BOK Working Paper

Systemic Risk of the Consumer
Credit Network across
Financial Institutions

Hyun Hak Kim, Hosung Jung

2019. 9

BANK OF KOREA

Economic Research Institute
Bank of Korea

Publisher
Juyeol Lee
(Governor of Bank of Korea)

Editor
Woon Shin
(Director General of the Institute)

BOK Working Paper is occasionally published by the Economic Research Institute, Bank of Korea. This is circulated in order to stimulate discussion and comments. Articles include research achievement by the staff and visiting scholars, and selected works sponsored by the Institute.

The views expressed in this paper do not necessarily reflect those of Bank of Korea or the Economic Research Institute.

Requests for copies of publications, or for addition/changes to the mailing list, should be sent to:

Economic Research Institute
Bank of Korea
39 Namdaemunno Jung-Gu
Seoul, 110-794, Korea

E-mail: eso@bok.or.kr

Fax: 82-2-759-5410

This publication available on the BOK
Economic Research Institute website
(<http://imer.bok.or.kr>)

© Bank of Korea, 2019
All rights reserved.

Reproduction for educational and non-commercial purposes is permitted provided that the source is acknowledged.

Systemic Risk of the Consumer Credit Network across Financial Institutions

Hyun Hak Kim*, Hosung Jung**

The views expressed herein are those of the authors and do not necessarily reflect the official views of Bank of Korea. When reporting or citing this paper, the authors' names should always be explicitly stated.

* Associate Professor, Department of Economics, Kookmin University, Tel: +82-2-910-4541, Email: hyunhak.kim@kookmin.ac.kr

** Senior Economist, Economic Research Institute, Bank of Korea, Tel: +82-2-759-5308, Email: hschung@bok.or.kr

The first author acknowledges the financial support from Bank of Korea. The views expressed herein are those of the authors and do not necessarily reflect those of Bank of Korea.

Contents

I. Introduction	1
II. Financial Network	3
III. Contagion Index	16
IV. Scenario Analysis	19
V. Concluding Remarks	24
References	26
Appendix	29

Systemic Risk of the Consumer Credit Network across Financial Institutions

We investigate a network of financial institutions in Korea using the Korea Consumer Credit Panel (KCCP). The main contribution of this paper is that we construct the network of financial institution from the consumer credit level. We assume each consumer make a loan from multiple institutions so that those institutions share same risk from same consumer no matter of quality or type of loan. Then we construct the financial network between institutions and compute contagion index based on those multiple connection with a weight of default probability of individual borrowers. We found strong connection with banking institutions and credit card firms due to convenience in making small-amount loans with credit cards. However, when we give an weight with default probability to the linkage among institutions, connections of banking institution with savings bank, non-credit card finance corporation and merchant banking are stronger than others, while banking institution holds center position and has biggest amount of loans individually. Contagion index hit a peak in 2013Q1 and then fell rapidly, finally has been fluctuated in relatively low level from 2016 to 2017Q2. The result in our paper enables the authority to watch the systemic risk from consumer credit level with specific consumer type with their default probability.

Keywords: Systemic risk, Financial network, Consumer credit, Financial stability

JEL Classification: C23, D14, G20, G21, G23

I . Introduction

Since the Great Recession has broken out, systemic risk has risen to be an important factor since the spill-over effect became serious within financial institutions. Starting with Bear Stearns in 2008, a number of commercial banks or other types of financial institutions went bankrupt serially and those threatened the rest of the financial agencies (Hellwig, 2009). Therefore, more attention has been paid to measuring systemic risk or the spill-over effects in a financial network, for the sake of financial stability or macroprudence. For example, Cont and Moussa (2010) propose a quantitative approach, so-called ‘a systemic risk index’, which measures the systemic impact of the failure of a large financial institution. Amini et al. (2012) propose a simulation-free framework to test the resilience of a financial network to external shocks affecting its balance sheets. Gai and Kapadia (2010) develop an analytical model of contagion in financial networks with an arbitrary structure, and Amini et al. (2016) propose a model for measuring the magnitude of contagion in a large counterparty network and give an analytical expression for the asymptotic fraction of defaults in terms of a network’s characteristics.

Korea has experienced several financial crises recently, such as the Asian financial crisis in 1997, the credit crisis of 2003, and a savings banks run in 2011. Especially the last two crises were exacerbated by consumer credit, while corporate credit was managed relatively better because of strong regulation like the Basel Accords or the government’s macroprudential policies. However, the recent increase in household debt is now regarded as a possible detonator of the next crisis in financial network and therefore several research has been made into this subject. Among a few, Suh (2011), Lee et al. (2013), Choi et al. (2015) and others investigated the systemic risk using the Copula or option pricing model. Kim et al. (2016) looked at systemic risk using network theory following Das (2016). They considered a theoretical network to model the

Korean financial system and measured contagion risk in that model so it lacks an empirical analysis.

Previous research about household debt focus on the aggregate amount of consumer credit as a part of financial network. That is, those regard the data as a measure of a household' risk exposed no matter of individual characteristic of them by type of loan, spread, or borrower's credit rate and so on. On the other hand, the authorities regarding financial stability focus on prudence at financial institutions to cope with economic turmoil caused by household debt. For example, a number of stress tests are conducted by authorities but no serious cracks are not found at the aggregate level since those financial intermediaries are well prepared due to BIS or some government's regulations. Both of sides viewed consumer credits as a whole and did not take care of disaggregate level. Consumer credit, unlike corporate credit, is shattered to pieces but is usually counted as a whole, so that idiosyncratic details are ignored. However, considering that the Great recession was ignited by subprime mortgages, which was a small part of the entire mortgage market, it is worth to see idiosyncratic characteristic of consumer credit. By doing so, we can identify the weak point in consumer credit and see how it affects the rest of financial network, and eventually which policy is necessary for current credit market.

Thanks to big-data environment recently, the Bank of Korea established a dataset in micro-level for household debt, the so-called 'Korea Consumer Credit Panel' (KCCP) which includes the amount, characteristics of the loan, the borrower's credit scores, the amount of credit card usage and related items. The panel reveals which institution debtors owe to, what type of loans and how long the borrowers have so that we compute how much each institution have loans from same consumer. In this sense, we assume that one borrower may not pay back one of their loans on time, the borrower might possibly not pay back others, then finally financial institutions share risk from same consumer and we define it as a financial linkage between two institutions.

Though there is no literature to construct a financial network from consumer credit level, we follow notable approaches in network literature. Cont et al. (2010) measure the magnitude of the contagion effect by computing which institutions give to and take from influence other institutions across the whole financial system. Acharya et al. (2017) and Huang et al. (2009) also estimate a risk measure for financial institutions in a similar way. Especially, Cont et al. (2010) simulated how the risk can be managed by other variables and that encouraged us to include macroeconomic variables as a factor in the vulnerability of the financial system. Therefore, we follow their steps to measure the how individual borrowers affect the financial network through financial institution and other macro variables such as a policy rate. Consequently, our framework has three layers (consumer, financial institutions and nationwide financial network) and control variables (interest rates and factors affecting consumer's behavior). Jung and Kim (2018) analyzed the impact on financial stability by household debt using this panel data with the emphasis on debt status by borrowers' employment status. We extend their point of view more generally to see the overall financial stability and construct numerical measure for this stability.

The next chapter introduces the data and the framework for measuring connectivity of a financial network using micro data, and the third chapter establishes a contagion index as a risk measure. In the fourth chapter, a scenario analysis is performed for robustness of our framework. The fifth chapter concludes this paper.

II. Financial Network

1. Data

The KCCP was introduced by the Bank of Korea based on a database from Korea's credit bureau, Korea Credit Bureau (KCB), from

the first quarter of 2012 with quarterly frequency. Original database consists of 41 million observations, which seems to be sufficient to represent Korean population when considering that older than 18-years-old residents in Korea is about 47 millions. 420,000 samples are extracted according to sampling strategy of the statistics department at the Bank of Korea following the the New York Fed's Consumer Credit Panel. With a randomly assigned personal identification number, each individual entry includes age, gender, postal code, credit rating, estimated income¹⁾, amounts of loans and overdue loans as well as credit and debit card usage. Postal code is based on the individual's registered address and Jung and Kim (2018) added the average house price of the place where the individual lives. BSI is also added based on that address in the metropolitan level. The default is defined when the due is over 90 days. Note that the panel is constructed at the individual borrower level, not the household level.

We report some interesting statistics from KCCP, as found in Table 1. Male borrowers constantly are more than female over time and it seems natural that more male borrowers exist in the sample. In the meanwhile, the distribution of credit grade has changed explicitly. Overall, the number of highest grade(1-3) and the lowest grade(8-10) has been expanded but the middle grade(4-7) are reduced. It indicates that there is a polarization even in consumers' credit level. Ratio of secured loan to the total amount loan has changed rarely during the sample period. However, the number of self-employed to the total population has been increased. Default rate, which measures number of borrowers who have declared default, picked up during the sample period but it is stabilized at the end of the sample. See the Bank of Korea's Financial Stability Report²⁾ for more details about the panel.

1) The estimated income is obtained when the individual applies to the credit card.

2) <https://www.bok.or.kr/eng/bbs/E0000737/list.do?menuNo=400042>

Table 1. Selective Statistics in KCCP from 2012Q1 to 2017Q2¹⁾

Variable	2012Q1	2014Q2	2016Q1	2017Q2
Gender (Male/Female)	0.610	0.610	0.610	0.610
Credit grade (1–3)	0.416	0.472	0.530	0.570
Credit grade (4–7)	0.487	0.415	0.354	0.326
Credit grade (8–10)	0.096	0.113	0.116	0.103
Secured loan/Total loan	0.442	0.446	0.436	0.449
Use of loan corporation	0.084	0.094	0.094	0.078
Number of self-employed	0.113	0.124	0.126	0.134
Default rate	0.016	0.023	0.020	0.015

Notes: 1) Gender is the ration male to female borrowers in the sample. Credit grade is the ratio of credit grade 1-3, 4-7 and 8-10 to the number of whole sample. Secured loan/Total loan is the ratio of amount of secured loans to the total amount of loan. Use of loan corporation is the ratio of borrowers who have used the loan from loan corporation to the whole sample. Number of self-employed is the ratio of number of self-employed to the whole sample.

Source: KCCP, Bank of Korea.

2. Framework of the Network

The existing literature measured the systemic risk of the financial network as a whole so that those could not count the idiosyncratic factor within the network. Following Cont et al. (2010), we construct a financial network and measure the relative influence of financial institutions due to systemic risk at the micro level. In this sense, we design a financial network from micro level. More specifically, the counter-party relationship in a financial system is defined as a weighted directed graph or network so that we define E as the matrix of bilateral exposure between two institutions. Then E_i is the sum of loans issued by a single institution i as the following,

$$E_i = \sum_{n=1}^N l_{i,n} \quad (1)$$

where E_i is the average loss at an institution i , and $l_{i,n}$ is the total loan of individual n .

We can expand our definition of exposures as the sum of expected losses from their own issued loans and the contagion effect from other institution's insolvency. If this insolvency is made at a large scale, it may cause a "financial crisis." As a first step, we define the linked loan of institutions, i is like the following.

$$D_i = E_i + E_{ij} = E_i + \sum_{n \in N} l_{ij,n} \quad (2)$$

where $l_{ij,n} = \frac{1}{2}(l_{i,n} + l_{j,n})$ so that l_{ij} is the average loan of an individual n is owed to two institutions, i and j simultaneously, and n_{ij} denotes the number of borrowers who have loans from the two institutions, i and j . For example, if borrower A borrow \$100 from institution 1 and \$50 from 2, $l_{12,A}$ is \$75. If this borrower may not pay back the loans from one institution, it is very likely that this borrower may not pay back the other loan. In this sense, institutions have more connectivity if the borrower owes more institutions. As shown in equation 2, balance of loan that the institutions hold consists of their own amount, E_i and the sum of its linked loan, E_{ij} . List of financial institutions are introduced in Table 2.

Table 2. List of Financial Institutions

Short	Description
F1	Banks (including Korea Housing Finance)
F2	Savings banks
F3	Credit unions
F4	Korean federation of community credit cooperatives
F5	Local union for agriculture and fisheries ¹⁾
F6	Insurance company
F7	Insurance company
F8	Non-card credit finance corporation
F9	Merchant banking, investment trust, venture capital and securities company
F10	Guarantee organization (credit guarantee fund, technology credit guarantee fund and so on), post bank

Notes: 1) The official name of the local union for agriculture is the agricultural cooperative federation and for fisheries is the federation of fisheries cooperatives.

Figure 1 depicts the total balance of loan that each institution holds, D_i . As expected, most of the balance are belongs to commercial banks (F1) including the Korea Housing Finance corporation (KHF), which is a mortgage-specialized corporation managed by the government like the Federal National Mortgage Association or the Federal Home Loan Mortgage Corporation in the US. The second largest creditor among financial institutions is the local unions for workers in the agricultural and fisheries industries (F5). Those institutions were established specifically to fund rural households where people work in those industries.

We analyze the linkages between financial institutions in terms of consumer credit. As a first step, we count how many loan contracts are made between institutions by same consumers. We define

$$k_{ij,n} = 1\{l_{ij,n} > 0\} \quad (3)$$

and accordingly,

$$k_{ij} = \sum_{n=1}^N 1\{l_{ij,n} > 0\} \quad (4)$$

as the number of pairs of institutions that share a consumers on their loan balances.

Figure 1. Balance of Loans by Institution¹⁾

Note: 1) See Table 2 for description of legend.

Source: KCCP

Most of borrowers who are able to borrow from commercial banks have enough credit scores and accordingly their risks of default are relatively low. If we look at the consumer credit market in aggregate level, the underlying risk may not be revealed due to huge share of loans of eligible borrowers from banking institutions. Therefore, we apply a weight to evaluate the balance of loans more appropriately. To do this, we estimate the individual's probability of default (PD), p_n , using dynamic probit model, following Jung and Kim (2018). The probability is estimated based on an individual's balance of loans, the spread due to their credit rating, the spread due to the purpose of the loan. Age, gender, and BSI and HPI based on where they live are included as the control variables. More specifically, borrower i 's default rate at time t is as following;

$$\begin{aligned} P(y_{i,t} = 1 | y_{i,t-1}, y_{i,t-2}, \dots, y_{i,0}, w_{i,t-1}, z_{i,t-1}, \varsigma_i) \\ = \Phi(w_{i,t-1}\beta_w + z_{i,t-1}\beta_z + \beta_y y_{i,t-1} + \varsigma) \end{aligned} \quad (5)$$

where the dependent variable, $y_{i,t}$ is the binary response variable, which is 1 when the borrower's loans are more than 90 days overdue and 0 otherwise, and z is the key determinants of default rates,

$$z_{i,t} \in \{spread_{p,i,t}, spread_{c,i,t}, \ln loan_{i,t}, iloan_{i,t}\} \quad (6)$$

where $spread_{p,i}$ is the spread depending on the purpose (secured/unsecured) of the loan for borrower i , $spread_{c,i}$ is the spread depending on the borrower i 's credit rating, $loan$ is the loan balance of the borrower, $iloan$ is a dummy variable which is 1 if the borrower has made additional loans in the most recent two quarters, and 0 otherwise, and w is the set of control variables such as the borrower's age, gender, and average house prices and BSI where the borrower resides. Note that both z and w are exogenous. See Jung and Kim (2018) for more computation details.

Most of loans made from financial institution are already passed by the institution's evaluation so that the distribution of default probability of existing loans are seriously skewed to zero. As seen in Table 3, the number of borrowers whose default probability is less than 0.1% is almost 24% of whole population. That is, more than three quarters of borrowers in the sample have less than 0.1% default probability. Meanwhile, share of borrowers who have relatively higher default probability had risen in 2014 but it has been lowered since then. This pattern is also shown in the average default probability of all samples and this average has similarly moved with the true default rate, shown in Table 1. In this circumstance, if we estimate equation (5) using fixed effect model, it may cause serious bias in parameter so that we estimate the equation using the correlated random effects model following Wooldridge (2005) and Jung and Kim (2018). We use this probability as the weight to assess their exposure at default. Then we can obtain a financial institution's expected losses from any given individual. We define the exposure at default E_i^* for one institution as the following,

$$E_i^* = \sum_{n \in N} l_{i,n} \times p_n \quad (7)$$

where p_n is the default probability of borrower n and the exposure shared with other institution as

$$E_{ij}^* = \sum_{n \in N} l_{ij,n} \times p_n \quad (8)$$

3. Financial Network

Figure 2 depicts the linkages between financial institutions by the number of loans shared between two institutions, k_{ij} . Since we have 10 different kinds of financial institution, there are ${}_{10}C_2 = 45$ possible

Figure 2. Linkage of Financial Institution by Number of Loan Shared¹⁾

Notes: 1) (i,j) denotes the number of loan that borrowers owe in both institutions, i and j . See notes to Table 2 for institution numbering and note that 'F' is missing for brevity.

connections. It is not a good way to draw every connection in one plot. We put those 45 connections in nine small figures. Note that the scale of subplot is various in Figure 2. Since a majority of consumer owing banks (F1), the linkages among F1 are greater than any other and the composition of the linkages among F1 changes very marginally.

This linkage can be expressed as the network of ten types of financial institutions in terms of the number of loans, as seen in Figure 3. The thickness of the branch in the figure represents the number of loans shared between two institutions k_{ij} , which is also expressed in Figure 2. The size of circle stands for the number of loans owned by institution i individually, namely k_i . Since the network can be defined in any observation period, we show the network in selective periods, 2013Q2 and 2017Q2. The former is when the contagion index, which will be introduced in the next chapter, was highest and the latter is the last observation in the sample and when the contagion index became stabilized at lower level. No matter of observation period, banking institution (F1) has strong connections with others while it owns the

Figure 3. Network of Financial Institution by Number of Loan Shared in the Quarter¹⁾

Note: 1) See notes to Figure 2. Width of branch stands for the number of loan that borrower owe to both institution.

largest number of loans among institutions. credit card companies (F7) and non-credit card finance corporation (F8) have the biggest connectivity with banks. It seems that many consumers use the short-term loan offered by two institutions conveniently as long as they hold eligible credit score. Local union for agriculture and fisheries (F5) also have significant number of loans because many farmers and fishermen easily borrow from them in the name of policy loans for the industry. It seems there is no dramatic change in the number of loans shared among institutions between two periods. Therefore, it is worth to see the amount of loans of shared in the sample period.

Figure 4 depicts the amount of loans shared by two institutions, E_{ij} . Since we compute the average balance of loans for each institution, we overestimate the share of non-bank institutions. But what we have an interest in is the change in loan balances with non-banking institution. Considering the robustness of borrowers who owe banking institutions, we pay more attention to the non-robust borrowers who usually pay higher interest at non-banking institutions. Different loans of different institutions share the identical risk because they are dealing with same borrower and this is the connection point of financial institutions.

Figure 4. Linkage of Financial Institution by Amount of Loan Shared¹⁾

Notes: 1) (i,j) denotes the aggregate amount of loan that borrowers owe in both institutions, i and j . See notes to Figure 2 and Table 2.

Figure 5 shows the network of financial institutions in terms of balance of loan shared. That is, the size of circle is E_i and the width of the branch is E_{ij} . While the banking institutions hold the largest amount of loan independently, they have more links with the local union for agriculture and fisheries (F5), non-card credit finance corporation(F8), and guarantee organization(F10) as well as the credit card companies (F7). The share of banking institution is so huge that we may not measure the network connectivity meaningfully. The size of node for each institution indicates the balance of loan of their own (not shared) and width of the edge between nodes is the balance of loan shared between two institutions. Therefore, we need more percipient measure to see the financial linkage, which is expected exposure at default, E_{ij}^* .

Figure 6 shows the linkages among financial institutions by expected exposure at default, which is E_{ij}^* . As expected, the volume of exposure with banking institutions is relatively higher than with any others type, since balance of loans in the banking sector is still high. However, the composition of shared risk is more dynamic than the number or the

Figure 5. Network of Financial Institution by Amount of Loan Shared¹⁾

Note: 1) Numbers in circle represents the financial institution listed in Table 2. The size of the circle indicates the amount of loan owned only by institution i , and the width of branch stands for the amount of loan shared by two institution, i and j . See notes to Figure 3.

balances of loans shared. Again, this figure is good for viewing the time series structure of financial linkage but not appropriate to see the financial network at a certain time.

Figure 7 depicts the network of financial institutions in terms of expected exposure at default in the quarter. Similar to figure 5, the size of the circle in the network is E_i^* and the width of the branch is E_{ij}^* . In 2013Q2, the individual expected exposures at default for local unions for agriculture and fisheries (F5) is as much as them for commercial banks due to high default rates of their' loan, though the shared amount of them is not as much as other connection. That is, borrower from two institutions could be distinctive. Closer linkage from commercial banks is made with savings bank (F2), non-credit card finance corporation (F8), and merchant banking and others (F9), though their individual expected exposures are not meaningful. This shape has changed in 2017Q2. While the total expected exposure of commercial banks is still the largest, expected exposures of saving banks have been

Figure 6. Linkage of Financial Institution by Expected Exposure at Default¹⁾

Notes: 1) (i, j) denotes the aggregate exposure to default shared by both institutions, i and j . See notes to Figure 2 and Table 2.

Figure 7. Network of Financial Institution by Balance of Expected Exposure Shared¹⁾

Note: 1) Numbers in circle represents the financial institution listed in Table 2. The size of the circle indicates exposures to default of institution i , and the width of branch stands for the exposure to default shared by two institution, i and j . See notes to Figure 3 and 5.

risen but the linkage between two types of banks has been weaker. It also means that borrowers from two institutions are heterogeneous. And the

size of F5 has shrunk while it has similar level of connection with banking institutions. The overall connection of non-commercial-bank financial institution has been weakened with commercial banks since the default probability of borrowers is lower as the economy gets stabilized.

To measure the connectivity across the network, we can use semiparametric tail estimates of distribution. The maximum likelihood estimate for the tail exponent (Clause et al, 2009) are estimated. This determines the shape of the Pareto distribution so that if we have a higher value, we can confirm that the network is more centralized. Since we have strong dominant player in the network, the value is over 100 in almost all cases and observations. Another interesting observation is that financial institutions that are highly connected tend to have larger exposure. We investigate the relationship between the number of loans shared and the balance of loans shared, and measures the exposure at default shared by computing the Kendall's tau for each of these pairs. The results show that all pairs have a positive dependence, as shown in Figure 8.

We additionally construct the financial network following borrowers' characteristic such as gender, overdue, credit score, use of loan corporation's loan, employment status and business type. The detailed result is summarized in the appendix.

Figure 8. Kendall's Tau

III. Contagion Index

Following Cont et al. (2010), we define the contagion index as the sum of the fundamental default risk and default by contagion. In this sense, we can use as the fundamental default risk and the shared exposure, E_{ij}^* between institutions as the default risk by contagion. Therefore, we can construct our default impact as the following,

$$D_i^* = \sum_{i=1}^{10} \sum_{j=1}^{10} E_{ij}^* = \sum_{ij \in K} \sum_{n=1}^N l_{ij,n} \times p_n \quad (9)$$

where K is the all combination of financial institution, ${}_{10}C_2$. Though we omit the time index for brevity, the index is defined at each observation period.

The contagion mechanism described above is similar to the one presented in Cont et al. (2010), Furfine (2003), Upper and Worms (2004) and Mistrulli (2007) in the sense that we divide the default risk into two terms. They are based on liabilities and assets between institutions and all asset and liabilities have a unique risk. However, if the borrower may have trouble paying back one of the loans on time, they are not likely to pay back the other loan. In this sense, the risk of one institution can be contaminated. The following Figure 9's left panel is the overall contagion index from 2012Q2 and the index is standardized by setting the value in 2012 equal to 100.

The index hit a peak in 2013Q1 and then fell rapidly and made small fluctuations during 2016 and 2017. The peak in 2012 and 2013 is considered to be have been made by the crisis in Europe and relatively a higher interest rate. The overall level is much lower than during 2012 and 2013.

Since the overall contagion index may not implicate the importance due to the average effect, we analyze the contagion index by classification following the results of the network analysis. Note that all indexes are

Figure 9. Contagion Index of All Borrowers and by Gender

Notes: The contagion index as the sum of fundamental default risk and default by contagion. In this sense, we can use as the fundamental default risk and the shared exposure, E_{ij}^* between institutions as the default risk by contagion.

standardized in the same manner. Right panel of Figure 9 depicts the contagion index by gender of the borrower. The two figures look similar but the female one has a slightly bigger fluctuation during the sample periods.

Figure 10 draws the contagion index for overdue borrowers, who are late more than 90 days paying back the interest, principal or both, and non-overdue ones. It is clear that most of the borrowers did not experience ‘an overdue’ notice, so that the non-overdue figure seems similarly to the overall index. However, overdue borrowers’ contagion was still high even, after the overall level fell after 2013Q1. It is still early to generalize the behavior of overdue borrowers’ contagion index.

Panel A in Figure 11 is for the contagion index by credit ratings. We classify borrowers by credit score following Jung and Kim (2018). The lower the number, the better the credit rating is. As expected, a low credit holder has a higher contagion index and rest of them look to follow the overall index. However, mid-level credit rating holders seem to have a more stable index those with higher credit scores. In particular, borrowers in grade 1 record the highest contagion level since 2015, and

Figure 10. Contagion Index by Overdue¹⁾

Note: 1) 'Overdue' is the borrower who are late to pay the interest more than 90 days in each period and 'Non-overdue' are ones who are not in 'Overdue'. See notes to Figure 9

it seems that borrowers in this group have more loans than other groups, because they are eligible to borrow. Since we do not have enough information, we doubt that most of the loans made by that group after 2015 are mortgage. Panel B of Figure 11 depicts the index used by loan corporations. Interestingly, the index without loans from loan corporations rose in 2014 and then fell afterward. This rise seems to have been temporary since we believe that the index with loans may produce a higher contagion level because more desperate and risky consumer borrows money from them.

Panel A of Figure 12 draws the index by employment status and business type of self-employed borrowers in the manner of Jung and Kim (2018). Employment status divides a borrower's employment into self-employed, and non-self-employed, which includes "not employed". The contagion effect from self-employed borrowers does not fluctuate over the sample period, except in 2015 when the index fell temporarily. Among self-employed borrowers, we classify them by business type following the Korean Standard Industry Classification (KSIC) system, which

Figure 11. Contagion Index by Credit Ratings and Use of Loan Corporation¹⁾

Note: 1) See notes to Figure 9

was updated in 2017.

For brevity, Panel B of Figure 12 shows the results of selected industries where enough samples were involved. The industries considered herein are manufacturing, wholesale and retail sales, hotels and restaurants, and real estate. The contagion effect of the four industries picked up in 2014 but fell quickly and then became stabilized afterward.

IV. Scenario Analysis

We perform a scenario analysis to observe how the systemic risk spreads due to an exogenous shock, such as a monetary policy or housing price change. We suppose a range of possible scenarios and examine the effects on systemic risk in financial network. We assume that the exogenous shock is made at the end, or one period before the end, of the sample period, and construct two scenarios depending on the direction of monetary policy: (1) raise 25 basis points and keep the rate steady in the next period, (2) raise 25 basis points in consecutive periods. For example, in scenario (1), we suppose that the interest rate is raised by 25 basis points in one quarter before the end

Figure 12. Contagion Index by Employment Status and Business Type¹⁾

Note: 1) See notes to Figure 9. In panel (b) C, G, I and J stand for manufacturing, wholesale and retail distribution, hotels and restaurants, and real estate, respectively.

of sample, 2017Q2. On the other hand, since households are holding most of their debt as mortgages we suppose two scenarios regarding this: (3) housing prices in Seoul metropolitan area picks up by 1% in the last two periods, (4) housing price in Seoul metropolitan area drop by 1% in the last two periods. We assess the effect of monetary policy and housing price shocks in a '*ceteris paribus*' manner.

In scenario (1), the interest rate is raised by 25 basis points and is kept at that level during the next quarter. In the results, we can expect that financial institutions will get a larger burden from debtors when other things are equal. It is expressed directly in the contagion effects as seen in Panel (a) of Figure 13. Comparing with Figure 9, in this scenario, the contagion index picks up in the last two quarters. This means that the contractionary monetary policy negatively affects on financial stability, as expected. A more interesting question regarding the effect of monetary policy is in the network of financial institutions and types of debtors. Panel (a) of Figure 14 depicts the network of financial institutions by expected shared exposure in scenario 1 in 2017Q2. The overall framework of the network is not much different from the situation

Figure 13. Contagion Index by Scenarios¹⁾

Note: 1) See notes to Figure 9

without the monetary policy, but a thick connection is found in the inner network. That is, a contractionary monetary policy may strengthen linkages inside the network. In Figure 15, we depicts the network of financial institutions when we observe self-employed borrowers who are shown to be more fragile, as in Jung and Kim (2018). As shown in Figure A.6, more burdens are condensed in savings banks. The size of the main player in this network gets bigger as monetary policy was implemented, and the connectivity among those key components are also strengthened. In scenario (2), a more contractionary monetary policy is implemented so that the base rate is raised by 25 basis points twice,

Figure 14. Network of Financial Institution by Expected Exposure in Selected Quarters¹⁾

Note: 1) See notes to Figure 7

consecutively. As shown in Panel (b) of Figure 14, overall network is not significantly different from scenario 1. However, according to Panel (b) of Figure 13, the contagion index picks up more than in scenario 1. We confirm that the network of financial institutions and the contagion effects among them are sensitive to the monetary policy.

On the other hand, we see the effects of housing price changes in the sense that the biggest portion of household debt comes from a household's mortgage. In Korea, housing prices are usually highest in the metropolitan area around Seoul, so we suppose the price in those areas changes. In scenario 3, where the housing prices in Seoul metro

Figure 15. Network of Financial Institution by Expected Exposure in Selected Quarters[self-employed households]¹⁾

(a) Scenario 1 in 2017 Q2

(b) Scenario 2 in 2017 Q2

(c) Scenario 3 in 2017 Q2

(d) Scenario 4 in 2017 Q2

Note: 1) See notes to Figure 7

area pick up by 1% during the most recent two periods, contagion index also picks up. And the magnitude of the effect is not as severe as the monetary policy, as shown in Panel (c) of Figure 13. Network connection seems to be affected in a limited level. Connection among financial institution are also strengthened marginally but the size of burden by individual institutions are slightly lowered than the original observation. The network of self-employed workers are not seriously affected by the changes in housing price, as expected and it is revealed well in panel (c) of Figure 15. In scenario 4, we lower the housing price in the metro area by 1% in last two quarters. We confirmed that the housing price have a negative effect on the contagion index, as seen in Panel (d) of Figure 13. And, same as in scenario 3,

self-employed network is not significantly affected by the price of house even in scenario 4. The results of above two scenarios may be against the common sense which is believed for financial risk to rise when the value of collaterals drops since the institution may not collect loans fully. However, the financial risk in this analysis is measured from the consumer's prospective and therefore as the housing price rise the amount of loan can rises. In result, more amounts of loans means that borrowers have to borrow from more sources and it raise the contagion risk in the financial system. Since we analyze in 'status quo' manner, this relationship between housing price and network risk should be interpreted in a limited way. Note that our systemic risk model is based on a static framework so that the result in this analysis has limits due to the second round shock. Nevertheless, the result is worth to review that our speculation about the effect of shock to financial system confirms in our partial equilibrium model. More precise analysis can be made in the general equilibrium model and we leave it for the future research.

V. Concluding Remarks

We investigate the network of financial institution in Korea using Korea Consumer Credit Panel (KCCP). The main contribution of this paper is that we construct the network of financial institution from consumer credit level. We construct the network of financial institution from 2012 when KCCP had been established. Combined with the default probability from Jung and Kim (2018), we construct how much risky the asset that each institution and two or more of them hold simultaneously. As expected, more than a half of total amount loan is made from commercial banks so that the influence of commercial banks are quite large in the network and always locates in the center of the network. Interesting result is that the biggest linkage turns out to be the link between commercial banks and credit cards company. Due to

convenience of short-term loan from credit card company, this link looks strong but if we weight the amount of loan in the network, this link is not as strong as in previous case, because the short-term loan from credit card company is usually under 300,000 Korean won (worth of about 270 US dollars). Using consumer's default probability, inspired from Jung and Kim (2018), we compute expected exposure by institutions. In result, the link between saving bank and credit card company is getting bigger over time. And the link between commercial and saving bank, commercial bank and agricultural and fisheries union is in higher level than any other linkage. Overall linkages among financial institution turn out to be strong in commercial banks-agricultural and fisheries union-non credit card finance corporations-merchant banking, investment trust-guarantee organization and post bank. Contagion index, constructed using the aggregate value of risk shared by institutions, had risen up during 2012-2013Q2 and then fell down gradually until 2015Q3. After then, there are small fluctuation in the level and keep to be in relatively lower level. Then we perform the scenario analysis for robustness of our framework. We suppose exogenous shocks such as monetary policy and housing price change. In result, contractionary monetary policy makes the inner part of the network to be more dense and raise the contagion effect in the network. Contagion effect reacts positively to increase in housing price but it doesn't seem sensitive to housing price decrease.

For more precise investigation regarding consumer credit, assets held by households should be updated, for example, in case of measuring the effect of housing price on consumer credit. And the current panel is also reorganized in household units. Since both of consideration needs lots of data work, we hope to develop our analysis to more advanced level.

References

- Acharya, V. V., Pedersen, L. H., Philippon, T., and Richardson, M. (2017). “Measuring systemic risk,” *The Review of Financial Studies*, Vol. 30(1), pp. 2–47.
- Allen, F., and Gale, D. (2000). “Financial contagion,” *Journal of Political Economy*, Vol. 108(1), pp. 1–33.
- Amini, H., Cont, R., and Minca, A. (2012). “Stress testing the resilience of financial networks,” *International Journal of Theoretical and Applied Finance*, Vol. 15(1), pp. 1–20.
- Amini, H., Cont, R., and Minca, A. (2016). “Resilience to contagion in financial networks,” *Mathematical Finance*, Vol. 26(2), pp. 329–365.
- Battiston, S., Gatti, D. D., Gallegati, M., Greenwald, B., and Stiglitz, J. E. (2012). “Liaisons dangereuses: Increasing connectivity, risk sharing, and systemic risk,” *Journal of Economic Dynamics and Control*, Vol. 36(8), pp. 1121–1141.
- Choi, K. W., Hyung, N. W., and Jung, W. K. (2015). “Measuring credit risk and systemic risk in the korean financial market,” *Sogang Economic Papers*, Vol. 44(2), pp. 1–42.
- Clauset, A., Shalizi, C. R., and Newman, M. E. J. (2009). “Power-law distributions in empirical data,” *SIAM Review*, Vol. 51(4), pp. 661–703.
- Cont, R., and Moussa, A. (2010). “Too interconnected to fail: contagion and systemic risk in financial networks,” Technical report, Financial Engineering Report 2010-03, Columbia University.
- Cont, R., Moussa, A., and Santos, E. (2010). “Network structure and systemic risk in banking systems,” Technical report, Columbia University Working Paper.

- Das, S. (2016). “Matrix metrics: Network-based systemic risk scoring,” *Journal of Alternative Investments, Special Issue on Systemic Risk*, Vol. 18(4), pp. 33–51.
- Elsinger, H., Lehar, A., and Summer, M. (2006a). “Risk assessment for banking systems,” *Management Science*, Vol. 52(9), pp. 1301–1314.
- Elsinger, H., Lehar, A., and Summer, M. (2006b). “Systemically important banks: an analysis for the european banking system,” *International Economics and Economic Policy*, Vol. 3(1), pp. 73–89.
- Freixas, X., Parigi, M., and Rochet, J. (2000). “Systemic risk, interbank relations and liquidity provision by the central bank,” *Journal of Money Credit and Banking*, Vol. 32(3), pp. 611–638.
- Furfine, C. (2003). “Interbank exposures: Quantifying the risk of contagion,” *Journal of Money, Credit and Banking*, Vol. 35(1), pp. 111–128.
- Gai, P., and Kapadia, S. (2010). “Contagion in financial networks,” *Proceedings of the Royal Society A*, Vol. 466(2120), pp. 2401–2423.
- Hellwig, M. (2009). “Systemic risk in the financial sector: An analysis of the subprime-mortgage financial crisis,” *De Economist*, Vol. 157(2), pp. 129–207.
- Huang, X., Zhou, H., and Zhu, H. (2009). “A framework for assessing the systemic risk of major financial institutions,” *Journal of Banking and Finance*, Vol. 33(11), pp. 2036–2049.
- Jung, H., and Kim, H. H. (2018). “Default probability by employment status in Korea,” Technical report, Kookmin University Working Paper.
- Kim, J., Pyun, D., Ahn, S., and Lee, S. (2016). “Network based financial systemic risk analysis,” *Review of Financial Information Studies*, Vol. 7(2), pp. 29–53.

- Lee, G. H., Lee, M. H., and Lee, J. H. (2013). “Measuring the systemic risk in the korean banking sector; the copula approach,” *Journal of Money and Finance*, Vol. 27(2), pp. 81–123.
- Mistrulli, P. E. (2007). “Assessing nancial contagion in the interbank market: Maximum entropy versus observed interbank lending patterns,” Technical report, Bank of Italy Research Paper Series 641, Bank of Italy, Economic Research Department.
- Niera, E., Yang, J., Yorulmazer, T., and Alentorn, A. (2007). “Network models and financial stability,” *Journal of Economic Dynamics and Control*, Vol. 31(6), pp. 2033–2060.
- Suh, S. W. (2011). “Measuring systemic risk of korean banking sector,” *Journal of Money and Finance*, Vol. 25(2), pp. 57–81.
- Upper, C. (2011). “Simulation methods to assess the danger of contagion in interbank markets,” *Journal of Financial Stability*, Vol. 7(3), pp. 111–125.
- Upper, C., and Worms, A. (2004). “Estimating bilateral exposures in the german interbank market: Is there a danger of contagion?” *European Economic Review*, Vol. 48(4), pp. 827–849.
- Wooldridge, J. (2005). “Simple solutions to the initial conditions problem in dynamic, nonlinear panel data models with unobserved heterogeneity,” *Journal of Applied Econometrics*, Vol. 20(1), pp. 39–54.

Appendix

A Financial Network by Groups

The connectivity of financial institution may vary along with specified groups, such as bad credit scores or the use of loan corporation's loan. In this sense, we construct a network of financial institution for specified groups to identify which group have more fragile network than others. Figures A.1 and A.2 depict the linkages among financial institutions by balance of loans shared depending on the gender. As shown in Table 1, male borrower consists 61% of the sample and connections for male borrowers are denser than for females. It indicates that female borrowers relatively take out loans from multiple sources, whereas male borrowers usually borrow from the first vendor, a commercial bank.

Figure A.3 shows the network of borrowers who are overdue, that is, who are late in paying the interest or principle by more than 90 days. According to the figure, those type of borrowers still have a large amount of loans from banks and the connections with other institutions have been strong since before 2016. However, these connections faded over time. This means that those who are in default cannot take out a loan at an other institution and the contagion effect due to them becomes weaker.

Figure A.4 is the network by the credit score. For brevity, we introduced only a select number of the credit score groups in given period (2017Q2), but the rest of result can be provided by reader's request. In the better credit score group (1 and 3), you can see the influence of saving banks, which is bigger than commercial banks. However, the size of the circle means that solely the effect of the certain institution, whereas the width of the branch means the effect of the contagion. That is, the weak connection between them indicates that borrowers from two institutions are distinctive, even though they have homogeneous credit score. In Panel C and D, for lower credit

group (4 and 6), the connection is not as strong as the others because they are less eligible to borrow from financial institutions. Credit score 7~10 is almost impossible to keep financial activity so that we exclude them in this figure.

If borrowers are not eligible to borrow from conventional financial institutions listed herein, they can still borrow from loan corporations, of course, at higher interest rates. Since those are not registered as official financial institutions, they are also called “private loans”. If people borrow from those institutions, they are extremely desperate and are believed to have a high probability of default. Figure A.5 constructs the financial network with only those borrowers. They still have a large amount of loans from commercial banks and the connection is strong with non-banking financial institutions such as credit card companies, financing companies, or guarantee corporations (F8~F10)

Figure A.6 depicts the network of financial institution for borrowers who run their own business, so-called self-employed borrowers. This type of borrower take out personal loans and pays them back as a corporate unit. They have multiple kinds of loans, so that they are considered more vulnerable than others. In 2012, their contagion effect was not that strong, but in 2014, more loans were made out to them from saving banks and the network contracted. This means that the connectivity between financial institutions is getting stronger over time, while more loans are made from saving bank to self-employed borrowers.

Self-employed borrowers may have a different strategy in borrowing, too, and it can cause different effects on the network. In this sense, we draw that network by the borrower’s business type, as shown in Figure A.7.

Figure A.1. Network of Financial Institution by Expected Exposure in Selected Quarters[male borrowers]¹⁾

Note: 1) See notes to Figure 7

Figure A.2. Network of Financial Institution by Expected Exposure in Selected Quarters[female borrowers]¹⁾

Note: 1) See notes to Figure 7

Figure A.3. Network of Financial Institution by Expected Exposure in Selected Quarters[overdue]¹⁾

Note: 1) See notes to Figure 7

Figure A.4. Network of Financial Institution by Expected Exposure in 2017 Q2[credit score]¹⁾

Note: 1) See notes to Figure 7

Figure A.5. Network of Financial Institution by Expected Exposure in Selected Quarters[use of loan corp.'s loan]¹⁾

Note: 1) See notes to Figure 7

Figure A.6. Network of Financial Institution by Expected Exposure in Selected Quarters[self-employed borrowers]¹⁾

Note: 1) See notes to Figure 7

Figure A.7. Network of Financial Institution by Expected Exposure in 2017 Q2[self-employed borrowers' business type]¹⁾

(a) Manufacturing 2017 Q2

(b) Wholesale and retails, 2017 Q2

(c) Hotels and restaurant, 2017 Q2

(d) Real estates, 2017 Q2

Note: 1) See notes to Figure 7

<Abstract in Korean>

금융업권별 소비자신용 네트워크를 활용한 시스템 리스크 분석

김현학*, 정호성**

본고에서는 한국은행 보유 가계부채 패널자료(2012년 1분기~2017년 2분기)가 나타내는 개별 차주의 대출정보를 이용하여 개별 차주에 따른 금융기관간 연계정도를 파악하고 다수의 금융기관을 이용하는 개별 차주가 유발하는 시스템리스크를 추정하였다. 또한 차주별 부도확률을 이용하여 개별 차주 부도시 금융기관의 예상손실액을 추정하고 이를 이용하여 개별 차주가 유발하는 금융기관의 리스크 전이수준을 바탕으로 금융기관간 전이지표(contagion index)를 측정하여 우리나라의 시스템리스크를 추정하였다. 그 결과, 금융네트워크로 표현된 차주 대출은 은행과 신용카드사간 연계가 강한 반면, 저축은행과 신용카드사간 차주의 부실 연계가 증가하고 있으며, 은행-저축은행, 은행-농·수·축협과의 부실 연계도 여타 연결고리에 비해 단단한 것으로 나타났다. 전이지표 추이를 살펴보면 2013년 2분기까지 상승하다가 2015년 3분기부터 점차 하락한 후 2017년 2분기부터 상승세를 보이고 있다. 본고의 결과는 개별차주가 유발하는 기대손실의 금융업권간 연결정도 및 전이지수를 통해 금융당국은 금융시장의 시스템리스크를 모니터링 할 수 있게하며, 본 논문에서 제시한 시스템리스크는 금융기관간 대차거래가 아닌 복수 금융기관과 거래하는 차주의 대출 및 기대손실액을 바탕으로 추정하였다는 점에서 기존 연구와 차별성이 있다.

핵심 주제어: 시스템 리스크, 네트워크 분석, 소비자신용, 금융안정

JEL Classification: C23, D14, G20, G21, G23

* 국민대학교 경제학부 부교수 (전화: 02-910-4541, E-mail: hyunhak.kim@kookmin.ac.kr)

** 한국은행 경제연구원 금융통화연구실 연구위원 (전화: 02-759-5308, E-mail: hschung@bok.or.kr)

이 연구내용은 집필자의 개인의견이며 한국은행의 공식견해와는 무관합니다. 따라서 본 논문의 내용을 보도하거나 인용할 경우에는 집필자명을 반드시 명시하여주시기 바랍니다.

BOK 경제연구 발간목록

한국은행 경제연구원에서는 Working Paper인 『BOK 경제연구』를 수시로 발간하고 있습니다. 『BOK 경제연구』는 주요 경제 현상 및 정책 효과에 대한 직관적 설명 뿐 아니라 깊이 있는 이론 또는 실증 분석을 제공함으로써 엄밀한 논증에 초점을 두는 학술논문 형태의 연구이며 한국은행 직원 및 한국은행 연구용역사업의 연구 결과물이 수록되고 있습니다. 『BOK 경제연구』는 한국은행 경제연구원 홈페이지(<http://imer.bok.or.kr>)에서 다운로드하여 보실 수 있습니다.

제2016 -1	The Spillover Effects of U.S. Monetary Policy on Emerging Market Economies: Breaks, Asymmetries and Fundamentals	Geun-Young Kim · Hail Park · Peter Tillmann
2	Pass-Through of Imported Input Prices to Domestic Producer Prices: Evidence from Sector-Level Data	JaeBin Ahn · Chang-Gui Park · Chanho Park
3	Spillovers from U.S. Unconventional Monetary Policy and Its Normalization to Emerging Markets: A Capital Flow Perspective	Sangwon Suh · Byung-Soo Koo
4	Stock Returns and Mutual Fund Flows in the Korean Financial Market: A System Approach	Jaebeom Kim · Jung-Min Kim
5	정책금리 변동이 성별·세대별 고용률에 미치는 영향	정성엽
6	From Firm-level Imports to Aggregate Productivity: Evidence from Korean Manufacturing Firms Data	JaeBin Ahn · Moon Jung Choi
7	자유무역협정(FTA)이 한국 기업의 기업내 무역에 미친 효과	전봉걸 · 김은숙 · 이주용
8	The Relation Between Monetary and Macroprudential Policy	Jong Ku Kang
9	조세피난처 투자자가 투자 기업 및 주식시장에 미치는 영향	정호성 · 김순호
10	주택실거래 자료를 이용한 주택부문 거시건전성 정책 효과 분석	정호성 · 이지은
11	Does Intra-Regional Trade Matter in Regional Stock Markets?: New Evidence from Asia-Pacific Region	Sei-Wan Kim · Moon Jung Choi
12	Liability, Information, and Anti-fraud Investment in a Layered Retail Payment Structure	Kyoung-Soo Yoon · Jooyong Jun
13	Testing the Labor Market Dualism in Korea	Sungyup Chung · Sunyoung Jung
14	북한 이중경제 사회계정행렬 추정을 통한 비공식부문 분석	최지영

제2016 –15	Divergent EME Responses to Global and Domestic Monetary Policy Shocks	Woon Gyu Choi • Byongju Lee • Taesu Kang • Geun-Young Kim
16	Loan Rate Differences across Financial Sectors: A Mechanism Design Approach	Byoung-Ki Kim • Jun Gyu Min
17	근로자의 고용형태가 임금 및 소득 분포에 미치는 영향	최충 • 정성엽
18	Endogeneity of Inflation Target	Soyoung Kim • Geunhyung Yim
19	Who Are the First Users of a Newly-Emerging International Currency? A Demand-Side Study of Chinese Renminbi Internationalization	Hyoung-kyu Chey • Geun-Young Kim • Dong Hyun Lee
20	기업 취약성 지수 개발 및 기업 부실화에 대한 영향 분석	최영준
21	US Interest Rate Policy Spillover and International Capital Flow: Evidence from Korea	Jieun Lee • Jung-Min Kim • Jong Kook Shin
제2017 –1	가계부채가 소비와 경제성장에 미치는 영향 – 유량효과와 저장효과 분석 –	강종구
2	Which Monetary Shocks Matter in Small Open Economies? Evidence from SVARs	Jongrim Ha • Inhwan So
3	FTA의 물가 안정화 효과 분석	곽노선 • 임호성
4	The Effect of Labor Market Polarization on the College Students' Employment	Sungyup Chung
5	국내 자영업의 폐업을 결정요인 분석	남윤미
6	차주별 패널자료를 이용한 주택담보대출의 연체요인에 대한 연구	정호성
7	국면전환 확산과정모형을 이용한 콜금리행태 분석	최승문 • 김병국

제2017-8	Behavioral Aspects of Household Portfolio Choice: Effects of Loss Aversion on Life Insurance Uptake and Savings	In Do Hwang
9	신용공급 충격이 재화별 소비에 미치는 영향	김광환 · 최석기
10	유가가 손익분기인플레이션에 미치는 영향	김진용 · 김준철 · 임형준
11	인구구조변화가 인플레이션의 장기 추세에 미치는 영향	강환구
12	종합적 상환여건을 반영한 과다부채 가계의 리스크 요인 분석	이동진 · 한진현
13	Crowding out in a Dual Currency Regime? Digital versus Fiat Currency	KiHoon Hong · Kyounghoon Park · Jongmin Yu
14	Improving Forecast Accuracy of Financial Vulnerability: Partial Least Squares Factor Model Approach	Hyeongwoo Kim · Kyunghwan Ko
15	Which Type of Trust Matters?: Interpersonal vs. Institutional vs. Political Trust	In Do Hwang
16	기업특성에 따른 연령별 고용행태 분석	이상욱 · 권철우 · 남윤미
17	Equity Market Globalization and Portfolio Rebalancing	Kyungkeun Kim · Dongwon Lee
18	The Effect of Market Volatility on Liquidity and Stock Returns in the Korean Stock Market	Jieun Lee · KeeH.Chung
19	Using Cheap Talk to Polarize or Unify a Group of Decision Makers	Daeyoung Jeong
20	패스트트랙 기업회생절차가 법정관리 기업의 이자보상비율에 미친 영향	최영준
21	인구고령화가 경제성장에 미치는 영향	안병권 · 김기호 · 육승환
22	고령화에 대응한 인구대책: OECD사례를 중심으로	김진일 · 박경훈

제2017 -23	인구구조변화와 경상수지	김경근 · 김소영
24	통일과 고령화	최지영
25	인구고령화가 주택시장에 미치는 영향	오강현 · 김솔 · 윤재준 · 안상기 · 권동휘
26	고령화가 대외투자에 미치는 영향	임진수 · 김영래
27	인구고령화가 가계의 자산 및 부채에 미치는 영향	조세형 · 이용민 · 김정훈
28	인구고령화에 따른 우리나라 산업구조 변화	강종구
29	인구구조 변화와 재정	송호신 · 허준영
30	인구고령화가 노동수급에 미치는 영향	이철희 · 이지은
31	인구 고령화가 금융산업에 미치는 영향	윤경수 · 차재훈 · 박소희 · 강선영
32	금리와 은행 수익성 간의 관계 분석	한재준 · 소인환
33	Bank Globalization and Monetary Policy Transmission in Small Open Economies	Inhwan So
34	기존 경영자 관리인(DIP) 제도의 회생기업 경영성과에 대한 영향	최영준
35	Transmission of Monetary Policy in Times of High Household Debt	Youngju Kim · Hyunjoon Lim
제2018 -1	4차 산업혁명과 한국의 혁신역량: 특허자료를 이용한 국가기술별 비교 분석, 1976-2015	이지홍 · 임현경 · 정대영
2	What Drives the Stock Market Comovements between Korea and China, Japan and the US?	Jinsoo Lee · Bok-Keun Yu
3	Who Improves or Worsens Liquidity in the Korean Treasury Bond Market?	Jieun Lee

제2018-4	Establishment Size and Wage Inequality: The Roles of Performance Pay and Rent Sharing	Sang-yoon Song
5	가계대출 부도요인 및 금융업권별 금융취약성: 자영업 차주를 중심으로	정호성
6	직업훈련이 청년취업률 제고에 미치는 영향	최충 · 김남주 · 최광성
7	재고투자와 경기변동에 대한 동학적 분석	서병선 · 장근호
8	Rare Disasters and Exchange Rates: An Empirical Investigation of Korean Exchange Rates under Tension between the Two Koreas	Cheolbeom Park · Suyeon Park
9	통화정책과 기업 설비투자 - 자산가격경로와 대차대조표경로 분석 -	박상준 · 육승환
10	Upgrading Product Quality: The Impact of Tariffs and Standards	Jihyun Eum
11	북한이탈주민의 신용행태에 관한 연구	정승호 · 민병기 · 김주원
12	Uncertainty Shocks and Asymmetric Dynamics in Korea: A Nonlinear Approach	Kevin Larcher · Jaebeom Kim · Youngju Kim
13	북한경제의 대외개방에 따른 경제적 후생 변화 분석	정혁 · 최창용 · 최지영
14	Central Bank Reputation and Inflation-Unemployment Performance: Empirical Evidence from an Executive Survey of 62 Countries	In Do Hwang
15	Reserve Accumulation and Bank Lending: Evidence from Korea	Youngjin Yun
16	The Banks' Swansong: Banking and the Financial Markets under Asymmetric Information	Jungu Yang

제2018-17	E-money: Legal Restrictions Theory and Monetary Policy	Ohik Kwon · Jaevin Park
18	글로벌 금융위기 전·후 외국인의 채권투자 결정요인 변화 분석: 한국의 사례	유복근
19	설비자본재 기술진보가 근로유형별 임금 및 고용에 미치는 영향	김남주
20	Fixed-Rate Loans and the Effectiveness of Monetary Policy	Sung Ho Park
21	Leverage, Hand-to-Mouth Households, and MPC Heterogeneity: Evidence from Korea	Sang-yoon Song
22	선진국 수입수요가 우리나라 수출에 미치는 영향	최문정 · 김경근
23	Cross-Border Bank Flows through Foreign Branches: Evidence from Korea	Youngjin Yun
24	Accounting for the Sources of the Recent Decline in Korea's Exports to China	Moon Jung Choi · Kei-Mu Yi
25	The Effects of Export Diversification on Macroeconomic Stabilization: Evidence from Korea	Jinsoo Lee · Bok-Keun Yu
26	Identifying Uncertainty Shocks due to Geopolitical Swings in Korea	Seohyun Lee · Inhwan So · Jongrim Ha
27	Monetary Policy and Income Inequality in Korea	Jongwook Park
28	How the Financial Market Can Dampen the Effects of Commodity Price Shocks	Myunghyun Kim
29	Which External Shock Matters in Small Open Economies? US Economic Policy Uncertainty vs. Global Risk Aversion	Youngju Kim · Hyunjoon Lim
30	Do Korean Exports Have Different Patterns over Different Regimes?: New Evidence from STAR-VECM	Sei-Wan Kim · Moon Jung Choi
31	기술진보와 청년고용	심명규 · 양희승 · 이서현

제2018-32	북한지역 장기주택수요 및 연관 주택건설투자 추정	이주영
33	기업규모간 임금격차 원인 분석	송상윤
34	우리나라 고용구조의 특징과 과제	장근호
35	창업의 장기 고용효과: 시군구 자료 분석	조성철 · 김기호
36	수출입과 기업의 노동수요	음지현 · 박진호 · 최문정
37	청년실업의 이력현상 분석	김남주
38	노동시장 이중구조와 노동생산성: OECD 국가를 중심으로	최충 · 최광성 · 이지은
39	한국과 일본의 청년실업 비교분석 및 시사점	박상준 · 김남주 · 장근호
40	노동시장의 이중구조와 정책대응: 해외사례 및 시사점	전병유 · 황인도 · 박광용
41	최저임금이 고용구조에 미치는 영향	송헌재 · 임현준 · 신우리
42	최저임금과 생산성: 우리나라 제조업의 사례	김규일 · 육승환
43	Transmission of U.S. Monetary Policy to Commodity Exporters and Importers	Myunghyun Kim
44	Determinants of Capital Flows in the Korean Bond Market	Soohyon Kim
45	Central Bank Credibility and Monetary Policy	Kwangyong Park
46	통화정책이 자본유출입에 미치는 영향: 행태방정식 분석	이명수 · 송승주

제2018 –47	Commodities and International Business Cycles	Myunghyun Kim
제2019 –1	Deciphering Monetary Policy Board Minutes through Text Mining Approach: The Case of Korea	Ki Young Park • Youngjoon Lee • Soohyon Kim
2	The Impacts of Macroeconomic News Announcements on Intraday Implied Volatility	Jieun Lee • Doojin Ryu
3	Taking a Bigger Slice of the Global Value Chain Pie: An Industry-level Analysis	Chong-Sup Kim • Seungho Lee • Jihyun Eum
4	Trend Growth Shocks and Asset Prices	Nam Gang Lee
5	Uncertainty, Attention Allocation and Monetary Policy Asymmetry	Kwangyong Park
6	Central Bank Digital Currency and Financial Stability	Young Sik Kim • Ohik Kwon
7	은행의 수익 및 자산구조를 반영한 통화정책 위험선호경로	김익진 • 정호성
8	혁신기업에 대한 산업금융 지원: 이론모형 분석	강경훈 • 양준구
9	가계부채 제약하의 통화정책: 2주체 거시모형(TANK)에서의 정량적 분석	정용승 • 송승주
10	Alchemy of Financial Innovation: Securitization, Liquidity and Optimal Monetary Policy	Jungu Yang
11	Measuring Monetary Policy Surprises Using Text Mining: The Case of Korea	Youngjoon Lee • Soohyon Kim • Ki Young Park
12	Tracking Uncertainty through the Relative Sentiment Shift Series	Seohyun Lee • Rickard Nyman
13	Intra-firm and Arm's Length Trade during the Global Financial Crisis: Evidence from Korean Manufacturing Firms	Moon Jung Choi • Ji Hyun Eum

제2019-14	특허자료를 이용한 우리나라 지식전파의 지역화 분석	이지홍 · 남윤미
15	Overhead Labour and Skill-Biased Technological Change: The Role of Product Diversification	Choong Hyun Nam
16	Does the Number of Countries in an International Business Cycle Model Matter?	Myunghyun Kim
17	High-Frequency Credit Spread Information and Macroeconomic Forecast Revision	Bruno Deschamps · Christos Ioannidis · Kook Ka
18	경제 분석을 위한 텍스트 마이닝	김수현 · 이영준 · 신진영 · 박기영
19	Takeover, Distress, and Equity Issuance: Evidence from Korea	Euna Cho
20	The Cash-Flow Channel of Monetary Policy: Evidence from Mortgage Borrowers	Sang-yoon Song
21	부의 효과의 분위 추정: 분위 정준 공적분회귀를 중심으로	김기호
22	Identifying Government Spending Shocks and Multipliers in Korea	Kwangyong Park · Eun Kyung Lee
23	Systemic Risk of the Consumer Credit Network across Financial Institutions	Hyun Hak Kim · Hosung Jung