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Herd behavior in the Japanese loan market: Evidence from bank panel data

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Abstract

This paper investigates whether Japanese banks had been following herd behavior in the domestic loan market from 1975 through 2000. Applying the technique developed by Lakonishok, Shleifer, and Vishny [Lakonishok, J., Shleifer, A., Vishny, R.V., 1992. The impact of institutional trading on stock prices, J. Finan. Econ. 32, 23–43] to the data from loans outstanding to different types of borrowers, we obtain evidence indicative of the existence of herding. City banks in Japan had been following a cyclical pattern of herding with one of the peaks around the bubble period in the late 1980s. Adjusting further for herding resulting from rational behavior, evidence indicative of the existence of irrational herding was observed only in the bubble period. Our estimate indicates that a total of some 5 trillion yen of loan increase by city banks during the period of 1987–1989 can be attributed to irrational herd behavior. The results imply that irrational bank behavior in the late 1980s might have contributed to the problems Japanese banks had with non-performing loans. We also obtained evidence for herding among regional banks and among geographically proximate banks.

JEL classification: C12; G14; G23

Keywords: Herd behavior; LSV herding measure; Adjusted LSV herding measure; Banks; Loan market; Japan

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1. Introduction

The non-performing loan problem is considered to be one of the biggest causes behind the Japanese banking crisis, which has existed since the early 1990s. It is very important to clarify the mechanism behind the accumulation of non-performing loans because the problem has caused a malfunctioning of the Japanese banking sector and deteriorated the credit channel of Japanese monetary policy.[1] Investigation of the mechanism is also important for other economies with bank-oriented financial systems to draw a lesson from the Japanese experience.

Irrational herd behavior by Japanese banks during the bubble period in the late 1980s is often blamed as one of the factors that brought about the accumulation of non-performing loans. An anecdotal explanation of this phenomenon is that Japanese banks did not exert sufficient monitoring effort, and uniformly pushed forward irrational lending behavior. The fact that bank loans to the real estate sector rapidly increased during the late 1980s is often considered as collateral evidence of this irrational herding.[2] This hypothesis implies that Japanese banks could have practiced better lending behavior, and thus were responsible for the non-performing loan problem. This behavioral explanation enjoys significant popularity, especially outside academic circles.

From an empirical point of view, this *irrational herding hypothesis* has proven to be quite challenging to substantiate, and several interesting questions can be raised in this regard. First of all, we can question the above hypothesis from the viewpoint of the very existence or non-existence of herding. Indeed herd behavior has been considered as typical behavior of Japanese banks for a long time, for which evidence can easily be obtained, for example, from articles in the Nihon Keizai Shinbun (Nikkei), a Japanese newspaper comparable to the Wall Street Journal. A database search through the Nikkei Telecom 21 Article Search Service indeed yielded 1437 articles in Nikkei containing the words "yokonarabi" (herding) and "ginko" (banks) from January 1, 1975 through December 31, 2000.[3] However, the information in those articles is based more on anecdotal evidence than empirical evidence. More empirical investigation should be conducted about the existence of herd behavior among Japanese banks.

Second, we can doubt the hypothesis above from the viewpoint of *rationality* in herding. As for real estate lending, for example, Ueda (2000) states that behind the loan influx, Japanese bank managers had expectations that surging land price levels would be sustainable, and that collateral for loans would not deteriorate, taking into account the favorable economic conditions during the late 1980s. Thus, although banks may have followed herd behavior, the behavior might have been based on this expectation, and therefore rational.[4] Indeed the expectation turned out

[1] See, for example, Hoshi and Kashyap (2001, Chapter 8) and Woo (2003). For other causes of the banking crisis, see Cargill (2000) for example.

[2] The fact is confirmed by Hoshi and Kashyap (2001, Chapter 8) and Nakagawa and Uchida (2003), for example.

[3] We have other incidental evidence of herding in Japanese banks. During the high growth period from the mid 1950s through the early 1970s, the existence of the "convoy system" was pointed out, in which Japanese banks were claimed to be herding to keep the weakest member alive with the aid of regulation and protection by the Ministry of Finance. See Hoshi (2002).

[4] As a matter of fact, *rational herding* has been paid much attention in theoretical studies. Herd behavior could rationally result (i) among fund managers with a similar comparative advantage (e.g. Falkenstein, 1996); (ii) when there are payoff externalities in following the herd (e.g. *bank run* in Diamond and Dybvig, 1983; *liquidity* in Devenow and Welch, 1996; and *information production* in Froot et al., 1992 and Hirshleifer et al., 1994); (iii) from reputation concerns (Scharfstein and Stein, 1990); (iv) based on common information; and (v) through inference from behavior of

to be wrong. However, this *rational herding* hypothesis implies that banks were not to blame for the non-performing loan problem; they were just unfortunate victims of speculation.

Finally, the irrational herding hypothesis put forward above, together with the accompanying discussion, remind us of the importance of intertemporal comparison. The existence of herding has long been suspected and, as shown above, anecdotal evidence for its existence can be found not only during the bubble period but also during other periods. This may imply that Japanese banks have long followed irrational herd behavior. If the banks had long been following irrational herd behavior, it is unlikely that the behavior brought about the non-performing loan problem, which emerged only in the 1990s. However, if the behavior of Japanese banks during the bubble period was abnormal, and irrational herding was observed only during this frantic period in the late 1980s, it is highly likely that the behavior precipitated the subsequent non-performing loan problem.

Summarizing the discussion thus far, we should ask three questions so as to investigate whether the irrational herding hypothesis holds or not: (1) First of all, has herd behavior existed among Japanese banks in the past? (2) If so, were banks rational or not in such behavior? And (3) was the irrationality (or rationality) observed only in the bubble period or was it a characteristic of Japanese banks consistently observed for a long time? These important questions must be answered based on a formal empirical analysis.

This paper is an attempt to answer the questions raised above. The analysis consists of two stages. First, we will determine the existence or non-existence of herd behavior among Japanese banks. Our methodology is indebted to a study of herd behavior among fund managers. Lakonishok et al. (1992) (henceforth LSV) devised an innovative index to measure the extent to which fund managers follow herd behavior in investing in equity. The measure, called the *LSV measure*, captures the extent to which fund managers deviate from average investment decisions which depend on overall economic conditions to collectively buy or sell specific stocks. Due to its appealing simplicity, the measure gained substantial popularity and was applied to investigate herd behavior in different contexts by numerous studies that followed.[5]

We apply the measure directly to individual banks' loans outstanding to different industries during the period of 1975 through 2000, for which banks' balance sheet data are available in the Nikkei Needs Company (Bank) Data File. Using the data, we will capture the extent to which Japanese banks deviate from lending policy based on macroeconomic conditions, and collectively increase or decrease loans to specific industries in each year. We calculate the measure for a representative type of commercial banks in Japan: city banks.[6]

Second, if the existence of herd behavior is confirmed at the first stage, we will further investigate possible rationality in the detected herding. Because the LSV measure quantifies banks' collective deviation from overall trends in increasing or decreasing loans outstanding, the measure does not capture bank behavior that can be rationally explained from a *macroeconomic* point of view. However, the collective deviation could yet result from banks' decisions that are rational *at an individual industry level*. For example, expanded or decreased loan demand from an industry due to drastic environmental changes, such as a surge in land prices during the bubble period,

other agents (Bikhchandani et al., 1992; Banerjee, 1992). See Bikhchandani et al. (1998), Devenow and Welch (1996), Bikhchandani and Sharma (2001), and Hirshleifer and Teoh (2003) for survey.

[5] For example, see Grinblatt et al. (1995), Wermers (1999), and Choe et al. (1999). See Bikhchandani and Sharma (2001) for survey of such studies. More recent studies include Wylie (2005) and Walter and Weber (2006). For the pros and cons of the LSV measure and alternative measures see Section 2.1.

[6] For the types of Japanese banks, see Section 2.2.

could have made Japanese banks behave collectively so as to lend to the industry. This behavior would be rational, but would be captured by the LSV measure as herding. Thus, in order to more exactly investigate whether the detected herding is rational or not, it is necessary to exclude from the LSV measure banks' rational behavior at an industry level.

To this end, we regress the extent of banks' collective deviation from average lending decisions on proxies for industry-specific factors. By using the resulting residual, we create an *adjusted LSV herding measure*. This adjusted measure quantifies the extent of herding which does not stem from macroeconomic *or* industry-specific reasons.[7]

After deriving the adjusted measure for the entire sample period, we will compare the level of this adjusted measure in the bubble period to that in other periods, and see whether Japanese banks followed exceptional behavior only in the bubble period, or whether they had been following consistent behavior throughout the sample period.

The results from the first stage of the analysis demonstrate the existence of herd behavior among Japanese banks during the sample period. City banks had followed a cyclical herding pattern along with business fluctuations in Japan. Interestingly, herding is observed around the second oil crisis in the late 1970s, during the bubble period in the late 1980s, and during the stagnation period that followed. These results are consistent with our image of banks as being frantic in lending to certain industries.

After disentangling herding caused by industry-specific factors, the results obtained from the second stage of the analysis show that most of the herding detected in the first stage disappears through adjustment. However, a large extent of herd behavior is still observed in the bubble period of the late 1980s. It is therefore highly likely that irrational bank behavior had been exceptionally present during the bubble period. Our estimate indicates that a total of some 5 trillion yen of loan increase by city banks during the period of 1987–1989 can be attributed to irrational herd behavior.

Since city banks have been playing a major role in the Japanese economy for a long time, the results are worthy of special mention. They imply that we cannot reject the hypothesis that Japanese banks had been following irrational herd behavior at least during the bubble period. The irrational herding might have contributed to the accumulation of non-performing loans, and what Japanese banks got may have been what they deserved.

For comparison purposes, we also apply the measures to regional banks: smaller banks that operate regionally on a smaller scale than city banks. For these banks, herding is consistently and significantly observed throughout the sample period. Even after adjusting for rational factors, herding among regional banks is still observed. In this sense, regional banks might have been more frequently following irrational herd behavior than city banks. This result is consistent with Uchida and Tsutsui's (2005) finding that city banks are more competitive than regional banks in the Japanese loan market.

Finally we conducted analysis not by bank type but by region. When we focus on banks in the two largest urban areas of Japan, statistically significant levels of herding *across different types*

[7] Although it is impossible to empirically specify the *exact* causes of rational herding, if we detect herding in our study, we can at least exclude reasons (i) through (iii) in footnote 4. First, Japanese banks might have had comparative advantage in lending to firms with a specific size or in a specific region, however they were unlikely to have an advantage in lending to a specific industry. As our dataset contains each bank's loans outstanding only at the industry level, we can exclude explanation (i). Second, at an industry level, one bank's lending is not likely to have positive externality to other banks' lending, which excludes explanation (ii). Finally, we cannot infer bank managers' ability based upon their performance in lending to a particular industry. This allows us to eliminate explanation (iii).

of banks are observed in both areas in the late 1980s. This implies that irrational herd behavior in the bubble period might have been followed among geographically proximate banks as well. However, the magnitude of herding is smaller than that by bank type, implying that it is type rather than geographical proximity that matters more when banks herd.

Few studies have empirically investigated herd behavior among banks, although there have been several theoretical studies.[8] Jain and Gupta (1987) examined causality in loans outstanding aggregated by bank type to find herding among groups of banks in the US. Based upon Jain and Gupta (1987), Nakagawa and Uchida (2003) detect the causality relationship in loans outstanding by different types of banks in Japan. However, these studies investigate the relationship between loans of different *groups of* banks. The LSV measure in this paper is calculated using the data of *individual* banks' loans outstanding, so that our results contain more specific information. By way of using the well-known LSV measure, we present the first evidence of herd behavior among banks at *an individual bank level*.

Our finding of a cyclical herding pattern (before adjustment) is closely related to a stylized fact called *procyclicality* in bank lending behavior. As introduced in Berger and Udell (2004), lending often increases significantly during business cycle expansions and then falls considerably during subsequent downturns. The cyclical herding behavior found in the present paper is perfectly in line with this fact and could be considered as a manifestation of lending procyclicality.[9]

Finally, the present paper contains some econometric contributions to the existing studies since the introduction of the LSV measure. We construct a formal procedure to test the statistical significance of the LSV measure. In the literature, some studies pay little attention to statistical testing. Other studies use the ordinary *t*-test, but the test could bring about some bias which makes the LSV measure less significantly different from zero and is not reliable in small-sample analysis. The present paper formally investigates the testing procedure and proposes a Chi-squared test for the LSV measure which is applicable to small-sample analysis.

The subsequent section of this paper explains the first stage of our analysis. After introducing the methodology and data, we report the results. Our Chi-squared test is also introduced in this section. In Section 3, we extend the second stage of our analysis. After the explanation of the methodology, we present the results. Regional banks' herd behavior and herd behavior by region are then investigated in Section 4. The final section concludes the paper with some suggestions for future study.

2. Analysis by LSV herding measure

2.1. Methodology

We detect herd behavior among Japanese banks using the LSV herding measure created by Lakonishok et al. (1992). Suppose that in each year indexed by t, banks have loans outstanding to industries j. For notational simplicity, we denote by i the index of each industry-year which

[8] Theoretical studies include Rajan (1994), Acharya (2001), Acharya and Yorulmazer (2005, 2006, 2007), and Ogura (2006).

[9] The focus of Berger and Udell (2004) is on a different explanation of procyclicality, called the *institutional memory hypothesis*. They provide empirical evidence suggesting that this hypothesis can explain the lending procyclicality. However, they mention that herding theory is one of several plausible and concomitant explanations for procyclicality (Berger and Udell, 2004, p. 493). As for procyclicality in bank lending, see also Rajan (1994), Acharya and Yorulmazer (2005), Pennacchi (2005), and Jiménez and Saurina (2006) as well.

is defined by a combination of one t and one j. The LSV herding measure is defined as follows.

$$LSV_i \equiv |P_i - P_t| - E|P_i - P_t|. \tag{1}$$

P_i is the proportion of banks that actually increased their loans outstanding in industry-year i (of industry j in year t). P_i is derived as

$$P_i \equiv X_i / N_i,$$

where N_i and X_i are the numbers of banks that were active in the industry-year i, and that increased loans outstanding in the industry-year i, respectively.

P_t is the expected proportion of banks that increased their loans outstanding in year t, which is calculated as a mean of all the observed P_is in the year. This can be considered as an indicator of the banks' overall lending policy that reflects macroeconomic factors. If every bank *independently* increases (or decreases) its loans outstanding in industry-year i with probability P_t (or $1 - P_t$), which is based rationally on macroeconomic factors, the observed value of P_i becomes close to P_t and the first term will become zero. If, on the other hand, banks *collectively* increase or decrease loans in an industry-year, the observed value of P_i departs from P_t. The first term of Eq. (1) thus quantifies the extent to which banks' lending policies in an industry-year i deviate from the overall lending policy in the year t.

The overall lending policy P_t thus represents the null hypothesis of no herding. Non-independent corrective increase and decrease amount to a larger value of the first absolute value and the measure itself. It is this sense of herd behavior that the LSV measure tries to capture. As we are interested in the change in banks' lending behavior over the sample period, we obtain in each year a sample mean of the LSV measure among all industries and analyze the time series of the mean.

Note that even if the null hypothesis holds and there exists no herding, the expected value of the first absolute term of LSV_i is positive. The last term $E|P_i - P_t|$ of Eq. (1) is subtracted so as to normalize the measure and make its mean zero under the null hypothesis of no herding.

The LSV measure is the most frequently-used measure to quantify herd behavior among equity investors. The measure is "a standard in the literature" (Wylie, 2005) and is applied in numerous studies.[10] Several alternative measures have been proposed. However, they are less useful and/or not appropriate to capture herd behavior among banks.[11]

This is not to say that the LSV measure is free from drawbacks. Bikhchandani and Sharma (2001) point out that the measure (1) only uses the number of investors that sold or purchased a particular stock, (2) cannot identify intertemporal trading patterns, and (3) may not be a good

[10] See references in footnote 5.

[11] First, a *portfolio-change measure* in Wermers (1995) focuses on collective movements in portfolio weights of stock investors (Bikhchandani and Sharma, 2001). However, the measure is complicated to calculate and, to the best of the authors' knowledge, has never actually been used in other studies. Second, Lakonishok et al. (1992) and Wermers (1999) use the *D ratio* and the *N ratio*, and Grinblatt et al. (1995) use the *momentum trading measures*. They are, however, measures of feedback trading or momentum investing, and do not necessarily represent herding. Third, different measures in Christie and Huang (1995), Hwang and Salmon (2004), and Nofsinger and Sias (1999) use stock return information. However they are impossible to use in the banking context where no comparable return data is available (Bikhchandani and Sharma, 2001). Fourth, herding among investment analysts is more directly tested by analyzing data of individual analysts' decisions (see Bikhchandani and Sharma, 2001; Hirshleifer and Teoh, 2003). However, such detailed data is not available in the banking context. Finally, instead of devising a measure of herd behavior, Kodres and Pritsker (1996) investigate correlations among changes in positions of futures market participants using daily trading data. Although the methodology is interesting, it does not hold sufficient explanatory power for our small-sample data set of Japanese banks.

measure unless the time interval and the choice of investment category over which the measure is averaged are appropriately chosen. In later sections, we will try to alleviate drawback (1) by interpreting the results with the addition of quantitative information as well. Since we will use annual data and focus on particular types of banks, the present study suffers less from drawbacks (2) and (3).

Wylie (2005) points out additional caveats: The accuracy of the LSV measure rests on two implicit conditions: (i) no short-selling constraints and (ii) no conditional propensity to buy depending on investors' initial holding in the stock and liquidity needs. Unless both of these conditions are satisfied, there is a bias in the measure. In the banking context, however, it should be reasonable to presume that these conditions are satisfied. On balance, it is appropriate to use the LSV measure in this study.

2.2. Data

The primary data to be used in this paper are loans outstanding to different types of industries, which are available from the Nikkei NEEDS Company (Bank) Data File. Loans to the following eleven industries by individual banks are available: (1) Manufacturing, (2) Agriculture, Forest and Fisheries, (3) Mining, (4) Construction, (5) Wholesale and Retail Trade, (6) Finance and Insurance, (7) Real Estate, (8) Transport and Communication, (9) Electricity, Gas, Heat supply and Water, (10) Services, and (11) Individuals and others.[12]

The data set includes two types of commercial banks in Japan. *City banks* have a main branch office in a big city and operate nationwide as well as multinationally. They are the biggest banks in Japan and mainly deal with bigger businesses. Their lines of operation include not only commercial banking but also some investment and international banking. In contrast, *regional banks* have their main branch in a smaller city and operate mainly inside the prefectures in which they are located. They are small- or medium-sized banks and are closely connected to local businesses and governments.[13]

Table 1 describes the distribution of average loans outstanding per bank for city banks and regional banks.[14] City banks are on average smaller in number, but larger in size, and thus extend more and larger loans. These observations reflect the fact that banks of the former type have been playing a dominant role in the Japanese economy. In the analysis that follows, we thus focus mainly on city banks. For comparison purposes, however, we will also investigate regional banks in Section 4.

The sample period in this study is from fiscal year 1975 through 2000. This allows us to investigate herd behavior in several interesting periods. Most importantly, the sample period includes the bubble period of the late 1980s through the early 1990s, in which land and stock

[12] We excluded loans to local governments since they are determined mainly by demand.

[13] Note that there are banks called *second regional banks* which were transformed from mutual banks to commercial banks around 1992. As these banks have similar characteristics to regional banks, we treat them together and call them "regional banks."

[14] Newly established banks are excluded from the sample in the year of establishment, since we cannot define increase or decrease in loans outstanding for those banks. In contrast, we did not exclude banks that experienced a merger or acquired failed banks' assets, since even by excluding these two types of banks, the level of the LSV measure did not change significantly.

Table 1
Descriptive statistics

Year	City banks			Regional banks		
	# of banks	Average loans outstanding per bank (million yen)	% of increase	# of banks	Average loans outstanding per bank (million yen)	% of increase
1975	13	3,783,817	N/A	131	299,648	N/A
1976	13	4,154,987	8.9	131	337,551	11.2
1977	13	4,510,592	7.9	131	374,147	9.8
1978	13	4,888,615	7.7	131	418,799	10.7
1979	13	5,215,223	6.3	131	455,844	8.1
1980	13	5,591,411	6.7	131	492,567	7.5
1981	13	6,127,892	8.8	131	544,733	9.6
1982	13	6,710,032	8.7	131	595,297	8.5
1983	13	7,390,521	9.2	131	646,877	8.0
1984	13	8,246,396	10.4	131	706,061	8.4
1985	13	9,076,686	9.1	131	734,584	3.9
1986	13	10,051,630	9.7	131	775,112	5.2
1987	13	11,024,705	8.8	131	842,798	8.0
1988	13	11,926,564	7.6	131	927,932	9.2
1989	13	13,121,687	9.1	131	1,044,786	11.2
1990	12	17,823,409	26.4	131	1,257,844	16.9
1991	11	19,992,428	10.8	131	1,316,307	4.4
1992	11	20,443,008	2.2	130	1,367,000	3.7
1993	11	20,306,336	−0.7	129	1,397,630	2.2
1994	11	19,966,124	−1.7	129	1,424,676	1.9
1995	11	19,823,569	−0.7	129	1,462,625	2.6
1996	10	21,607,731	8.3	128	1,476,369	0.9
1997	9	23,185,396	6.8	126	1,505,497	1.9
1998	9	23,453,673	1.1	124	1,536,494	2.0
1999	8	23,439,792	−0.1	122	1,503,922	−2.2
2000	8	23,240,364	−0.9	117	1,534,155	2.0

Source: The Nikkei NEEDS Company (Bank) Data File.

prices were inflated. As Table 1 demonstrates, outstanding loans had been consistently increasing until this period, but suddenly stopped expanding afterward.[15]

Because of the long sample period, the results for the bubble period can be compared with those for other interesting periods. First, the second oil crisis in the late 1970s is included in the sample. Herd behavior might have been followed around this panic year. Second, the sample includes the period of financial liberalization in the 1980s. In this period, Japanese banks had lost their traditional borrowers, who were freed from regulation and obtained other financing sources. As Hoshi and Kashyap (2000) and Nakagawa and Uchida (2003) show, banks had to expand loans to borrowers with whom they had less information accumulated. Third, the period after the bubble collapse is included in the sample. Herding among Japanese banks in this panic period might be as plausible as that among fund managers in the period of the international

[15] Note that although a considerable increase may be naturally observed in this period, a surge in loans outstanding in fiscal year 1990 seems unexpected. It is highly probable that this surge was caused by a change in the accounting standard in fiscal year 1990, in which banks began to include overdrafts in loans outstanding by industry in their annual financial statement.

currency crisis.[16] Finally, the sample period contains the stagnation period in the 1990s when the Japanese economy had been struggling to escape from its weak economic condition. Banks uniformly decreased loans in this period. We will interpret the results of our study based on this historical background of interest.

2.3. Results

The sample means of the LSV measure for city banks obtained for 1975 through 2000 are represented in Table 2, and depicted in Fig. 1. The calculated sample means of the LSV measure stand for average (over industries) fractions of city banks that increased or decreased loans outstanding due to herd behavior. For example, the value of 0.0077 in 1975 implies that since there were 13 city banks in that year, an increase or decrease in loans outstanding by 0.1 banks (= 0.77% of 13 banks) was extra, caused by herd behavior.

Table 2 also contains p-values for statistical significance of the estimated coefficients. The statistics are to be explained and interpreted in Section 2.4 with theoretical background, since one of the statistics, Chi-squared statistic, is our innovation.

Table 2
Mean LSV measure for city banks

Year	Mean LSV	p-value from t test	p-value from Chi^2 test
1975	0.0077	0.35	0.11
1976	0.0323	0.03	0.04
1977	−0.0033	0.68	0.65
1978	0.0543	0.11	0.00
1979	0.0942	0.00	0.00
1980	0.0297	0.04	0.06
1981	0.0135	0.31	0.00
1982	0.0045	031	0.33
1983	0.0365	0.02	0.03
1984	0.0296	0.08	0.03
1985	0.0311	0.17	0.01
1986	0.1243	0.00	0.00
1987	0.1429	0.02	0.00
1988	0.1156	0.02	0.00
1989	0.0849	0.03	0.00
1990	−0.0069	0.82	0.75
1991	0.1290	0.00	0.00
1992	0.0930	0.02	0.00
1993	0.1122	0.02	0.00
1994	0.1084	0.02	0.00
1995	0.1332	0.01	0.00
1996	0.1118	0.01	0.00
1997	0.0623	0.12	0.01
1998	0.0397	0.12	0.13
1999	0.0202	0.32	0.15
2000	0.0108	0.39	0.31

Note. Sample means of the LSV measure and respective p-values are shown. Shaded figures represent the results in which the null hypothesis of no herding is rejected at a 5% significance level.
Source: Authors' calculations.

16 See Kim and Wei (2002b).

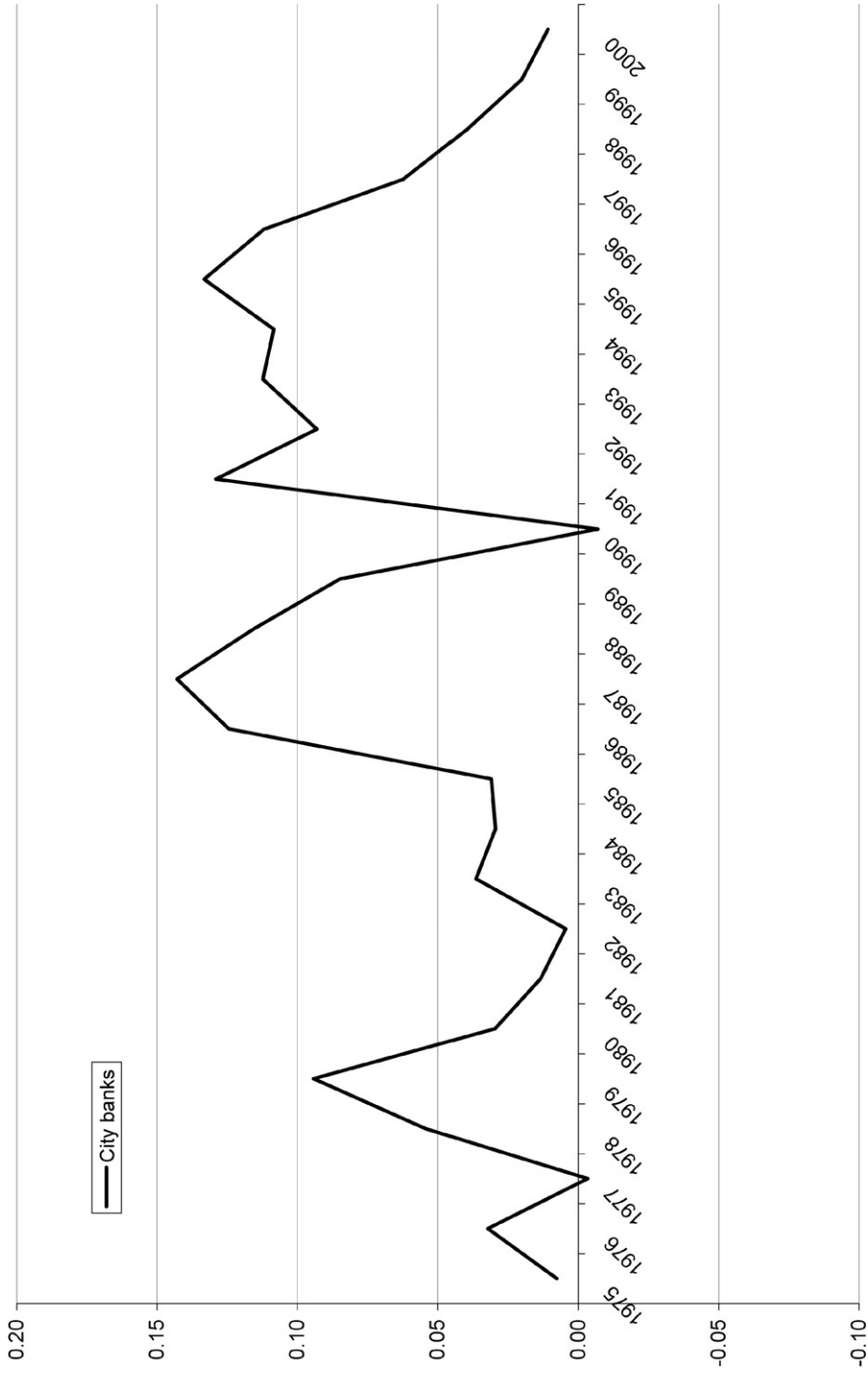


Fig. 1. Mean LSV measure for city banks.

Source: Authors' calculations

As shown in Fig. 1, city banks seem to follow a cyclical herding pattern.[17] A significant magnitude of herding can be found around the late 1970s, when Japan was hit by the second oil crisis. This result is consistent with our image of banks being frantic to herd in an 'abnormal' circumstance.

As for the first half of the 1980s, the period of financial liberalization, we do not find obvious herding. This is consistent with the results of Uchida and Tsutsui (2005). They found that the degree of competition for city banks became fierce after 1980. Our Fig. 1 looks similar to their Fig. 2 in depicting the degree of competition before the bubble began to form.

A significant extent of herding is observed around the bubble period in the late 1980s. We observe a maximum of 14.3% of collective deviation from the overall lending policy in this period.[18] A great extent of herding is also observed when the bubble collapsed and stagnation followed in the 1990s.[19]

Finally, in the late 1990s, city banks in Japan had come into a period of severe competition due to the financial system reform called the *big-bang*. Consistent with this backdrop, they ceased to herd after 1997.

Looking at the entire sample period, the largest extent of herding is observed in 1987, right in the middle of the bubble period. Since the number of city banks was then 13, 14.3% of banks following herd behavior means that the loan increase or decrease by almost 2 city banks was caused by herd behavior. This is not insignificant, since as we can see from Table 1, city banks have been playing a dominant role in the Japanese loan market.

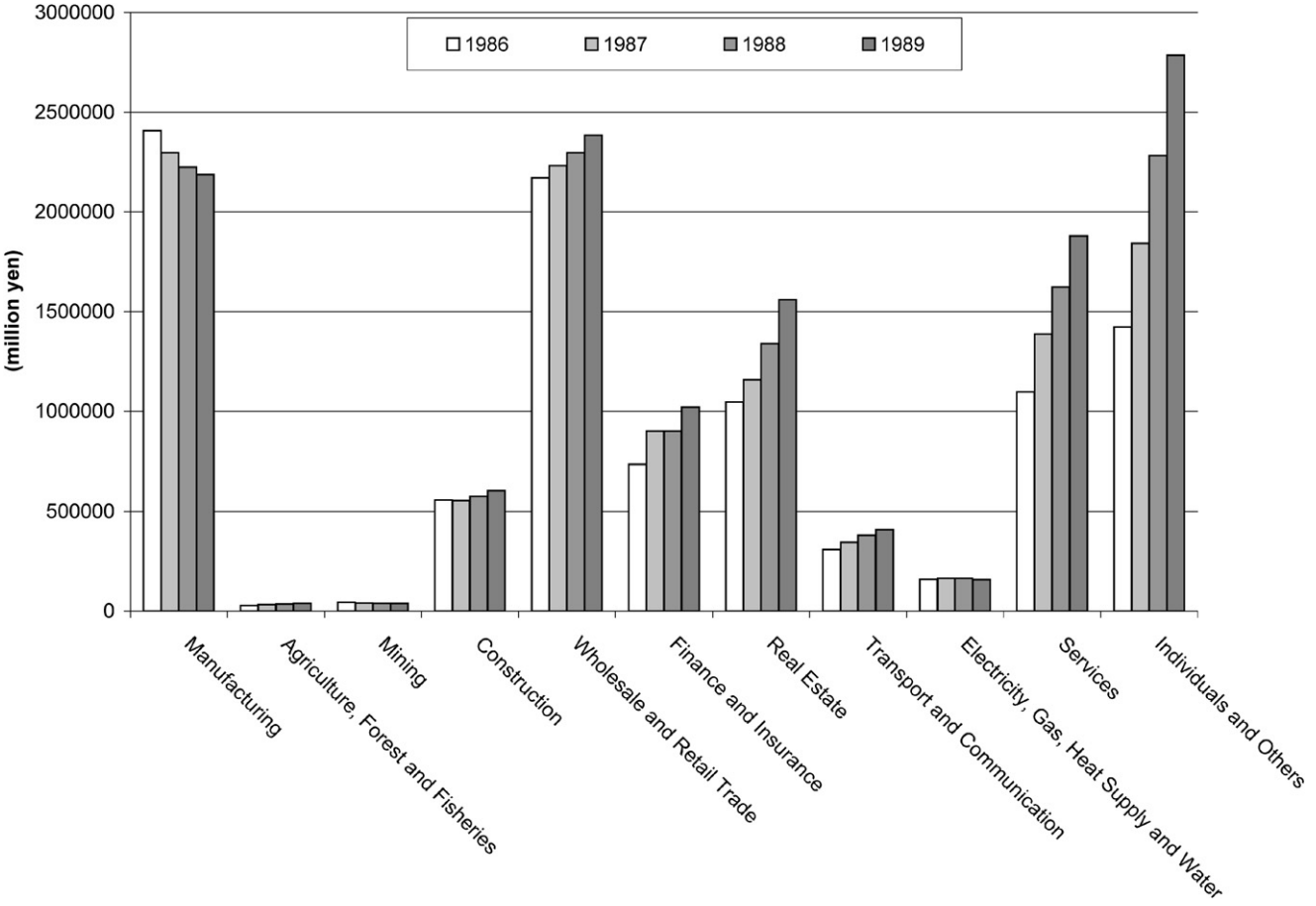
The analysis thus far is based on a simple mean of the LSV measure over 11 industries in each year of the sample period. There are however great discrepancies in loans outstanding by industry. Figure 2 depicts average loans outstanding by industry during the bubble period. As it confirms, city banks had large outstanding loans to Manufacturing and Wholesale and Retail Trade, but very little to Mining and Agriculture, Forest and Fisheries. It might not therefore be appropriate to use a simple mean of the LSV measure. We then calculated a weighted mean LSV measure, whose weight for each industry is loans outstanding to the industry divided by total loans outstanding.

Figure 3 plots the weighted mean LSV measures together with the simple mean measures. Comparing the two mean measures, we can confirm that qualitative results from the simple mean measure still hold for the weighted mean measure. The general trend does not change even if we focus on the weighted mean measure. However, the weighted means fluctuate to a greater extent than the simple means.

[17] We would like to recall here that as pointed out in the Introduction, the cyclical herding pattern is closely related to the stylized fact that bank lending is procyclical (Berger and Udell, 2004).

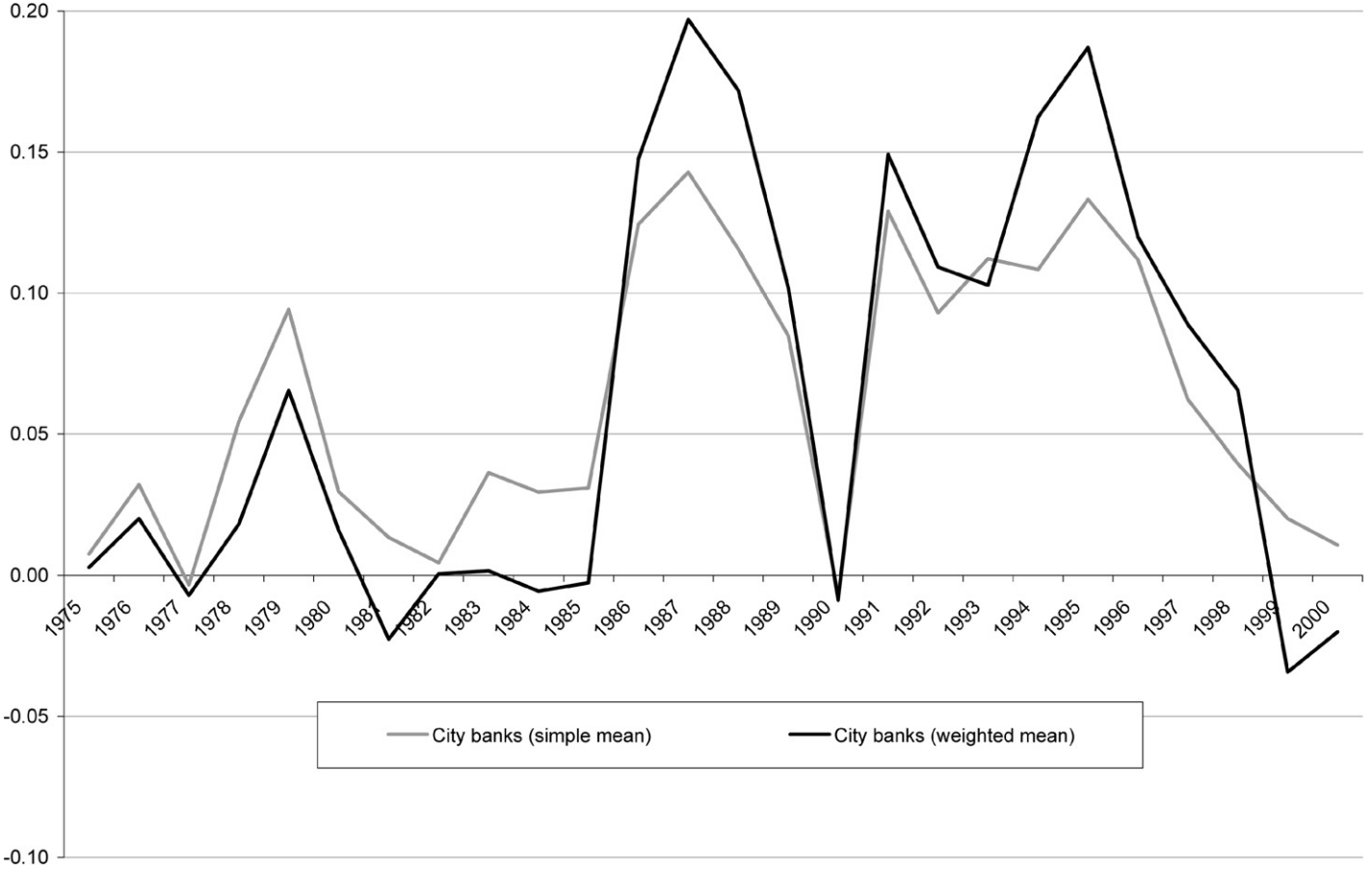
[18] The magnitude is much larger than that of fund manager herding in the US. Lakonishok et al. (1992) report the mean LSV measure of 2.7%, Grinblatt et al. (1995) reports 2.5%, and Wermers (1999) reports 3.4%.

[19] It is also interesting to observe a sudden drop in herding in 1990. Upon close inspection of the LSV measure for each industry in this year, it turns out that almost all the city banks increased loans outstanding to all the industries, which makes P_t large and $|P_i - P_t|$ small. It is almost certain that this unanimous increase was caused by the change in the accounting standard of loans outstanding by industry in fiscal year 1990 (see footnote 15). Thus, the result for 1990 might not be trustworthy.



Source: Nikkei NEEDS Company (Bank) Data File.

Fig. 2. Average loans outstanding by industry (city banks).



Source: Authors' calculations.

Fig. 3. Simple and weighted mean LSV measure for city banks.

2.4. Statistical testing of LSV measure

2.4.1. Conventional test and distribution of LSV measure

In this subsection, we focus on the statistical significance of herd behavior detected by the LSV measure. We propose a Chi-squared test which is suitable for small-sample analysis. In some of the literature, careful treatment of statistical testing has not been of concern. The focus has only been on the economic significance or the magnitude of the measure.[20]

In other studies which do mention the statistical significance of the measure, the standard t-test has been conventionally applied. Lakonishok et al. (1992), Kim and Wei (2002a, 2002b), Borensztein and Gelos (2000), and Choe et al. (1999) present the standard errors and even t-values of sample means of the measure. Based on these values, they determine the statistical significance of the measure and thus the existence of herd behavior.[21]

It is highly probable, however, that the conventional test has a considerable small-sample bias in the present paper. We can confirm this simply by investigating the probability distribution of the LSV measure. Suppose that there is no herding for an industry-year i. Then, P_i follows a binomial distribution with mean P_t and variance $P_t(1-P_t)/N_i$. If N_i, the number of banks, is sufficiently large, we can approximate this binomial distribution to the normal distribution with the same mean and variance, which is conventionally allowed if $N_i P_t > 5$ and $N_i(1-P_t) > 5$.[22] This approximation implies that the first term of the LSV measure, $|P_i - P_t|$, follows a half-normal distribution, and thus the distribution of the measure (1) has a longer tail to the right. Therefore, if we test a sample mean of the LSV measure using the conventional test based on normal distribution, the test results might be biased toward accepting the null hypothesis of no herding when we have a small sample. That is, only when there is a large number of industry-years, the sample mean approximately follows a normal distribution and the conventional test is reliable.

As far as the existing studies on fund managers are concerned, this condition seems to be satisfied, since they include a large number of samples. As for a sample like ours that has a small number of industry-years, however, testing results obtained from the conventional test are not reliable. In the following section, therefore, we devise a test procedure that does not suffer from small-sample bias, which could enhance the test's reliability over the conventional test.

2.4.2. Chi-squared test for LSV measure

Now define a statistic Z_i as

$$Z_i \equiv \frac{P_i - P_t}{\sqrt{P_t(1-P_t)/N_i}}.$$

From Eq. (1), this equals (the non-absolute value of) the first term of the LSV measure which is normalized for its variance to take the value of 1 under the null hypothesis of no herding. From the discussion above, we know that the approximation of $Z_i \sim N(0,1)$ is allowed when

[20] No explicit comments are made about the statistical significance of the measure in Grinblatt et al. (1995) or Gelos and Wei (2002).

[21] Another interesting attempt is Wermers (1999). He depicts in his Fig. 1 an actual distribution of the LSV measure and compares it with a simulated one obtained from a sufficiently large number of samples under the null hypothesis of no herding. Wermers (1999) notes the difference in shape between these two distributions and concludes in favor of the existence of herding. Borensztein and Gelos (2000) also take the same approach. Although this is indeed an interesting approach, it depends upon visual perception and is not an objective test.

[22] See Rice (1995, p. 172).

$N_i P_t > 5$ and $N_i(1 - P_t) > 5$. This leads to the result that

$$Z_i^2 \sim \chi(1).$$

This is the statistic we propose in order to test the significance of the herding detected by the LSV measure. When we test the statistical significance of herding for a group of industry-years Φ (or a sample mean of the LSV measure over Φ), we can use the relationship that

$$Z_\Phi^2 \equiv \sum_{i \in \Phi} Z_i^2 \sim \chi(I),$$

where I is the number of samples (industry-years) included in Φ. Note that as absolute values and squared values correspond to each other, we have a close correspondence between Z_i^2 and the LSV measure, and between Z_Φ^2 and a sample mean of the LSV measure.

It should be stressed here that in order to derive the probability distribution of the Chi-squared statistic Z_i^2 (or the sum Z_Φ^2), we do not rely on the normal approximation of a sample mean of the LSV measure, which is only justified with a large number of industry-years (i.e. large I). Even if we are interested in herding among a small number of I, as long as the normal approximation of a binomial distribution of P_i is allowed, the Chi-squared test based on the Z_i^2 statistic would be more reliable than the conventional t-test. The use of the Chi-squared test together with the t-test would improve the reliability of the test to detect herding.

2.4.3. Statistical significance of the results

The results with the Chi-squared and the t-tests are presented in Table 2. For both tests, the results of the statistical significance represented by the p-values parallel the results represented in Fig. 1. A cyclical herding pattern for city banks is supported from a statistical point of view as well. We can therefore confirm the conclusion in Section 2.3 from a statistical point of view.

Note that the two tests reveal some differences. p-values from the t-test are larger in general than those from the Chi-squared test. The conventional test has a bias toward accepting the null hypothesis of no herding. As was expected above, this implies that the Chi-squared test could avoid the small-sample bias of the t-test.[23]

We can thus conclude that the conventional t-test is unreliable for small-sample analysis, and that the Chi-squared test could make an improvement over the conventional one. Although the conventional testing is indeed easy and convenient, and appeals to our intuition, it may demonstrate a loss of test efficiency and may bias the results for small samples.

3. Rationality in herding

3.1. Methodology

3.1.1. Rationality in LSV herding measure

Having detected the existence of herd behavior, we are now interested in investigating in further detail its rationality. As explained in Section 2.1 the LSV measure quantifies the extent to which banks' behavior to lend to each industry collectively deviates from the overall trend in increasing or decreasing loans outstanding. Since P_t is subtracted from P_i, the measure does not include banks' rational decisions based on overall macroeconomic conditions.

[23] In Section 3.2, we will confirm this point in more detail.

However, as mentioned in the Introduction, this does not necessarily imply that banks are irrational when the LSV measure indicates the existence of herding. Rational banks make lending decisions not only based on overall macroeconomic conditions but also on conditions specific to individual industries. Although P_t is subtracted from P_i in the measure, the measure could still reflect an increase or decrease in loans outstanding that is based on industry-specific rational factors. For example, if there are growing industries and declining industries, most banks would collectively increase loans to the former and decrease loans to the latter. The increase or decrease should reflect increased or decreased loan demand as well, which also has nothing to do with banks' irrational behavior. In order to more closely investigate the rationality of the detected herding, it would be better to adjust for the deviation from the overall lending policy that is based on industry-specific rational reasons.

3.1.2. Adjusted LSV herding measure

In order to eliminate industry-specific reasons for herding, we estimate the following equation by the ordinary least squares (OLS):

$$P_i - P_t = a + bX_i + \epsilon_i, \tag{2}$$

where X_i is a vector of industry-specific control variables.[24] ϵ_i represents the *after adjustment* deviation from the overall lending policy that cannot be explained by industry-specific factors. In other words, ϵ_i captures the portion of herding which cannot be explained by rational factors. We can therefore quantify the extent of herding *after adjustment* by the following measure:

$$LSV_i^A \equiv |\epsilon_i| - E|\epsilon_i|.$$

We call this the *adjusted LSV herding measure*.[25] Averaging this adjusted measure in each year, we can grasp the extent of herding that cannot be explained by industry-specific factors.

The statistical significance of this measure can be tested in a manner similar to that of LSV_i. Define a statistic W_i as follows:

$$W_i \equiv \frac{\epsilon_i}{\sqrt{P_t(1-P_t)/N_i}}.$$

As W_i asymptotically follows the standard normal distribution under the null hypothesis of no herding, we obtain the following relationship:

$$W_\Phi^2 \equiv \sum_{i\in\Phi} W_i^2 \sim \chi^2(I-K),$$

where Φ is the relevant group of samples (industry-years), I is the number of samples included in Φ, and K is the number of parameters of the regression (2).

The basic idea behind this adjusted measure is to disentangle loan increase or decrease stemming from industry-specific rational factors, X_i. This is essentially the same as what Hirshleifer and Teoh (2003) wrote as "to include proxies for possible variables that may jointly affect the behavior of different individuals" (p. 49), in order to rule out clustering from herding.

[24] Estimation results without a constant term produced similar results.

[25] Note that $E|\epsilon_i|$ is equivalent to $E|P_i - P_t|$, the second term of the original measure (1). This is because, under the null hypothesis of no herding, $P_i - aX_i$ follows a binomial distribution with mean P_t as does P_i in the original measure.

The adjusted LSV measure is original in that it attempts to control for rational herding. This methodology has some contribution to further study since it is very difficult to empirically specify causes of herding.[26] Although there have been some studies that attempted to (implicitly or explicitly) investigate causes of herding, they suffer from drawbacks.[27] Some studies on momentum strategy go even further by investigating the LSV measures for "past winners" and "past losers" (e.g. Grinblatt et al., 1995), but we are not sure whether momentum strategy is rational or not. Also, momentum strategy is implausible in the banking context.

One might think of checking rationality using variables representing *ex post* profitability of loans to each industry, as studies such as Kim and Wei (2002a, 2002b) do, rather than running the regression on variables representing ex ante profitability. We did not pursue this possibility because, if we are to judge bank rationality based on ex post profitability, Japanese banks would no doubt behave irrationally because of the miserable performance of loans after the bubble period. Detailed data on loan performance by industry are not available as well.

3.1.3. Control variables

We use the following three industry-specific variables to further control for rationality. Although there is always an omitted variable problem (Hirshleifer and Teoh, 2003, p. 49), to retain a sufficient degree of freedom, it would be reasonable to use the variables that are plausible and available.[28]

First, we adopt a variable representing the relative magnitude of economic activity of the eleven industries in the Japanese economy. We use the real GDP growth by industry for the ten industries other than 'Individuals and others,' and the growth rate of real final consumption expenditure of households for 'Individuals and others.' These variables are to control for the relative profitability of each industry. The data are available from the Annual Report on National Accounts.[29]

Second, land prices are used as a control variable. In Japan, land is highly valued as collateral. In the bubble period, it is often claimed that increased collateral values due to surging land prices contributed to the influx of loan funds into the real estate industry, for example. Thus, we took the index of urban land price as an explanatory variable, which is available from the Japan Real Estate Institute. We used the index only for four industries that are highly likely to be affected by the change in land prices: Construction, Finance, Real Estate, and Individuals and others. Specifically, we constructed a variable which is a product of the rate of increase in the price index and a dummy variable that takes the value of 1 for the four industries and 0 for the others.[30]

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[26] Due to this difficulty, Graham (1999) distinguishes *empirical herding* from several types of theoretically-explained herding.

[27] See the "second" and "third" analyses in footnote 11.

[28] Note that in each year, we have only 11 samples corresponding to 11 industries.

[29] We also considered the use of stock price indices by industry, which is available from the Tokyo Stock Exchange, but because of the mismatch of industry classification and the limited availability of data (only after 1983), we decided not to use them.

[30] One might think of introducing the amount of non-performing loans in the 1990s as a control variable. It is however highly probable that the impact of the non-performing loan problem in the 1990s was uniform among loans to all the industries and is thus reflected in P_t. In fact, it turns out (in Fig. 4) that most of the herding for city banks in the 1990s was eliminated by the three control variables introduced here. We therefore concluded that the variables we had used were sufficient and there was no need to incorporate a variable representing non-performing loans. Note that P_t should reflect not only non-performing loans but also any other macroeconomic factors that evenly affect loans to all the industries.

Finally, we take into account the idiosyncratic impact of financial liberalization in the 1980s as an institutional factor in herding. The difference in the availability of alternative sources of funds across industries brought about by the liberalization could be proxied by the rate of increase in corporate bonds outstanding by industry. However, as the rate is available only for total bonds outstanding and not for those by industry, we constructed a variable which, for Manufacturing and Wholesale, equals the rate of increase in total bonds outstanding, and is zero for the others.[31] Total corporate bonds outstanding are the sum of outstanding corporate bonds, asset-backed bonds, and convertible bonds. These statistics are available from the Financial and Economic Statistics Monthly issued by the Bank of Japan.

All three control variables are utilized in the relevant years. We also tried the same variables with a one-year lag. However, they had considerably weaker explanatory power.

3.2. Results

The sample means of herding measures adjusted for rational factors are presented in Table 3. Figure 4 depicts the adjusted measures together with the unadjusted measures. The difference between the solid and the dotted lines represents the portion of herding which was adjusted by industry-specific rational factors.

Most of the herd behavior by city banks can be explained on rational grounds. As for herding in the late 1970s and the early 1990s, Fig. 4 shows us that purely rational herding was dominant, although the Chi-squared test results tell us that the herding was still statistically significant. We can therefore conclude from an economic point of view that city banks' herding was rational in most of the sample period.[32]

The interesting exception to rational herding is the late 1980s, however, which is exactly the period when the asset price bubble was formed. Even after adjusting for rational factors, we still observe a large extent of herding in Fig. 4. The adjusted LSV measure is statistically significant for three years: 1987, 1988, and 1989.

Figure 4 also plots the weighted mean LSV measures before and after adjustment. Comparing the two mean measures (both before and after adjustment), we can confirm that qualitative results remain the same between the simple and the weighted mean measures. Quantitatively, as was the case for the unadjusted measure, the weighted means fluctuate to a greater extent than the simple means. However, observation of the rise of the adjusted measure only during the bubble period is still confirmed. Therefore, we may be able to conclude that the late 1980s seems to be the period when irrational herding of city banks is most distinctly observed.

Finally, it is worth noting the difference in the two testing results. The conventional t-test produces larger p-values than the Chi-squared test does. This result is more apparent than that observed in Table 2. We could therefore confirm the earlier claim that the Chi-squared test reduces the small-sample bias of the conventional test.

[31] As Nakagawa and Uchida (2003) demonstrate, loan shares to these two industries, which had been banks' main customers (*traditional* industries) decreased drastically after financial liberalization. It is therefore highly probable that firms in these two industries benefited from financial liberalization and gained independence from banks.

[32] The drop in the adjusted measure in 1990 is observed again, and the reason would be the same as that for the unadjusted measure. See footnote 19.

Table 3
Mean adjusted LSV measure for city banks

Year	Mean LSV	p-value from t test	p-value from Chi^2 test
1975	−0.0012	0.53	0.08
1976	0.0122	0.28	0.02
1977	−0.0126	0.91	0.44
1978	0.0378	0.14	0.00
1979	0.0273	0.13	0.01
1980	0.0150	0.21	0.03
1981	0.0098	0.35	0.00
1982	−0.0011	0.56	0.23
1983	0.0027	0.41	0.21
1984	0.0079	0.33	0.06
1985	−0.0232	0.94	0.61
1986	0.0536	0.10	0.00
1987	0.1064	0.01	0.00
1988	0.0985	0.01	0.00
1989	0.0773	0.01	0.00
1990	−0.0229	0.98	0.67
1991	0.0058	0.44	0.04
1992	−0.0152	0.81	0.45
1993	0.0084	0.42	0.03
1994	0.0068	0.44	0.02
1995	0.0290	0.24	0.01
1996	0.0364	0.20	0.01
1997	0.0473	0.14	0.01
1998	0.0143	0.30	0.11
1999	−0.0082	0.59	0.16
2000	−0.0116	0.64	0.22

Note. Sample means of the adjusted LSV measure and respective p-values are shown. Shaded figures represent the results in which the null hypothesis of no herding is rejected at a 5% significance level.
Source: Authors' calculations.

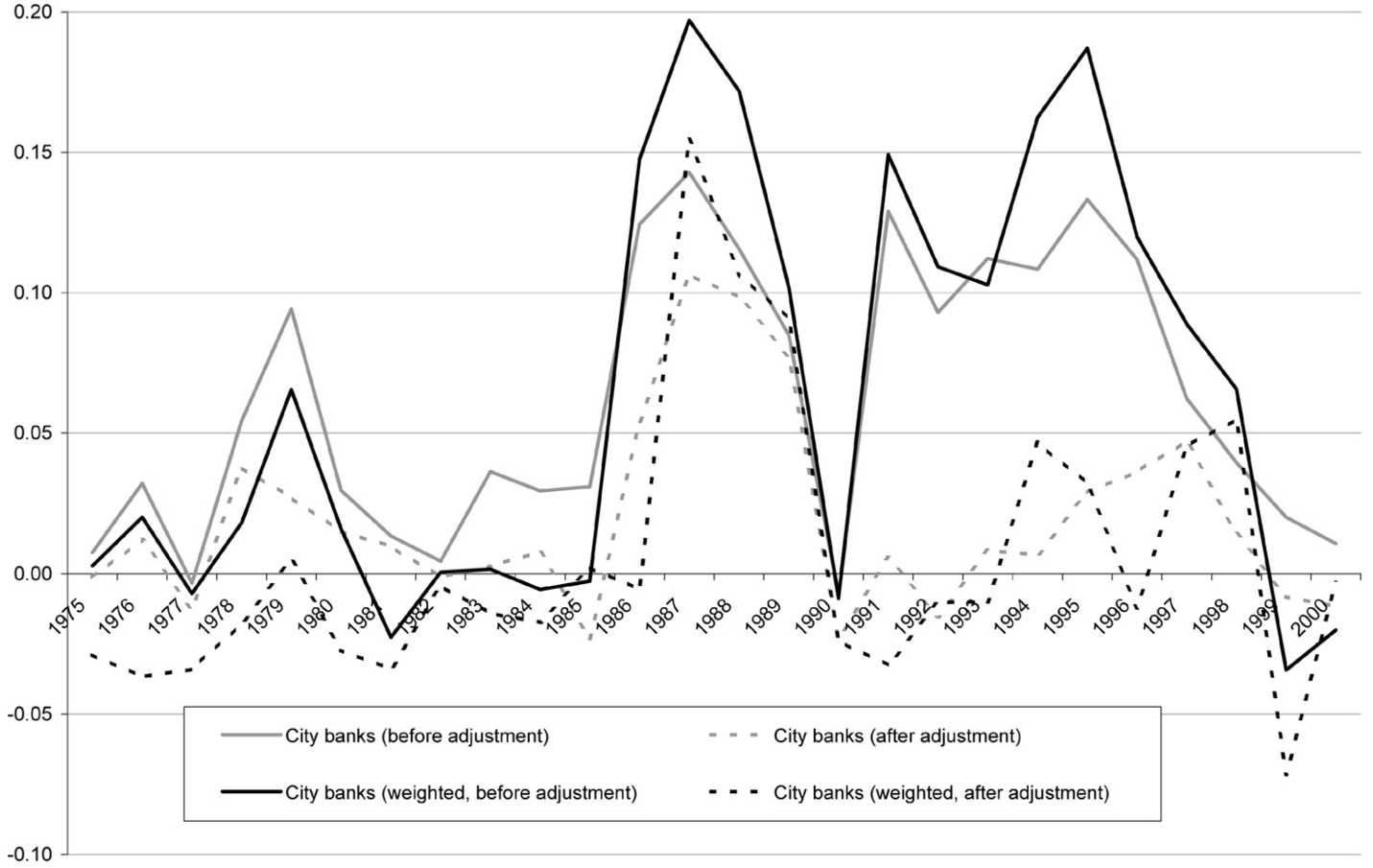
3.3. Amount of loan increase due to irrational herding

Finally, let us try to estimate the total amount of loan increase or decrease during the bubble period that can be attributed to irrational herd behavior. For an industry-year i, denote an average increase (decrease) in loans outstanding in the industry-year as $AINC_i > 0$ ($ADEC_i < 0$), so that the *actual* amount of loan increase or decrease can be represented as $AINC_i \cdot P_i \cdot N_i + ADEC_i \cdot (1 - P_i) \cdot N_i$. According to the definition of the LSV measure, the number of banks that increased or decreased loans outstanding due to herd behavior is represented by $|P_i - P_t|N_i$. Thus, when there is an increase in loans outstanding due to herd behavior ($P_i > P_t$), then the amount of an excess loan increase due to herding can be represented as

$$AINC_i(P_i - P_t)N_i - ADEC'_i(P_i - P_t)N_i,$$

where $ADEC'_i(< 0)$ is the amount by which the banks that increased their loans outstanding would have decreased them in the absence of herd behavior.[33] Since we cannot observe $ADEC'_i$,

[33] To simplify the analysis, we assume that all the banks would have decreased their loans outstanding by the same amount.



Source: Authors' calculations.

Fig. 4. Simple and weighted mean LSV measure for city banks (before and after adjustment).

as an approximation we assume that $ADEC'_i = ADEC_i$, i.e. those banks that have increased their loans outstanding due to herding would have decreased them by the amount of an actual average decrease in the industry-year.[34] The *total* amount of loan increase or decrease due to herd behavior in a specific year is the sum of the estimates over the industry-years that belong to the relevant year.

For the three years 1987–1989 when the adjusted LSV measure is statistically significant, the estimates of the total amount of loan increase due to herd behavior are 2.07, 1.78, and 1.47 trillion yen, respectively. In sum, around 5 trillion yen of increase in total loans outstanding by city banks during the bubble period might have been attributed to irrational herd behavior. This amount is non-negligible in terms of its economic significance. For reference, the amount of non-performing loans of city banks as of the end of March 1998 was 12.9 trillion yen.[35] Although we cannot directly link these numbers under a causality relationship, irrational bank behavior in the late 1980s might have contributed to the accumulation of non-performing loans. If banks had practiced rational lending behavior based more on available information, they might have been able to avoid accumulation of some portion of non-performing loans.

4. Herding among regional banks and herding by region

4.1. Herding among regional banks

In this section, we apply the LSV measure to regional banks and compare the results with those for city banks. The simple and weighted mean LSV measures obtained for regional banks (before and after adjustment) are presented in Table 4 and Fig. 5.

For regional banks, the results from a simple mean LSV measure (the gray solid line in Fig. 5) demonstrate the existence of consistent herding. We observe about 10% of collective deviation from the overall lending policy in each year. Consistent herding is also significant from a statistical point of view (Table 4). We can reject the null hypothesis of no herding for the entire sample period.

In contrast to the results for city banks, herd behavior is still consistently observed for regional banks even after the adjustment (the gray dotted line in Fig. 5).[36] We can see that with some exceptions around 1980, only a small proportion of herding was due to rational factors. Still, a large magnitude of adjusted herding manifests itself consistently. The p-values from the Chi-squared test (Table 4) reveal that they are significant not only economically but also statistically. We could therefore conclude that it is highly probable that regional banks had been consistently following irrational herd behavior. This makes a good contrast with the results for city banks, which represent irrationality mainly in the late 1980s.[37]

[34] As for the industry-year in which banks excessively *decreased* their loans outstanding (i.e. $P_i < P_t$), we follow the same procedure but assume that $AINC'_i = AINC_i$.

[35] This amount is the sum of loans to borrowers in legal bankruptcy, past due loans in arrears by 6 months or more, loans in arrears by 3 to 6 months, and restructured loans. See "The Current Status of Risk Management Loans held by Deposit-Taking Financial Institutions in Japan," a press release by the Financial Services Agency, the Government of Japan, July 1998 (available at http://www.fsa.go.jp/p_fsa/news/newse/news-e-717.html).

[36] As a control variable representing land price for regional banks, the index of land price for the region outside the six largest urban areas is used.

[37] One might infer that the reason a great extent of herding is consistently observed for regional banks even after the adjustment is not because they are irrational but because they are making lending decisions based on regional economic conditions. However, this type of herding is not likely to be captured in the LSV measure. The LSV measure captures

Table 4
Mean adjusted LSV measure for regional banks

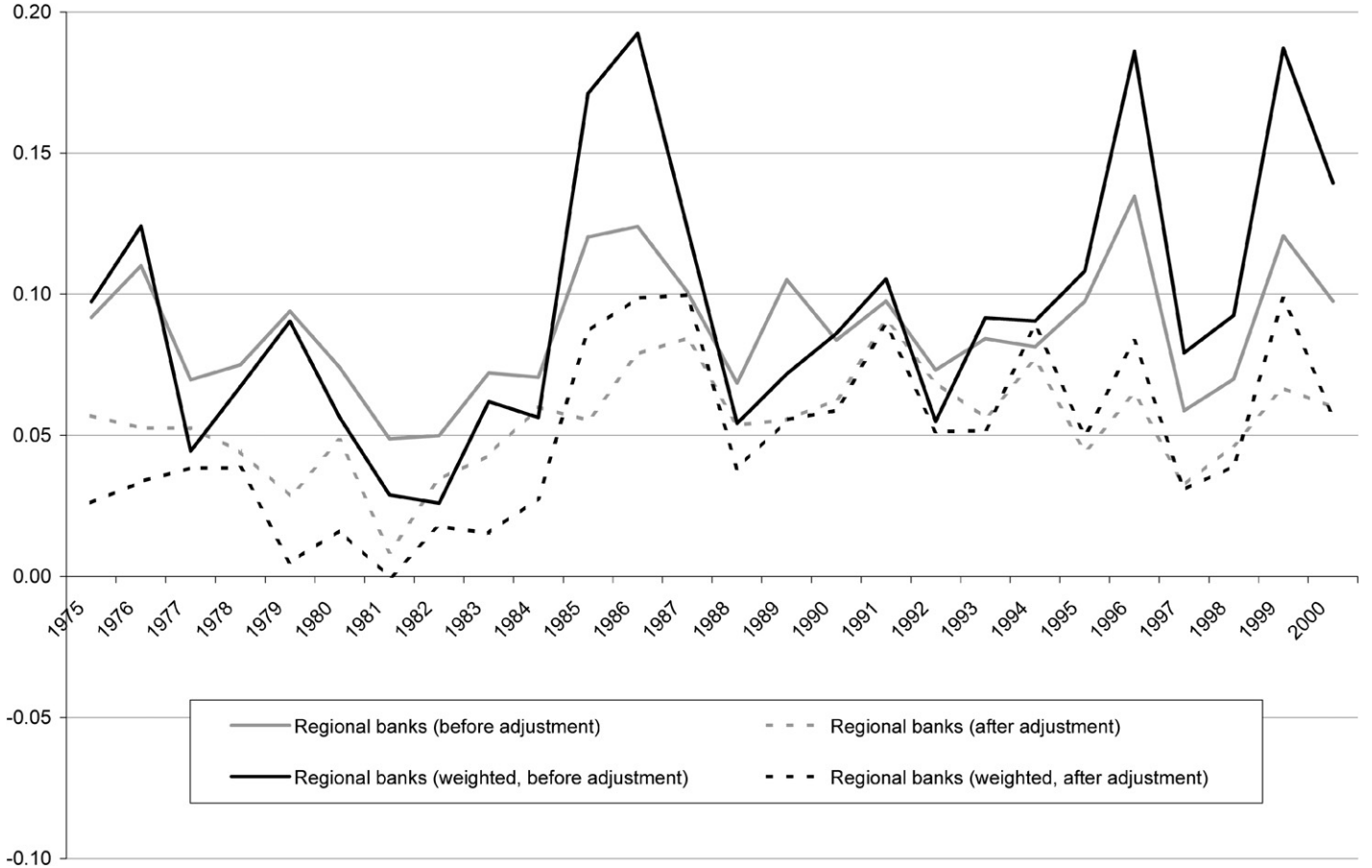
Year	Mean LSV (before adjustment)			Mean LSV (after adjustment)		
	Mean LSV	p-value from t test	p-value from Chi^2 test	Mean LSV	p-value from t test	p-value from Chi^2 test
1975	0.0918	0.00	0.00	0.0569	0.01	0.00
1976	0.1101	0.00	0.00	0.0526	0.02	0.00
1977	0.0697	0.00	0.00	0.0526	0.00	0.00
1978	0.0750	0.00	0.00	0.0443	0.02	0.00
1979	0.0940	0.00	0.00	0.0285	0.03	0.00
1980	0.0741	0.00	0.00	0.0482	0.02	0.00
1981	0.0488	0.01	0.00	0.0088	0.16	0.00
1982	0.0499	0.01	0.00	0.0343	0.03	0.00
1983	0.0721	0.01	0.00	0.0428	0.05	0.00
1984	0.0705	0.00	0.00	0.0600	0.01	0.00
1985	0.1203	0.00	0.00	0.0553	0.01	0.00
1986	0.1240	0.00	0.00	0.0788	0.00	0.00
1987	0.1009	0.00	0.00	0.0845	0.00	0.00
1988	0.0684	0.01	0.00	0.0536	0.02	0.00
1989	0.1051	0.00	0.00	0.0555	0.01	0.00
1990	0.0837	0.00	0.00	0.0625	0.01	0.00
1991	0.0975	0.00	0.00	0.0907	0.00	0.00
1992	0.0732	0.00	0.00	0.0689	0.01	0.00
1993	0.0842	0.00	0.00	0.0561	0.00	0.00
1994	0.0814	0.00	0.00	0.0766	0.00	0.00
1995	0.0974	0.00	0.00	0.0444	0.01	0.00
1996	0.1347	0.00	0.00	0.0646	0.00	0.00
1997	0.0587	0.01	0.00	0.0323	0.03	0.00
1998	0.0699	0.01	0.00	0.0467	0.03	0.00
1999	0.1207	0.00	0.00	0.0667	0.02	0.00
2000	0.0975	0.00	0.00	0.0600	0.02	0.00

Note. Sample means of the LSV measure before and after adjustment, and respective p-values are shown. Shaded figures represent the results in which the null hypothesis of no herding is rejected at a 5% significance level.
Source: Authors' calculations.

Finally, the weighted mean measure is smaller than the simple mean measure until 1985 (after adjustment). This underscores the rationality of regional banks in the years around 1980. The difference between the simple and weighted mean measures indicates that in this period, the level of the adjusted LSV measure is smaller for industries with larger weight, while the level is larger for those with smaller weight. It is therefore safe to adopt the result from the weighted mean measure and conclude that rationality in regional banks had been observed to some extent before the bubble period of the late 1980s. In contrast, for the period after 1985, we still confirm the result that consistent irrational herding existed for regional banks.

If we are allowed to interpret that the results represent the irrationality of regional banks throughout the period, it is in line with the results obtained in Uchida and Tsutsui (2005). They

the difference between a proportion of banks who increased loans in an industry-year (P_i) and an overall lending policy (P_t) in the year. What we have to control for is a rational factor affecting this difference, but the difference depends only on industry- and year-specific factors (X_i) and not on region-specific factors.



Source: Authors' calculations.

Fig. 5. Simple and weighted mean LSV measure for regional banks (before and after adjustment).

report that regional banks were consistently under less stringent competitive pressure than city banks throughout the period. They might thus have been able to afford to herd.[38]

4.2. Regional herding

Thus far, we have treated banks of the same type in a uniform manner, irrespective of their *location* in relation to each other. An implicit assumption behind this approach is that banks of the same type herd. However, it may also be plausible to suppose that banks herd with nearby banks, *irrespective of their type*. For example, a regional bank in Hokkaido prefecture (the north end of Japan) is not likely to herd (at least directly) with one in Okinawa prefecture (the south end), more than 2000 kilometers away. Rather, the bank is more likely to herd with a city bank which operates in Hokkaido. Thus, if we confine sample banks based on their geographical location, we may find a greater degree of herding.

Thus we now focus on two major urban areas in Japan and investigate herding in the two areas without separating sample banks by their type.[39] The first area is the Kanto area, which consists of Tokyo, Kanagawa, Saitama, Chiba, Ibaragi, Tochigi, and Gunma prefectures. This area is the economic center of Japan. The other area is the Kansai area, consisting of Osaka, Hyogo, Kyoto, Nara, Shiga, and Wakayama prefectures. This area constitutes the second largest focal point of the economy of Japan.[40] We constructed two separate samples consisting of banks whose main office is located in each of the two areas outlined above, irrespective of whether the bank is a city bank or a regional bank.

The mean LSV measures before and after adjustment for the two areas are represented in Figs. 6 and 7. We can see moderate levels of herding. That is, although the line depicting the transition is almost exactly in between that of city banks and regional banks, the magnitude of the measures is slightly smaller. The Chi-squared test (not reported) reveals that after adjustment, significant levels of herding are observed almost exclusively during the 1983–1989 period.

These results, together with those in the previous sections, imply that a larger extent of herding is observed by type of bank rather than by region. That is, banks tend to herd more with those of the same type than with those of geographical proximity. If the herding is caused by banks' inference from behavior of other banks, this finding implies that banks are more likely to infer among the same type of bank than to infer among geographically proximate banks (across different types).[41] This finding is also consistent with the hypothesis that the banking market in Japan is segmented by type.[42]

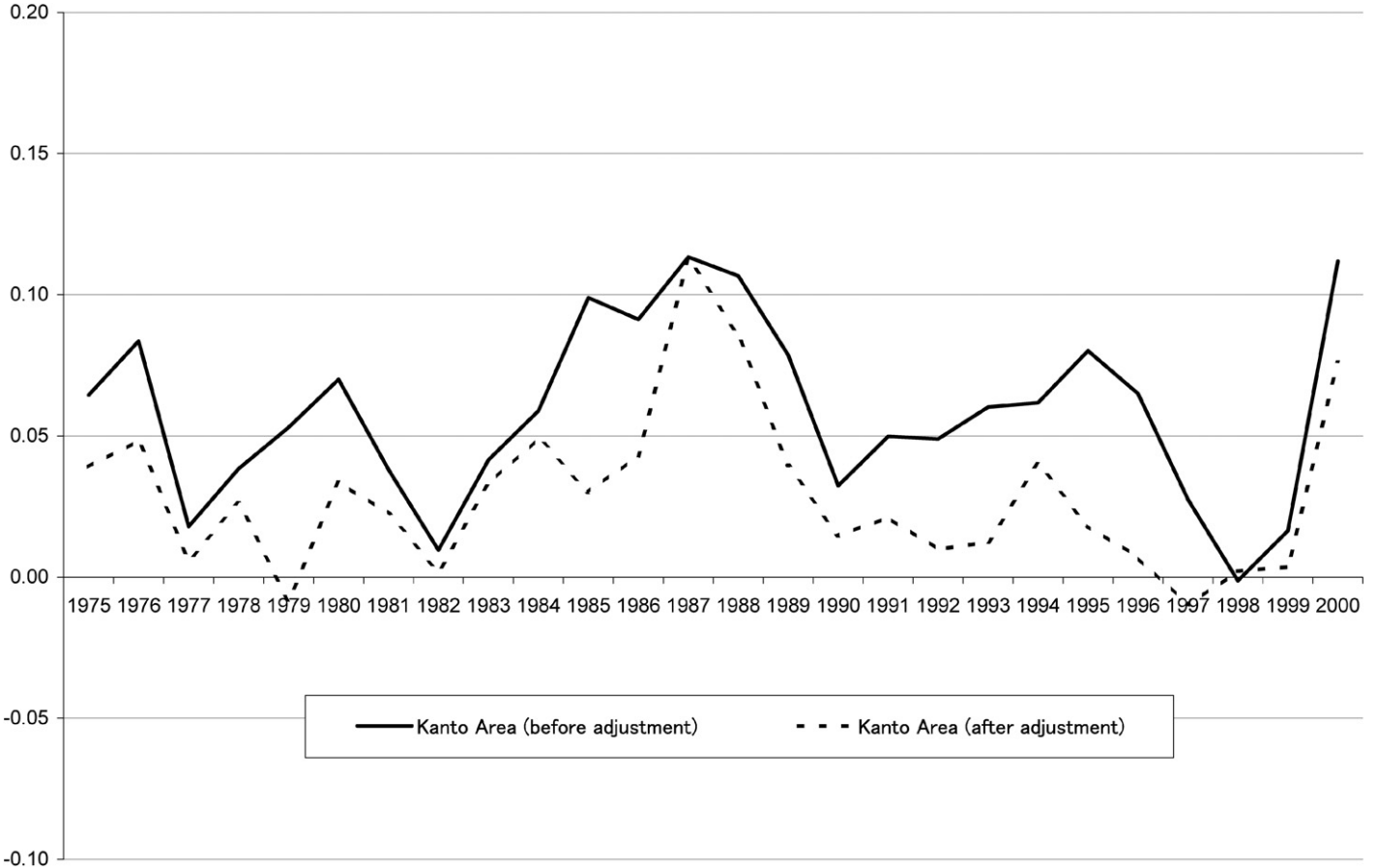
[38] A less stringent competitive environment for regional banks might have been due to regional segmentation of their markets. One might then speculate that banks as regional monopolists would not follow herd behavior at all, which contradicts the evidence obtained in this paper. However, Kano and Tsutsui (2003) demonstrate that markets for regional banks were not segmented by prefecture, although they were not perfectly competitive. Together with the results of Uchida and Tsutsui (2005), this implies that regional banks in Japan *were* under competition even if it was not very severe. The result of consistent herding is thus not contradictory.

[39] The analysis in this subsection is based on a suggestion by an anonymous referee, for which we are grateful.

[40] We chose a division not by prefecture but by area greater than prefecture so as to retain a sufficient number of samples, and because prefectures seem to be small geographically to focus on as markets in which banks herd.

[41] See footnote 4.

[42] Although the hypothesis has not directly been tested, there is some evidence that supports it. Uchida and Tsutsui (2005) demonstrate that the degree of competition of city banks is different from that of regional banks, which implies a market segmentation between city banks and regional banks. Also, Kano and Tsutsui (2003) demonstrate that the banking



Source: Authors' calculations.

Fig. 6. Mean LSV measure for banks in Kanto area (before and after adjustment).

Source: Authors' calculations.

Fig. 7. Mean LSV measure for banks in Kansai area (before and after adjustment).

5. Conclusion

For the purpose of investigating herd behavior among Japanese banks, we calculated the herding measure invented by Lakonishok et al. (1992). The results obtained in this paper give us information to answer the question raised in the Introduction. First of all, city banks had followed a cyclical pattern of herding. After adjusting for rational factors that are contained in the original measure, it turned out that herd behavior by city banks was mainly due to rational factors. However, results indicative of irrational herding in the late 1980s were still obtained. Our estimate indicates that a total of some 5 trillion yen of loan increase by city banks during the 1987–1989 period can be attributed to irrational herd behavior. These results imply that irrational herd behavior by city banks during the bubble period might have contributed to the non-performing loan problem in the 1990s. This made a good contrast with the results for regional banks, which demonstrated evidence consistent with the existence of irrational herd behavior from the mid-1980s. Finally, we found that herd behavior is likely to be followed among the same types of banks rather than across different types, and moderately followed among geographically proximate banks.

There is an interesting issue that remains unchallenged in this paper. Although we were able to present empirical evidence to answer the three questions raised in the Introduction, investigation of the *effect* of irrational herding that we found is still insufficient. Further investigation is anticipated about whether and how irrational behavior has contributed to the accumulation of non-performing loans.

The financial system in Japan has long been bank-oriented, and banks have been playing a major role in the economy. The existence of herding among Japanese banks shown in this paper is thus as important as that among fund managers in the US, whose financial system is market-oriented. Taking account of the serious banking crisis in Japan in the 1990s, investigation of herd behavior should be an important research topic in other economies. The present paper demonstrates the possibility of applying the method of analysis for herd behavior among fund managers to that among banks. In order to obtain some lesson from the Japanese banking crisis, it would be interesting to apply the same analysis to other bank-oriented economies.

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market for regional banks is not strictly segmented by prefecture, whereas that for Shinkin banks (smaller cooperative banks) *is* segmented by prefecture, which implies a market segmentation between regional banks and Shinkin banks.

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