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Monetary Policy:
Evidence from Mortgage Borrowers

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The Cash-Flow Channel of Monetary Policy: Evidence from Mortgage Borrowers

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The Cash-Flow Channel of Monetary Policy: Evidence from Mortgage Borrowers

This paper investigates the relationships between consumption and mortgage interest reduction caused by an expansionary monetary policy, using comprehensive borrower-level information on mortgages and credit card purchases from a credit bureau company in South Korea. The main findings are as follows: (i) the significant and negative relationship between mortgagors' interest payments and consumption comes from borrowers with ARMs (Adjustable-Rate Mortgages), (ii) among mortgagors with ARMs, those with low liquidity and credit accessibility show a high interest-induced MPC (Marginal Propensity to Consume), (iii) the debt burdens of mortgagors have a weaker effect on the interest-induced MPC heterogeneity due to active deleveraging behavior of borrowers with a high debt burden, (iv) while unconstrained borrowers consistently show low and insignificant MPCs, constrained borrowers (those with low liquidity, credit accessibility) maintain long-lasting high MPCs for eight quarters after interest reduction, and (v) the MPC of those with low liquidity becomes lower as time goes by, indicating that windfall gains by mortgage interest reduction help to relax the liquidity constraints they face. These results imply that financial characteristics of mortgage borrowers can affect the magnitude and persistence of the cash flow channels of an expansionary monetary policy.

Keywords: Mortgage, Consumption, Monetary Policy, Household Debt

JEL Classification: D14, E21, E52

I . Introduction

It has long been sought to understand the channels through which the changes in monetary policy affect household consumption. A fundamental question on this issue is to what degree monetary policy affects aggregate demand. Recently, beyond the fundamental question, the heterogeneous effects of monetary policy on consumption have gotten much attention, focusing particularly on the cash-flow channel of monetary policy (e.g., Di Maggio et al., 2017; Floden et al., 2017; Jappelli and Scognamiglio, 2018). Despite efforts to figure out the heterogeneous effects via the cash-flow channel, researchers have met with difficulty in fully accounting for the sources of them due to insufficient data and potential measurement errors. In this paper, we investigate the heterogeneous effects of an expansionary monetary policy on mortgage borrowers' consumption across their financial characteristics, using comprehensive credit bureau data from South Korea.

A monetary loosening can affect mortgage borrowers' consumption via several channels.¹⁾ The decrease in interest rates raises the value of current consumption more than that of future consumption, which leads to an increase in aggregate consumption in the current period (the intertemporal substitution channel). The changes in asset prices can also affect mortgage borrowers' consumption. Lower interest rates can lead to a rise in asset prices, which is translated to increase the life-time resources of borrowers, that encourages them spend more (the wealth effect channel). The last one is the cash-flow channel, which is the main interest of this paper. A decline in interest rates can directly influence mortgage borrowers' cash flows through the reduction of interest expenses, which leads to an increase in their consumption.

To observe the cash flow channel of monetary policy, We examine whether the consumption of borrowers with Adjustable Rate Mortgages

1) For more general explanations about the channels through which the monetary policy affects household consumption, See Floden et al. (2017) and La Cava et al. (2016).

(ARMs) responds more sensitively to an expansionary monetary policy than those with Fixed Rate Mortgages (FRMs). If the cash flow channel works, borrowers with ARMs respond more sensitively to mortgage interest reductions than those with FRMs. After identifying the borrowers with ARMs who do show high correlation between their COFIX (Cost Of Fund Index) and their mortgage rates, we conduct regressions to capture the differential responses between ARM and FRM borrowers.²⁾ Next, we explore the heterogeneous interest-induced Marginal Propensity to Consume (MPC) for ARM borrowers by their liquidity, credit accessibility, and debt burden. Lastly, we investigate the persistence of interest-induced MPCs. Since an interest rate is an economic variable that shows high persistence, mortgage interest reductions are likely to affect the consumption of mortgage borrowers across a span of time. We check this possibility, using the local projection methodology of Jordà (2005).

Empirical results show that the significant and negative relationship between mortgagors' interest payments and consumption comes from the borrowers with ARMs. This implies that the share of ARMs can be a source of the transmission mechanism of monetary policy to the real economy. We also find the significant heterogeneity of consumption responses to the mortgage interest reductions across different types of mortgagors. Those who are faced by liquidity- or credit-constraints show higher interest-induced MPCs than others. That is, constrained borrowers use the windfall gains by interest reductions to spend rather than to pay down their mortgages, implying that these constraints hamper the attainment of an optimal consumption level for them. In terms of debt burden, those with a higher debt burden show lower interest-induced MPCs, and this is due to their active deleveraging behavior. Lastly, the persistence of the effects of interest reduction is also different across different types of mortgagors. While unconstrained borrowers (high liquidity or credit accessibility) have insignificant or short-term low

2) The COFIX is the main reference rate for Korean mortgage rates. See section III-2 for details.

interest-induced MPCs, constrained borrowers maintain the long-lasting high interest-induced MPCs for eight quarters after interest reductions. These results imply that financial characteristics of mortgage borrowers can affect both the magnitude and the persistence of the cash flow channels of an expansionary monetary policy.

Our study complements previous empirical studies in four ways. First, unlike some developed countries such as the U.S., South Korea has seen a high growth in household debt since the Great Recession and a high proportion of ARM borrowers.³⁾ These two situations provide us with good circumstances to explore mortgage borrowers' consumption responses to declines in interest rates. Second, we overcome several potential measurement error issues that other studies have. Compared to survey data, the card purchase data from the credit bureau company, which is a measure of consumption, have relatively small measurement errors, and include all kinds of consumption expenditure information. This means that card purchases by mortgage borrowers can be a good measure of their durable and non-durable consumption.⁴⁾ In terms of mortgage loans and their rates, our data are more accurate than previous studies. For instance, Floden et al. (2017) cannot identify mortgage loans in their data, and they assume that the main share of homeowners' debts consists of mortgage debt. Jappelli and Scognamiglio (2018) use self-reported mortgage rates that are likely to have large measurement errors. Third, the data used in this paper was gathered by a credit bureau company that has comprehensive information on loan- (e.g., principal and interest expenses and sectors in which the mortgages originate) and borrower-level

3) According to the OECD, while the household debt to net disposable income ratio dropped from 136.87% to 108.78% between 2008 and 2017 in the U.S., it rose from 143.27% to 185.88% in the corresponding periods in South Korea. In terms of ARM shares, according to the Bank of Korea and the Financial Supervisory Service of Korea, the average share of outstanding balances of fixed-rate mortgage loans was only 14.2% in the end of 2012.

4) The general payment method used in South Korea is a credit or debit card, regardless whether it's for durable or non-durable goods. According to a survey conducted by the Bank of Korea, about 70.2% of payment transactions were done with a card in 2014, and the share increased to 71.0% in 2016. This card transaction data for all card holders are gathered by credit bureau companies for the purposes of credit scoring.

characteristics (e.g., annual income and credit score). This allows us to analyze the heterogeneous effects of monetary policy on mortgage borrowers' consumption in several dimensions. Fourth, previous studies did not pay attention to the dynamic interest-induced MPCs. We estimate them using the local projection method of Jordà (2005), providing the implication on the persistence of cash flow channels induced by the expansionary monetary policy.

The remainder of this paper is structured as follows. In the next section, we review the literature related to our study. Section III introduces the data and main variables used in this study. We will provide details about the data, identification strategy for ARM borrowers, and some measures for key variables. Section IV describes the empirical methodology used in this paper. We report empirical findings in Section V, and Section VI concludes.

II. Literature Review

From a broad perspective, this paper is related to the theoretical studies on the effects of income changes on consumption. According to the traditional theory, such as the life-cycle and permanent income hypothesis model introduced by Modigliani and Brumberg (1954) and Friedman (1957), anticipated and transitory income shocks should not affect consumption. Furthermore, some papers theoretically show the effects of financial constraints on consumption responses to income changes. Deaton (1991) represents that, in the presence of borrowing constraints, consumption of households can respond forcefully to income changes. Carroll and Kimball (1996) and Carroll (1997) show that households with a low income and wealth respond more sensitively to a positive income changes relative to households with a high income and wealth. More recently, Kaplan and Violante (2014) provide a theoretical background for the effects of liquidity constraints on MPC heterogeneity, using a life-cycle model with liquid and illiquid assets. Our empirical

works build on these theoretical predictions.

A number of empirical studies verify the theoretical prediction by using policy changes, such as tax rebates and Growth Dividend Program (e.g., Johnson et al., 2006; Jappelli and Pistaferri, 2014; Agarwal and Qian, 2014).⁵⁾ In addition, there is a variety of studies on the effects of financial characteristics on the relationship between income changes and consumption. Kaplan et al. (2014) focus on the effects of liquidity constraints to investigate differences in the MPCs among households by developing the concept of hand-to-mouth consumers. Baker (2018) and Mian et al. (2013) have analyzed the effects of a credit buffer on the MPC out of income or out of wealth. Furthermore, two recent papers have paid attention to MPC heterogeneity across the direction of income changes. Bunn et al. (2018) show that households with a liquidity shortage, credit constraints, and a higher risk of lower income in the future have higher MPCs after a negative income changes than a positive one. Christelis et al. (2017) show that in the presence of liquidity constraints, the MPC that results from negative income changes is larger than that from positive ones. These results imply that the interest-induced MPCs are also asymmetric by the direction of monetary policy, and thus the results of this paper have to be interpreted in case of an expansionary monetary policy.

There is a relatively small body of literature that investigates the relationship between mortgage interest reduction and consumption. La Cava et al. (2016) show that the borrower cash flow channel is stronger than the lender cash flow channel in times of interest rate reductions, which lead to higher aggregate spending in the case of Australia. Floden et al. (2017) show that the consumption of highly indebted homeowners with ARMs responds more sensitively to a change in the monetary policy rate. Di Maggio et al. (2017) show that a decline in mortgage payments associated with a drop in interest rates causes a significant increase in car

5) See Jappelli and Pistaferri (2010) and Jappelli and Scognamiglio (2018) for more detailed reviews of this issue.

purchases by focusing on mortgage borrowers who experience the resets of their mortgage rates from fixed- to adjustable-rates in the U.S. They also reveal the heterogeneous responses of car purchases to a decline in mortgage payments across households' income, loan-to-value (LTV) ratios, and FICO scores. Unlike these two studies, Jappelli and Scognamiglio (2018) show the insignificant differences of consumption responses ARM and FRM borrowers to a reduction in interest rates in the case of Italy. They reveal that this is because the positive income changes, associated with a reduction of mortgage rates, are perceived as temporary and they are counterbalanced by a drop in income from financial assets.

III. Data and Main Variables

1. Data and Sample Selection

Data The data used in this paper come from one of the main credit bureau companies in South Korea, Nice Information Service. The credit bureau company has loan-level data for all segments of the Korean population that have debt, including detailed information about credit card transactions, as well as mortgages. The 5 percent random sample of data that was used was anonymized for the removal of personal identifying information and provided to the Bank of Korea (BOK) on a quarterly frequency for the purpose of monitoring the stability of the household debt market and for academic research. Specifically, the data used in this paper consist of three sets. The first is loan-level information, including deidentified borrower ID, financial sector (e.g., commercial bank and saving bank), principal, interest payment, balance, and default status of each mortgage. The second is borrower-level information, such as age group, credit score, and annual income of the mortgage borrower. The third is the information about card purchases, including the credit card limit and a history of credit and debit card purchases. To combine these datasets into one borrower-level dataset, we

first aggregate the loan-level data to borrower-level data, and then connect the three datasets using borrower IDs and time variables.⁶⁾ Our data cover from the first quarter of 2012 to the third quarter of 2017, during which time the monetary policy was expansionary.

Sample Selection Before combining these datasets, we restrict our attention to obtain our analysis samples. We first drop any mortgage loans in arrears that account for about 2.4 percent of the dataset. Since the borrowers with mortgage loans in arrears are not paying their interest, their mortgage rates may not be associated with their consumption behavior. We also exclude about 11.1 percent of mortgage loans from our dataset because they have increasing loan rates within the sample period. As mentioned in the introduction, since the purpose of this study is to analyze the effects of an expansionary monetary policy on consumption, those who show rising mortgage rates for whatever reason (e.g., a drop in their credit score) are not suitable for our study.⁷⁾ Furthermore, some outliers are dropped. We first eliminate the mortgages with changes in the mortgage rate within the sample period that was greater than 7.2 percentage points (1 percent of the outliers). In addition, in the credit card usage dataset, we drop the borrowers with the top 1 percent (greater than 4.98) and the bottom 1 percent of outliers (lower than -0.98) in terms of growth in credit card use. We treat such borrowers as extreme outliers or even as measurement errors. After these processes, we aggregate loan-level data into a borrower-level dataset, and then combine the three datasets. In the combined unbalanced panel dataset, we restrict our analysis to borrowers who appear in the sample

6) The difference between loan- and borrower-level data comes from those with more than one mortgage. To aggregate the loan-level data to borrower-level data, we sum principals, interest payments and balances of mortgage borrowers who have more than one mortgage.

7) Moreover, several recent studies show the significant of MPC asymmetry by the direction of income changes (e.g., Bunn et al., 2018; Christelis et al., 2017). In our study, since the data do not cover the periods of a tightening monetary policy and thus the observations of borrowers who show that rising mortgage rates are not sufficient, the MPC asymmetry induced by the sign of interest payment changes cannot be investigated.

for at least three consecutive years (12 quarters) and have an Expenditure to Income Ratio (EIR), defined as principal and interest expenses plus card purchases divided by income on a yearly basis, smaller than 1.63 (top 1%). We also drop multiple borrowers who have both an ARM and an FRM to compare the responses of consumption to interest payment changes between ARMs and FRMs more clearly.⁸⁾ The final sample has 106,236 observations over the period from 2012 to 2017.

2. Identification of Adjustable Rate Mortgage Borrowers

To identify ARM borrowers, we first calculate the loan- and borrower-level mortgage rates. The data obtained from the credit bureau company does not provide a loan-rate type for each mortgage. However, since outstanding balances and interest expenses of mortgage loans are provided on a quarterly basis, we can calculate loan-level mortgage rates of loan k held by borrower i at quarter t like this:

$$r_{k,i,t} = \frac{\text{interest expenses}_{k,i,t}}{(\text{mortgage balance}_{k,i,t-1} + \text{mortgage balance}_{k,i,t})/2} \quad (1)$$

In general, the mortgage rates for this month are determined by the average mortgage balances of the previous month and the interest payments of this month. Since we do not have the monthly data, to calculate the loan-level mortgage rates we use the average balances between current and previous quarter for the denominator and interest expenses of this quarter for the nominator. As mentioned in section III.1, our analysis data is not loan-level but borrower-level data, so it is necessary to calculate the borrower-level mortgage rates. To do so, we average loan-level into borrower-level rates weighted by outstanding

8) Even though an ARM borrower is defined as one who has at least one ARM loan, the general results are not changed that much. However, the differences of responses of consumption to interest payment changes between the two groups slightly shrinks. See section IV.2 for details about the identification of ARMs and FRMs.

balances. If one has a mortgage, two interest rates, the loan- and borrower-level loan rates are the same.

The identification of ARM borrowers is based on the loan- and borrower-level rates. To identify ARM borrowers, we adopt two conditions. The first one is that ARM borrowers have to have mortgage rates that show a high correlation with the COFIX, which is the main reference rate for Korean ARMs.⁹⁾ Since a loan rate of an ARM is generally determined by the sum of the COFIX and the idiosyncratic spread of each borrower that reflects one's default risk, the variations of COFIX show a high correlation with adjustable rates. When the calculated correlation is greater than the median (0.815), we regard the mortgage as an ARM. The average correlation of identified ARMs between the COFIX and loan-level rates is 0.925, while that of FRMs shows only 0.333.¹⁰⁾ If one has several mortgage loans, to be an ARM borrower, all mortgage loans have to meet this condition. The second is that the variation of mortgage rates in the sample period is larger than half the variation of the COFIX in the same period. This complements the first condition based on correlation coefficients. Since the correlation coefficients between the COFIX and the mortgage rates reflect the linear relationship between two variables, if we adopt the first condition only, FRMs could be erroneously identified as ARMs due to various reasons, such as the renewal of a loan contract. Overall, to be an ARM borrower, these two conditions have to be satisfied, and conversely, to be an FRM borrower, neither of these two conditions must be met.

Figure 1 illustrates several interest rates over the sample period. The left panel shows the BOK base rate and the COFIX. The two interest rates have similar trends, indicating that monetary policy has a large

9) The COFIX is calculated based on costs of funding information provided by eight large banks in Korea. There are three different indexes: COFIX by outstanding balance, COFIX by monthly acquired new funds, and short-term COFIX. We use the COFIX by outstanding balance that is the weighted average of interest rates applied to the outstanding balance of funds at the end of the month. The Korea Federation of Banks (KFB) announces this figure monthly.

10) Floden et al. (2017) also utilize this method to identify ARM households.

Figure 1: Trends in Interest Rates

Notes: This figure illustrates several trends in interest rates. The left panel shows the BOK base rate and the COFIX (Cost of Fund Index), and the right one presents the mortgage rates of ARM and FRM borrowers. The borrower-level mortgage rates are calculated by averaging loan-level mortgage rates weighted by outstanding balances. See the text for details about the identification of ARMs and FRMs.

impact on the COFIX. The right panel presents the mortgage rates of ARM and FRM borrowers. We can see that the mortgage rates on ARMs drop more steeply than those on FRMs, suggesting that the consumption of ARM borrowers is likely to be more affected by an expansionary monetary policy.

3. Some Measures

As mentioned in Section 1, previous theoretical and empirical literature has shown that consumption responses to income changes can differ across borrowers' financial characteristics. In this section, we briefly introduce some measures employed in our study that show financial characteristics of mortgage borrowers.

Borrowers' Liquidity In line with the intuitions of theoretical

Table 1. Insolvency and Cash Service Usage by Expenditure to Income Ratio

Groups by EIR	Average EIR (%)	Insolvency Experience Ratio (%)	Cash Service Experience Ratio (%)
Low	0.606	0.049	36.1
Middle	0.961	0.051	39.2
High	1.318	0.065	48.5

Notes: This table shows the insolvency and cash service experience ratios (%) by EIR (Expenditure to Income Ratio) groups. The insolvency experience ratio represents the number of borrowers who have experienced insolvency of more than five days overdue during the sample period. The cash service experience ratio shows the number of borrowers who have experienced using cash services provided by credit card companies within the sample period.

predictions mentioned in Section 1 (e.g., Carroll and Kimball, 1996; Kaplan and Violante, 2014), we adopt two liquidity measures. The first measure is annual income of the borrowers. Those with a low income are more likely to face liquidity constraints that hamper the attainment of an optimal consumption level. The second measure is the Expenditure to Income Ratio (EIR), which is defined as principal and interest expenses of all debts, plus card purchases, divided by their income. We assume that if the EIR of a borrower is higher, one is likely to have fewer liquid assets on average. There are two points of evidence for the plausibility of using EIR as a measure of liquidity of a mortgage borrower. The one is that the ratio of borrowers with experience in arrears within the sample period is higher in borrowers with a higher than average EIR. We divide borrowers into three groups using average EIRs, and then calculate the share of borrowers who have any experience of insolvency (more than five days overdue) in each group. The corresponding values of those groups are 0.049%, 0.051% and 0.065%, respectively. This indicates that borrowers with a high average EIR are likely to suffer more from liquidity constraints relative to those with a low average EIR.

Another point of evidence suggesting the robustness of EIR as a measure of mortgage borrowers' liquidity comes from the financial products, called Cash Advance service, provided by credit card companies in Korea. Credit card holders can withdraw cash from an Automated

Teller Machine (ATM) using their credit cards, and repay it by their next settlement day at a high rate of interest.¹¹⁾ Using this service means that the borrower suffers from a scarcity of cash liquidity. In the fourth column of Table 1, we calculate the share of mortgage borrowers who have experienced using credit card cash advances by each EIR group. The corresponding values are 36.1%, 39.2% and 48.5%, respectively. Like the insolvency ratio, the higher the average EIR is, the more likely a borrower will have used the cash advance feature of their credit cards. From these two points of evidence, we feel that the EIR is quite a proper measure for mortgage borrowers' liquidity.

Credit Accessibility We employ two empirical proxies to capture the variations in credit accessibility of mortgage borrowers: the credit bureau score of borrowers and the sector where the mortgage originated (e.g., commercial banks vs. non-commercial banks). Credit bureau scores are frequently used to capture the credit accessibility of borrowers, as in previous studies. Since mortgage borrowers with low credit scores face borrowing constraints that impede consumption smoothing behavior, their consumption is likely to react more sensitively to mortgage interest reductions. The second measure of credit accessibility, the sector where the mortgages originated, comes from a unique aspect of the household debt market in Korea. In general, all mortgage borrowers in Korea prefer commercial banks over non-commercial banks due to lower financial costs.¹²⁾ Some borrowers, however, have mortgages that originated at non-commercial banks, and this is for two reasons. First is the low quality of collateral they have. Since mortgage applications with unqualified collateral are likely to be rejected in commercial banks, people with low-quality collateral are forced to apply for a mortgage in the

11) According to the Credit Finance Association of Korea, the interest rates of cash advances provided by credit card companies vary with borrowers' credit scores. On average, the interest rates were close to 20% in the third quarter of 2013.

12) The difference between the mortgage rates in the two sectors is about 0.96%p in our samples.

non-commercial banking sector. The second is due to the differences in the Loan-To-Value (LTV) regulations between sectors. Since LTV regulations in Korea are more loose for non-commercial banks, if one wants to borrow more than the LTV regulations would allow in commercial banks, the applicant may apply for a loan from a non-commercial bank at a higher mortgage rate. Borrowers with mortgages that originated in a non-commercial bank may face more tightened borrowing constraints because their credit histories, of having loans from non-commercial banks, may have negative effects on their credit limits for things like credit cards or unsecured loans, and they might not be able to borrow additional loans using their houses as collateral due to their high LTV ratio. These two factors may impede their consumption smoothing behavior. We therefore see that the sector where the mortgage originated can be a plausible measure to capture the credit accessibility of mortgage borrowers.

Debt Burden Although a variety of studies have shown the relationship between debt burden and consumption, few works have studied the effects of the debt burden on borrowers compared to their interest rate-induced MPC. To investigate the link between debt burden of mortgage borrowers and interest-induced MPCs, we use the Loan-To-Income (LTI) ratio as a measure of the debt burden.¹³⁾ While some studies adopt the Loan-To-Value (LTV) ratio to capture the effects of the loan amount on consumption of the mortgage borrowers (e.g. Di Maggio et al., 2017; Andersen et al., 2014), others choose the Debt-to-Service Ratio (DSR) or LTI to do so (e.g. Floden et al., 2017; Johnson et al., 2007). Since the

13) In calculating LTI ratio, there is an issue due to a unique housing rental system, called *Jeonse*, in Korea. Under *Jeonse* contracts, a tenant pay a lump-sum deposit to landlord to occupy a house during the contract period. In the interim period between contracting and termination date, there are no additional payments in either direction. Since the lump-sum deposit has to be repaid to the tenant in the termination date, it can be treated as a debt of the landlord. If the *Jeonse* system is considered, the LTI ratio have to be calculated including the lump-sum deposits of landlords in the numerator of LTI. Unfortunately, as our dataset do not have the information on lump-sum deposits of *Jeonse*, we cannot consider them when calculating the LTI ratio. Shin and Kim (2013) and Song (2018) for details on *Jeonse* system in Korea.

LTV ratio is a measure of the debt burden, which puts a bigger emphasis on the collateral value rather than the borrowers' income, it is more suitable for an economy in which housing prices show large fluctuations, like in the U.S. in and around the Great Recession of 2008. Unlike in the U.S., since housing prices in Korea have risen over the sample period and because this is one of the factors that has led to a high debt burden among Korean households, due to the expectation that housing prices would rise, we feel that the LTI would be a more compatible measure for the debt burden of mortgage borrowers.

Table 2. Summary Statistics

	All	ARM	FRM	Difference
Card Purchases				
Total Purchases	47.91	50.07	43.29	6.78
Credit Card Purchases	44.38	46.56	39.72	6.84
Debit Card Purchases	3.34	3.29	3.43	-0.14
Credit Card Limit	150.31	159.22	131.26	27.95
Mortgage-related				
Mortgage Rates (%)	4.23	4.14	4.43	-0.28
Balance	928.45	1098.59	564.51	534.08
Quarterly Interest Payments	9.36	10.95	5.97	4.98
Liquidity				
Income	453.97	469.55	420.65	48.90
Expenditure to Income Ratio	0.53	0.55	0.49	0.06
Credit Accessibility				
Credit Score	858.43	859.54	856.07	3.47
Share of Commercial Bank	0.70	0.68	0.76	-0.08
Loan-to-Income Ratio	2.09	2.42	1.38	1.04
Observations	106,236	72,393	33,843	-

Notes: This table shows the summary statistics of main variables used in this paper. We report all monetary values (card purchases, mortgage balance, interest payments, and Income) in Korean Won (KRW) and amount unit is a hundred thousand won. All differences between ARM and FRM in fourth column are statistically significant at least at the 10% level.

4. Summary Statistics

This section describes the summary statistics of the main variables identified and defined in Section III.2 and III.3. Table 2 shows the summary statistics for the main variables. Our sample consists of 72,393 ARM and 33,843 FRM borrowers. The first column in Table 2 shows the statistics for all samples, and the second and third columns are for ARM and FRM borrowers, respectively. The fourth column shows the difference between each variable between ARM and FRM borrowers. According to t-test results for the differences, all differences are statistically significant at least at the 10 percent level. We show all monetary values in Korean won (KRW) and the units are hundred thousands of won.¹⁴⁾ All prices are real values based on the consumer price index.

On average, ARM borrowers use their credit and debit cards slightly more (Total Purchases) than FRM borrowers. Moreover, credit card limits for ARM borrowers are also higher than for FRM borrowers, indicating that the credit card limits have to be controlled to eliminate any effects of the limits on card purchases in analyzing the relationship between mortgage rates and consumption. In terms of mortgage-related variables, FRM borrowers show a higher average mortgage rate over the sample period, as seen in Figure 1. The mortgage balance and interest payments show great gaps between the two mortgage types, suggesting that borrowers who need large mortgages are likely to choose ARMs to reduce their financial costs in the short term.¹⁵⁾¹⁶⁾

14) The average exchange rate to the U.S. dollar is about 1,116 KRW/USD over the period 2012-2017.

15) Several studies have shown that one's choice of mortgage type is myopic. Badarinza et al. (2017) show that households tend to take the longer-term rate movements quite lightly in order to maintain their level of current consumption. Using the Bank of Italy's Survey of Household Income and Wealth, Paiella and Pozzolo (2007) also report that ARM borrowers do not fully consider the risk of a future rise in the interest rates.

16) The levels of EIR ratios in Table 2 are smaller than those in Table 1. This is because while the average EIR ratios in 1 are calculated using averaged individual-level EIR ratios within the sample periods, those in Table 2 are calculated using individual-time level ones.

IV. Econometric Methodology

As mentioned in the introduction, this paper aims at resolving the following questions. First, what are the different responses in consumption to mortgage rates between ARM and FRM borrowers? Second, what are the heterogeneous static and dynamic interest-induced MPCs within ARM borrowers across several groups divided by liquidity constraints, credit accessibility and debt burden? In this section, we introduce the econometric methodologies to answer these two questions.

To examine whether the consumption of ARM borrowers is more sensitive to interest rate changes or not, we interact interest rates ($IR_{i,t}$)—that is, either the COFIX or else borrower-level mortgage rates—with a dummy variable (ARM_i) that has a value of 1 if one is an ARM borrower. Consider the following regression:

$$CP_{i,t} = \alpha + \beta_1 IR_{i,t} + \beta_2 (IR_{i,t} \times ARM_i) + X_{i,t} \Phi + \delta_i + \varepsilon_{i,t} \quad (2)$$

where $CP_{i,t}$ denotes the real credit and debit card purchases of borrower i at period t . $X_{i,t}$ is a set of control variables including borrowers' real income, credit card limits, credit scores, age group dummies, and year and season dummies. δ_i is the fixed effects of the borrowers. The focus in this equation is on the significances and signs of β_1 and β_2 . In this specification, the intertemporal substitution channel of monetary policy, which affects all borrowers regardless of mortgage types, is absorbed by year fixed effects included in $X_{i,t}$, and β_1 and β_2 capture the effects of the cash flow channel of monetary policy on consumption of FRM and ARM borrowers, respectively. If β_1 and β_2 are negative and the absolute value of β_2 is greater than that of β_1 , it suggests that the effects of an expansionary monetary policy on consumption of mortgage borrowers are larger in ARM than in FRM borrowers. On the contrary, if the difference of consumption responses between ARM and FRM borrowers is not significant, the estimated β_2 will be insignificant.

Secondly, we conduct the regressions to estimate the heterogeneous interest-induced MPCs by splitting the samples into several groups using the measures of liquidity, credit accessibility, and debt burden. The empirical specification is as follows:

$$CP_{i,j,t} = \alpha_j + \beta_j INT_{i,j,t} + X_{i,j,t} \Phi_j + \delta_i + \varepsilon_{i,t} \quad (3)$$

where $INT_{i,j,t}$ denotes the real interest expenses of borrower i who belongs to group j at period t . Other variables and indexes in Equation (3) are the same as those in Equation (2), except for year dummies. Contrary to Equation (2), we do not include year dummies as a control variable in Equation (3) so as to more clearly capture the effects of interest payment reduction on MPCs.¹⁷⁾ The main point in Equation (3) is the heterogeneity of β_j across group j , which shows the interest-induced MPC. Moreover, if needed, we use the interaction terms between interest expenses and dummy variables for several groups to illustrate the statistical significance in differences of interest-induced MPCs among the groups.

Lastly, we explore the dynamic interest-induced MPCs that would be caused by the reduction of interest expenses, using the local projection method developed by Jordà (2005). He shows that an impulse response function estimated by a local projection method is robust to a misspecification of the data generating process and can accommodate nonlinearities that would be intractable in VARs. As we know, since the interest rate is one of the economic variables that shows high persistency, changes in the interest rate can affect mortgage borrowers' consumption throughout various periods. In particular, we focus on the different dynamics of interest-induced MPCs among borrowers with contrasting financial characteristics by using the various measures used in Section

17) To be specific, this is due to two reasons. First, if year dummies are included, the estimated interest-induced MPCs, β_j , are within-year estimates. Since interest payments show little variation within a year, the MPCs are not well-identified under this specification. Second, as interest payments decrease consistently within the sample periods, the year dummies can absorb the effects of any reduction of interest payments on consumption.

III.3. Except for a dependent variable, the specification of local projections is quite similar with Equation (3):

$$CP_{i,j,t+k} = \alpha_j^k + \beta_j^k INT_{i,j,t} + X_{i,j,t} \Phi_j^k + \delta_i + \varepsilon_{i,j,t+k} \quad (4)$$

As seen in Equation (4), a local projection method is based on simple regressions of the endogenous variable shifted forward. In Equation (4), $CP_{i,j,t+k}$ denotes the card purchases of borrower i at period $t+k$. The control variables, $X_{i,j,t}$, are all the same as in Equation (3). The main points of interest in Equation (4) are β_j^k for $k=0, 1, 2, \dots, K$, that show the dynamic interest-induced MPCs. We restrict our attention to eight quarters including $k=0$ ($K=7$). In the estimations of all equations mentioned above we use borrower-based cluster-robust standard errors.

V. Main Results

This section consists of three parts. In the first part, to observe the effects of mortgage interest reduction on consumption, we begin with regressions that illustrate the relationship between interest rates (the COFIX and the borrower-level loan rates) and card purchases. We will show the contrasting responses of consumption to interest rates between ARM and FRM borrowers. In the second part, we estimate the interest-induced MPCs for ARM borrowers by dividing the samples into several groups using the measures of borrowers' liquidity, credit accessibility, and debt burden. We will show the heterogeneous interest-induced MPCs across those groups. In the third part, we observe the dynamics of interest-induced MPCs and their heterogeneity across groups using the local projection method of Jordà (2005).

1. Interest Rates and Consumption: ARM vs. FRM

The main interest of this section is whether the responses of

Table 3. Interest Rates and Consumption of Mortgage Borrowers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All		Single Mortgage		All		Single Mortgage	
COFIX	-2,088*** (0.214)	0.067 (0.920)	1.119 (0.966)	1.098 (0.987)				
COFIX × ARM			-1.478*** (0.430)	-1.352*** (0.439)				
Mortgage Rate					-1.470*** (0.162)	-0.518*** (0.176)	0.33 (0.260)	0.21 (0.264)
Mortgage Rate × ARM							-1.142*** (0.345)	-0.996*** (0.350)
Income		0.021*** (0.002)	0.021*** (0.002)	0.021*** (0.002)		0.021*** (0.002)	0.021*** (0.002)	0.021*** (0.002)
Credit Card Limit		0.059*** (0.004)	0.060*** (0.004)	0.061*** (0.004)		0.059*** (0.004)	0.060*** (0.004)	0.060*** (0.004)
Credit Score		0.028*** (0.004)	0.028*** (0.004)	0.027*** (0.004)		0.028*** (0.004)	0.027*** (0.004)	0.027*** (0.004)
Constant	53.122*** (0.535)	-4.597 (5.309)	-4.581 (5.306)	-4.294 (5.421)	54.133*** (0.686)	-1.192 (3.767)	-1.308 (3.765)	-0.659 (3.834)
Year Dummy	X	O	O	O	X	O	O	O
Season Dummy	X	O	O	O	X	O	O	O
Age Dummy	X	O	O	O	X	O	O	O
Overall R^2	0.001	0.25	0.24	0.24	0.01	0.249	0.232	0.235
Observations	106,236	106,236	106,236	101,288	106,236	106,236	106,236	101,288

Notes: This table shows the effects of interest rates (the COFIX and borrower-level mortgage rates) on credit and debit card purchases. The dependent variable is total amount of card purchases. The COFIX (Cost Of Fund Index) is a reference rate of mortgage rates, calculated based on costs of funding information provided by eight Korean domestic banks. The mortgage rate is the borrower-level rate. Single Mortgage means people who only have a single home mortgage loan. Standard errors clustered by borrowers are in parentheses. *, ** and *** indicate the 10%, 5% and 1% significance levels, respectively.

consumption to interest rates differ between ARM and FRM borrowers. The results presented in column (1) to (3) of Table 3 show the effects of the COFIX on mortgage borrowers' consumption across all samples. Column (1) includes only the COFIX as an independent variable, and in Column (2) we add several control variables that can affect borrowers' consumption. The regression results show that while the unconditional association between the COFIX and consumption is negative and significant (Column (1)), the conditional one is not significant (Column (2)). This indicates that the significant coefficient of the COFIX in Column (1) comes from the association between the COFIX and the control variables.¹⁸⁾

In Column (3), we add the interaction between the COFIX and an

ARM dummy variable to look at different responses of consumption between ARM and FRM borrowers. While the coefficient of the COFIX is not significant, that of the interaction term is negative and significant at the 1 percent level. This result indicates that the insignificant coefficient of the COFIX presented in Column (2) is attributed to FRM borrowers, and the consumptions of borrowers with ARMs respond more sensitively to the COFIX.

In Columns (5) to (7), we conduct the same regressions as in Columns (1) to (3), but we alter the COFIX to use borrower-level mortgage rates. The regression results of Column (5) are similar to that of Column (1). The unconditional relationship between the mortgage rate and consumption is significant and negative. Contrary to the results of Column (2), in Column (6), the association between mortgage rates and consumption is significant, even after controlling for several variables that can affect mortgage borrowers' consumption. This is because while the COFIX is highly uncorrelated with FRM borrower consumption, the mortgage rate is relatively more correlated with both the consumptions of borrowers with ARMs and those with FRMs. As in Column (3), the results of Column (7) show that while the coefficient of borrower-level mortgage rates is insignificant, that of the interaction term between the mortgage rate and an ARM dummy variable is negative and significant at the 1 percent level.¹⁹⁾

18) There may be several direct and indirect effects of an expansionary monetary policy on the control variables. For instance, an expansionary monetary policy may positively affect mortgage borrowers' income, and this could lead to a significant relationship between the COFIX and mortgage borrowers' consumption in Column (1). Furthermore, such increases in annual income could affect the credit card limits of mortgage borrowers. The different results between Column (1) and (2) may be attributed to these direct and indirect effects.

19) In Table A1 in the Appendix, we conduct the same regressions as models (3) and (6) in Table 3, using several alternative definitions of ARM borrowers. According to the results, when the definition of ARM borrower becomes more tightened (e.g., those who have a correlation between mortgage rates and the COFIX greater than 75% percentile rather than the median), the estimated coefficients of interaction terms between interest rates and ARM tend to be larger. This result indicates that the conditions for definition of ARM borrowers are plausible to observe the different consumption responses to interest rates between ARM and FRM borrowers. See the notes in Table A1 for details.

Lastly, in Columns (4) and (8), we conduct the same regressions as in Column (3) and (7) for those with a single mortgage. The purpose of these regressions is to observe whether the significant coefficients of the interaction term between interest rates and ARMs are mainly attributed to those with multiple mortgages. If the above results are dominated by those with multiple mortgages that show a much smaller share than those with single mortgages (4.6% vs 95.4%), the empirical analysis that would follow would not be meaningful. Since borrowers with multiple mortgages are likely to buy houses for investment purposes, their consumption can be far more sensitive to drops in interest payments than that of those with only a single mortgage. This is due to two reasons. First, multiple mortgage debtors are likely to have low liquidity or credit accessibility owing to their high debt. This can make their consumption more sensitive to interest payments. Second are wealth effects. If the decrease in interest rates led to an increase in house prices in our sample period, the estimated coefficients of interaction terms would be largely affected by the wealth effects of those with multiple mortgages.²⁰⁾ The results show that while the estimated coefficients of interaction terms are slightly changed, these changes are not meaningful statistically. This means that the results shown in Columns (1) to (3) and (5) to (7) are dominated by those with single mortgages who are likely to be less affected by the wealth effects caused by any changes in housing prices.

The results in Table 3 can be summarized as follows. The decrease in the COFIX caused by an expansionary monetary policy is translated into a drop in mortgage rates of ARM borrowers, and this leads to an increase in consumption among them. While the consumption of borrowers with FRMs is less sensitive to mortgage rates, that of borrowers with ARMs responds forcefully to any reduction in mortgage rates. These results imply that the cash flow channel of expansionary monetary policy is valid only for the borrowers with ARMs.

20) Choi et al. (2015) show that the effect of housing prices on consumption of those with single mortgages is modest in the South Korea economy.

2. The Heterogeneity of Interest-Induced MPCs

Now we investigate the interest-induced MPC and its heterogeneity by liquidity constraints, credit accessibility, and debt burden. Since we already showed that the significant association between mortgage rates and consumption comes only from borrowers with ARMs, we will focus on them.

2.1 Liquidity Constraints

In this section, we explore the role of liquidity constraints, measured by mortgage borrowers' income and EIR ratio, in the association between interest payment reduction and consumption. Table 4 presents the interest-induced MPCs by income level of the mortgage borrowers. In Column (1) of Table 4, we first estimate the interest-induced MPC for all

Table 4. Interest Expenses and Consumption by Income Level

	(1)	(2)	(3)	(4)	(5)	(6)
	All	ARM				
		All		High Income	Low Income	
Interest	-0.292*** (0.080)	-0.302*** (0.086)	-0.456*** (0.083)	-0.563*** (0.138)	-0.186* (0.109)	-0.626*** (0.080)
Interest × High Income			0.201*** (0.044)			
Interest × Income				0.034* (0.078)		
Income	0.021*** (0.002)	0.022*** (0.003)	0.019*** (0.003)	0.017*** (0.004)	0.018*** (0.005)	0.047*** (0.004)
Credit Card Limit	0.056*** (0.004)	0.058*** (0.005)	0.058*** (0.005)	0.058*** (0.005)	0.059*** (0.007)	0.049*** (0.006)
Credit Score	0.034*** (0.004)	0.032*** (0.005)	0.031*** (0.005)	0.031*** (0.005)	0.039*** (0.009)	0.023*** (0.004)
Constant	-6.845* (3.949)	-4.115 (5.084)	-0.917 (5.061)	0.642 (5.249)	-6.089 (10.434)	-3.73 (4.688)
Overall R^2	0.172	0.167	0.17	0.162	0.121	0.033
Observations	106,236	72,393	72,393	72,393	35,465	36,928

Notes: This table shows the effects of mortgage interest payments on card purchases by Expenditure to Income Ratio (EIR) and income level. The dependent variable is total amount of card purchases. Low (high) EIR means borrowers with an EIR smaller (greater) than the median EIR within each quarter. All models include age and seasonal dummies. Standard errors clustered by borrowers are in parentheses. *, ** and *** indicate the 10%, 5% and 1% significance levels, respectively.

samples. The results show that on average the estimated interest-induced MPC is 0.292. That is, lowering the mortgage interest expense by KRW 100 is associated with card purchases rising by KRW 29.2. In Column (2), we run the same regression as Column (1) for ARM borrowers. The estimated MPC (0.302) is similar to that of the whole sample, indicating that the significantly estimated MPC in Column (1) stems from ARM borrowers.²¹⁾

Columns (3) to (6) of Table 4 demonstrate the robust link between borrowers' incomes and interest-induced MPCs. As seen in Column (3), the interaction between interest expenses and a dummy variable, which equals 1 if a borrower's income is larger than the median within each period, is both positive and significant. In Column (4), we add the interaction between interest expenses and borrowers' log incomes instead of the dummy variable for borrowers with a high income. The coefficient of interaction term is also positive and significant at the 10 percent level. In Column (5) and (6), to allow the control variables to respond differently across income levels, we divide the samples into those with high and low incomes and conduct the regressions separately. According to the results, the interest-induced MPC is about three times larger for borrowers with low incomes than those with high incomes. These results of Column (3) to (6) reveal that consumption among borrowers with a high income is less sensitive to mortgage interest payments.

In Table 5, we investigate the relationship between interest-induced MPC and mortgage borrower's EIR. To do this, we divide the sample into two groups, low and high EIR borrowers, using the median of EIR within each period. Column (1) and (4) in Table 5 show that the interest-induced MPC of low EIR borrowers (0.343) is lower than that of high EIR ones (0.603). This result provides the possibility that the level of EIR, one of the measures of borrowers' liquidity, significantly affects

21) In unreported regressions, we also conduct the same regression for FRM borrowers. The estimated MPC for them is not significant. This result is natural because the variations in interest expenses of FRM borrowers are little.

Table 5. Interest Expenses and Consumption by EIR Ratio and Income Level

	(1)	(2)	(3)	(4)	(5)	(6)
	Low EIR			High EIR		
	All	Low Income	High Income	All	Low Income	High Income
Interest	-0.343*** (0.043)	-0.422*** (0.049)	-0.300*** (0.054)	-0.603*** (0.102)	-0.988*** (0.097)	-0.453*** (0.129)
Income	0.029*** (0.002)	0.035*** (0.003)	0.031*** (0.003)	0.097*** (0.005)	0.111*** (0.006)	0.097*** (0.009)
Credit Card Limit	0.017*** (0.003)	0.017*** (0.003)	0.016*** (0.004)	0.052*** (0.006)	0.040*** (0.007)	0.055*** (0.008)
Credit Score	0.025*** (0.003)	0.022*** (0.003)	0.029*** (0.005)	0.017*** (0.006)	0.010** (0.005)	0.018 (0.013)
Constant	-12.447*** (3.169)	-13.818*** (2.879)	-15.604** (7.724)	4.438 (6.385)	10.533* (5.376)	0.684 (14.939)
Overall R^2	0.422	0.159	0.312	0.452	0.247	0.298
Observations	36,211	17,492	18,719	36,182	19,436	16,746

Notes: This table shows the effects of mortgage interest payments on card purchases by Expenditure to Income Ratio (EIR) and income level. The dependent variable is total amount of card purchases. *Low (high) EIR* means borrowers with EIR smaller (greater) than the median EIR within each quarter. All models include age and season dummies. Standard errors clustered by borrowers are in parentheses. *, **, and *** indicate the 10%, 5%, and 1% significance levels, respectively.

the response of consumption to mortgage interest reduction.

However, since the EIR is a ratio variable, the effects of the EIR on MPC heterogeneity can also be affected by income levels of mortgage borrowers. For instance, though borrowers have the same EIR, if income levels are different, their consumption responses can vary with their income levels. To check the possibility, in Columns (2), (3), (5) and (6), we conduct the same regression as in Column (1) and (4) by the income levels of borrowers. Three results are noteworthy. First, the results shown in Column (1) and (4) are maintained within two income groups. Regardless of income level, the interest-induced MPC of borrowers with a high EIR is larger than that of those with a low EIR. Second, although the borrowers belong to the low income group, if their EIR is not high, their interest-induced MPC (0.422) is modest. In particular, it is analogous with that of borrowers with a high EIR and income (0.453). Third, the difference of interest-induced MPC between a borrower with sufficient liquidity (high income, low EIR) and those with insufficient liquidity (low

income, high EIR) is exceedingly large (0.300 vs. 0.988). These results indicate that borrowers' liquidity plays a critical role in the heterogeneity of interest-induced MPCs across mortgage borrowers.

2.2 Credit Accessibility

We here explore the effect of credit accessibility on the relationship between mortgage payment reduction and consumption. Table 6 presents the interest-induced MPCs by splitting samples into several groups by their measures of credit accessibility, credit scores and sectors from where the mortgages originated. Columns (1) and (2) of Table 6 show that the consumption of borrowers with low credit scores has a much stronger response to mortgage interest reduction than that of those with high credit scores (0.430 vs. 0.06). Moreover, the estimated interest-induced MPC of borrowers with low credit scores is statistically significant at the 1 percent level, while the corresponding estimate of those with high credit scores is not. These results provide for the possibility that the credit accessibility measured by credit score is one of the sources that affects the heterogeneity of interest-induced MPCs across mortgage borrowers.

In Columns (3) to (6) of Table 6, to observe the effects of sectors, mentioned above, we additionally divide the sample into two groups, borrowers with mortgages originating at commercial banks (Columns (3) and (4)) and at non-commercial banks (Columns (5) and (6)). According to our results, the consumption of those with mortgages from commercial banks are less sensitive to interest reduction than those with mortgages from non-commercial banks. While the interest-induced MPCs of borrowers with mortgages from commercial banks are not statistically significant, those of borrowers with mortgages from non-commercial banks are highly significant, regardless of credit scores. While the results of Columns (4) and (5) are plausible, those of Columns (3) and (6) need more explanation in order to interpret them. The results of Column (3),

Table 6. Interest Expenses and Consumption by Credit Accessibility

Credit Scores	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	All		Commercial Bank		Non-Commercial Bank		Low Liquidity		High Liquidity	
	Low	High	Low	High	Low	High	Low	High	Low	High
Interest Expenses	-0.430*** (0.110)	-0.06 (0.124)	-0.311 (0.194)	0.046 (0.137)	-0.549*** (0.104)	-0.518*** (0.162)	-1.033*** (0.129)	-0.703*** (0.146)	-0.323** (0.137)	-0.013 (0.136)
Annual Income	0.026*** (0.005)	0.017*** (0.003)	0.022*** (0.005)	0.014*** (0.004)	0.040*** (0.008)	0.034*** (0.010)	0.113*** (0.009)	0.103*** (0.008)	0.029*** (0.006)	0.020*** (0.004)
Credit Card Limit	0.072*** (0.010)	0.054*** (0.005)	0.061*** (0.012)	0.054*** (0.006)	0.098*** (0.015)	0.054*** (0.012)	0.047*** (0.011)	0.039*** (0.008)	0.066*** (0.012)	0.053*** (0.006)
Credit Score	0.021*** (0.005)	0.214*** (0.022)	0.020*** (0.007)	0.238*** (0.024)	0.021*** (0.007)	0.130*** (0.048)	0.006 (0.006)	0.173*** (0.029)	0.025*** (0.007)	0.206*** (0.027)
Constant	0.787 (5.824)	-158.726*** (21.365)	6.865 (7.953)	-191.103*** (22.748)	-6.661 (8.461)	-70.725 (43.741)	16.379*** (6.301)	-134.227*** (27.566)	-14.056* (7.602)	-154.893*** (25.794)
Overall R^2	0.149	0.222	0.153	0.221	0.149	0.188	0.272	0.282	0.245	0.288
Observations	36,931	35,462	21,687	27,325	15,244	8,137	11,176	8,260	25,755	27,202

Notes: This table shows the effects of interest payment reduction on card purchases by credit accessibility of mortgage borrowers. The dependent variable is the total amount of card purchases. A *Low (high) credit score* represents borrowers with credit score smaller (greater) than the median score within each quarter. *Low liquidity* means borrowers with a low income and a high EIR ratio, and *High liquidity* means other borrowers than those with low liquidity. All models include age and seasonal dummies. Standard errors clustered by borrowers are in parentheses. *, **, and *** indicate the 10%, 5% and 1% significance levels, respectively.

insignificant interest-induced MPCs of borrowers with mortgages from commercial banks and low credit scores, may come from the tightened LTV regulations of commercial banks. As mentioned in Section III.3, since the LTV regulations are more tight in the commercial banking sector than in other sectors, those with mortgages from commercial banks can borrow a second loan from another sector. This enhances access to credit of those with mortgages from commercial bank, although they have low credit scores. The results of Column (6), high and significant MPCs of borrowers with mortgages from a non-commercial bank and with a high credit score, may stem from two reasons. First, in spite of high credit scores, owing debts to a non-commercial bank is a bad signal to credit suppliers in the household debt market in Korea. As mentioned in Section III.3, this could restrict other credit activities, such as borrowing unsecured loans. Second, since the LTV regulations for non-commercial banks are relatively loose, the mortgages originating from non-commercial banks have higher LTV ratios on average. The high LTV ratio of borrowers with mortgages originating from non-commercial banks may restrict them getting additional loans that use their houses as collateral.

Finally, in Columns (7) to (10) of Table 6, we estimate the interest-induced MPCs by dividing the samples into an additional two groups by liquidity constraints, borrowers with low liquidity (low income and high EIR) and those with high liquidity (everyone else). In the regression results of Columns (7) to (10), two things are noteworthy. The first is that the consumption of borrowers with low credit scores is more sensitive to mortgage interest reduction within each liquidity group. This implies that liquidity constraints and credit accessibility are complementary sources of heterogeneous interest-induced MPCs. The second is that the interest-induced MPC of borrowers with low liquidity and high credit scores is higher than that of those with high liquidity and low credit scores (0.703 vs. 0.323). This means that although liquidity constraints and credit accessibility are complementary factors of MPC heterogeneity, liquidity constraints affect interest-induced MPCs more than credit

accessibility.

Overall, the results of Table 6 show that credit accessibility, measured by the credit score of borrowers and the sector where the mortgage originated, is a significant factor that affects MPC heterogeneity, together with the liquidity constraints of mortgage borrowers.

2.3 Debt Burden

In this section, we investigate the effects of mortgage borrowers' debt burden on interest-induced MPCs, using the Loan-To-Income (LTI) ratio as a measure. The LTI ratio can have a high correlation with liquidity constraints and credit accessibility. For instance, a low LTI ratio could be due to low credit accessibility. In this case, if borrowers with low LTI ratios show higher interest-induced MPCs than others, it is due to not the LTI ratio but to credit accessibility. In addition, since borrowers with a high LTI ratio are likely to have tightened liquidity constraints due to high financial costs, their interest-induced MPC would be similar to that of liquidity-constrained borrowers. Hence, we estimate the interest-induced MPCs for borrowers with high liquidity (excluding those with low income and high EIR) and credit accessibility (excluding those with low credit score and mortgages from the non-commercial banking sector) as well as the whole sample.

In Columns (1) to (4) of Table 7, we first divide the samples into two groups, borrowers with lower and higher LTIs than the median LTI within each period. We then estimate the interest-induced MPCs for the whole sample (All) and for the unconstrained borrowers (Uncons.). In Columns (1) and (2), we run the regressions for mortgage borrowers with low LTIs in the whole sample and in the restricted sample. According to the results, The interest-induced MPC (0.62) is significant at the 10 percent level in Column (1), while it is not significant in Column (2). These results indicate that the significant interest-induced MPC of borrowers with low LTIs is due to the effects of liquidity constraints and

Table 7. Interest Expenses and Consumption by Debt Burden

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Card Purchases				Principal Payments			
	Low LTI		High LTI		Low LTI		High LTI	
	All	Uncons.	All	Uncons.	All	Uncons.	All	Uncons.
Interest Expenses	-0.620* (0.323)	-0.579 (0.369)	0.04 (0.124)	0.225 (0.147)	-0.018 (0.011)	-0.012 (0.013)	-0.063*** (0.015)	0.052*** (0.019)
Annual Income	0.021*** (0.004)	0.024*** (0.005)	0.031*** (0.004)	0.035*** (0.007)	0.021*** (0.004)	0.024*** (0.005)	0.033*** (0.004)	0.038*** (0.007)
Credit Card Limit	0.029*** (0.007)	0.041*** (0.010)	0.018*** (0.006)	0.014 (0.011)	0.033*** (0.007)	0.043*** (0.010)	0.021*** (0.006)	0.017* (0.010)
Credit Score	0.061*** (0.007)	0.052*** (0.007)	0.056*** (0.007)	0.049*** (0.010)	—	—	—	—
Constant	3.46 (8.111)	-1.906 (10.270)	1.475 (6.099)	2.537 (11.129)	6.505 (7.777)	0.324 (9.585)	7.391 (5.505)	12.77 (10.604)
Overall R^2	0.209	0.301	0.274	0.311	0.125	0.217	0.191	0.236
Observations	29,740	19,744	42,653	24,047	29,740	19,744	42,653	24,047

Notes: This table shows the effects of interest payment reduction on card purchases by the debt burden of mortgage borrowers. The dependent variables of Columns (1) to (4) and Columns (5) to (8) are total amount of card purchases and principal payments, respectively. LTI is the Loan-To-Income ratio, and *Uncons.* means mortgage borrowers with high liquidity and credit accessibility. All models include age and season dummies. Standard errors clustered by borrowers are in parentheses. *, ** and *** indicate the 10%, 5% and 1% significance levels, respectively.

credit accessibility. In Columns (3) and (4), we conduct the same regression as in Columns (1) and (2) for mortgage borrowers with high LTIs. The estimated interest-induced MPCs are not significant in both samples, indicating that the consumption of those with high LTIs are not sensitive to interest payment reductions.

The next question from the results of Column (3) and (4) is why the consumption of borrowers with high LTIs are not sensitive to interest payment reductions. A plausible explanation for this is that borrowers with a high debt burden may be more active in deleveraging of the debts to reduce financial costs. The possibility of this explanation can be checked by investigating the association between interest payment reductions and principal repayments of borrowers with high LTIs. If the explanation is true, principal repayments of borrowers with high debt burden respond more to interest payment reductions than those with low

debt burdens. To look at this, in Columns (5) to (8), we conduct regressions with principal payments as a dependent variable. Since credit card limits do not affect the principal payments of mortgages, they are excluded from the set of independent variables. The other specifications of Columns (5) to (8) are the same as those of Columns (1) to (4). According to the regression results, the principal payments of borrowers with low LTI levels show insignificant responses to interest expense reductions, while those with high LTI levels present a significant response in both models. These results imply that the insignificant interest-induced MPCs of borrowers with high LTI ratios may come from their active deleveraging behavior. Moreover, the estimated coefficient in column (8) is smaller than that in column (7), indicating that the principal payments of the constrained borrowers respond more sensitively to interest expenses. This implies that although the consumptions of borrowers with debts are constrained due to liquidity constraints and credit accessibility, if their LTI ratios are high, they first repay their debts to reduce the financial costs.

Overall, the results of Table 7 provide three implications. First, compared to liquidity constraints and credit accessibility, the effects of the debt burden of mortgage borrowers on their MPC heterogeneity is modest. The divided groups by LTI ratio do not show any big differences of interest-induced MPCs. Second, the mortgage borrowers with high LTI ratios show more active deleveraging behavior using windfall gains from interest payment reductions than those with low LTI ratios. Third, although the consumptions of mortgage borrowers are constrained due to liquidity constraints and credit accessibility, if their debts are high in terms of their income, they prefer the repayment of mortgage debts rather than consumption.

3. Dynamic Interest-Induced MPC

We so far stick to the simultaneous relations between mortgage interest reduction and interest-induced MPCs. The dynamic interest-induced MPCs can provide the additional implications for the persistence of cash flow

channels of an expansionary monetary policy. In this section, we investigate the heterogeneity of dynamic interest-induced MPCs using the local projection method of Jordà (2005). Since MPC heterogeneity is not large across LTI ratio levels, we focus on the groups divided by liquidity constraint and credit accessibility.²²⁾ Figure 2 shows the impulse responses of interest-induced MPCs estimated by Equation (4). The x-axis of Figure 2 shows eight quarters, including quarter 0, and the y-axis is the interest-induced MPCs. The black lines marked with circles present the point estimates of interest-induced MPCs in the corresponding quarters. The dark (light) regions are for the 68 percent (95 percent) confidence intervals of the MPCs.

According to the results of impulse responses in Figures A and C, borrowers with high liquidity or credit accessibility show an insignificant interest-induced MPC over the period. Their 68 percent confidence intervals include zero after three quarters of interest reduction shocks, and 95 percent confidence intervals include zero at all periods. Meanwhile, as seen in Figures B and D, borrowers with low liquidity or credit accessibility show relatively long-lasting and significant responses in consumption to mortgage interest reduction. Their confidence intervals of interest-induced MPCs do not include the zero at all periods, even at the 95 percent level. This result implies that liquidity- and credit-constraints that borrowers face cannot be resolved by interest payment reductions. If the windfall gains by an interest payment reduction lead to addressing the two constraints within the short periods, and thus constrained borrowers achieve the optimal consumption level, their dynamic interest-induced MPCs would be close to zero as time goes by.

Next, we can see that the slope of dynamic interest-induced MPCs of borrowers with low liquidity is steeper than that of those with low credit accessibility. One possible explanation for this phenomenon is that while the windfall gains from interest payment reductions affect the positive

22) In unreported analysis, we also conduct the local projections by LTI ratio levels. None of the estimated MPCs are statistically insignificant, regardless of LTI ratio levels and time periods.

Figure 2. Dynamic Interest-Induced MPCs

Notes: This figure shows the dynamic interest-induced MPCs across the groups divided by liquidity constraints and credit accessibility. The borrowers with high (low) liquidity are those with lower (higher) EIR or with higher (lower) income than the median of each variable. Borrowers with high (low) credit accessibility are those with higher (lower) credit scores than the median or with mortgages that originated at commercial (non-commercial) banks. The black lines marked with circles present the point estimates of interest-induced MPCs in the corresponding quarters. The dark (light) regions are for the 68% (95%) confidence intervals of the MPCs.

effects of mortgage borrowers' liquidity as time goes by, low credit accessibility cannot be resolved within the short periods. This may be in part due to the term of validity of credit information. According to Korea's Use and Protection of Credit Information Act, as credit bureau companies can use credit information for up to five years to establish someone's credit score, once lost, a better credit score is particularly hard

to improve within the short periods.

VI. Concluding Remarks

Drawing on the credit bureau data that have comprehensive information on the debt-side and the demographic characteristics of mortgage borrowers, we explore the relationship between mortgage interest reduction and consumption, focusing on the period from 2012 to 2017 of expansionary monetary policy. Our regression analysis uncovers five main results. First, the borrower cash flow channel operates only for mortgage borrowers with ARMs. Second, among mortgagors with ARMs, those with low liquidity and credit accessibility show high interest-induced MPCs. Third, compared to liquidity and credit accessibility, the debt burdens of mortgagors have a weaker effect on the interest-induced MPC heterogeneity. Those with a high debt burden show low or insignificant interest-induced MPCs due to their active deleveraging behavior, and those with a low debt burden show insignificant MPCs. Fourth, while unconstrained borrowers consistently show low and insignificant MPCs, constrained borrowers (with low liquidity and credit accessibility) maintain long-lasting high MPCs for eight quarters after an interest reduction. Finally, fifth, the MPC of those with low liquidity becomes lower as time goes by, indicating that windfall gains by mortgage interest reductions help to relax the liquidity constraints they face.

Our empirical findings provide several meaningful implications about the borrower cash flow channel of an expansionary monetary policy. First, the share of those with ARMs can affect the magnitude of cash flow effects of any reduction in mortgage rates caused by an expansionary monetary policy. Although a low share of ARMs can have positive effects on financial and economic stability in the long term (e.g., Rubio, 2011), it can attenuate the short-term positive consumption effects of an expansionary monetary policy.

Second, the cash flow channel of an expansionary monetary policy can improve mortgage borrowers' balance sheets, in particular liquidity-constrained ones. However, monetary authorities have to know that the cash flow channel of a tighter monetary policy can damage the balance sheets of mortgagors. While this channel, in general, can function as an automatic stabilizer of macroeconomic conditions, as pointed out by Di Maggio et al. (2017), the function can show asymmetric effects across the direction of monetary policy. It is worth noting that some recent studies have found that the MPC from negative income changes is much higher than that from positive ones (e.g., Bunn et al., 2018; Jappelli and Scognamiglio, 2018).

Third, the high debt burdens of mortgage borrowers with ARMs can neutralize the positive consumption effects of an expansionary monetary policy by their active deleveraging behavior. If mortgage borrowers feel that their debt levels are excessive and could hamper future consumption under their expected income paths, they would use the windfall gains to redeem their debts. Hence, policy makers need to carefully consider the optimum debt level that borrowers can repay using their life-time resources without a big burden.

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Appendix

Table A1. Interest Rates and Consumption Using Alternative ARM Definitions

	(1)	(2)	(3)	(4)	(5)	(6)
	Alternative Definition 1		Alternative Definition 2		Alternative Definition 3	
COFIX	1.592 (1.169)		0.892 (0.864)		0.524 (0.793)	
COFIX × ARM	−1.503*** (0.500)		−1.356*** (0.412)		−0.652* (0.350)	
Loan Rate		0.298 (0.253)		0.489* (0.265)		−0.230* (0.125)
Loan Rate × ARM		−1.347*** (0.431)		−1.053*** (0.316)		−0.425* (0.242)
Income	0.020*** (0.003)	0.020*** (0.003)	0.021*** (0.002)	0.021*** (0.002)	0.021*** (0.002)	0.021*** (0.002)
Credit Card Limit	0.061*** (0.005)	0.061*** (0.005)	0.059*** (0.004)	0.059*** (0.004)	0.059*** (0.004)	0.059*** (0.004)
Credit Score	0.027*** (0.004)	0.027*** (0.004)	0.027*** (0.003)	0.027*** (0.003)	0.029*** (0.003)	0.029*** (0.003)
Constant	−5.119 (6.514)	0.648 (4.673)	−3.027 (4.626)	−1.632 (3.266)	−5.036 (4.383)	−1.493 (3.084)
Overall R^2	0.246	0.232	0.258	0.251	0.266	0.265
Observations	74,790	74,790	133,602	133,602	144,610	144,610

Notes: This table shows the effects of interest rates (the COFIX and borrower-level mortgage rates) on credit and debit card purchases, using alternative definitions of ARM borrowers. We conduct the same regressions as models (3) and (6) in Table 3 by each alternative definition of ARM borrowers. In alternative definitions 1 and 2, we define ARMs as those who have a correlation between mortgage rates and COFIX greater than 75% percentile (about 0.96) and 25% percentiles (about 0.58), respectively. In these definitions, the second condition for ARMs, who have the variation of mortgage rates is larger than half the variation of COFIX in the sample period, is maintained. In alternative definition 3, we define them as those who have a correlation greater than the median (the same as Table 3), but the second condition is excluded. The dependent variable is the total amount of card purchases. The COFIX (Cost Of Fund Index) is a base rate of mortgage rates, calculated based on costs of funding information provided by eight Korean domestic banks. The mortgage rate is a borrower-level rate. All models include year, season, and age group dummies as independent variables. Standard errors clustered by borrowers are in parentheses. *, ** and *** indicate the 10%, 5% and 1% significance levels, respectively.

<Abstract in Korean>

통화정책이 소비에 미치는 영향: 차입자 현금흐름경로를 중심으로

송상윤*

본 논문에서는 한국은행 가계부채 DB를 이용하여 우리나라의 확장적 통화정책이 주택담보대출 차입자의 소비에 미친 영향을 분석하였다. 분석기간은 2011년 3분기부터 2017년 3분기까지다. 분석 결과를 요약하면 다음과 같다. 첫째, 확장적 통화정책에 따른 주택담보대출 이자상환액의 감소는 변동금리 주택담보대출 차입자들의 소비를 증가시키는 방향으로 작동하였다. 둘째, 변동금리 차입자 중에서는 유동성이 부족하고 신용접근성이 낮은 차입자들의 소비가 이자상환액 감소에 더 민감하게 반응하는 것으로 나타났다. 셋째, 부채수준이 높은 차입자의 이자상환액 감소는 소비보다 원금상환에 더 큰 영향을 미쳤다. 특히, 이자상환액 감소가 원금상환액 증가에 미치는 영향의 크기는 유동성 및 신용 접근성이 높은 차주보다 낮은 차주에서 더 컸으며, 이는 유동성 및 신용접근성이 낮아 소비에 제약을 받고 있더라도 부채가 많으면 소비보다 디레버리징(deleveraging)에 더 적극적인임을 의미한다. 이러한 연구결과는 우리나라의 확장적 통화정책이 현금흐름경로를 통해 소비를 증가시키는 방향으로 작동하고 있으나, 그 영향정도는 주택담보대출 차입자의 특성에 따라 상이할 수 있음을 시사한다.

핵심 주제어: 주택담보대출, 소비, 통화정책, 가계부채

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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	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 거시 모형(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