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Monetary Policy, Homeowner Balance Sheet Channel, and Integration: A Lesson from South Korea during the 2000s

Yejin Kim[1+] and Wonmun Shin[2]

[1]*Department of Economics, Yonsei University, Republic of Korea*
[2]*Department of Economics, Sejong University, Republic of Korea*

Abstract We estimate the household consumption function using the Korean labor and income panel data (2001-2012) with the instrument of the housing supply to figure out the homeowner balance sheet channel of monetary policy in South Korea during the 2000s and the early 2010s. We find that monetary policy has a significant effect through both the wealth and collateral effects comprising the homeowner balance sheet transmission channel. Furthermore, the wealth effect shows a significant result across all income quantile groups, whereas the collateral effect is significant in the low- and middle-income quantile groups. This finding implies that the lower-income groups are more sensitive to changes in the value of real estate assets. Based on the analysis, we derive policy implication that socio-economic integration will be enhanced under the considerately targetted monetary policy, which is a lesson for the emerging or developing countries whose current economic situation is similar to the past South Korea.

Keywords: monetary policy, homeowner balance sheet channel, wealth effect, collateral effect, economic integration, panel regression

JEL Classifications: E21, E52, E61, R20

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I. Introduction

South Korea has often been proposed as a role model for other emerging market economies or developing countries because it has been one of the most successful latecomer economies with rapid economic growth and has achieved the ranks of advanced economics. However,

+Corresponding Author: Yejin Kim
Ph. D. Student, Department of Economics, Yonsei University, 50 Yonsei-ro, Seodaemun-gu, Seoul, Republic of Korea. E-mail: kimyejin87@yonsei.ac.kr
Primary Author: Wonmun Shin
Assistant Professor, Department of Economics, Sejong University, 209 Neungdong-ro, Gwangjin-Gu, Seoul, Republic of Korea. E-mail: wonmun.shin@sejong.ac.kr
Acknowledgment: We would like to thank an anonymous referee. We also clarify that this work is revised and improved based on the manuscript awarded in the 2014 Bank of Korea Research Paper Competition. The awarded paper's title was "Can monetary policy influence on household consumption through housing prices?: Empirical analysis on homeowner balance sheet channel" written in Korean and by the same authors. We got approval for publication from the Bank of Korea Academy, and the views expressed in the paper do not represent the Bank of Korea. All authors contributed equally, and all remaining errors are our own.

the rapid economic growth does not guarantee the soundness of the economy. The skyrocketing growth of South Korea has caused diverse socio-economic inequality and impeded economic internal integration. One remarkable example is asset polarization between the low-income and high-income groups. The polarization worsened during the 2010s when there was an abnormal housing boom in South Korea. In general, severe asset inequality is considered to be harmful to economic internal integration in the sense that it leads to consumption inequality across households, and consumption is linked to welfare. Therefore, governments make efforts to reduce asset inequality through various policy instruments. Among them, monetary policy receives a lot of attention from policymakers and researchers. While the primary goal of monetary policy is to achieve price stability and manage economic fluctuations, monetary policy has broad effects on an economy. Therefore, it is important to figure out the transmission channel of the monetary policy; if we want to discuss the role of monetary policy in reducing asset inequality and consumption inequality, we need to understand how the monetary policy affects household consumption through asset values.

With the aim of deriving policy implications for emerging or developing countries whose economic conditions, especially related to housing markets and monetary policy environments, are similar to past South Korea, we investigate the monetary policy transmission mechanisms to consumption through non-financial asset values. Note that we focus on the 2000s and the early 2010s in South Korea because there was a moderately increasing housing market, and the economy experienced an unexpected downward pressure that was a global financial crisis during the periods. When we consider the recent COVID-19 crisis, the analysis of 2000s South Korea is appropriate to obtain meaningful implications for other emerging or developing countries. Also, we can remove a concern of biases from a recent housing boom in South Korea by focusing on the past periods. Therefore, this paper tries to estimate the monetary policy transmission channel related to the housing market using household-level panel data. By figuring out the channel, we expect we can provide helpful lessons for improving a country's socio-economic integration.

The main focus of this paper, the transmission mechanism of monetary policy through the housing market, has been discussed from various perspectives in Mishkin (2007). Mishkin (2007) argues that monetary policy can directly impact the housing market through changes in the cost of capital, expectations regarding housing prices, and shifts in housing supply. Also, it states that the wealth effect and credit effect indirectly transmit the policy effects to overall demand. Recently, Aladangady (2014) explored explicitly the household balance sheet channel of monetary policy and empirically analyzed the mechanism between monetary policy, housing prices, and household consumption, verifying its significance. We are also interested in the household balance sheet channel, rather than the traditional interest rate channel of monetary policy, to figure out the effect of monetary policy on household consumption through housing price

changes. Slacalek et al. (2020) also discuss the household balance sheet channel in the euro area. While Aladangady (2014) and Slacalek et al. (2020) discussed the channel in the U.S. and the euro area, respectively, we analyze South Korea, which is regarded as a role model to other emerging or developing countries. Also, we employ different methodologies and model specifications to vary from the previous studies.

The estimation of consumption function using the Korean Labor and Income Panel Survey (KLIPS) data shows that the household balance sheet channel worked in South Korea during the sample period. Specifically, monetary policy affects household consumption through two specific paths of the homeowner balance sheet channel: the wealth effect and the collateral effect. The wealth effect refers to the increased consumption of households with homeownership due to additional wealth resulting from rising housing prices during an expansionary monetary policy. On the other hand, the collateral effect signifies an additional increase in consumption by households facing borrowing constraints under home ownership, triggered by the rise in collateral value. Also, by analyzing the homeowner balance sheet channel by income level, we find that while the wealth effect is significant across all income groups, the collateral effect is only significant for lower-income groups. Based on the results, we provide the policy implication, suggesting that considerate and targeted monetary policy can contribute to enhancing socio-economic integration.

This paper is mainly related to the literature on how house price changes affect consumption. Berger et al. (2017) and Kaplan et al. (2020) discuss the housing wealth effect that arises from increases in household wealth followed by increases in housing prices, stimulating positive effects on household consumption. On the other hand, Aoki et al. (2004), Aladangady (2017), Iacoviello (2005), and Shin (2022) discuss a credit market effect that arises from the increases in the value of housing collateral, relaxing household budget constraints for consumption. Since the household balance sheet channel this paper tries to figure out encompasses both the wealth and collateral effects, this paper's empirical finding contributes to the literature. Secondly, this paper relates to the impacts of monetary policy. While this strand of literature is broad, covering optimal monetary policy in closed or open economies (e.g., Woodford, 1999) or the effectiveness of monetary policy (e.g., Mishkin, 2009), we focus on the transmission mechanism of the monetary policy.

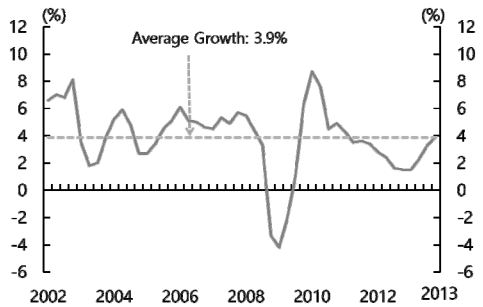
This paper is structured as follows. Section 2 provides background information regarding the economic condition in South Korea before and after a global financial crisis and monetary policy transmission channels. Section 3 presents the empirical model, data, and main results. Finally, after presenting the additional results regarding heterogeneous household groups in Section 4, Section 5 concludes the paper.

II. Backgrounds

A. Economic conditions in South Korea after the global financial crisis

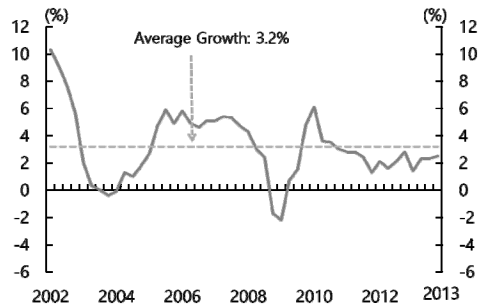
As of the early 2010s, the South Korean economy had continued in a low-growth phase without substantially recovering since the global financial crisis (see Figure 1). Specifically, it even recorded ten consecutive quarters of economic growth rate lower than the average growth rate in the 2000s (3.9%).[1] Similarly, consumption, which accounts for 63.2% of national income (as of the fourth quarter of 2013), also maintained a low growth trajectory (see Figure 2).

<Figure 1> Economic growth



(Source) Bank of Korea.
Note. YoY growth in real GDP.

<Figure 2> Consumption growth



(Source) Bank of Korea.
Note. YoY growth in real final consumption expenditure.

Meanwhile, the housing market in South Korea showed a sluggish trend due to delayed economic recovery and policy uncertainties. Housing prices had been on a downward trend since the end of 2012, with some signs of recovery towards the end of 2013 (see Figure 3). The slump in the housing market was not only reflected in housing prices but also prominently evident in the volume of housing transactions. It was observed that since 2012, monthly housing transaction volumes had often fallen below the average monthly volume of 93,000 units (see Figure 4).[2] Due to the sluggish housing market, concerns had been raised about the possibility of the Korean economy entering a vicious cycle characterized by "increased demand for repayment of mortgages by the financial sector due to the decline in housing collateral value → sharp increase in collateral disposals → decline in real estate prices." There was also apprehension about this cycle's potential for debt deflation.

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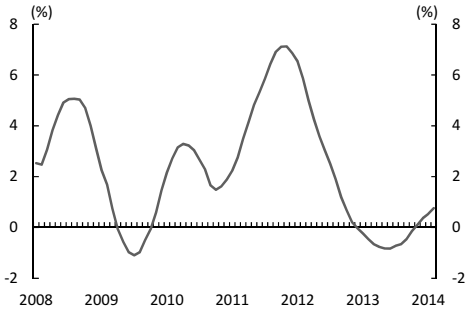
1) The high growth rate from the fourth quarter of 2009 to the second quarter of 2010 is attributed to the base effect caused by the low growth rate during the global financial crisis.

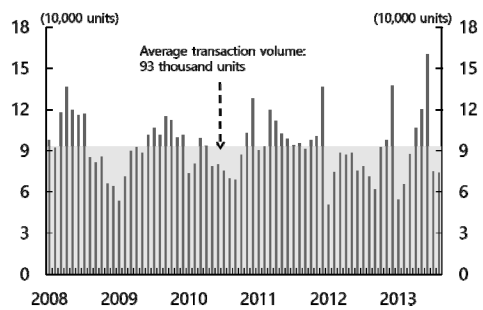
2) From April to June 2013, the housing transaction volume surpassed the average for the entire period (January 2008 to August 2013). This could be attributed to the temporary impact of tax reduction benefits for property acquisition during that period.

<Figure 3> Housing prices



(Source) Kookmin Bank.
Note. YoY growth in housing sales price index.

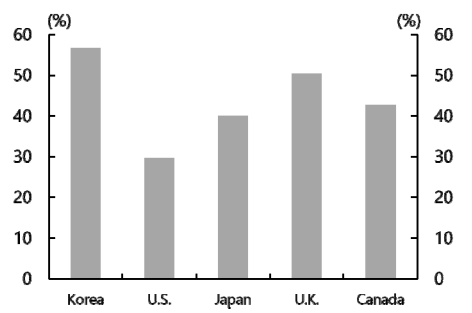
<Figure 4> Housing transactions



(Source) Korea Ministry of Land, Infrastructure and Transport.

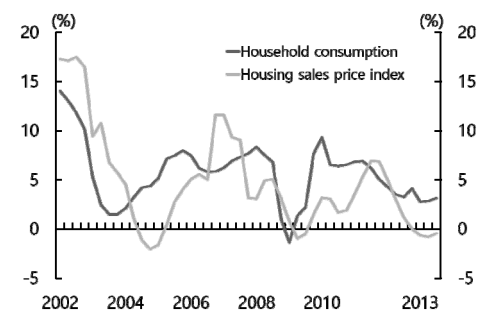
Examining the asset structure of Korean households as of 2012, the proportion of tangible assets to total assets was relatively high at 56.6%, compared to other OECD countries (see Figure 5). Due to the substantial share of tangible assets in household portfolios, housing price changes were expected to affect household economic activities in South Korea substantially. In fact, household consumption in South Korea showed a relatively high correlation with fluctuations in housing prices. Analyzing the correlation coefficient between the growth rates of household consumption and housing transaction prices since 2002 revealed a strong positive relationship at 0.60 (see Figure 6).

<Figure 5> Share of non-financial asset



(Source) OECD.
Note. Households' non-financial asset / Households' total asset (as of 2012).

<Figure 6> Household consumption and housing prices



(Sources) Bank of Korea, Kookmin Bank.
Note. YoY growth rates.

As confirmed above, aggregate consumption and the state of the housing market are closely interrelated. Therefore, this study focuses on elucidating the transmission mechanism through which monetary policy, using interest rates as a policy instrument, affects household consumption via housing prices. In order to achieve the goal, the following subsection will discuss both

the traditional monetary policy transmission channel and the pathway that this study aims to identify.

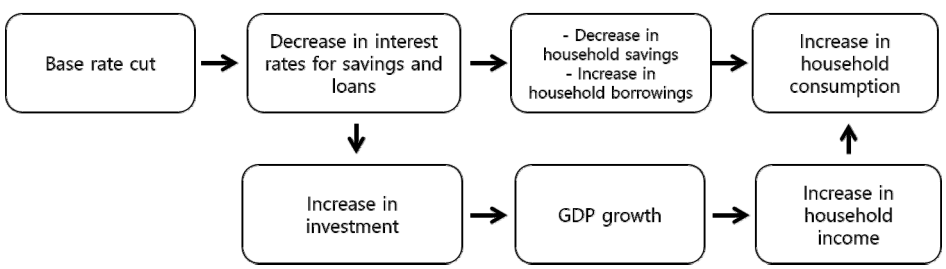
B. Monetary policy transmission channels on household consumption

The monetary policy transmission channels refer to the mechanisms through which monetary policy affects economic activities or variables such as production and inflation. The impact of monetary policy on the real economy occurs through various pathways. Since this study is primarily concerned with the influence of changes in monetary policy on household consumption, the focus will be on exploring the transmission pathways through which a reduction in the policy interest rate leads to an increase in household consumption.[3)]

1. Traditional interest rate channel

The traditional interest rate channel of monetary easing unfolds in two main stages. Firstly, a reduction in the policy interest rate leads to a decline in the interest rates on financial institutions' deposits and loans.[4)] This monetary policy transmission in the financial market leads to real economic effects in the subsequent stage. The second stage, the transmission pathway to household consumption, can be divided into three branches. Firstly, the decrease in deposit interest rates reduces the incentive for household savings, leading to an increase in household consumption. Secondly, the decline in loan interest rates stimulates household demand for loans, increasing household liquidity that leads to higher consumption. Lastly, from a general equilibrium perspective, the economic stimulus from the reduction in loan interest rates contributes to increased household income, leading to a rise in household consumption (refer to Figure 7).[5)]

<**Figure 7**> Traditional interest rate channel



3) Note that this study does not consider the effect of foreign monetary policy on consumption, which is considered in Kim (2022) and Kim (2024), since it is beyond the scope of this paper.

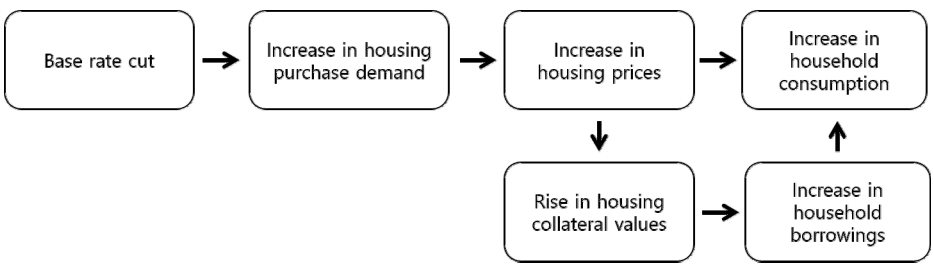
4) The pathway connecting the policy rate cut to the decline in deposit and loan interest rates in the financial market includes expectations driven by signaling effects.

5) According to Fujiwara and Teranishi (2008) and Kim and Song (2022), it is obvious that monetary policy has different influences on consumption across age groups. Nevertheless, we do not consider this because it is beyond the scope of this paper.

2. Homeowner balance sheet channel

The transmission of expansionary monetary policy through the balance sheet channel can lead to an increase in household consumption by improving the cash flow of households.[6] In the interest rate channel, the economic stimulus resulting in increased household income is observed, with a focus on labor income. However, in the balance sheet channel, attention is given to the increase in household wealth due to the rise in the value of assets held by households and the subsequent improvement in the balance sheet. Specifically, we are interested in housing prices and household consumption. Therefore, the discussion revolves around the transmission of monetary policy through the increase in household housing asset prices. The reduction in the policy interest rate leads to a decrease in lending rates and expectations of economic expansion, prompting an increase in housing demand, subsequently leading to a rise in housing prices. The increase in housing prices can lead to an increase in household consumption through two main effects: first, the wealth effect, as the increased value of owned homes enhances household asset value, and second, the collateral effect, as the ability to borrow against the appreciated housing value relaxes household liquidity constraints, expecting a subsequent increase in household consumption (refer to Figure 8).

<**Figure 8**> Homeowner balance sheet channel



Therefore, it is essential to analyze whether such a balance sheet channel exists and whether households, as the primary consumers, are reacting in accordance with the balance sheet channel. Hence, this paper aims to empirically examine the balance sheet channel for homeowners and derive its policy implications related to economic integration. Also, note that, as we mentioned above, we are interested in the 2000s when South Korea experienced a moderately increasing

6) While the boost in household consumption due to rising housing prices from expansionary monetary policy is often interpreted through the asset price channel, the balance sheet channel is introduced as part of the credit channel, suggesting that changes in monetary policy affect the financial position of households and induce fluctuations in external funding premiums. Following Aladangady (2014), this paper considers the view that rising housing prices improve household balance sheets, leading to an increase in wealth and subsequent growth in household consumption, incorporating both asset price and balance sheet channels. In other words, the concept of the balance sheet channel used in this paper is emphasized as a more comprehensive notion than the conventional asset price and credit channels.

housing market to eliminate concerns regarding distortion coming from an abnormal housing boom and, more importantly, to provide lessons for emerging or developing countries that are similar to the 2000s' South Korea.

III. Evidence of Homeowner Balance Sheet Channel in South Korea

A. Econometric model

This study employs panel data to estimate the household consumption function in order to verify the balance sheet channel for homeowners in South Korea. Accordingly, the consumption function is set up with disposable income, financial assets, non-financial assets, financial debt, and the policy interest rate reflecting monetary policy shocks as explanatory variables, as follows.[7] In the following consumption function, we also add control variables such as the age of the head of the household and the number of household members to account for the impact of household characteristics on consumption.

$$\log(C_t^i) = \beta_0 + \beta_1 \log(H_t^i) + \beta_2 \log(Y_t^i) + \beta_3 \log(W_t^i) + \beta_4 \log(D_t^i) + \beta_5 r_t + \beta_6 \delta_t^i + e_t^i \quad (1)$$

In equation (1), C_t^i represents consumption, H_t^i denotes the value of non-financial assets, Y_t^i is household disposable income, W_t^i is the value of financial assets, D_t^i is financial debt, r_t is the base rate (or policy rate), and δ_t^i is the vector of household characteristics (such as the age of the head of the household, the number of household members, etc.).[8] Note that, in this setup, the value of non-financial assets is treated as an exogenous variable affecting consumption, similar to the policy interest rate. However, in the balance sheet channel that this study aims to figure out, the value of non-financial assets is an endogenous variable influenced by monetary policy. To address the endogeneity issue, the paper proposes to conduct a panel 2SLS (two-stage least squares) analysis by adding the following equation to the estimation model, where the value of non-financial assets becomes the dependent variable, and variables such as monetary policy become explanatory variables.

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7) For the estimation model specification of the consumption function, we refer to Aladangady (2014), Kim and Kim (2010), Chang and Lee (2006), and Cooper (2013).

8) We use the non-financial asset as an explanatory variable instead of housing assets, considering the data availability issue. If we have more detailed data, we can extract the effects of housing assets from those of non-financial assets. Also, note that one advantage of using non-financial assets as the regressor is that we can incorporate the effects of non-financial assets other than residential ones.

$$\log(H_t^i) = \alpha_0 + \alpha_1 r_t + \alpha_2 \log(X_t^i) + u_t^i \quad (2)$$

(X_t^i is a vector consisting of Y_t^i, W_t^i, D_t^i, and δ_t^i)

The simultaneous equation model, consisting of equations (1) and (2), can be succinctly expressed as the following equations (1') and (2'):

$$C = \beta_0 + \beta_1 H + \beta_2{}' X + \beta_5 r + e \quad (1')$$

$$H = \alpha_0 + \alpha_1 r + \alpha_2 X + u \quad (2')$$

By differentiating both equations with respect to the variable representing monetary policy, r, we obtain:

$$\frac{\partial C}{\partial r} = \beta_1 \frac{\partial H}{\partial r} + \beta_2{}' \frac{\partial X}{\partial r} + \beta_5 \quad (1'')$$

$$\frac{\partial H}{\partial r} = \alpha_1 + \alpha_2 \frac{\partial X}{\partial r} \quad (2'')$$

The implications of the derived equations (1") and (2") after differentiating each variable in the model with respect to the monetary policy shock variable are clear. The term corresponding to the balance sheet channel for homeowners in the model is precisely the first term in equation (1"). The subsequent terms represent the traditional interest rate channel and other transmission pathways that are less transparent and pertain to non-real asset effects. Therefore, the coefficients of interest in this paper are those associated with equation (1) (or equations (1') and (1")). Through the estimation of these coefficients, the balance sheet channel for homeowners in South Korea can be elucidated.

B. Data for analysis

The anlaysis utilized micro-level panal data at the household-level from the Korean Labor and Income Panel (KLIPS) data (4th to 15th waves; 2001 to 2012). To track the dynamic changes in the sample households, the analysis was based on households that responded from 2001, excluding split or non-responsive households. Additionally, households that reported having debts borrowed from financial or non-financial institutions but inconsistently responded as having no principal and interest repayments or households that were reported to have debts or assets but lacked consistency in entering actual amounts were excluded from the estimation. The homeowners in the sample are the households identified in the KLIPS as indicating 'homeownership' when asked about the occupancy type and those who marked 'housing' for

the property in the real estate asset (excluding housing they currently live in) survey. As a result, 71% of the sample (37,367 households) are categorized as homeowners, and the financial status by homeownership is presented in Table 1. Homeowners exhibit higher income and consumption levels than renters (or non-homeowners) and demonstrate a larger scale of assets and debts.

<Table 1> *Mean Values of Key Variables, by Homeownership*

	Homeowners	Renters
# of Households	26,531	10,836
Financial Liability (10 thousand KRW)	3,053	1,645
Financial Asset (10 thousand KRW)	2,754	858
Non-Financial Asset (10 thousand KRW)	29,950	9,700
Disposable Income (10 thousand KRW)	4,356	2,726
Consumption (10 thousand KRW)	2,524	1,802

Note. While the sample period for analysis is the twelve years from 2001 to 2012, we provide the mean values of 2012, considering a concern about bias from inflation when we average the twelve years' value. The number of households is subject to the full sample.

In the empirical analysis, disposable income used as an explanatory variable encompasses labor income, financial income, real estate income, transfers, and other sources of income (such as insurance payouts and retirement benefits). Consumption includes non-durable consumption expenditure, excluding durable consumption and insurance payments. Financial liabilities include debts from financial and non-financial institutions, excluding security deposits received from housing rentals. Financial assets comprise bank deposits, stocks, bonds, savings-type insurance, and other assets (such as money lent to others and down payments). Non-financial assets include residential and non-residential assets (such as buildings, farmland, and land).

C. Empirical analysis: 2SLS estimation with random effects

In the simultaneous equations (equation (1) and (2)) established in subsection 3.1, we add the instrument variable to equation (2). As a result, the estimated model is as follows:

[Model 1]

$$\log(C_t^i) = \beta_0 + \beta_1 \log(H_t^i) + \beta_2 \log(Y_t^i) + \beta_3 \log(W_t^i) + \beta_4 \log(D_t^i) + \beta_5 r_t + \beta_6 \delta_t^i + e_t^i$$

$$\log(H_t^i) = \alpha_0 + \alpha_1 r_t + \alpha_2 \log(X_t^i) + \alpha_3 Z_t^i + u_t^i$$

The newly added variable Z_t^i in [Model 1] is the number of new housing units, included in equation (2) as an exogenous variable explaining housing supply. The reason for introducing

the new variable into the model is that the initially established model is under-identified, failing to satisfy the order condition necessary for estimating the simultaneous equations model. Therefore, according to the empirical findings that non-financial asset prices should consider both demand and supply factors, the housing supply variable is incorporated into the model as an instrumental variable.

The estimation method for [Model 1] involves the use of the two-stage least squares (2SLS) panel estimation with random effects because the sample households used in the analysis are randomly drawn from a larger population, and it is reasonable to assume that individual effects are randomly distributed.[9] To estimate the impact of housing price fluctuations on consumption based on monetary policy, [Model 1] was estimated by distinguishing between households that own homes (homeowners) and those that do not own homes (renters). The estimation results are in Table 2.

<Table 2> *Estimation Result of [Model 1], by Homeownership Status (2SLS with Random Effects)*

	Homeowners	Renters
log(NFA)	0.0899***	-9.163
	(0.0106)	(8.017)
log(DI)	0.233***	0.198***
	(0.00422)	(0.0261)
log(FA)	0.0652***	0.0391***
	(0.00296)	(0.0114)
log(FL)	0.0215* **	0.0182***
	(0.00203)	(0.00662)
BR	-0.0245***	-0.0187*
	(0.00416)	(0.0132)
AGE	0.0286***	0.0558***
	(0.00187)	(0.0108)
$(AGE)^2$	-0.000319***	-0.000562***
	(1.67e-05)	(0.000105)
SIZE	0.152***	0.157***
	(0.00286)	(0.0118)
Observations	16,127	5,360
R^2	0.6704	0.3425

Note. NFA is a non-financial asset, DI is disposable income, FA is a financial asset, FL is financial liability, BR is the base rate (or policy rate), AGE is the age of a representative member of the household, and SIZE is the number of the members of the household. The estimation model includes a constant. Variables excluding household characteristics are used as real variables (using CPI). The numbers in parentheses represent the standard errors. *, **, *** implies the estimate is significant at the significance level 10%, 5%, 1%, respectively.

9) Typically, the Hausman test is conducted to assess model specification. The test statistic indicated that at the 1% significance level, the null hypothesis of no fixed effects was rejected. However, we would like to note that the Hausman test compares the coefficients of the fixed effects model and the random effects model, rejecting the null hypothesis if there is a significant difference in the coefficients. Therefore, relying solely on the results of the Hausman test to determine model specification may not be desirable in cases where sample selection exhibits peculiarities, as is the case in this paper.

The estimation of the consumption function by housing ownership status revealed that the non-financial asset value has a significant positive coefficient only in homeowners. This result is attributed to the fact that the majority of non-financial assets used in the analysis, particularly for households, are confined to housing assets. While not a few households (29% of the total surveyed households) reported owning non-housing assets (such as buildings, farmland, and land), most of these households did not provide accurate responses regarding the market value of the owned real estate assets, making them unsuitable for inclusion in the sample. Financial assets and disposable income (representing the financial characteristics of households), household age and the number of family members (representing non-financial characteristics) showed significant positive coefficients. Regardless of homeownership, having more financial assets, higher disposable income, a larger number of family members, and an older household representative led to an increase in consumption. The positive effect of financial liability on consumption is consistent with previous research using the KLIPS data (e.g. Kim and Kim, 2010), suggesting that it results from easing liquidity constraints associated with debt.

Since the estimation results of [Model 1] indicate the existence of a consumption increase effect based on the ownership of non-financial assets, we now proceed to estimate the consumption function for homeowners, taking into account borrowing constraints to decompose the homeowner balance sheet channel. As mentioned in subsection 2.2.2, the effect of increased non-financial asset value on consumption can be divided into two paths. The first path is the wealth effect, and the second path is the collateral effect. Especially for borrowing-constrained homeowners, the additional consumption induced by increased housing collateral value will correspond to the collateral effect. Also, for households facing borrowing constraints due to the imperfect financial market, both debts and assets can directly affect their consumption. Therefore, the types of borrowing constraints are classified, considering both assets and debt (see Table 3).

<Table 3> *Types of Borrowing Constrained Households*

	Condition	# of households (Share in sample)
Constrained 1	Net asset[1] < 0	3,174 (8.5%)
Constrained 2[2]	(Real estate asset*0.7 + Financial asset) < Financial liability	4,990 (13.4%)
Constrained 3	(Real estate asset + Financial asset) < Financial liability	4,429 (11.9%)

Notes. 1) Net asset = (Real estate asset + Financial asset + Other assets) - (Financial liability + Rental deposit + Other debts).
2) Constrained 2 reflects loan-to-value ratio (70%).

Reflecting the three types of borrowing constraints in <Table 3>, households with negative net assets (Constrained 1) constitute 8.5% of the total sample households, households with real estate and financial assets reflecting the loan-to-value ratio being less than financial

liabilities. (Constrained 2) account for 14.3%, and households with the sum of real estate and financial assets being less than financial liabilities (Constrained 3) account for 11.9%. The model with the addition of a dummy variable indicating borrowing constraints is as follows:

[Model 2]

$$\log(C_t^i) = \gamma_0 + \gamma_1 \log(H_t^i) + \gamma_2 \log(H_t^i) * I_t^i + \gamma_3 \log(Y_t^i) + \gamma_4 \log(W_t^i) + \gamma_5 \log(D_t^i) + \gamma_6 r_t + \gamma_7 \delta_t^i + e_t^i$$

$$\log(H_t^i) = \eta_0 + \eta_1 r_t + \eta_2 \log(X_t^i) + \eta_3 Z_t^i + u_t^i$$

If a collateral effect exists, the coefficient for the dummy variable representing it (γ_2) is expected to be significantly positive. Additionally, the estimated coefficient for γ_1, representing the wealth effect excluding the estimated collateral effect from [Model 2], is expected to be smaller than the corresponding coefficient β_1 in [Model 1]. The results of estimating [Model 2] using the panel 2SLS are in Table 4.

<Table 4> *Estimation Result of [Model 2], by Types of Borrowing-Constrained Homeowners (2SLS with Random Effects)*

	Constrained 1	Constrained 2	Constrained 3
log(NFA)	0.0713*** (0.0107)	0.0712*** (0.0108)	0.0715*** (0.0108)
log(NFA)*Constrained 1	0.0199*** (0.00684)		
log(NFA)*Constrained 2		0.0125** (0.00501)	
log(NFA)*Constrained 3			0.0182** (0.00752)
log(DI)	0.233*** (0.00423)	0.233*** (0.00423)	0.233*** (0.00423)
log(FA)	0.0652*** (0.00296)	0.0653*** (0.00296)	0.0652*** (0.00296)
log(FL)	0.0204*** (0.00212)	0.0201*** (0.00219)	0.0205*** (0.00215)
BR	-0.0245*** (0.00416)	-0.0245*** (0.00416)	-0.0244*** (0.00416)
AGE	0.0284*** (0.00187)	0.0285*** (0.00187)	0.0284*** (0.00187)
$(AGE)^2$	-0.000318*** (1.67e-05)	-0.000319*** (1.67e-05)	-0.000318*** (1.67e-05)
SIZE	0.152*** (0.00286)	0.152*** (0.00286)	0.152*** (0.00286)
Observations	16,127	16,127	16,127
R^2	.6048	.6053	.6052

Note. NFA is a non-financial asset, DI is disposable income, FA is a financial asset, FL is financial liability, BR is the base rate (or policy rate), AGE is the age of a representative member of the household, and SIZE is the number of the members of the household. The estimation model includes a constant. Variables excluding household characteristics are used as real variables (using CPI). The numbers in parentheses represent the standard errors. *, **, *** implies the estimate is significant at the significance level 10%, 5%, 1%, respectively.

The estimated results show that all three types of borrowing constraints (γ_2) have significant positive coefficients, indicating the presence of collateral effects. Among them, Constrained 1, where households have negative net assets, showed the highest collateral effect. Additionally, the estimated coefficient for the wealth effect excluding the collateral effect in [Model 2] is smaller than the coefficient representing the wealth effect in [Model 1], as expected ($\gamma_1 < \beta_1$).[10)]

D. Policy implication

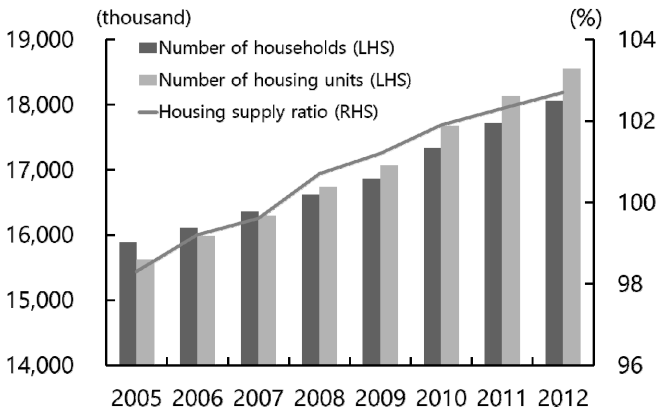
Based on the empirical analysis results from the previous subsection, let us derive the policy implications.[11)] Firstly, this paper, through the estimation of [Model 1], has successfully identified the existence of the homeowner balance sheet channel in South Korea during the 2000s. In other words, we confirm the significance of β_1 representing the transmission of monetary policy through the impact on housing prices, which in turn influences household consumption. The monetary policy transmission mechanism where changes in housing prices have repercussions on household consumption worked at least before the abnormal housing boom in South Korea. The results are particularly important as they confirm the expectations and findings of previous studies that the high proportion of non-financial assets in South Korea (see Figure 5) substantially affects household consumption. It implies an emerging or developing country whose proportion of non-financial assets is high will exhibit the homeowner balance sheet channel. Therefore, it is necessary to carefully consider the transmission channel through the housing market when implementing monetary policy. Furthermore, efforts should be made to enhance understanding of the characteristics of the homeowner balance sheet channel so that monetary policy can be effectively utilized to have an impact on the real economy. Although the analysis of the balance sheet channel in this study is limited to homeowners, it is a meaningful analysis given that

10) When interpreting the results in Table 2, it is crucial not to place undue emphasis on the magnitude of the coefficient for the non-financial asset value variable compared to the financial asset value variable. Concluding that homeowners are more sensitive to changes in non-financial asset value than financial asset value under a given monetary policy shock could be misleading. In the analysis, non-financial assets are treated as endogenous variables responding to monetary policy, while financial assets are treated as exogenous variables. Therefore, comparing directly the magnitudes of these two coefficients may lead to risky interpretations. It is advisable to focus on interpreting the significance and direction of the coefficients for financial assets and other variables.

11) Before discussing the policy implications, it is important to note that the empirical analysis results of this paper are based on estimates using the panel data from 2001 to 2012. As mentioned in the background section in section 2, there was sluggish growth due to weak consumption despite prolonged low interest rates during the sample period. In other words, even with interest rate cuts, there was an apparent lack of response in asset prices, and consequently, the interest rate reduction did not lead to increased consumption. However, it is crucial to acknowledge that the discussion in this paper is based on an analysis using the past long-term panel data, and may not perfectly align with the recent situation. The reason for conducting the analysis using long-term panel data is to figure out the homeowner balance sheet channel during the moderate housing market in South Korea, to identify policy implications for monetary policy and economic integration, and to provide lessons to other emerging or developing countries. If the objective is a comprehensive understanding of the recent situation, a multifaceted approach using recent panel data would be required.

the housing supply ratio in South Korea had surpassed 100% (see Figure 9).[12)]

<Figure 9> Housing supply ratio



Next, let us discuss the estimated coefficients γ_1 and γ_2 in [Model 2]. One potential limitation of the [Model 2] estimation is whether the proportion of households facing borrowing constraints is reasonably reflective of reality, as this could significantly harm the explanatory power of the results. We assume that households with weak financial conditions face liquidity constraints. In reality, even financially stable households may face borrowing constraints. However, we had to set somewhat stringent conditions to postulate borrowing constraints quantitatively. Therefore, it is noted that the estimation results of [Model 2] may be underestimated. Despite the above-mentioned limitation, the analysis explicitly distinguishes the wealth effect represented by γ_1 and the collateral effect represented by γ_2. It shows that the homeowner balance sheet channel operates through two distinct paths, even if there may be some underestimation. A noteworthy observation is that the wealth effect due to rising housing prices appears to have a more significant impact than the collateral effect. However, considering the proportion of households facing borrowing constraints relative to the overall sample (see Table 3), the estimated consumption-boosting effect due to the collateral effect is substantial. Therefore, in implementing monetary policy, it is essential to consider the ripple effects through the homeowner balance sheet channel. Particularly for households facing borrowing constraints, additional consideration should be given to the impact of collateral effects under the constraints.

12) Using the housing supply ratio may result in an overestimation of the proportion of homeowners since it does not catch multiple homeowners. On the other hand, using the owner-occupancy rate may lead to an underestimation of homeownership, as it does not consider those who own a house but reside in another property through rent or lease. Therefore, the housing supply ratio can be considered an upper bound, and the owner-occupancy rate is a lower bound. As of 2012, the owner-occupancy rate is 53.8%.

IV. Homeowner Balance Sheet Channel by Income Level

A. Subsamples by income level

In order to analyze the heterogeneity in the homeowner balance sheet channel by income levels, the sample was classified into three groups based on annual income. The low-income group includes households with an annual income of 35 million KRW or less, the middle-income group includes households with an annual income between 35 to 50 million KRW, and the high-income group includes households with an annual income of 5,000 million KRW or more. The financial status across income levels is presented in Table 5.

<Table 5> *Mean Values of Key Variables, by Income Level*

	Low Income	Middle Income	High Income
# of Households	24,740	6,171	6,435
# of Homeowners	15,974	4,876	5,660
(Share, %)	(64.6)	(79.0)	(88.0)
# of Constrained 1	2,608	319	237
(Share, %)	(10.5)	(5.2)	(3.7)
# of Constrained 2	3,873	644	468
(Share, %)	(15.7)	(10.4)	(7.3)
# of Constrained 3	3,520	553	351
(Share, %)	(14.2)	(9.0)	(5.5)
Financial Liability (10 thousand KRW)	1,356	2,239	5,477
Financial Asset (10 thousand KRW)	1,288	2,216	4,187
Non-Financial Asset (10 thousand KRW)	14,526	19,328	39,929
Disposable Income (10 thousand KRW)	1,705	4,163	7,933
Durable Consumption (10 thousand KRW)	1,397	2,596	3,924

Notes. Low-income group refers to household whose total annual income is below 35 million KRW, middle-income group refers to households whose total annual income is between 35 million KRW and 50 million KRW, and high-income groups refers to households whose total annual income is above 50 million KRW. While the sample period for analysis is the twelve years from 2001 to 2012, we provide the mean values of 2012, considering a concern about bias from inflation when we average the twelve years' value. The number of households is subject to the full sample. The types of constrained households follows the definition in Table 3.

Homeowners account for 64.6% of the low-income group, 79.0% of the middle-income group, and 88.0% of the high-income group. The proportion of households facing borrowing constraints tends to be higher in lower-income groups, with 10.5% of the low-income group, 5.2% of the middle-income group, and 3.7% of the high-income group falling into the category of households facing borrowing constraints, specifically with negative net assets (Constrained 1).

B. Empirical analysis: System GMM estimation

In this section, the specific estimation is carried out using the system GMM method. This method is chosen due to the characteristics of the sample, which combines cross-sectional and time-series data. The system GMM method is considered more efficient compared to fixed-effects models, random-effects models, and pooled OLS, given the nature of the data where cross-sectional and time-series components are combined. The Generalized Method of Moments (GMM), in general, provides efficient parameter estimation without requiring additional information beyond the sample moments conditions, and it is known for its ability to control endogeneity issues. In the previous section, the 2SLS estimation confirmed the significance of the transmission channel of "monetary policy shock → changes in non-financial asset value → consumption changes." Therefore, in this section, focusing specifically on the consumption function in [Model 2], the system GMM method is employed for a more delicate analysis. Also, we expect the use of different methodology could provide robustness of the results.

To examine the wealth effect and collateral effect corresponding to the homeowner balance sheet channel across different income levels, the entire households were divided into three groups based on annual total income (below 35 million KRW, 35 million to 50 million KRW, and above 50 million KRW). As all three types of borrowing constraints we considered (see Table 3) were found to be significant in the previous section, the most strict constraint, represented by a negative net asset position (Constrained 1), was used as a dummy variable.

Table 6 presents that the wealth effect is significant with a positive coefficient regardless of income level. Moreover, the impact on consumption increases as the income level increases. The collateral effect from borrowing constraints was found to be significant only in the low-income group (below 35 million KRW) and the middle-income group (35 million to 50 million KRW), showing a positive effect. It suggests that households facing borrowing constraints, particularly those with lower income levels, are motivated to increase consumption in response to the increase in collateral value associated with the rise in the value of non-financial assets.

<Table 6> *Estimation for Consumtpion Function, by Income-Levels of Homeowners*

	Low Income	Middle Income	High Income
log(NFA)	0.0509***	0.0587***	0.0953***
	(0.00292)	(0.00384)	(0.00315)
log(NFA)*Consrained 1	0.0236***	0.0158*	0.00536
	(0.00714)	(0.00815)	(0.00577)
log(DI)	0.134***	0.140***	0.112***
	(0.00319)	(0.0123)	(0.00515)
log(FA)	0.0468***	0.0209***	0.0391***
	(0.00213)	(0.00332)	(0.00268)
log(FL)	0.0131***	0.00531**	0.00938***
	(0.00206)	(0.00227)	(0.00164)

<Table 6> *Continued*

	Low Income	Middle Income	High Income
BR	-0.0137***	-0.0131*	-0.0138*
	(0.00386)	(0.00474)	(0.00357)
AGE	0.0246***	0.0240***	0.0432***
	(0.00170)	(0.00282)	(0.00259)
$(AGE)^2$	-0.000295***	-0.000258***	-0.000456***
	(1.51e-05)	(2.62e-05)	(2.39e-05)
SIZE	0.169***	0.103***	0.120***
	(0.00284)	(0.00403)	(0.00326)
Observations	8,503	3,314	4,299

Note. NFA is a non-financial asset, DI is disposable income, FA is a financial asset, FL is financial liability, BR is the base rate (or policy rate), AGE is the age of a representative member of the household, and SIZE is the number of the members of the household. Low-income group refers to household whose total annual income is below 35 million KRW, middle-income group refers to households whose total annual income is between 35 million KRW and 50 million KRW, and high-income groups refers to households whose total annual income is above 50 million KRW. The estimation model includes a constant. Variables excluding household characteristics are used as real variables (using CPI). The numbers in parentheses represent the standard errors. *, **, *** implies the estimate is significant at the significance level 10%, 5%, 1%, respectively.

C. Policy implication

This section conducted a more detailed analysis to derive specific policy implications by estimating the homeowner balance sheet channel considering income levels. The results show that the collateral effect due to borrowing constraints is significant, especially in the lower-income group. It implies that in an expansionary monetary policy leading to an increase in the value of non-financial assets, the lower-income group experiences a more pronounced collateral effect, resulting in additional consumption. While it is natural to observe a prevalence of borrowing constraints among lower-income households, the meaningful aspect of these results lies in the significant wealth and collateral effects for this demographic. Therefore, when implementing monetary policy, it is crucial to consider the income-level-specific spillover effects of the homeowner balance sheet channel. Given the results implying that the consumption contraction might be relatively larger for lower-income groups in the event of a decline in housing prices or non-financial asset values, policy considerations aimed at mitigating the impact on this demographic become imperative.

V. Concluding Remarks: Implication on Socio-Economic Integration

After the COVID-19 crisis, the housing market in many emerging or developing countries, including South Korea, has been facing challenges due to delayed economic recovery and policy uncertainties. In this context, concerns have arisen about the possibility of the real estate market entering a negative cycle characterized by "increased demand for repayment of housing collateral

loans due to a decline in collateral value → a surge in properties for disposal → a decline in real estate prices." Particularly, worries about debt deflation stemming from a decline in housing prices have been raised. In this situation, we aim to understand the correlation between household consumption and housing prices, focusing on the 2000s in South Korea. Specifically, this paper explores how monetary policy affects household consumption through the housing market and estimates the homeowner balance sheet channel using micro-level data. While the limitation of this paper lies in its primary focus on the homeowners, the analysis is deemed to be highly relevant in countries where housing supply condition is relatively fine, and the concern of the house-poor (those who own houses but are burdened with heavy mortgage payments) households is latent in the economy.[13)]

Monetary policy shocks such as changes in the policy interest rates affect household consumption through two specific paths of the homeowner balance sheet channel: the wealth effect and the collateral effect. The wealth effect refers to the increased consumption of households with homeownership due to additional wealth resulting from rising housing prices during an expansionary monetary policy. On the other hand, the collateral effect signifies an additional increase in consumption by households facing borrowing constraints under home ownership, triggered by the rise in collateral value. This paper's results indicate the significance of both effects, suggesting that the homeowner balance sheet channel effectively works. Therefore, monetary policymakers should consider not only the traditional transmission channels of monetary policy but also the homeowner balance sheet channel when formulating policies. In particular, analyzing the homeowner balance sheet channel by income level reveals that while the wealth effect is significant across all income groups, the collateral effect is only significant for low- and middle-income groups. This underscores the need for policy considerations specifically tailored to these income groups, particularly in situations of declining asset prices where lower-income groups are more sensitive to changes. When the policies are appropriately designed and targeted based on a better understanding of their transmission mechanism, the inequality across heterogeneous households will be reduced, and socio-economic integration will be enhanced. It is the lesson regarding integration this paper wants to deliver to emerging or developing countries whose economic situation is similar to the past South Korea.

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13) Another limitation is that the analyses of this paper are limited to a closed economy setting. Therefore, foreign monetary policy and dollar pricing, such as Kim (2023), which might have influences on household consumption, are not considered in this paper. Although considering them would be interesting, we leave them for future research.

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