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The Economic Impact of Herd Behavior in the Japanese Loan Market

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ABSTRACT

This paper investigates whether inefficient herd behavior of Japanese financial institutions in the domestic loan market affected the real economy during the period between 1975 and 1999. By using Japanese loan data, arranged by geographical area, we show that the loans that stemmed from inefficient herd behavior of Japanese financial institutions tended to have a negative impact on the GDP and land prices in the following years, while aggregated loans of those financial institutions had a positive impact. Our results indicate that the deterioration of the real economy in the 1990s may have been attributable partly to the inefficient herd behavior in the Japanese loan market during the period of the economic bubble in the late 1980s.

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Keywords: impact of herding; loan market; economic bubble

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1. INTRODUCTION

A number of the literature has been investigating whether investors in financial markets follow herd behavior, that is, to imitate the behavior of each other, when they choose assets to buy or sell. Fund managers investing into stocks, international capital investors, and banks lending to firms are main research subjects of herding.[1]

Herding by banks in loan markets, in particular, is focused upon as one of the possible reasons for misallocations of financial resources and macroeconomic fluctuations. Banks rarely have enough information of the profitability of firms. This makes them lend money to firms that other banks have already chosen as borrowers, because decisions of other banks indicate the profitability of firms. If firms chosen by other banks were profitable, banks could realize efficient financial allocations by herding behavior. Otherwise, their herding would result in an inefficient outcome by expanding loans to unprofitable firms.

The related literature has examined the existence of bank herding in loan markets. Jain and Gupta (1987) and Barron and Valev (2000) provide the evidence of herding by US banks in lending to Latin American countries in the 1980s. Buch and Lipponer (2006) show that foreign direct investments of German banks tend to concentrate in OECD countries. Uchida and Nakagawa (2007), Nakagawa (2008), and Nakagawa and Uchida (2010) provide the strong evidence of herding by Japanese banks in the period of the asset price bubble in the late 1980s.[2]

In spite of many studies examining the existence of herding by banks, few studies have examined how bank herding affects the real economy. In particular, it has not been clarified whether bank herding improves financial allocations by helping banks know more about borrowers, or whether bank herding deteriorates the efficiency of loan markets by misleading banks into lending to unprofitable borrowers. To be precise, the three studies on Japanese banks mentioned above show that their herd behavior was *inefficient* in the sense that loans resulting from their herding were not explained by the profitability of firms. But, the literature does not directly examine the economic impact of such herding on the Japanese economy.

This paper investigates whether herd behavior by banks affects the real economy, by focusing on the loan data of Japanese banks and other financial institutions during the period between 1975 and 1999. First, using the methodology presented by Nakagawa (2008) the paper examines whether Japanese financial institutions followed

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[1] The next section reviews the related literature.

[2] In addition, Chang, Chaudhuri, and Jayaratne (1997) find the herding by US banks when opening branches in new cities, and de Juan (2003) detects the similar behavior by Spanish banks.

herd behavior when providing loans in financial markets. Second, based on evidence of herd behavior the paper investigates whether and how loans made by their herding had an impact on the Japanese economy.

Japanese financial institutions are considered to be a favorable subject of research to examine the economic impact of herding. There has been an anecdotal argument that when Japanese financial institutions provided financing to private businesses, they followed herd behavior, resulting in the inefficiency of the Japanese financial market. In particular, some economists criticize that their herd behavior in lending practices might have led to inadequate scrutiny over the financial condition of borrowers and other oversights, which might have contributed to the later accumulation of non-performing loans, during the time period from the formation of the asset-price bubble in the 1980s to the period following the collapse of the bubble in the 1990s.[3]

This paper presents empirical results that support this anecdotal prediction. These results also show the same characteristics of impact of herding as those found in the related literature introduced in the next section. First, the paper provides evidence of inefficient herd behavior across different types of Japanese financial institutions that is not explained by economic variables, in particular during the formation of the asset-price bubble in the late 1980s. This evidence complements the results found by Nakagawa (2008) by including many types of financial institutions. Next, the paper finds that loans that stemmed from inefficient herding were negatively correlated with GDPs and land prices in the following years. In contrast, ordinary loans that were independent of inefficient herding were positively correlated with those macroeconomic variables. This suggests a high possibility that herd behavior by Japanese financial institutions had a negative impact on the Japanese economy.

The remainder of this paper is structured as follows. The next section shows the related literature of herd behavior and recent empirical studies. Section 3 explains the methodology for testing the existence of herd behavior and its effect on the economy. Section 4 outlines the data of loans outstanding of financial institutions used in the analysis. Section 5 shows the empirical results of our tests. Sections 6 and 7 provide robustness checks and our conclusions, respectively.

2. LITERATURE REVIEW

[3] For overviews of the Japanese financial system, see Teranishi (1994), Kitagawa and Kurosawa (1994), and Hoshi and Kashyap (2001). Ueda (2000) discusses the interaction between the asset-price bubble in the late 1980s and the loans that banks simultaneously extended to finance or real estate industries in the same period. Ogawa and Kitasaka (2000) take the collective contraction of bank loans as the *credit crunch* that might have generated the long stagnation of the 1990s.

In this section, we review the related literature that considers the economic impact of herd behavior on markets and the real economy. There are a bunch of studies examining the economic impact of investors' herding in stock markets on stock prices, while the impact of herding by banks is rarely investigated. By reviewing the literature, we consider the methodology of testing the economic impact of herding by banks in loan markets.[4]

Herd behavior is commonly defined to include any behavior similarity brought about by the direct or indirect interaction of individuals (see Hirshleifer and Teoh, 2009). The literature gives theoretical reasons for herding by rational agents and its negative impact on the economy. For example, Banerjee (1992) and Bikhchandani, Hirshleifer, and Welch (1992) consider *informational cascades*, in which an agent ignores his own information when deciding his action and follow the behavior of other agents, for the reason that he believes that the behavior of others reflects more accurate information. Scharfstein and Stein (1990) emphasize *reputational herding*, in which agents feel like to imitate the behavior of others when agents' payoffs are determined by their reputations or relative performances. Other studies focus on *payoff externality*, in which an agent's action affects the payoffs to others of taking that action, to explain financial market runs (see Diamond and Dybvig 1983, Bernardo and Welch 2004). Although these reasons for herding differ from each other, their common implication is that herd behavior can cause an inefficient outcome, such as mispricing in stock markets and macroeconomic fluctuations through bank loans.

A large number of the empirical literature has examined the existence of the economic impact of herding, by focusing upon trades of investors in stock markets. The methodology employed there is to test the correlation between investors' herding and subsequent stock prices.

Most of the earlier literature provided evidence of positive effects of herding to stabilize market pricing. Wermers (1999) shows that mutual fund herding accelerated the adjustment process of stock prices from 1975 through 1994. Froot, O'Connell, and Seasholes (2001) find that international portfolio flows caused by herding in 44 countries in the mid-1990s had positive forecasting power for future equity returns. Sias (2004) and Choi and Sias (2009) provide evidence that an increase in demand for stocks caused by herding of institutional investors was positively correlated with short-term stock returns in the US stock market during the past three decades.

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[4] For surveys of herd behavior, see Bikhchandani and Sharma (2000), Devenow and Welch (1996), Hirshleifer and Teoh (2003, 2009).

In contrast, some of the recent literature have found not only stabilizing effects of herding in the short-term, but also destabilizing effects in the long-term. Brown, Wei, and Wermers (2007) provide the evidence indicating that stocks bought by herding of mutual fund managers experienced a sharp increase in price in the short-term and a reversal in price in the longer term. Dasgupta, Prat, and Verardo (2009) also find a similar reversal effect of herding by institutional investors on stock prices in the US market.

Although the impact of herding by banks is rarely investigated, the literature suggests a possible methodology for examining the economic impact of herding by banks. Following the same regression method adopted by the literature, we will test whether loans resulting from bank herding are positively or negatively correlated with subsequent economic variables such as GDPs and land prices. Similar to the previous literature, it might be difficult to discern which theoretical reason drove herding by banks in loan markets. Hence, we will focus on finding characteristics of their herding and its impacts on the real economy.

3. METHODOLOGY

To investigate how the Japanese economy is affected by the herd behavior of Japanese financial institutions in the domestic loan market, we employ a two-step method. First, we examine whether Japanese financial institutions exhibit herd behavior in the domestic loan market, based on the methodology used in Nakagawa (2008), by using panel data of the domestic loan market during the period between 1975 and 1999. Second, we investigate how the Japanese economy is affected by the herd behavior in the loan market.

In the first step, we estimate the following dynamic panel model, by using a two-step generalized method of moments (GMM) estimator based on Arellano and Bond (1991). We employ the two-year lagged variables as instrumental variables, as follows:

$$dL^{s}_{i,t} = \alpha^{s}_{i} + \beta^{s} dZ_{i,t-1} + \gamma^{s} dL^{s}_{i,t-1} + \delta^{-s} dL^{-s}_{i,t-1} + \varepsilon^{s}_{i,t} \qquad (1)$$

where

dX = rate of change of the variable, that is,

$$dX_t = \frac{X_t - X_{t-1}}{X_{t-1}}, \text{ and } dX_{t-1} = \frac{X_{t-1} - X_{t-2}}{X_{t-2}}$$

s = type of financial institutions

$-s$	=	types of financial institutions other than s
i	=	prefecture
t	=	year
Z	=	vector of economic activities, including (a) GDP of agriculture, forestry, and fishing, (b) GDP of mining and manufacturing, (c) GDP of private service industries, (d) GDP of government services, (e) land prices, (f) amount of liabilities of bankrupt companies, and (g) number of new construction starts of dwellings
L	=	amount of loans outstanding
ε	=	zero-mean disturbance term

As an explained variable, we use the amount of loans outstanding of type s of financial institutions in the current year, that is, L_t^s. For explanatory variables, we include L_{t-1}^s and L_{t-1}^{-s}, which stand for the amount of loans of type s in the previous year and the amount of loans of other types in the previous year. We use a one-year lag of these variables to avoid a possible bias from endogeneity. The coefficient of L_{t-1}^{-s}, δ^{-s}, is our target, measuring the degree of inefficient herd behavior by type s following to types -s. An interpretation of a related variable, γ^s, needs some caution because this variables may capture inefficient herd behavior among type s financial institutions as well as auto-correlation of a certain type of financial institution. Because it is difficult to distinguish one factor from another by using aggregated data, our analysis carefully considers both possibilities.

Z is a vector of economic activities, which consists of variables that might affect lending behaviors and loan demands, including the following seven variables: GDPs, land prices, bankruptcy liabilities, and new construction. We employ these variables to control for herd behavior based on common economic factors. We also use a one-year lag of Z to eliminate the possible bias from the endogeneity.

If financial institutions make a loan decision based only on economic factors, such as GDP and financial conditions of debtors, they do not follow the behavior of other financial institutions. If this is the case, the following model should be appropriate to estimate the amount of loans:

$$dL_{i,t}^s = \alpha_i^s + \beta^s dZ_{i,t-1} + \varepsilon_{i,t}^s \tag{2}$$

In other words, the two variables in model (1), i.e., γ^s and δ^{-s}, should equal zero. Otherwise, herd behavior is expected to be present among financial institutions in the loan market.

Following Nakagawa (2008), we estimate the model (1) for a period of five years and sequentially change the period by one year to examine time-variations in the herd parameters, γ^s and δ^{-s}. In addition, we conduct the over-identifying restrictions test developed by Hansen (1982).

Next, we analyze how the Japanese economy is affected by herd behavior by using the estimated parameters, γ^s and δ^{-s}. We first calculate the market-wide herd parameter called *HerdBehavior1* by summing up parameters γ^s and δ^{-s} across types of financial institutions:

$$HerdBehavior1_{i,t} = \sum_s \left(\gamma^s_{i,t} \times \frac{1}{5} \sum_{t'=t-5}^{t-1} dL^s_{i,t'} \times \frac{L^s_{i,t}}{\sum_{s'} L^{s'}_{i,t}} \right) + \sum_{m,n} \left(\delta^{m \to n}_{i,t} \times \frac{1}{5} \sum_{t'=t-5}^{t-1} dL^m_{i,t'} \times \frac{L^n_{i,t}}{\sum_{s'} L^{s'}_{i,t}} \right) \quad (3)$$

where

$\gamma^s_{i,t}$ = herd parameter from loans by type *s* to loans by type *s*

$\delta^{m \to n}_{i,t}$ = herd parameter from loans by type *m* to loans by type *n*

$\frac{1}{5} \sum_{t'=t-5}^{t-1} dL^m_{i,t'}$ = five-year average growth rate of loans by type *m*

$\frac{L^n_{i,t}}{\sum_{s'} L^{s'}_{i,t}}$ = share of loans by type *n*

This parameter measures the growth rate of loans that result from herd behavior between all different types of financial institutions in prefecture *i* in period *t*. The first term measures the herding loans caused by one type of financial institution following the same type of financial institutions. The second term measures the herding loans caused by one type of financial institution following another type of financial institutions.

Note that *HerdBehavior1* is a sum of two kinds of herd parameters, i.e., γ^s and δ^{-s}, and thus includes both herd behavior of one type of financial institution following the same type of financial institution and herd behavior of one type of financial institution following another type of financial institution. However, it is possible that the parameter γ^s also captures auto-correlation of loans made by one financial institution as well as herd behavior of one type of financial institution following the same type of financial institution. Because it is difficult to distinguish these two kinds of lending behavior, we next construct *HerdBehavior2* to include only herd behavior among different types of financial institutions:

$$HerdBehavior2_{i,t} = \sum_{m,n}\left(\delta_{i,t}^{m\rightarrow n} \times \frac{1}{5}\sum_{t'=t-5}^{t-1} dL^{m}_{i,t'} \times \frac{L_{i,t}^{n}}{\sum_{s'} L_{i,t}^{s'}}\right) \quad (3)'$$

Then, by using the variable, *HerdBehavior*, which is *HerdBehavior1* or *HerdBehavior2*, calculated by equations (3) and (3)', we estimate the following model:

$$dY_{i,t} = \alpha_i + \beta HerdBehavior_{i,t} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \quad (4)$$

where $Y_{i,t}$ is a variable representing economic activity. We employ growth rates of GDP and land prices for this explained variable. The variable Z' includes the following variables to capture the effect of the real economy: GDP, land prices, and new constructions.

Our target here is the coefficient of *HerdBehavior*, β, which represents the economic impact of herd behavior of financial institutions in the loan market. If the null hypothesis $\beta = 0$ is rejected statistically, loans stemming from herding by financial institutions should have influence on the real economy. By sequentially changing the estimation period of model (4) by one year, we examine how fast the herd behavior affects the Japanese economy, as follows:

$$\begin{aligned} dY_{i,t} &= \alpha_i + \beta_t HerdBehavior_{i,t} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \\ dY_{i,t} &= \alpha_i + \beta_{t-1} HerdBehavior_{i,t-1} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \\ &\vdots \\ dY_{i,t} &= \alpha_i + \beta_{t-5} HerdBehavior_{i,t-5} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \end{aligned} \quad (4)'$$

We estimate the models (4)' by using two-step GMM estimator and employing the two-year lagged variables as instrumental variables.

Note that the herd parameter can be either positive or negative. A positive parameter indicates herd behavior, as one type of financial institution tends to make loans to the same prefecture as the other financial institutions have made loans to. In contrast, a negative parameter indicates that two types of financial institutions compete with each other, as their loans are substitutable. To eliminate the impact of this competing behavior, we test the alternative model by including the dummy variable (Dummy), which takes 1 if the herd parameter is positive, and 0 otherwise:

$$\begin{aligned} dY_{i,t} &= \alpha_i + \beta HerdBehavior_{i,t} \times Dummy_{i,t} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \\ dY_{i,t} &= \alpha_i + \beta HerdBehavior_{i,t-1} \times Dummy_{i,t} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \\ &\vdots \\ dY_{i,t} &= \alpha_i + \beta HerdBehavior_{i,t-5} \times Dummy_{i,t} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{5}$$

For comparison, we estimate the following models by using aggregated loans as explanatory variables. Model (6) employs the loans simply aggregated across types of financial institutions, while model (7) uses ordinary loans, which is obtained by subtracting *HerdBehavior* from aggregated loans:

$$\begin{aligned} dY_{i,t} &= \alpha_i + \beta_t d\sum_s L^s_{i,t} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \\ dY_{i,t} &= \alpha_i + \beta_{t-1} d\sum_s L^s_{i,t-1} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \\ &\vdots \\ dY_{i,t} &= \alpha_i + \beta_{t-5} d\sum_s L^s_{i,t-5} + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{6}$$

$$\begin{aligned} dY_{i,t} &= \alpha_i + \beta_t \left(d\sum_s L^s_{i,t} - HerdBehavior_{i,t} \right) + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \\ dY_{i,t} &= \alpha_i + \beta_{t-1} \left(d\sum_s L^s_{i,t-1} - HerdBehavior_{i,t-1} \right) + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \\ &\vdots \\ dY_{i,t} &= \alpha_i + \beta_{t-5} \left(d\sum_s L^s_{i,t-5} - HerdBehavior_{i,t-5} \right) + \gamma dZ'_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{7}$$

We estimate the models (6) and (7) by using two-step GMM, and employ the two-year lagged variables as instrumental variables.

4. DATA

In the present study, we use annual data classified by prefecture. Following Nakagawa (2008), the source of bank loan data is the *Financial Journal Monthly* (*Gekkan Kin-yu Journal* in Japanese) published by the Japan Financial News Co., Ltd. The other economic variables are collected from *Nikkei NEEDS*. We analyze six types of financial institutions: city banks, regional banks, second-tier regional banks, shinkin banks,[6] credit cooperatives, and agricultural cooperatives. City banks are the largest

[6] Shinkin banks are cooperative regional financial institutions that serve small- and medium-sized

banks and have nationwide branches. Their lines of business include multiple operations such as commercial, investment, and international banking. The other financial institutions operate locally. Their businesses are closely connected to local residents, enterprises, and governments.

Figure 1 presents loan shares of the six types of financial institutions. City banks occupy approximately 35-40% of total loans outstanding and a particularly dominant loan share in urban prefectures. However, as shown in Nakagawa (2008), loan shares of city banks are quite small in local prefectures where regional banks have the dominant shares. Figure 1 also shows that loan shares of credit cooperatives and agriculture cooperatives are rather small. Except for urban prefectures, these two types have 5-10% of shares, indicating that the herd behavior of these types may have some influence on local economy.

[Figure 1 here]

By using loan data of six types of financial institutions, we examine (a) which type follows which other type, (b) which type is more likely to herd, and (c) which type acts like a leader in the Japanese loan market.

5. RESULTS

5.1. Analyses of herd behavior of Japanese financial institutions

Figure 2 presents the herd parameter estimated by Model (1). Each graph shows the herd parameter of the type listed in the column, followed by lending behavior of the type in the row. We eliminate the period in which strong multicollinearity exists among explanatory variables and the misspecification found by the over-identification test. Figure 2 shows that we can observe the following characteristics found in the domestic loan market. First, herd behavior is observed frequently among financial institutions other than city banks. Although city banks rarely behave as a leader, lending behavior of local financial institutions, especially regional banks, is followed by other financial institutions.

[Figure 2 here]

Note that coefficients on the herd parameter take both positive and negative signs.

companies and local residents.

Although positive coefficients are consistent with herd behavior, negative coefficients indicate that two types of financial institutions compete with each other, as their loans are substitutable. Table 1 presents the number of positive coefficients, that of negative coefficients, and the difference between the two. The table shows that herding behavior is prevalent in all periods. In particular, the difference between the number of positive coefficients and that of negative coefficients is more than ten in the period including the late 1980s. These results indicate the presence of herd behavior in the domestic loan market, particularly in the period of the economic bubble.

[Table 1 here]

5.2. Economic impact of herd behavior

Tables 2 and 3 present the economic impact of herd behavior in the loan market by using the estimated herd parameters. Table 2 uses GDP as an explained variable, while Table 3 employs land prices as an explained variable. For both tables, Panels A and B are based on *HerdBehavior1* and *HerdBehavior2*, respectively.

[Tables 2 and 3 here]

Panel A of Table 2 shows that for both estimation models GDP is positively associated with *HerdBehavior* at the 1% significance level in the current period, negatively associated at the 1% significance level in the following three years, and then positively associated at the 1% significance level again after that. Panel B of Table 2 provides similar results. Although Model (5) does not report significantly negative correlation in any periods, for Model (4)', GDP is positively associated with *HerdBehavior* at the 1% significance level in the current period, negatively associated at the 1% significance level in the following two years, and then positively associated after that. These results indicate that the herd behavior in the domestic loan market tends to affect GDP positively immediately, negatively later in a couple of years, and then positively after that.

This characteristic of the short-term positive and long-term negative impacts of bank herding is similar to the results found by Brown, Wei, and Wermers (2007) and Dasgupta, Prat, and Verardo (2009), shown in the literature review. They find that stocks bought by herding of institutional investors experienced an increase in their prices in the short-term and a reversal in the prices in the longer term. Our finding implies that herding by Japanese financial institutions had the same destabilizing effect on the macroeconomy.

The impact on land prices is more negative than that on GDP. Panel A of Table 3 shows that land prices are negatively associated with *HerdBehavior* at the 1% significance level in the first five periods for Model (4)' and in the first four periods for Model (5). Panel B of Table 3 provides similar results. Land prices are negatively associated with *HerdBehavior* at the 1% significance level in the first three periods, positively associated at the 1% significance level in the following one year, and then negatively associated after that. In sum, the results in Tables 2 and 3 indicate that herd behavior among financial institutions generates loans to risky firms, which has a negative influence in the medium-term.

5.3. A comparison with the impact of aggregated loans

We also investigate the impact of aggregated loans on GDP and land prices for comparison. Tables 4 and 5 present the estimation results of Models (6) and (7), respectively. Panels A and B of Table 5 provide estimation results by using GDP and land prices as explained variables, respectively. Table 4 shows that the aggregated loans tend to affect GDP positively for all periods except one. Panel A of Table 5 also provides similar result by using *HerdBehavior1*, in which GDP is positively affected by ordinary loans for all periods except for one. These results contrast the negative long-term effect of the herd behavior on GDP, although the result by using *HerdBehavior2* shows that GDP is positively affected by ordinary loans at the 1% significance level for the first two periods, negatively affected for the following three periods.

The impact of ordinary loans on land prices is more negative. Both Table 4 and Panel B of Table 5 show that the effect of ordinary loans on land prices is significantly negative for all periods except for one or two. Thus, the impact of inefficient herd behavior on land prices is not much different between lending based on inefficient herd behavior and ordinary loans. Only real economy tends to be affected more negatively by herd lending.

[Tables 4 and 5 here]

6. ROBUSTNESS CHECK

To ensure robustness, we conduct robustness check by using another parameter representing herd behavior, *HerdBehavior3,* which consists of only herd behavior among different types of financial institutions over one year, as follows:

$$HerdBehavior3_{i,t} = \sum_{m,n} \left(\delta_{i,t}^{m \to n} \times dL_{i,t-1}^{m} \times \frac{L_{i,t}^{n}}{\sum_{s'} L_{i,t}^{s'}} \right) \tag{8}$$

The difference from *HerdBehavior2* is that *HerdBehavior3* is calculated using the growth rate of loans in one year, instead of the five-year average growth rate of loans.

Table 6 presents the estimation results of Models (4)' and (5) by using *HerdBehavior3*. Panels A and B show estimation results of Models (4)'and (5) by using GDP and land prices as an explained variable, respectively.

[Table 6 here]

Panel A shows that for both Models (4)' and (5) GDP is positively associated with *HerdBehavior* at the 1% significance level in the current period, negatively associated at the 1% significance level in the following three years, and then positively associated at the 1% significance level again after that. This result is consistent with that provided by Panel A of Table 2, which is estimated by using *HerdBehavior1*. In addition, Panel B presents that land prices are positively associated with *HerdBehavior* at the 1% significance level in the first two periods, and negatively associated at the 1% significance level in the following four years for Model (4)' and three years for Model (5), respectively. Thus, the results of robustness checks using *HerdBehavior3* are almost consistent with the results estimated by *HerdBehavior1* and *HerdBehavior2*.

Panel C reports mixing results. It shows that GDP is positively associated with ordinary loans at the 1% significance level in the current period, and negatively associated at the 1% significance level for the following years. However, land prices are positively associated with ordinary loans at the 1% significance level for all periods except for one. Thus, both results of land prices are more different between *HerdBehavior* and ordinary loans, though the results of GDP are not much different.

7. CONCLUDING REMARKS

We investigated whether or not Japanese financial institutions demonstrated herd behavior in the loan market by following the lending behavior of other financial institutions. We also examined what type of impact herd behavior had on the real economy. There have been a large number of theoretical studies conducted on herd behavior. There have also been many arguments stressing that herding by Japanese financial institutions caused inefficiency in the loan market and destabilized the real economy. However, few studies have empirically investigated the impact of herd behavior on the real economy.

Using the data of loans outstanding from financial institutions by prefecture and industry, we show empirically that Japanese financial institutions followed herd behavior across different types of financial institutions from the 1980s through the 1990s. In particular, the evidence for herd behavior was frequently observed in the late 1980s, which is the period of the formation of the asset-price bubble. These findings are consistent with the results of Nakagawa (2008).

The results also show that the evidence for herd behavior by financial institutions was not related to variations in near future GDPs or land prices, but was negatively correlated with variations in far future GDPs and land prices. The results imply that in the long run, loans made by herding of financial institutions caused the inefficiency of financial markets and destabilized the real economy in the form of a downturn in the GDP and land prices. These findings suggest that strong herd behavior by financial institutions in the late 1980s might have contributed to the formation of the asset-price bubble and the subsequent burst of the asset-price bubble.

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Figure 1: Loan shares of the Japanese financial institutions

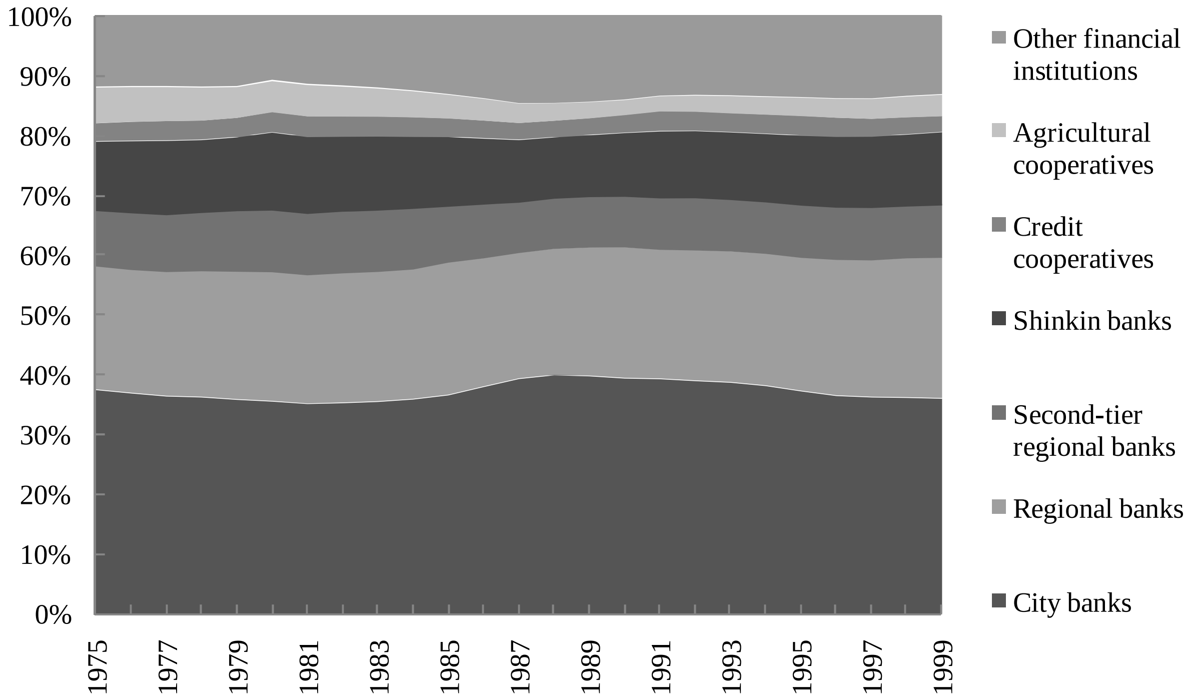

Figure 2: Herd parameters of the Japanese financial institutions by using growth rates of variables

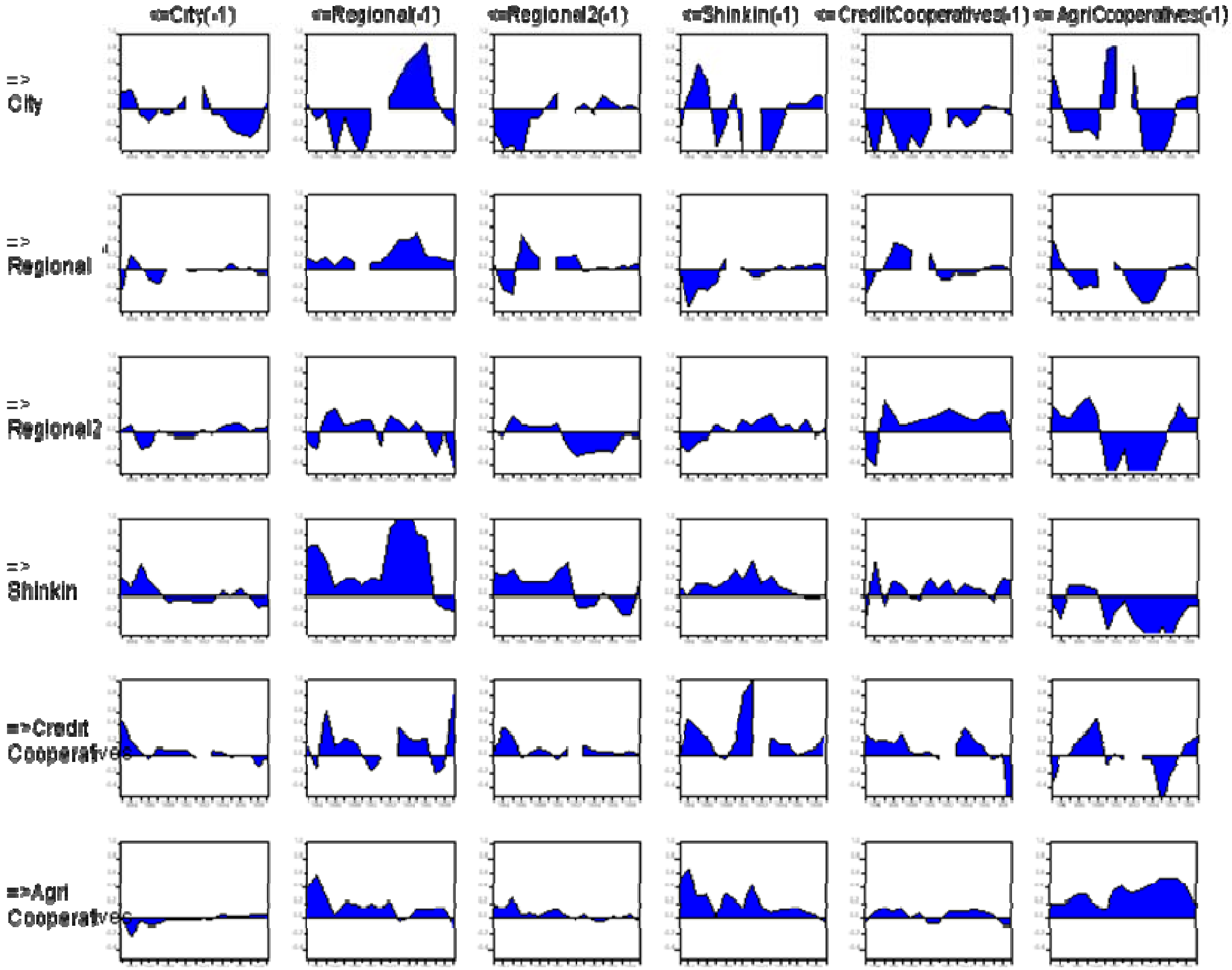

Table 1: A comparison between herding (positive coefficients) and competing (negative coefficients)

year	Herding # of posoitive coefficients (a)	Competing # of negaitive coefficients (b)	Difference (a) - (b)
1979-1983	9	5	4
1980-1984	12	8	4
1981-1985	12	5	7
1982-1986	14	8	6
1983-1987	15	2	13
1984-1988	13	4	9
1985-1989	9	6	3
1986-1990	14	4	10
1987-1991	7	3	4
1988-1992	9	5	4
1989-1993	9	7	2
1990-1994	7	7	0
1991-1995	11	5	6
1992-1996	8	3	5
1993-1997	5	3	2
1994-1998	12	5	7
1995-1999	8	4	4

Table 2: The impact of herd behavior on GDP based on the rate of change

Panel A: Regression results by using *HerdBehavior1*

	Model (4)'			Model (5)		
Variable	Coefficient	(t-Statistic)		Coefficient	(t-Statistic)	
$HerdBehavior_{t}$	0.039	(4.17)	***	0.123	(7.12)	***
$HerdBehavior_{t-1}$	-0.137	-(9.84)	***	-0.234	-(14.20)	***
$HerdBehavior_{t-2}$	-0.290	-(24.62)	***	-0.592	-(21.40)	***
$HerdBehavior_{t-3}$	-0.076	-(2.98)	***	-0.107	-(3.60)	***
$HerdBehavior_{t-4}$	0.196	(17.87)	***	0.485	(12.21)	***
$HerdBehavior_{t-5}$	0.280	(14.10)	***	0.704	(15.01)	***

Note: *** indicates statistical significance at the 1% level.

Panel B: Regression results by using *HerdBehavior2*

	Model (4)'			Model (5)		
Variable	Coefficient	(t-Statistic)		Coefficient	(t-Statistic)	
$HerdBehavior_{t}$	0.212	(19.73)	***	0.552	(43.31)	***
$HerdBehavior_{t-1}$	-0.164	-(10.89)	***	-0.015	-(0.74)	
$HerdBehavior_{t-2}$	-0.240	-(9.67)	***	-	-	
$HerdBehavior_{t-3}$	0.119	(6.98)	***	0.448	(22.00)	***
$HerdBehavior_{t-4}$	0.337	(10.56)	***	0.629	(12.04)	***
$HerdBehavior_{t-5}$	0.009	(0.53)		-0.608	-(35.06)	***

Note: 1. *** indicates statistical significance at the 1% level.

2. Model (5) cannot be estimated for $HerdBehavior_{t-2}$ due to multicollinearity.

Table 3: The impact of herd behavior on land prices based on the rate of change

Panel A: Regression results by using *HerdBehavior1*

Variable	Model (4)' Coefficient	(t-Statistic)		Model (5) Coefficient	(t-Statistic)	
$HerdBehavior_{t}$	-0.159	-(13.99)	***	-1.177	-(35.50)	***
$HerdBehavior_{t-1}$	-0.417	-(43.43)	***	-1.136	-(71.55)	***
$HerdBehavior_{t-2}$	-0.351	-(83.20)	***	-1.204	-(74.33)	***
$HerdBehavior_{t-3}$	-0.171	-(13.72)	***	-0.489	-(20.04)	***
$HerdBehavior_{t-4}$	-0.399	-(16.81)	***	-0.006	-(0.15)	
$HerdBehavior_{t-5}$	-0.013	-(0.26)		1.041	(20.83)	***

Note: *** indicates statistical significance at the 1% level.

Panel B: Regression results by using *HerdBehavior 2*

Variable	Model (4)' Coefficient	(t-Statistic)		Model (5) Coefficient	(t-Statistic)	
$HerdBehavior_{t}$	-0.218	-(4.57)	***	-1.394	-(16.93)	***
$HerdBehavior_{t-1}$	-0.187	-(11.95)	***	-1.295	-(24.07)	***
$HerdBehavior_{t-2}$	-0.251	-(24.04)	***	-2.005	-(24.02)	***
$HerdBehavior_{t-3}$	0.634	(11.71)	***	2.524	(18.58)	***
$HerdBehavior_{t-4}$	-0.693	-(11.42)	***	-0.707	-(7.05)	***
$HerdBehavior_{t-5}$	-0.072	-(0.56)		1.326	(22.29)	***

Note: *** indicates statistical significance at the 1% level.

Table 4: The impact of simply aggregated loans on GDP and land prices

	GDP			Land prices		
Variable	Coefficient	(t-Statistic)		Coefficient	(t-Statistic)	
ΣL_t	0.599	(170.65)	***	1.355	(69.06)	***
ΣL_{t-1}	0.081	(11.90)	***	-0.341	-(24.62)	***
ΣL_{t-2}	-0.077	-(11.80)	***	-0.746	-(54.39)	***
ΣL_{t-3}	0.012	(1.90)	*	-0.679	-(66.95)	***
ΣL_{t-4}	0.059	(10.16)	***	-1.331	-(116.26)	***
ΣL_{t-5}	0.289	(31.48)	***	-0.574	-(25.88)	***

Note: *** indicates statistical significance at the 1% level.

Table 5: The impact of ordinary loans on GDP and land prices

Panel A: The impact of ordinary loans on GDP

	HerdBehavior1			*HerdBehavior2*		
Variable	Coefficient	(t-Statistic)		Coefficient	(t-Statistic)	
$d\ \Sigma L_t$ -$HerdBehavior_t$	0.387	(38.88)	***	0.446	(83.35)	***
$d\ \Sigma L_{t-1}$ -$HerdBehavior_{t-1}$	0.122	(7.18)	***	0.121	(10.11)	***
$d\ \Sigma L_{t-2}$ -$HerdBehavior_{t-2}$	0.079	(5.72)	***	-0.004	-(0.47)	
$d\ \Sigma L_{t-3}$ -$HerdBehavior_{t-3}$	0.039	(4.66)	***	-0.017	-(3.32)	***
$d\ \Sigma L_{t-4}$ -$HerdBehavior_{t-4}$	-0.031	-(5.65)	***	-0.031	-(7.40)	***
$d\ \Sigma L_{t-5}$ -$HerdBehavior_{t-5}$	0.155	(12.70)	***	0.311	(29.76)	***

Note: *** indicates statistical significance at the 1% level.

Panel B: The impact of ordinary loans on land prices

	HerdBehavior1			*HerdBehavior2*		
Variable	Coefficient	(t-Statistic)		Coefficient	(t-Statistic)	
$d\ \Sigma L_t$ -$HerdBehavior_t$	0.843	(79.89)	***	-	-	
$d\ \Sigma L_{t-1}$ -$HerdBehavior_{t-1}$	0.058	(8.20)	***	-0.128	-(10.04)	***
$d\ \Sigma L_{t-2}$ -$HerdBehavior_{t-2}$	-0.345	-(28.17)	***	-0.591	-(21.34)	***
$d\ \Sigma L_{t-3}$ -$HerdBehavior_{t-3}$	-0.579	-(65.64)	***	-0.868	-(62.70)	***
$d\ \Sigma L_{t-4}$ -$HerdBehavior_{t-4}$	-1.005	-(88.64)	***	-1.171	-(72.80)	***
$d\ \Sigma L_{t-5}$ -$HerdBehavior_{t-5}$	-0.516	-(18.78)	***	-0.497	-(23.03)	***

Note: 1. *** indicates statistical significance at the 1% level.

2. Model (6) cannot be estimnated for $HerdBehavior_{t-2}$ due to multicollinearity.

Table 6: The impact of herd behavior by using *HerdBehavior3*

Panel A: The impact on GDP

Variable	Model (4)' Coefficient	(t-Statistic)		Model (5) Coefficient	(t-Statistic)	
$HerdBehavior_{t}$	0.339	(27.07)	***	0.957	(23.48)	***
$HerdBehavior_{t-1}$	-0.206	-(19.41)	***	-0.292	-(22.94)	***
$HerdBehavior_{t-2}$	-0.417	-(30.79)	***	-0.400	-(13.76)	***
$HerdBehavior_{t-3}$	-0.038	-(2.64)	***	-0.145	-(5.70)	***
$HerdBehavior_{t-4}$	0.269	(20.43)	***	0.570	(21.78)	***
$HerdBehavior_{t-5}$	0.338	(24.60)	***	0.714	(13.51)	***

Note: *** indicates statistical significance at the 1% level.

Panel B: The impact on land prices

Variable	Model (4)' Coefficient	(t-Statistic)		Model (5) Coefficient	(t-Statistic)	
$HerdBehavior_{t}$	1.326	(42.00)	***	2.943	(50.13)	***
$HerdBehavior_{t-1}$	0.814	(28.90)	***	0.738	(11.98)	***
$HerdBehavior_{t-2}$	-0.235	-(19.77)	***	-1.903	-(15.91)	***
$HerdBehavior_{t-3}$	-0.252	-(15.64)	***	-1.526	-(54.86)	***
$HerdBehavior_{t-4}$	-0.995	-(39.16)	***	-2.769	-(26.86)	***
$HerdBehavior_{t-5}$	-0.690	-(31.79)	***	-0.056	-(0.73)	

Note: *** indicates statistical significance at the 1% level.

Panel C: The impact of ordinary loans on GDP and land prices by using *HerdBehavior3*

Variable	GDP Coefficient	(t-Statistic)		Land prices Coefficient	(t-Statistic)	
$d\,\Sigma L_{t}$-$HerdBehavior_{t}$	0.358	(30.61)	***	0.362	(29.77)	***
$d\,\Sigma L_{t-1}$-$HerdBehavior_{t-1}$	-0.719	-(59.80)	***	0.177	(11.54)	***
$d\,\Sigma L_{t-2}$-$HerdBehavior_{t-2}$	-0.565	-(16.29)	***	0.148	(6.49)	***
$d\,\Sigma L_{t-3}$-$HerdBehavior_{t-3}$	-0.864	-(44.29)	***	0.071	(9.08)	***
$d\,\Sigma L_{t-4}$-$HerdBehavior_{t-4}$	-1.170	-(83.60)	***	-0.177	-(21.84)	***
$d\,\Sigma L_{t-5}$-$HerdBehavior_{t-5}$	-0.239	-(10.32)	***	0.251	(29.25)	***

Note: ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.