

Empirical Estimation of Banks' Herding in the Korean Loan Markets

Jong-Ku Kang*

Abstract

This paper presents an improved index for measuring the intensity of herding. The index presented in this paper is able to measure the intensity of an individual economic agent's herding and it conforms to the economic definition of herding. The results of measuring Korean banks' herding using the index show that the intensity of banks' herding in the household loan market was high from late 2002 to early 2003 and that in the SME loan market was high around early 2004 and late 2006. These days, however, the herding indexes for both these loan markets are on the decrease.

Next, the results of empirical estimations that use the intensity of each bank's herding as an dependent variable, and the proxies of the factors affecting banks' herding as independent variables, reveal that a bank with smaller amount of information is more likely to herd. And a bank that attaches less importance to liquidity or has a lower loan market share tends to herd greatly. It is also found that variables indicating the level of business activity or loan market structure can explain changes in the intensity of herding: the higher is the MI/Lf ratio, the severity of competition among banks, or loan market concentration, the greater the intensity of herding.

JEL Classification Number: G14, G21, G10

Keywords: Herding, Bank loan, Financial stability

* Microeconomics Studies Team, The Bank of Korea (E-mail: jongku@bok.or.kr)

This paper is the translated version of the paper from 「Economic Analysis」 Vol.16 No.1 in 2010.

I. Introduction

Herd behavior on the part of economic agents is frequently observed in financial markets around the world nowadays, generating sharp volatility in stock prices and interest rates and a decline in macroeconomic stability. Herding arises in financial markets largely because economic agents, having insufficient information on the markets, strive to acquire information by observing the behavior of other economic agents.

The frequency and intensity of such herding seem more pronounced than in the past in line with the acceleration of globalization and financial liberalization. For instance, financial institutions' reckless mortgage lending, which generated the subprime mortgage crisis, stemmed from excessive herd behavior. For Korea, which has in the recent past been characterized by the low degree of transparency of information, massive in-and outflows of foreign capital, heavy dependency on external markets and dramatic institutional changes in finance have resulted in sharp portfolio shifts among financial markets and instruments along with high asset price volatility, herding seems to occur more frequently than in advanced markets. Private investors in the Korean stock market showed herd-like behavior during bull markets. And the competition among credit card companies to increase their credit card lending in 2002 also originated from herding. Between 2006 and 2007, the significant rise in lending to small and medium sized companies is known to be also attributable to banks' herding behavior.

Herding occurs when some economic agents observe and follow other economic agents. This phenomenon arises while individual economic agents maximize their utility. However, it evolves into a problem when this causes side effect for an entire economy. Herd behavior by certain agents does not just weaken asset soundness but also brings about financing imbalances among sectors in every period, which worsens the stability of the financial system and the efficiency of resource distribution. Furthermore, a marked intensification of the pattern of the herd behavior of financial institutions and the household sector could trigger prolonged financial instability and recession in the real economy. When the capital requirement regulation considering each borrower's credit rating is fully implemented, herding behavior could pick up still further in accordance with the expanded pro-cyclicality. In addition, once the Capital Market Consolidation Act is brought into effect, the market size of investable financial instruments would expand, and this would worsen the damage brought

about by herd behavior. In this regard, it is necessary for us to understand the process and the causes of herd behavior.

Notably, as banks play an integral part as financial intermediaries, worsening of bank asset quality induced by the adverse effect of herding could weaken their function as financial intermediaries and exercise seriously negative effects on the real economy. Considering all these points, it is important to analyze the herd behavior of banks. As banks' lending to SMEs and households is more likely to increase the possibility of banks' herd-like behavior and the souring of such loans than that of the other sector, we need to carefully investigate and respond to the herding of banks' lending to the SMEs and households.

For the empirical analysis of herding, intensity of herding should be measured first. Much of the existing literature uses indices measuring herding intensity for the entire market but few studies use indices that measure the herding intensity of individual economic agents. Even the existing indices have limitations in that they do not measure intensity in accordance with an economic definition of herding behavior. In this regard, this paper provides an index which measures the herding intensity of individual economic agents in conjunction with the economic definition of herding in Section II.

And using this index, I measure the herding intensity in bank lending in accordance with the type of lending. According to the measurement results of banks' lending to households exhibits high herding intensity between the end of 2002 and early 2003 while, in the case of lending to SMEs, herding was greatly intensified between the first quarter of 2004 and the third quarter of 2006. Lately, though, the intensity of herding behavior seems to have weakened across the board. In Section III, I conduct an empirical analysis by setting the herding intensity of banks and the factors affecting the herding as a dependent variable and explanatory variables, respectively, covering the period since the Asian currency crisis. Based on the analysis, certain policy implications are set out in Section IV.

II. Measurement of Herding Intensity

1. Definition of Herding

Hirshleifer and Teoh (2003) define herding as “the similarity of behaviors resulting from interaction among economic agents” and Bikhchandani and Sharma (2000) point out it is herd behavior when individual economic agents make similar choices after observing others’ behaviors. Devenow and Welch (1996) define it as “a behavior pattern correlated across individual agents” and according to these literature, herding is defined as the process that each economic agents influenced by other follow them. And herding occurs sequentially as economic agents respond to the behavior of other agents.

One of the primary reasons for herding is the ‘flow of information.’ Additionally, ‘the reward system’ and ‘the externality of rewarding’ also affect herding. When economic agents have insufficient information or are not capable of analyzing information, they refer to and imitate the behaviors of other economic agents. As economic agents experience difficulties in observing information held by other economic agents, they estimate this information by observing the behavior of these other agents. When economic agents have much less information than others, they may choose to ignore the information they do hold and simply follow others after observing latter’s behavior.

Herding related to information flow among economic agents was analyzed first by Bikhchandani, Hirshleifer and Welch (1992) and Banerjee (1992). Later, Ellison and Fudenberg (1993) constructed and analyzed a model where economic agents behave irrationally. Zhang (1997) examines herd behavior using a model where the order of action is determined endogenously. Avery and Zemsky (1998) carry out an analysis about the process of herding in case the expected rate of return varies depending on economic agents’ behavior. Lee (1998) establishes a model where the existence of transaction costs blocks the flow of information temporarily. Smith and Sørensen (2000) conduct an analysis assuming the continuity of signals and the heterogeneity of preferences among investors.¹⁾

The herding caused by the reward structure was analyzed first by Scharfstein and Stein (1990). According to them, it is difficult for a principal to evaluate the

1) Please refer to Hirshleifer and Teoh (2003) for the survey related to the existing theoretical analyses and Bikhchandani and Sharma (2000) for the one related to empirical analysis.

ability of an agent, he/she evaluates the agent based on the performance of other agents who are engaged in the same business, and this leads the agent having a risk-averse utility function to follow the behavior of other agents in order to narrow the gaps in their rewards across different circumstances. Rajan (1994) also points out an example of bank managers who tend to imitate other banks' behavior by accumulating a lesser amount of loan loss provisions in order to avoid criticism. Herding stemming from the reward structure also arises in other cases. For instance, when some financial institutions expand their lending to corporations, these corporations may increase their purchases from other corporations. If this is the case, then in line with their improved profitability, these other corporations are able to borrow more from the financial institutions they do business with. For another example, the expansion of mortgage lending by banks is likely to increase real estate prices. If this indeed happens, other banks may expand mortgage lending following the bank, expecting the value of the mortgage collateral to rise.

2. Existing Literatures about measurement of the Herding Intensity

A. LSV Method

For empirical analysis of herding, it is necessary for us to measure the herding intensity. The existing literature uses the LSV method, the PCM method and others in measuring herding intensity. LSV, developed by Lakonishok, Shleifer and Vishny (LSV, 1992), measures the intensity by using the ratio of agents who bought or sold stocks among a certain investor group. In LSV (1992), equity-type fund data for the years between 1985 and 1989 are used in order to estimate whether herding took place among fund managers. The study shows that there had been no obvious herd behavior. Since this studies, many other ones use LSV in measuring the herding intensity in stock markets.

Although LSV has an advantage in measuring the herding intensity more easily than other methods do, it has the following limitations. First, in LSV method, the herding intensity is determined by the numbers of investors buying or selling stocks for a certain period. In reality, however, the fluctuation in stock markets is determined by the size of buying or selling rather than numbers of buyers or sellers, and this could make LSV index differ from the fluctuation in stock markets (Bikhchandani and Sharma, 2000). Second, using LSV index, it is

impossible to measure the herding resulting from the interaction among economic agents. This is because LSV index appears higher even if investors respond to common information. Third, although it is possible to measure the herding intensity among investors within a certain group by using this index, it is impossible to measure the herding intensity for an entire stock market. In respect of an entire stock market, sellers exist whenever there are buyers, which makes it impossible to figure out toward which direction herding occurred only by using LSV method.

Uchida and Nakagawa (2007) measure, by using LSV method, the herding intensity in bank lending market. This study derives LSV index, that is the ratio of a number of bank who expanded or reduced lending, make it regress by using the factors affecting bank lending such as GDP and land prices as explanatory variables and regard the residual as herding index. As the LSV method measures the herding intensity on the basis of numbers of banks in bank lending market, it has all the limitations the LSV presents with the exception of the fourth. Meanwhile, Uchida and Nakagawa (2007) set the time lag of the explanatory variable as identical with that of the dependent variable. This causes an endogeneity problem in which the variation of dependent variable may affect the explanatory variable. That is, the effects of changes in the LSV index on the explanatory variables as the LSV index rises, the effects of explanatory variables such as GDP and land prices are reflected in the estimated coefficient.

B. PCM Method

Wermer (1995) develops a method of measuring herding intensity by using a time lagged correlation, which is known as the Portfolio Change Measure (Bikhchandani and Sharma (2001)). This method was introduced in order to measure whether there is herding within a certain investor group such as mutual fund managers. The PCM method divides investors into two groups in a randomized way and fund managers divides to derive the time lag correlation between the portfolio changes of the two groups. Deriving the time lag correlation by reiterated division of groups and using this average of the derived time lag correlation coefficient make it possible to examine whether there is herding among investors. The PCM method seeks to measure herding intensity by using the correlation of the proportions of assets among agents, which solves the first problem of the LSV. It goes on to tackle the second limitation of LSV through its use of a time lag correlation. However, the PCM does not eliminate the third and fourth limitations of LSV.

The PCM method, in spite of its merits, has the following problems. First, as it derives the correlation among changes in portfolios, it cannot be used in measuring herding intensity for individual agents. Second, if there is an agent that increases a certain class of assets, there also exists an agent that decreases its own holdings of those assets. Thus, even if it is possible to measure the herding intensity of a certain group, it is impossible to measure herding for an entire stock market simply by using the PCM. Third, when the price of a certain stock is on the rise without much trading, the weight of the corresponding stock in the various portfolios rises simultaneously or after some time lag, which could make it seem like herding. (Bikhchandani and Sharma (2001)). Fourth, by examining the correlation among changes in portfolio asset weights between two periods, PCM measures the herding intensity for the corresponding periods, and this could generate serious measurement errors because of the irregularities of times series data. Fifth, the PCM index is calculated only when the data on the detail asset portfolios of many individual investors are available. As the PCM method faces a large number of problems, few studies use it for their empirical analysis (Uchida and Nakagawa (2007)).

C. Other Methods

Jain and Gupta (1987) conduct the analysis of the lending behavior of U.S. banks. They measure the extent to which a bank in a certain group of banks follows other group, by using the Granger causality coefficient their method involves measuring the herding caused by interaction, in that it examines whether a group follows other group after a certain time lag. However, although it is possible to measure the average herding intensity for a certain group during a certain period by using this method, it is impossible to measure the herding intensity of individual agents and how the intensity change over periods.

Chirstie and Huang (1995) and Nofsinger and Sias (1999) both measure herd behavior using stock returns. Based on the fact that, when there is no herding within a stock market, the correlations among returns on individual stocks are low, they consider that the herding intensity to be high when returns on individual stocks approach the average return on all stocks. However, when an external shock occurs affecting the entire market, most stock prices are likely to fluctuate in the same direction. For this reason, it is difficult to measure the herding resulting from the interaction among agents by using this method.

Graham (1999) analyzes the herding of investor newsletters. He selects a certain newsletter which is the leader in a certain market, measures the herding

of other newsletters by using the extent to which the content of other “newsletters” resembles this leading investor newsletter. He confirms that the herding of other newsletters intensifies in line with the lower ability of analysts, the greater uncertainty of information and the higher obsession over reputation. This study by Graham (1999) is considered the only one that verifies theories about herding in an empirical way (Bikhchandani and Sharma (2000)).

There are many studies about trading behaviors of investors in the Korean stock market around the time of the Asian Currency Crisis, Kim and Wei (1999) use the history of monthly stock ownership of economic agents in order to analyze the stock trading behavior of the corresponding investors. After measuring herding intensity using the LSV index, they conclude that non-residents and individual investors are more likely to herd than residents and institutional investors.

3. New Herding Index and the Herding Intensity in Bank Lending

A. Derivation of Herding Index and its Characteristics

As already seen above, the indexes in some of existing literature measure herding in an entire market. However, there is no index measuring the herding of individual economic agents except one used by Graham (1999). In regard to the market of newsletters for investors, which are analyzed by Graham (1999), the evident leading newsletter in a market is predetermined and agents’ optional behavior are just to follow or not to follow the leader, which make it difficult for us to apply the methods to other sectors such as bank lending. Furthermore, the previous herding indexes including Garaham (1999) present several limitations in that they lack theoretical conformity. In this study, I suggest a new herding index which makes it possible for us to measure the herding intensity of individual economic agents including banks.

Herding implies economic agents follow the behaviors of other economic agents, without making independent decisions based on their own information and judgment (Bikhchandani and Sharma (2001)). This can be interpreted as meaning that, when economic agents show behavior similar to that of other agents after some time lag, herding occurs with some time lag after the former’s observation of the behavior of the latter. Therefore, we can measure the intensity of herding for individual banks using time lag covrelation. That is, the herding index of bank i ($HI_{t,t+k}^i$) for the period of $k+1$, which is between t and $t+k$, is

derived by the following time lag correlation coefficient.

$$HI_{t,t+k}^i = \frac{\sum_{j=0}^k (\Delta L_{t+j-1}^m - \Delta L_{t-1,t+k-1}^{mA}) (\Delta L_{t+j}^i - \Delta L_{t,t+k}^{iA})}{\sigma_{t-1,t+k-1}^m \sigma_{t,t+k}^i} \quad (1)$$

* where ΔL_{t+j-1}^m denotes the average growth rate of whole banking sector's lending at period $t+j-1$, $\Delta L_{t-1,t+k-1}^{mA}$ and $\sigma_{t-1,t+k-1}^m$ the average and standard deviation of ΔL_{t+j-1}^m , respectively between $t-1$ and $t+k-1$, ΔL_{t+j}^i growth rate of bank i 's lending at period $t+j$ and, $\Delta L_{t,t+k}^{iA}$ and $\sigma_{t,t+k}^i$ the average and standard deviation of ΔL_{t+j}^i , respectively between t and $t+k$

I look into the difference between the herding index of equation (1) and existing indexes. The herding index in this study is similar to PCM method in that it derives herd behavior using time lag correlation coefficient.²⁾ By using time lag correlation coefficient in this study, the first and the second problems of LSV method are solved. And unlike the LSV and PCM that measure average herding of a certain group is measured, this study measure herding of individual economic agents, and this addresses the third and first problems of LSV and PCM, respectively. In addition, the fourth problems of LSV and the second and the third problems of PCM that might occur in stock market, do not affect this study as the latter analyzes bank lending. Not only that, this study derives correlation across several periods rather than between two periods in order to substantially reduce the noise caused by irregularity of times series. Therefore, the fourth problems of PCM is tackled in this paper. This study is not required to collect the data on the asset portfolio of individual economic agents because it analyze the herding of bank lending. Thus, the fifth problems of PCM index does not matter in this study.

B. Trend of Herd Behavior of Bank Lending in Korea

By using the herding index obtained above, I derive the herding indexes for all individual banks' lending activity, and the average herding index of whole

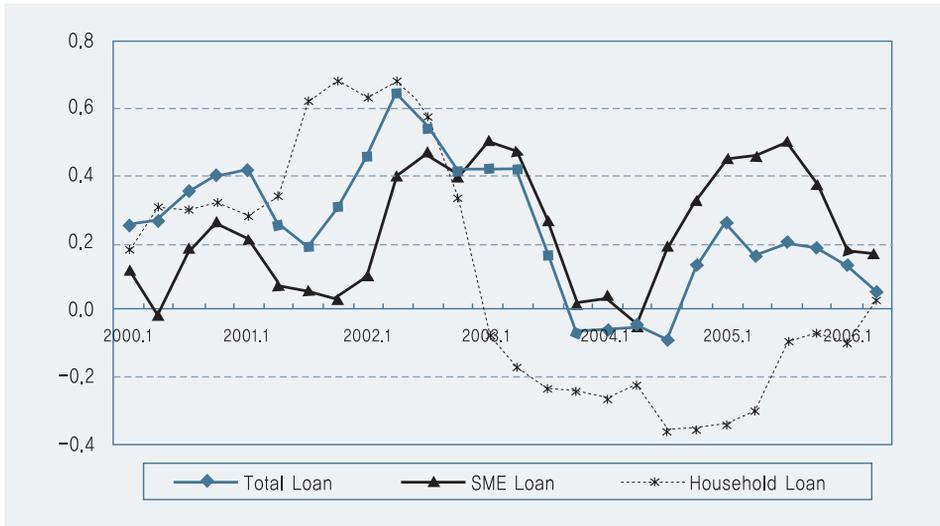
2) When we use simple correlation coefficient instead of time lag correlation coefficient for the corresponding period, the coefficients not just for the banks who follow others but also the bank who leads market could appear high. For this reason, it is difficult for us to measure herding of individual banks accurately using simple correlation coefficient as defined in section II.

banking sector for each of lending markets by averaging the indexes, which is displayed in <Figure 1>. In this figure, herding index at a certain period implies the average herding intensity, which consists of current period and the previous 7 periods.³⁾ The herding index for household lending exceeds 0.6 during the period between the third quarter of 2001 and the third quarter of 2003. This implies that herding in the household lending market between the third quarter of 2002 and the third quarter of 2003 has been highly intensified.⁴⁾ This seems to stem from the fact that financial institutions in Korea sharply expanded their lending to households as Korean government has eased regulation on housing loan and taken policy to encourage credit card use in order to stimulate domestic economic activity. On the other hand, the occurrence of highly intensified herding exceeding 0.6 in terms of its index in the lending to household market, brought about side effects of radically increasing delinquency in household lending.

3) To use 8-periods average herding index is most reliable in terms of its explanatory variables' explanatory power in the empirical analysis of section III. The result of empirical analysis using average herding index for 7 periods is similar to the result using the index for 8 period but the explanatory variables from empirical analysis for 9 periods were less significant than those for 8 periods (please refer to <Table 2> and <Appendix 2>). The data show that although the correlation between average herding indexes of banks for 7 periods and 8 periods appeared high, that between the indexes for 8 periods and 9 periods was not so high. This could happen when banks' internal decision making and their lending behavior tend to fundamentally change after two years.

4) As herding index for a specific period represents the average herding intensity for 8 quarters since that period, the herding index for a specific period represents the average herding intensity of previous and later 4 quarters and on a basis of that period.

Figure 1 Changes in the herding intensity of all commercial banks ($HI_{i,t+7}^A$)



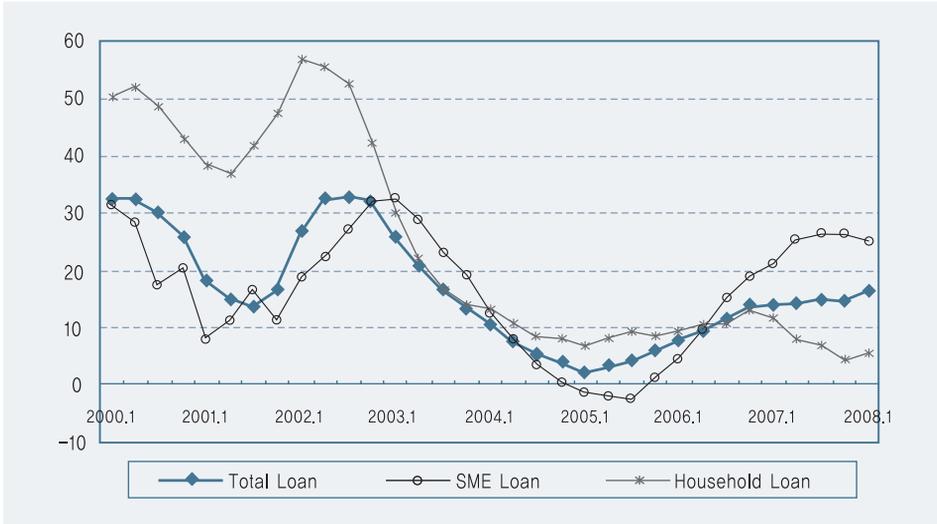
* The herding intensity of all commercial banks for period t to t+7 ($HI_{i,t+7}^A$) is derived from $HI_{i,t+7}^A = (1/N) \sum_{i=1}^N HI_{i,t+7}^i$, where N is the number of all banks.

The herding indexes of lending to SME remain high around the first quarter of 2003 and the third quarter of 2005. This implies the herding of lending to SMEs was greatly intensified around the first quarter of 2004 and the third quarter of 2006. But the herding index, nevertheless, does not exceed 0.5. Meanwhile, historic data indicate that delinquencies on SME loans did not increase dramatically following the occurrence of herding.⁵⁾

5) There is no sign of growth in delinquency rate in commercial banks' lending to SMEs since the herding in SMEs loan market was intensified

The rate of late-payment in SME loan by the commercial banks

quarter	'04.1	'04.2	'04.3	'04.4	'06.3	'06.4	'07.1	'07.2
rates	2.97	2.43	2.64	2.34	1.6	1.22	1.3	1.07

Figure 2 Rates of increase in commercial bank loans

Note: The rates are obtained by being compared to the same quarter of the previous year.

Source: Korea Financial Supervisory Service Database

III. Empirical Analysis of the Causes of Herding in Bank Lending

1. Previous Empirical Analyses

It is difficult to find any previous studies about the causes affecting the herding of bank lending. Uchida and Nakagawa (2007) measure herding intensity using LSV method. However, it is only for examining the trends of herding intensity of bank lending for each of periods, not for analyzing the factors that affect herding. Granham (1999) is the only one about the factors affecting herding. However, it is based on the herding of investor newsletters. The leading newsletter is perceived in advance in Granham (1999)'s study and the optional behavior of the newsletters are just simplified as two: to follow or not to follow the leader. For this case, it is easy to grasp the intensity that the other newsletters follow the leading one without using the herding index. For the lending market of Korean bank, there exists no surely leading bank and even if there is, that bank could be replaced with others over times. Not only that, as banks decide the size of their lending, their numbers of options the banks could have are

unlimited as they may increase their size of lending by 2% or 2.3% etc. For this reason, I utilize the herding index derived in Section II for empirical analysis of the factors which cause herding in bank lending market in Korea.

2. Causes of Herding and Explanatory Variables

As the purpose of this subsection is to analyze the factors intensifying herding in bank lending, I discuss the factors generating the herding first, and then seek the explanatory variables for the empirical analysis. The herding intensity of individual banks can differ depending on the characteristics of individual banks, and market structure and macroeconomic factors.

A. Characteristics of Individual Economic Agents

(1) Amounts of Information

If economic agents can anticipate the rise or fall in future asset prices using the information they hold, they behave based on their own information without observing the others. However, if they undergo difficulties in predicting the future change because of their insufficient information, they strive to refer to the information held by others. Because economic agents cannot directly observe the information of others, they estimate those information based on the behavior of others (Hirshleifer and Teoh (2003)). The less sufficient information economic agents hold, the more highly likely it is for them to follow others. Regarding this, Zhang (1997) conducts analysis of the model where the order of investors' behavior is determined endogenously, arguing that the investors having less information are more likely to follow the others.

Applying this analytical results to banking industry, the results indicate that, when the banks with low capacity to produce information, have difficulties in making decision by using the information they hold, they are highly likely to herd. Generally banks who are conducting a variety of business activities besides lending, could not have sufficient capacity to produce information about lending, as their resources are diversified into other business (Burger and Udell (1996)). Not only that, the more capacity to produce information banks have, the more likely the banks are to expand their credit lending rather than to expand secured loan and collateral loan. In this regard, we can use 「interest income/total revenue」 and 「credit lending/total lending」 ratios as variables representing banks' capacity to produce information (Hahm (2008)). This implies that the higher the ratios of 「interest income/total revenue」 and 「credit lending/total

lending, the lower possibility of herding. Meanwhile, if banks have low capacity to produce information about borrowers, it is expected that the banks have more non-performing loans. Giving consideration to this, I use 「non-performing loan to total loan」 ratio as an additional explanatory variable representing information production capacity.

(2) Emphasis on short-term profit

When economic agents put their emphasis on short-term profit, their herd behavior could be intensified. Several price variables in a financial market such as interest rates, stock prices, exchange rates, change depending on economic fundamentals. From a short-term perspective, however, these variables move in line with the expectation of market participants and short-term liquidity within financial markets rather than economic fundamentals. Change in economic fundamentals are estimated based on market indicators or data. However, the market participants' expectations for fluctuation in asset prices can be estimated by observing what behaviors market participants take. This means that, when economic agents pursue short-term profits, it can be a reasonable choice for them to invest based on the behaviors of other market participants. Froot, Scharfstein and Stein (1992) point out that such behaviors generate herding among market participants.

When banks pursue long-term profits, they tend to secure adequate equity capital in order to prevent their failure and exit from the market which could be caused by a sudden deterioration in management conditions. Therefore, the extent to which banks emphasize their long-term profits can be measured via the capital adequacy ratio. As the banks having low capital adequacy ratios are likely to focus more on short-term profits, they are expected to generally show herd behavior.

(3) Emphasis on Stability of Business

The financial institutions who put their priority on business stability are expected not to expand their risky assets easily when other institutions expand the assets during economic boom. At a time other banks decrease their investment on risky assets due to the growing possibility of deterioration of risky assets, the financial institutions having maintained high share of safe assets because of their priority on business management stability, would not reduce their asset size so significantly, because they have low possibility of bankruptcy. This implies the banks emphasizing their management stability are highly

unlikely to follow the behavior of other banks.

As the banks putting more emphasis on their business stability are expected to secure more safe assets, they would hold higher share of safe securities among their total securities. That is, high ratio of 「safe securities/total securities」 of banks implies that the banks put their priorities on safe management and are less likely to show herd behavior.

(4) Market Dominance

As financial institutions with very strong market dominance tend to cause great externality of rewards, institutions with low market power are highly likely to follow the former. For instance, bank A's lending to corporation a will bring about the externality that corporation b, which has trade relationship with corporation a⁶⁾, can make greater earning, and consequently bank B, which does business with corporation b, can expand its lending to corporation b. In this way, similarly, many banks will expand their lending to corporations. This is another example in the real estate lending market. If an expansion in real estate mortgage lending by a certain bank results in a rise in demand for real estate, this leads to a run-up in real estate prices and the collateral value of real estate. Consequently, other banks may show herd behavior in expanding their real estate mortgage lending. Meanwhile, when corporate revenues are under strain or the value of the assets decline, banks could exhibit herd behavior in excessively contracting their lending as they scramble to collect their loans.

As an increase in lending by small-sized banks does not have a large externality effect, other banks will not follow the former. However, if large banks having massive assets expand their lending, this will trigger great externality, raising the possibility that other small-sized banks will follow them. This implies that the banks with a low market presence in a lending market are highly likely to follow the banks that have a high degree of market dominance. Consequently, those banks that have a low ratio of 「individual bank lending/total bank lending」 are expected to frequently exhibit herd behavior.

6) When banks expand lending to the corporations who purchase intermediate goods, demand for intermediate goods also would rise, leading to increase credit rating for the corporations. On the other hand, expanded lending to corporations who sell intermediate goods, would raise their efficiency in production, which makes the corporation who purchase intermediate goods can buy the goods at cheap prices, leading to rise in credit rating for the latter.

B. Market Structural and Macroeconomic Factors

(1) Loan Maturity

The shorter loan maturities are, the more flexibly financial corporations can adjust the scale of their total loan. Thus, shortening loan maturities may result in more intensified herding in lending. When maturities between assets and liabilities are mismatched, this may exacerbate losses due to the risks of interest rate and liquidity fluctuations. Considering this, financial corporations make adjustments to avoid any widening of the maturity mismatch between assets and liabilities. This implies that a shortening of deposit maturities leads to a shortening of loan maturities. When financial institutions have higher proportions of short-term deposits among their total deposits, the maturity of loans may decrease, intensifying herding in lending. The higher the ratio of 「M1/Lf」, the proxy indicator measuring the ratio of short-term liability to total liability increase, the greater intensification of herding in bank lending is expected.⁷⁾

(2) Intensified Competition among Banks

When competition among economic agents to increase their market share becomes intensified, the aggressive operations of one economic agent could provoke an active response from others. For instance, if a financial corporation expands its assets significantly, other corporations that have observed this expansion could increase their assets in order to avoid a decrease in their market shares. When financial corporations are in competition to expand their market shares, they tend to tolerate short-term losses and raise their assets, which causes a dramatic increase in assets held by financial corporations, and this could in turn reduce the soundness of their assets. Similarly, in the U.S. extremely fierce competition among financial corporations was one of the culprits in exacerbation of soundness on subprime mortgage loans. The more intense the competition among banks to make loans is, the further the spread between deposit and lending interest rate narrows. As a consequence, it is expected that a decrease (increase) in the spread between 「loan interest rate and deposit interest rate」 will generate intensified (reduced) herding in bank lending.

7) I use M1/Lf ratio because it is difficult to find the indicators which measure directly the extent of the increase in short-term of loan or deposit maturities for individual financial institution.

(3) Structure of Banking Sector

Since the Asian Financial Crisis, banks have consolidated via mergers and acquisitions, and the number of banks has decreased along with growing market concentration in the banking sector. It can be said that such structural changes in the banking industry have affected the occurrence of herding. When consolidated banks expand their lending beyond their existing specialized customers or communities to a variety of classes and communities, they come to have almost the same customer base as other banks do. In the course of this process, banks tend to expand transactional lending, in which they lend based on publicly accessible data such as financial statements rather than relationship lending, in which banks review and monitor lending depending on the private information they hold (Berger and Udell (1996)). In relationship lending, banks tend to place importance on individual information about borrowers while in transactional lending, they focus on common information affecting all borrowers such as information on macro economic activities. This implies that the enlargement of the banks heightens the similarity of their customer base and this may in turn bring about a expansion of their transaction lending, raising the possibility that new positive information signals gained from one bank may act as a positive factor to others. Therefore, when a bank expands its lending in a consolidated banking sector, it is more advantageous for a counterpart bank to also expand its lending, which implies that the consolidation of banking industry could intensify herding. Meanwhile, when the consolidation of banking industry by way of M&A reduces the numbers of banks in the market, it becomes easier for banks to observe the behavior of other banks, which could be another reason for intensified herding in banking industry. When the enlargement and consolidation of banks increases market concentration, an increase of the HHI (Herfindahl-Hirschman Index), which measures market concentration, is also expected to be accompanied by a rise in the herding index.

(4) Business Cycle

In the course of the business cycle, changes in economic agents' expectations could induce herding. Generally when an economy is in good shape, financial institutions that expect their lending risk to be alleviated expand lending significantly while those who expect the current economic conditions to deteriorate prefer safer assets and significantly reduce their risky assets such as

lending to SMEs. Over the business cycle, when positive or negative expectations prevail among executives and managers of financial corporations, bank lending fluctuates more dramatically than the real sector variables including income and consumption. Likewise a situation in which economic agents' expectations are uni-directional is considered herding. Herding occurs when positive or negative expectations are concentrated excessively in one direction. Thus, herding can be further intensified when there are sharper fluctuations in the business cycle. As a result, herding is expected to be intensified more when the gap between the CCI (Coincident Composite Index) and its average value widens.

Table 1 Explanatory Variables for the Estimation

Factors		Proxy Variables	E.S. ¹⁾
Bank characteristics (panel data)	(1) Information capacity	「Unsecured loan/total loan」 _{it}	(-)
		「Interest Income/total revenue」 _{it}	(-)
		「Non performing loan/total loan」 _{it}	(+)
	(2) Long-term profit concerns	BIS capital ratio	(-)
	(3) Bank stability concerns	「Government bonds/total securities」 _{it} ratio	(-)
	(4) Loan market share	「Each bank's loan/all banks' loan」 _{it}	(-)
(5) Foreign bank's characteristics	Dummy variables for foreign banks	(+/-)	
Market structure and macro factors (time series data)	(1) The ratio of short term liquidity	The ratio of M1 to liquidity aggregates of financial institutions (L1)	(+)
	(2) The intensity of competition among banks	「Deposit interest rate – loan interest rate」 _{it}	(+)
	(3) Loan market concentration	HHI ²⁾ for loan market	(+)
	(4) Business fluctuation	Composit index of coincident indicators – 100	(+)
	(5) Other structural factors	Time trend	(+/-)

Notes: 1) E.S. stands for expected signs of coefficients.

2) HHI refers to Herfindahl-Hirschman Index.

C. Setting Explanatory Variables

Based on the theoretical discussions in section A and B above, I describe the explanatory variables affecting the herding of banks in <Table 1>. The proxy variables and their expected signs in <Table 1> were previously referred to in section A and B. Meanwhile, dummy variables for commercial banks under foreign management⁸⁾ and time trend are not mentioned in A and B but included

among explanatory variables to control the other factors. This is because commercial banks under foreign management in Korea account for a very large part of the Korean banking industry, and some point out that their management practices differ greatly from those of commercial banks under domestic management. While commercial banks under foreign management are more likely to herd than commercial banks under domestic management as the former have insufficient information on the domestic market, they could exhibit much less frequent herding if they pursue management practices focusing on asset stability. Giving consideration to this, I mark the expected signs of dummy variables as undetermined. I add a time trend variable in order to control other changes in structural factors beside market structure and macro factors which could have effects on herding. The basic statistics of explanatory variables in this analysis are presented in <Appendix 1>.

3. Setting Estimation Method

The empirical analysis is conducted based on the period between the first quarter of 2000 and the first quarter of 2008⁹⁾ and the quarterly data are used for the analysis. All the data used in the empirical analysis are seasonally adjusted in order to eliminate the distortion caused by seasonality of variables. Thirteen commercial banks that are currently in business are the subjects of the analysis while those that were taken over during this period are included for our purpose in merged banks.¹⁰⁾

For the dependent variable, the herding intensities of total lending, lending to SMEs and lending to households are used, given that herding in lending to SMEs and household could result in bank insolvency. As the characteristics of individual banks included in explanatory variables and structural variables such as the structure of financial markets do not change dramatically in the short-term, they are closely linked with long-term herding intensity. I look into the effects of the explanatory variables at a certain period on the next 2-year average

8) Banks managed by foreigners such as Korea Exchange Bank, Standard Chartered First Bank, and CitiBank amount to 14.7% out of total loans held by banks in Korea on the basis of the first quarter of 2008.

9) As dependent variables are the average intensity of herding during 8 quarters since period t , the herding intensity between the second quarter of 2006 and the first quarter 2008 becomes the last dependent variables. Therefore, the weighted value numbers of dependent variables used in empirical analysis become 338 (13 commercial banks * 26 quarters).

10) The amount of lending, interest income, total revenue, safe stock and bonds, total stock and bonds are aggregated to derive the proportion of safe securities, herding intensity and share of lending market and BIS capital adequacy ratio is derived by adding weighted value to the share of asset among the ratio.

herding intensity. To this end, as dependent variables, I use $HI_{t,t+7}^i$ representing the average herding intensities of individual banks' total lending, lending to SMEs and lending to households during the eight quarters since period t . In consideration of all this, I set the panel analysis estimation equation as follows:

$$HI_{t,t+7}^i = \alpha^i + \beta X_t^i + \gamma I_t + \epsilon_t^i \quad (2)$$

* where $HI_{t,t+7}^i$ denotes herding intensity of bank i during the 8 quarters between t and $t+7$, α^i dummy variables of individual banks, X_t^i characteristic vector of bank i at period t , I_t time series variable vector, and β and γ coefficient vectors.

The endogeneity problem that dependent variables could affect explanatory variables does not appear here because I use the average herding intensity during 8 quarters since period t as dependent variables.¹¹⁾ Meanwhile, according to the estimation by using the correlation between average growth rate of bank lending at period t except bank i 's lending and the growth rate of bank i 's lending at period $t+1$ as herding index, the result is not so different from the one in this paper (Refer to <Appendix3>). I estimate using the Fixed Effect model.¹²⁾ Given that insufficient information is a crucial factor for herding, I use three proxy variables representing the extent of information holding and capacity to produce information. Estimation 1, 2 and 3 are the ones using ratios of 「credit loan/total loan」, 「interest income/total revenue」 and 「non-performing loan/total loan」 as proxy variables, respectively.

4. Results of Empirical Analysis

The estimation results for herding intensity in total bank lending are presented in <Table 2>. <Table 2> demonstrates that the variables representing the characteristics of banks have low significance. It also reveals that, among time series variables, the ratio of 「M1/LF」, 'deposit interest rate-loan interest rate' differential and the lending market HHI are all significant regardless of estimation equations and that the signs of the estimated coefficients are consistent with the expectations. However, the estimation result that the

11) The trends of herding indexes of individual banks fluctuate more dramatically with time. This implies the empirical analysis using past time lag can mitigate the endogeneity problem.

12) It is known that fixed effect model derives efficiency at higher consistency than random effect model although the former derives low efficient estimated coefficient

variables of bank characteristics do not affect herding in total lending does not necessarily imply that the variables will not affect the herding intensity of individual lending markets such as lending to SMEs or households. This is because the effect the variables of bank characteristics have on lending to SMEs could differ from that on lending to households. Even if herding does not arise in total lending, funds are concentrated excessively on a specific sector when herding occurs in the lending to SMEs and household, which causes side effects such as growing loss of banks or surpassing rise in asset prices.

Looking into the estimation results in detail, the coefficient of 「M1/Lf」 ratio which represents the degree of loan maturity shortening is estimated to be significant, supporting that herding of banks is intensified in case funds are accumulated in short-term financial products. The estimated coefficients of 「deposit interest rate-average lending interest rate」 have significant positive values, and this implies that, when competition among banks becomes fierce, the herd behavior of banks could be intensified. Given that coefficient of lending market HHI is estimated to be a significant value, it is found that the herding intensity of banks deepens in a case the market is highly concentrated by reduced numbers of banks due to merger among banks. However, the variables

Table 2 Estimation Result of Herding intensity in Total Loan

Models Explanatory Variables	Model 1		Model 2		Model 3	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Unsecured loan ratio	-0.505	0.376	-	-	-	-
Interest income ratio	-	-	-0.154	0.261	-	-
NPL ratio	-	-	-	-	0.011	0.056
BIS capital ratio	-0.018	0.025	-0.021	0.028	-0.020	0.027
Government bond ratio	-1.149	1.169	-0.888	1.128	-0.833	1.155
Loan market share	-4.641	2.903	-4.330	3.295	-4.256	3.409
Foreign bank dummy	0.126	0.096	0.067	0.111	0.064	0.126
M1/Lf ratio	7.385	2.090***	8.370	1.918***	8.591	1.939***
Deposit rate-Loan rate	0.473	0.142***	0.455	0.145***	0.473	0.162***
Loan market HHI	0.151	0.071**	0.165	0.075**	0.172	0.082**
Business fluctuation	0.029	0.032	0.018	0.031	0.018	0.031
Time trend	0.006	0.012	0.007	0.012	0.008	0.016
\bar{R}^2	0.29		0.28		0.28	

Note: **, *** indicate statistically significant at the 5%, 1% significance level, respectively. The number of total observation is 338.

representing the fluctuation of business cycle, are not significant, showing that the herding of bank's total lending has little correlation with business cycle.

The results of empirical analysis of the herding intensity of lending to SMEs are displayed in <Table 3>. In contrast to the estimation of total lending, I use 「Individual banks' lending to SMEs/whole banking sector's lending to SMEs」 ratio as a variable of lending market share. In addition, I use the 'deposit interest rate - SME loan interest rate' differential as a time series variable of the interest rate differential. The analysis result as to the herding intensity of lending to households is presented in <Table 4>. I use the 'individual banks' lending to households/whole banking sector's lending to households' ratio as a variable of lending market share. I also use the 'deposit interest rate - household loan interest rate' as a time series variable representing the intensity of competition among banks in the household loan market.

Unlike the estimation using the herding intensity of total lending, that using the herding intensity of lending to SMEs or households as dependent variables indicates that the characteristic variables of individual banks, including those that represent the capacity to produce information, are significant. This indicates that, although the characteristics of individual banks do not affect the herding of total lending at a significant level, they may have effect on specific lending markets.

Table 3 Estimation Result of Herding intensity in SME Loan

Models Explanatory Variables	Model 1		Model 2		Model 3	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Unsecured loan ratio	0.144	0.283	-	-	-	-
Interest income ratio	-	-	-1.073	0.389***	-	-
NPL ratio	-	-	-	-	0.070	0.042*
BIS capital ratio	-0.020	0.033	-0.008	0.029	-0.007	0.030
Government bond ratio	-1.976	1.020*	-2.208	0.937**	-1.880	1.124*
Loan market share	-7.823	1.793***	-7.257	1.406***	-7.639	1.654***
Foreign bank dummy	0.022	0.315	-0.012	0.288	-0.032	0.317
M1/L1 ratio	5.742	1.418***	5.101	1.756***	7.077	1.227***
Deposit rate-Loan rate	0.205	0.098**	0.125	0.094	0.233	0.093**
Loan market HHI	0.019	0.060	-0.011	0.062	0.029	0.066
Business fluctuation	0.061	0.031**	0.071	0.028**	0.067	0.031**
Time trend	0.014	0.014	0.011	0.013	0.020	0.015
\bar{R}^2	0.17		0.23		0.20	

Note: *, **, *** indicate statistically significant at the 10%, 5%, 1% significance level, respectively. The number of total observation is 338.

Table 4 Estimation Result of Herding intensity in Household Loan

Explanatory Variables	Model 1		Model 2		Model 3	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Unsecured loan ratio	-1.681	0.380***	-	-	-	-
Interest income ratio	-	-	0.003	0.528	-	-
NPL ratio	-	-	-	-	-0.002	0.070
BIS capital ratio	-0.003	0.032	-0.017	0.046	-0.017	0.043
Government bond ratio	-1.460	0.612**	-0.554	0.851	-0.559	0.962
Loan market share	3.085	2.453	3.020	3.968	3.018	3.984
Foreign bank dummy	0.202	0.095**	0.033	0.126	0.035	0.160
M1/Lf ratio	16.915	2.262***	18.031	2.077***	17.998	1.797***
Deposit rate-Loan rate	0.811	0.055***	0.702	0.096***	0.702	0.061***
Loan market HHI	0.334	0.030***	0.370	0.040***	0.369	0.027***
Business fluctuation	-0.021	0.028	-0.048	0.027*	-0.048	0.028*
Time trend	0.033	0.008***	0.033	0.009***	0.032	0.012***
\bar{R}^2	0.52		0.42		0.42	

Note: *, **, *** indicate statistically significant at the 10%, 5%, 1% significance level, respectively. The number of total observation is 338.

Next, I would like to compare the estimation results which use the herding intensity of lending to SMEs with those using the herding intensity of lending to household as an explanatory variable. Among dependent variables representing the capacity to produce information, the estimated coefficient of credit lending ratio appears significantly negative when the herding intensity of lending to households is used as a dependent variable (<Table 4>) while it is insignificant when the herding intensity of lending to SMEs is used as a dependent variable (<Table 3>). Here, the size of credit lending used in calculating the ratio of credit lending includes that to both SMEs and households. The extent to which the proportion of credit lending reflects the capacity to produce information can differ between lending to household and SMEs. For instance, as mortgage-lending to households against the collateral value of housing, is highly liquid so that banks in Korea can easily foreclose on the mortgage and seize the collateral to retrieve their funds. However, the value of production facilities or factory sites, which are mortgage collateral for lending to SMEs, not only declines sharply in line with the deteriorated operating performance of the corresponding corporation, but assets are also less liquid, which makes it difficult to overcome the problem of information insufficiency by securing such SME loans. For these reasons, it is highly likely that the proportion of credit lending to households is

closely linked to banks' capacity to produce information. However, it is relatively less likely that the ratio of credit lending to SMEs is closely linked with banks' capacity to produce information. Therefore, the effect of the proportion of credit lending on herding intensity is highly likely to become more obvious in lending to households rather than in lending to SMEs.

I would also like to use the proportion of interest income, which is the second explanatory variable representing the capacity to produce information. When the herding intensity of lending to household is used as a dependent variable, the estimated coefficient is not significant. However, it is significant when the herding intensity of lending to SMEs is used as a dependent variable. Among the types of interest income used as explanatory variables, the incomes earned from lending to SMEs and households are included. As commission income, which accounts for a significant proportion of non-interest income, is gained through retail banking and transactions with households, the larger the proportion of non-interest income (the lower the proportion of interest income) the larger the weight of retail banking and household-related business and the lower the proportion of corporate business. This implies that although a lower weight of interest income may weaken a bank's capacity to produce information related to SMEs but it may not weaken the one related to households. It follows that it is possible that the estimated coefficient of the proportion of interest income may be significant for lending to SMEs whereas it is insignificant for lending to households.¹³⁾

According to the estimation results using the non-performing loan ratio, which is the third explanatory variable, representing capacity to produce information, the estimated coefficient is insignificant when the herding intensity of lending to households is used as a dependent variable. However, it is moderately significant when the herding intensity of lending to SMEs is used as a dependent variable. The ratio of non-performing loans used as explanatory variable includes bad lending to both SMEs and households. As most lending to household is small in scale, a bank's household loans are well distributed across households. Consequently, in regard to a bank's lending to households, their debt servicing capacity fluctuates sharply in accordance with largely macroeconomic shocks. Thus, there is little difference between the severity of the delinquencies in individual banks' household lending. However, for lending to SMEs which is

13) For lending to household, as it is standardized thanks to the development of credit scoring method and is done based on the publicly available information, transactional lending accounts for significant parts among the lending. For this reason, it is difficult to see that the banks who lend much to household lending, have better method to screen loan to household than other banks do.

larger in scale and less evenly distributed across the population than household lending, the ratio of non-performing loans is greatly affected by microeconomic factors such as the characteristics of individual corporations. As a result, SME loan delinquencies exhibit a great deal of variation among banks. And notably, it is expected that the banks which lack an adequate capacity for the production of information will have a high proportion of non-performing SME loans.

Second, when we use the capital adequacy ratio as an explanatory variable, the signs of estimated coefficients in both lending to SMEs and households are negative, which fulfills our expectations. However, their significance is low. High capital adequacy ratios could result in low herding intensity as incentives arise to manage banks from a long-term perspective. Their significance, nevertheless, appears low because the capital adequacy ratio in banking industry has changed exogenously in accordance with government policy or regulations.

Third, the estimated coefficient of the proportion of safe securities has a very significant negative value when the herding intensity of lending to SMEs is used as a dependent variable. However, it is partially significant when the herding intensity of lending to households is used. This seems to stem from the fact that banks which place their priority on management stability tend to show less herd behavior in their lending to SMEs than in their lending to household. In practice, the risk of delinquency in lending to SMEs is higher than that in lending to households.¹⁴⁾ Thus, banks need to be cautious in expanding their lending to SMEs in order to maintain stable management.

Fourth, the estimated coefficient of the explanatory power of lending market dominance is not significant when the herding intensity of household lending is used as a dependent variable while it is significantly negative when the herding intensity of lending to SMEs is used as a dependent variable. These results seem ascribable to the fact that lending to households is relatively safe than lending to SME, making it unnecessary for banks to observe and follow the leading bank's lending behavior in the household loan market.

Fifth, when the dummy variable for commercial banks managed by foreigners is used as an explanatory variable, the estimated coefficient is not significant where the herding intensity of lending to SMEs is used as the dependent variable. However, it exhibits a partially significant positive value when the herding intensity of lending to households is used as a dependent variable. This

14) In practice, the delinquency rate of SMEs remains higher than that of household on a basis of Korean commercial bank lending. The gap of delinquency rates between lending to household and SMEs recorded average 0.7%p between the first quarter of 2004 and the first quarter of 2009. Notably it has expanded to 1.67% during the first quarter of 2009 when the credit crunch was severely raging.

seems to result from the tendency of foreign management that emphasize bank stability to be cautious in lending to SMEs while expanding their market share in lending to households.¹⁵⁾

Next, I would like to examine the estimated coefficients of market structure and macroeconomic variables. First, 「M1/Lf ratio」 is shown to have a significant positive value. This implies that the increase in short-term money has an effect on more intensified herding of both the lending to SMEs and household.

Second, I examine the estimated coefficient of the explanatory variable of 「deposit interest rate - loan interest rate」 differential which reflects the intensity of competition among banks. When lending to SMEs is used as a dependent variable, the coefficient in the most of estimation equations has a significant positive value. In the case lending to household is used as a dependent variable, the coefficient in all the estimation equations has a significant positive value.

Third, the estimated coefficient of HHI which is lending market concentration, has a significant positive value when the total lending and lending to household are used as dependent variables. However, it has a insignificant value in the case the lending to SMEs is used as a dependent variable. The transactional lending which banks deal with in a standardized method by using publicly available information, is mostly small sized lending to household. Therefore, the significant increase in transactional lending in line with consolidation of banks is highly likely to occur in the lending to household rather than in the lending to SMEs. For this reason, the rise in HHI seems have effects more on the herding intensity of lending to household rather than on that of lending to SMEs.

Fourth, I look into the estimated coefficient of explanatory variable of $|CCI - 100|$ which represents the size of business fluctuation. When the herding intensity of lending to SMEs is used as a dependent variable, the coefficient of the corresponding explanatory variables has a significant positive value while it is a negative value in the case the lending to household is used as dependent variable. This implies the herding of lending to SMEs intensifies at the time the economy is booming or slowing down. As lending to SMEs responds sensitively to economic condition, it is expected that the herding would intensify around the peak or trough of business cycle. However, given the several cases that lending to household expanded as the authority had offered incentive banks to expand

15) In practice, among the total size of banks' lending to household between the first quarter of 2004 and the first quarter of 2009, the lending to household by Foreign Exchange Bank, Citi Bank and Standard and Chartered First Bank accounts for 17.4% while 14.3% of the total lending to SMEs was done by these three banks.

lending to household in order to tackle the economic recession in Korea, this implies the herding in the household loan market is likely to be intensified at the time economic downturn (boom) turns into recovery (recession).

IV. Summary and Implication

Herding is defined as the behavior of economic agents that are affected by other economic agents and follow them. The herd behavior of economic agents results largely from the choppy nature of information flow and it may also result from the reward structure and the utility function. This study presents a herding index that conforms to the economic definition of herding and is able to measure the herding intensity of individual economic agents using this index, it proceeded to measure the herding intensity of Korean banks. Additionally, this study conducted an empirical analysis about the causes of herding in bank lending based on Korean bank panel data.

The past average herding index of banks for each lending market in Korea was derived using the improved herding index. According to the results, the herding intensity in household lending was extremely high, exceeding 0.6 at the end of 2002, after which many household loans turned sour. In lending to SMEs, herding occurred around early 2004 and late 2006, but did not exceed 0.5, and this was not followed by any obvious episode of widespread delinquencies on SME loans.

An empirical analysis was conducted into the factors causing the herd behavior of banks. The results may be summarized as follows. In terms of macroeconomic factors, when fund inflows into short-term financial products increase further or competition among banks becomes fiercer, herding in total lending, lending to SMEs and lending to households becomes further intensified. However, it seems that an increase in lending market concentration results largely in intensified herding in household lending. Meanwhile, it is estimated that herding in lending to SMEs may become further intensified when the business cycle is close to a trough or a peak whereas that in lending to household is intensified further when the cycle is in the process of shifting away from a peak or trough. The proportions of interest income and non-performing loans among bank characteristic variables reflect the capacity to produce the information related to lending to SMEs while the proportion of credit lending mirrors the capacity to produce information related to household lending. These

variables are found to be significant in both the estimation equation using the herding intensity of lending to SMEs as the dependent variable and in that using the herding intensity of lending to household as the dependent variable. This implies that banks' weak capacity to produce information could intensify herding in both these lending markets. Among bank characteristic variables, the proportion of safe securities in total securities and lending market share have significantly positive values in the estimation equation of herding intensity in lending to SMEs while almost none of them are significant in lending to households. This implies that the lower is a bank's tendency to emphasize stable management or its market presence, the more likely is the incidence of frequent herding in lending to SMEs. Lastly, the estimated coefficients in the empirical analysis coincide with the theoretically expected signs mentioned in the causes of herding, which makes the herding index derived in Section II useful in measuring the herding intensity of individual economic agents.

Meanwhile, wide-ranging discussions may arise on whether competition among economic agents to expand their market share should be classified as herding. This is because, unlike the herding stemming from the flow of information that is the main form of herding, competition for market share causes the behavior of an economic agent to result in negative externalities for other economic agents. In this connection, Scharfstein and Stein (1990) and Rajan (1994) carried out an analysis about the herd behavior of fund managers and bank managers. These studies imply that the occurrence of negative externalities caused by competition for market share is regarded as herding. In this study, it is difficult to estimate the herding intensity of other economic agents' behavior excluding the effect of competition for market share. Accordingly the development of herding indexes that consider this issue must be left as a task for future research.

<References>

- Avery, Christopher and Peter Zemsky (1998), "Multidimensional Uncertainty and Herd Behavior in Financial markets," *American Economic Review*, 88, 724-748.
- Berger, A. and G. Udell (1996), "Universal banking and the future of small business lending," in Saunders, A. and I. Walter (Eds), *Financial System Design: The case for universal banking*, Irwin Publishing, 559-627.
- Berger, A. and G. Udell (2003), "The Institutional Memory Hypothesis and the Procyclicality of Bank Lending Behavior," Federal Reserve Board, Feb.
- Banerjee, Abhijit(1992), "A simple model of herd behavior," *Quarterly Journal of Economics*, 107, 797-818.
- Bikhchandani, Sushil, David Hirshleifer and Ivo Welch (1992), "A Theory of Fads, Fashion, Custom and Cultural Change as Informational Cascades," *Journal of Economic Perspectives*, 12, 151-170.
- Bikhchandani, S. and S. Sharma (2001), "Herd Behavior in Financial Markets," IMF Staff Papers, 47(3)
- Calvo, Guillermo and Enrique Mendoza (2001), "Rational contagion and globalization of securities markets," *Journal of International Economics*, 51, 79-113.
- Chirstie, William and Roger Huang (1995), "Following the Pied Piper: Do Individual Retrurns Herd Around the Market," *Financial Analysts Journal*, 31-37.
- Devenow, Andrea and Ivo Welch (1996), "Rational herding in financial economics," *European Economic Review*, 40, 603-615.
- Ellison, G and D. Fudenberg (1993), "Rules of thumb for social learning," *Journal of Political Economy*, 101, 612-643.
- Froot Kenneth A., David D. Scharfstein and Jeremy C. Stein (1992), "Herd on the street: Informational inefficiencies in a market with short-term speculation," *Journal of Finance*, 47, 1461-1484.
- Gale, Douglas, and Onur Ozgur (2005), "Are bank capital ratios too high or too low? - Incomplete markets and optimal capital structure," *Journal of the European Economic Association*, 3, April~May, 690-700.
- Graham, John (1999), "Herding among Investment Newsletters: Theory and Evidence," *Journal of Finance*, 54, 237-268.
- Hahm, Joon-Ho (2008), "Non-Interest Income of Commercial Banks," Working

- Paper No. 330, The Institute for Monetary and Economic Research, The Bank of Korea, 1-37.
- Hirshleifer, D. and S. H. Teoh (2003), "Herd Behavior and Cascading in Capital Markets: a Review and Synthesis," *European Financial Management*, 9(1), 25-66.
- Jain, A. and S. Gupta (1987), "Some evidence on herding behavior by U.S. banks," *Journal of Money, Credit and Banking*, 19, 78-79.
- Kim, Woochan and Shang-Jin Wei (2002), "Foreign Portfolio Investors Before and During a Crisis," *Journal of International Economics*, 56(1), 77-96.
- Lakonishok, Josef, Andrei Shleifer and Robert Vishny (1992), "The Impact of Institutional Trading on Stock Prices," *Journal of Financial Economics*, 32, 23-43.
- Lee, In-ho (1998), "Market Crashes and Informational Avalanches," *Review of Economic Studies*, 65, 741-759.
- Nofsinger, J. and R. Sias (1999), "Herding and Feedback Trading by Institutional and Individual Investors," *Journal of Finance*, 54, 2263-2295.
- Rajan, R. (1994), "Why Credit Policies Fluctuate: a Theory and Some Evidence," *Quarterly Journal of Economics*, 109, 399-442.
- Scharfstein, D. and J. C. Stein (1990), "Herd Behavior and Investment," *The American Economic Review*, 80(3), Jun, 465-479.
- Smith, L. and P. Serrensen (2000), "Pathological Outcomes of Observational Learning," *Econometrica*, 68, 371-398.
- Uchida, Hirofumi and Ryuichi Nakagawa (2007), "Herd Behavior in the Japanese Loan Market: Evidence from Bank Panel Data," *Journal of Financial Intermediation*, 16, 555-583.
- Wermer, Russ, "Herding, Trade Reversals, and Cascading by Institutional Investors," mimeo, University of Colorado, Boulder
- Zhang, J. (1997), "Strategic delay and the Onset of Investment Cascades," *RAND Journal of Economics*, 28, 188-205.

[Appendix 1]**The Values of Mean and Variance of Explanatory Variables**

	Explanatory Variables	Mean	Variance
Information Capacity	Unsecured Loan Ratio	0.37362	0.00981
	Interest Income Ratio	0.48225	0.01805
	Non-performing Loan Ratio	2.12344	1.33747
Long-term Profit Concerns	BIS Capital Ratio	11.24172	2.21434
Bank Stability Concerns	Government Bond Ratio	0.03677	0.00159
Loan Market Share	in the Loan Market	0.07693	0.00748
	in the SME Loan Market	0.07692	0.00538
	in the Household Loan Market	0.07697	0.01275
Short-term Liquidity Ratio	The Ratio of M1 to Liquidity Aggregates of Financial Institutions(Lf)	0.22547	0.00050
The Intensity of Competition	Deposit Rate-Loan Rate	-1.86655	0.09645
	Deposit Rate-SME Loan Rate	-1.80545	0.15907
	Deposit Rate-Hous. Loan Rate	-2.10108	0.28213
Market Concentration	HHI	17.39074	1.87246
Business Fluctuation	Composit Index - 100	0.94865	0.48259

[Appendix 2]

**Estimation Result of Herding Intensity in the Loan Market
(Herding Index measured with 7 quarters)**

Models Explanatory Variables	Model 1		Model 2		Model 3	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Unsecured loan ratio	-0.530	0.426	-	-	-	-
Interest income ratio	-	-	-0.139	0.275	-	-
NPL ratio	-	-	-	-	0.022	0.056
BIS capital ratio	-0.010	0.025	-0.012	0.029	-0.010	0.026
Government bond ratio	-1.079	1.306	-0.802	1.276	-0.723	1.305
Loan market share	-4.463	2.800	-4.132	3.282	-4.023	3.462
Foreign bank dummy	0.098	0.096	0.038	0.116	0.024	0.131
M1/Lf ratio	7.225	2.886**	8.251	2.512***	8.737	2.215***
Deposit rate-Loan rate	0.493	0.167***	0.476	0.170***	0.500	0.180***
Loan market HHI	0.167	0.087*	0.182	0.090**	0.192	0.093**
Business fluctuation	-0.008	0.035	-0.019	0.035	-0.019	0.035
Time trend	0.008	0.014	0.009	0.014	0.011	0.018
\bar{R}^2	0.25		0.24		0.24	

Note: *, **, *** indicate statistically significant at the 10%, 5%, 1% significance level, respectively. The number of total observation is 351.

Estimation Result of Herding Intensity in the Loan Market (Herding Index measured with 9 quarters)

Models Explanatory Variables	Model 1		Model 2		Model 3	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Unsecured loan ratio	0.236	0.322	–	–	–	–
Interest income ratio	–	–	–0.466	0.487	–	–
NPL ratio	–	–	–	–	0.074	0.059
BIS capital ratio	0.003	0.036	0.009	0.033	0.017	0.033
Government bond ratio	0.543	1.062	0.347	1.132	0.595	1.099
Loan market share	–2.357	1.842	–2.677	1.907	–2.270	1.845
Foreign bank dummy	0.025	0.087	0.028	0.076	–0.019	0.058
M1/Lf ratio	–0.105	2.246	–0.409	2.695	1.245	2.971
Deposit rate–Loan rate	0.243	0.142*	0.220	0.130*	0.303	0.160*
Loan market HHI	0.072	0.061	0.056	0.063	0.091	0.079
Business fluctuation	0.071	0.014***	0.077	0.015***	0.078	0.016***
Time trend	0.022	0.012*	0.022	0.012*	0.029	0.015*
\bar{R}^2	0.09		0.10		0.11	

Note: *, **, *** indicate statistically significant at the 10%, 5%, 1% significance level, respectively. The number of total observation is 325.

[Appendix 3]**Estimation Result of Herding Intensity in the Loan Market**

* Each bank's loan growth rate is excluded when calculating the average growth rate of Korean commercial banks' loan, and then that bank's herding intensity is obtained.

Models Explanatory Variables	Model 1		Model 2		Model 3	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Unsecured loan ratio	-0.457	0.405	-	-	-	-
Interest income ratio	-	-	-0.130	0.251	-	-
NPL ratio	-	-	-	-	-0.004	0.053
BIS capital ratio	-0.024	0.024	-0.026	0.027	-0.028	0.027
Government bond ratio	-1.082	1.173	-0.845	1.139	-0.832	1.170
Loan market share	-4.568	3.372	-4.284	3.656	-4.271	3.688
Foreign bank dummy	0.040	0.094	-0.012	0.105	-0.002	0.124
M1/Lf ratio	7.256	2.239***	8.144	2.111***	8.007	1.934***
Deposit rate-Loan rate	0.499	0.120***	0.483	0.122***	0.489	0.137***
Loan market HHI	0.161	0.066***	0.173	0.071***	0.175	0.076***
Business fluctuation	0.020	0.032	0.011	0.031	0.010	0.031
Time trend	0.007	0.012	0.008	0.012	0.008	0.015
\bar{R}^2	0.30		0.29		0.29	

Note: *, **, *** indicate statistically significant at the 10%, 5%, 1% significance level, respectively. The number of total observation is 338.