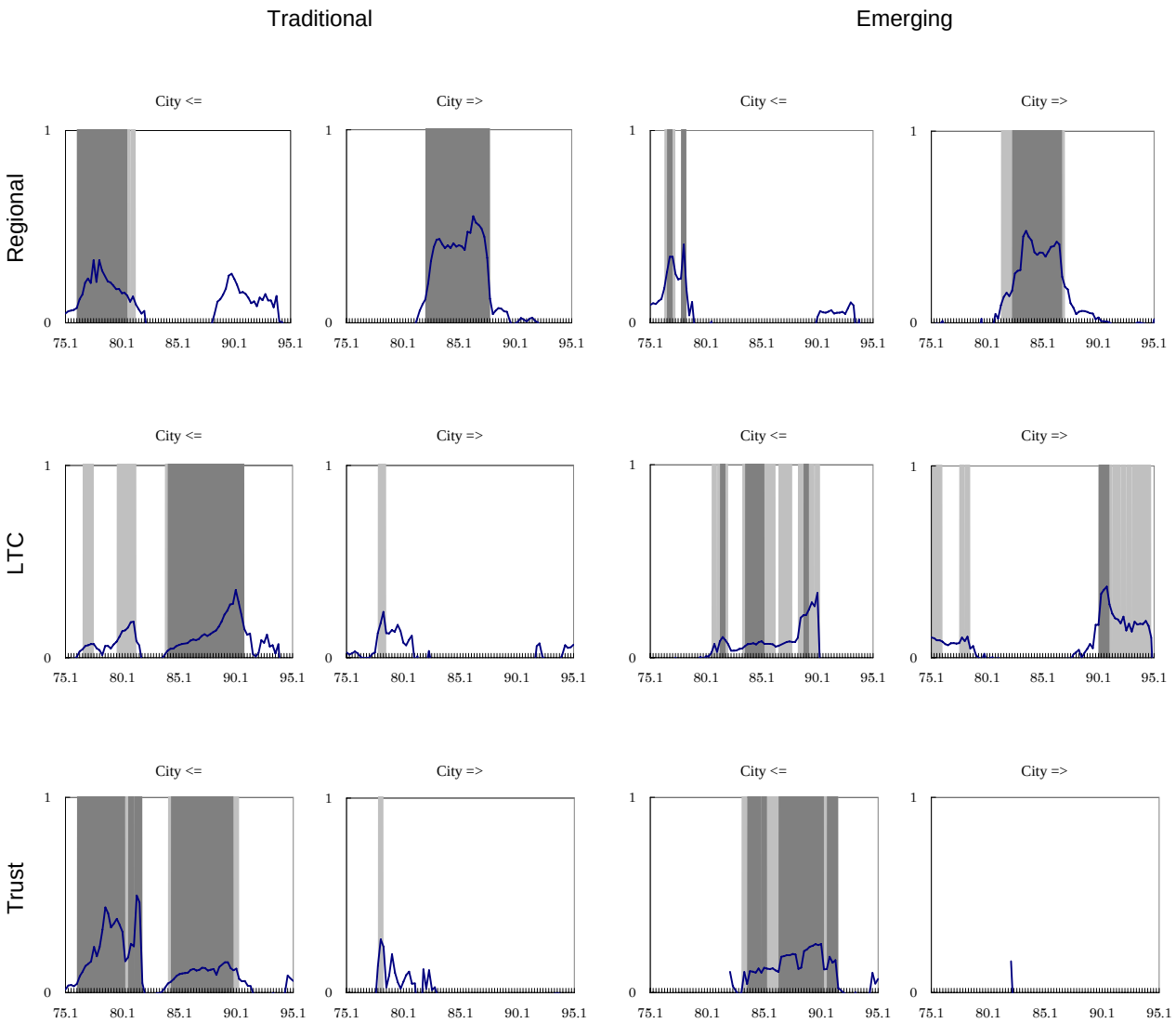


(d) Loans outstanding



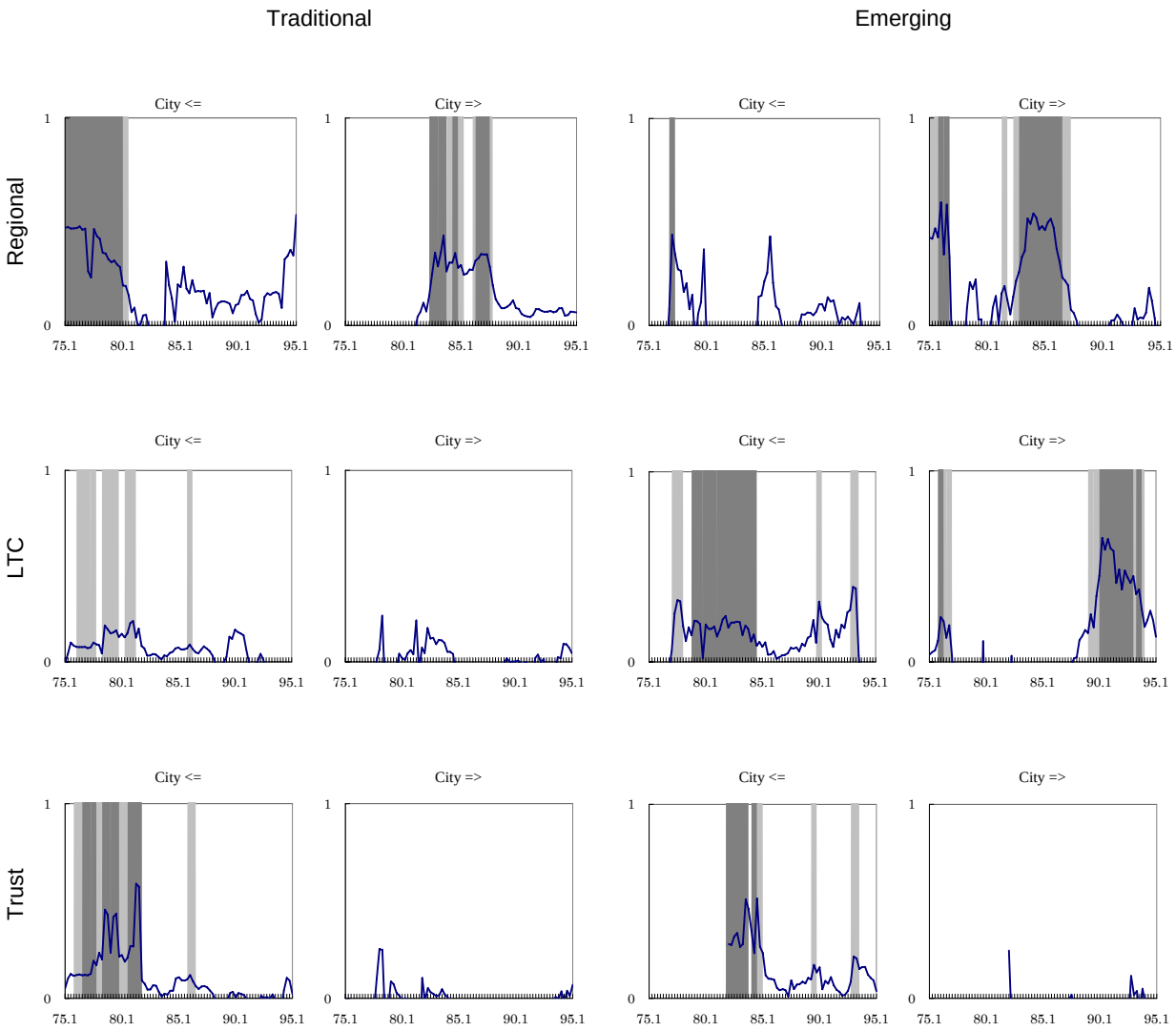
Note: A jump in the second quarter of 1993 reflects changes in the definition of the data.

Figure 2 Sequential Causality Tests regarding Existence of Herd Behavior



Note: This figure shows the results regarding sequential causality tests between loan ratios of city banks and those of the other types of banks in individual industry groups, without macroeconomic variables. The rows are the types of banks (except for city banks). The columns are the industry groups as borrowers. In each panel, " => City " represents a causality from the relevant type of banks to city banks. " City => " is the reverse causality. The horizontal axis is the median of each sumple period (e.g., the results at "1982:1" represent the results of the sample period "1977:1 -- 1986:4"). The data from 1970:1 to 1999:4 are used to obtain results for 1975:1 ("1970:1 -- 1979:4") through 1995:1 ("1990:1 -- 1999:4"). 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 results of trust banks are not obtained by 1981:4 because of lack of the data.

Figure 3 Sequential Causality Tests regarding Inefficient Herd Behavior



Note: This figure shows the results of sequential causality tests between loan ratios of city banks and those of the other types of banks in individual industry groups, 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.