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U.S. Interest Rate and Household Debt Sustainability: The Case of Korea

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Abstract: This paper revisits the issue of household debt sustainability in Korea responding to changes in U.S. interest rates. We investigate not only the transmission channels from U.S. interest rates to domestic interest rates, using the Bayesian VAR (vector autoregression) model, but also the issue of identifying households that are vulnerable in terms of their debt repayments, and we execute projections for the upcoming years given conditional forecasts and various macroeconomic scenarios. The estimation results indicate that first, the domestic policy rate will likely increase and then stagnate conditionally on the path of the U.S. policy rates. Second, the ratios of vulnerable households over total indebted households, which has been growing since 2012, will likely expand mildly over the upcoming years given an approximately 1.6%p gradual increase in interest rates and stable macroeconomic environments. Finally, however, the projected trend of domestic interest rates can cause a rapid expansion in the ratios of vulnerable households, in conjunction with a series of combined negative shocks such as highly concentrated principal repayment schedules, sharp declines in housing prices, and the occurrence of a crisis.

Keywords: household debt sustainability; vulnerable households; over-indebted households; marginal households; households at risk of default; Bayesian VAR

JEL Classification: D12; E47; F42

1. Introduction

The United States has been leading a reduction in global liquidity through means such as increasing interest rates and exiting from quantitative easing since December 2015. Recently, the market expectations for raising U.S. policy interest rates have been reversed to modestly declining, presumably as a result of elevated uncertainty for the world economy. In Korea, a small open economy, macro and financial variables such as domestic interest rates, economic growth, foreign exchange rates, and housing prices can all change greatly in reaction to external shocks such as changes in global interest rates. Given the expected upcoming trend of global interest rates, we need to revisit the issue of household debt sustainability in Korea.

However, to date, there have been few studies of domestic debt sustainability in the Korean household sector as it relates to external shocks. Several studies do not fully consider the macrofinancial structure of Korea as a small open economy in their analyses [1,2], nor have they undertaken many simulations involving realistic external shock scenarios. For example, the authors of [3,4] conduct simulations based mainly on crises or immediate shock scenarios in which the transmission linkages running from the external shocks to domestic economic and financial variables have hardly been explored. We are interested in the gradual effects of U.S. policy rate changes on domestic interest rates and the household debt overhang in a normal economic situation, as well as its effects during a crisis.

Against this backdrop, we first investigate the channels of transmission from U.S. interest rates to key domestic variables using conditional forecasts based upon a Bayesian vector autoregression (VAR) model. We also explore issues related to the identification of households that are vulnerable in their debt repayments, such as over-indebted households, marginal households, and households at risk of default. Finally, we carry out projections for vulnerable households for the upcoming years, given conditional forecasts and various assumed macroeconomic scenarios.

The overall results of our analysis indicate that the domestic policy rate will likely increase and then stagnate conditionally on the projected path of the U.S. interest rates. Forecasts conditional on the U.S. interest rates find that the ratio of vulnerable households over total indebted households is likely to grow modestly over the upcoming years, given an approximately 1.6%p gradual increase in interest rates and a stable macroeconomic environment. However, the trend of rising domestic interest rates can cause the ratio of vulnerable households to grow rapidly if it is accompanied by a series of combined negative shocks, involving, for example, highly concentrated principal repayment schedules, sharp declines in housing prices, and crisis occurrence.

This paper can fill the gap in the literature by investigating the linkages from external shock to the degree of sustainability of domestic household debt in a long-term perspective when compared with the previous literature [1–4]. The previous literature has been heavily focused on unrealistic or excess abnormal situations such as crisis scenarios or one-time shocks to steeply increase interest rates, rather than considering more realistic and long-term scenarios based upon the macro and financial economic outlook. For the crisis simulations, the estimation results of this paper are overall consistent with those in the works of [3,4].

The remainder of this paper proceeds as follows. In Section 2, relevant literature is provided. In Section 3, the issue of identifying vulnerable households following a shock in the U.S. policy rate is discussed. In Section 4, the sustainability of household debt in Korea is investigated under various macroeconomic scenarios. Finally, in Section 5, we summarize our empirical findings and draw some policy implications.

2. Literature Review

Controversy remains about which countermeasures to use to get rid of the debt crisis, but the majority of studies show that lowering household debt is capable of paving the way for sustainable economic growth. Thus, reasonable household debt ratios and allocations are of concern from macroeconomic and microeconomic perspectives.

The author of [5] fell into two categories based on an overview of some of the existing literature concerning demand and supply. Excessive and irrational consumer behavior will probably give rise to unsustainable household loans on the demand side. Regarding supply, modest household loans tend to be vulnerable to misconduct in credit assessments by the relevant financial institutions. They demonstrate that households are not capable of obtaining access to more loans with the housing market in a recession. Additionally, household income plays an important role in debt sustainability. Several studies pay more attention to the critical sustainable debt ratio at different income levels (see the work of [6]). In addition, an increasing number of studies emphasize the impact of monetary policy on households' debt sustainability, especially interest rates. The authors of [7] summarize that the likelihood of occurrence of household nonperforming loans rests on mortgage contract characteristics. The empirical results also illustrate that repayment of debt will inevitably become more burdensome to a family as the interest rate increases. The authors of [8] outline a number of economic indices, such as inflation rate, unemployment rate, and interest rate. The empirical analysis is predicted to be in line with previous studies that the debt sustainability of the private sector is likely to vary with the interest rate, regardless of real or nominal terms.

In this sense, what additional consequences will result from, especially in emerging market economies (EMEs), when and if the Federal Reserve Board implements an expansionary or contractionary policy at a macroeconomic level? The authors of [9] point out that interest rate spillovers

from developed countries to EMEs cannot be attributed to trade flows but rather, to some extent, to financial openness. Countries that have closer ties with the United States or the European Union are more sensitive to this transmission mechanism than those having a comparatively long-distance relationship. The authors of [10] draw an approximate conclusion that U.S. monetary policy regulation exerts a profound influence worldwide. For example, EMEs will experience domestic currency depreciation, capital outflows, and slumping stock prices, among others. To be specific, the effect of U.S. monetary policy on the international bond market has increased sharply since the global financial crisis. Unlike developed countries, EMEs will encounter a dilemma that either narrows the gap in interest rates or they will struggle with exchange rate fluctuations (see the work of [11]).

From a microeconomic perspective, interest rates impact the economic behavior of households, one of the most important market participants, by means of diversified channels, such as consumption, investment, and savings. The authors of [12] distinguish adjustable rates and fixed rates on mortgages to investigate which pose a greater threat to the Swedish household. They finally argue that the households whose debt-to-income ratio is more than 2 and whose borrowing interest rate is adjustable have less marginal propensity to consume than other subgroups. In consideration of the heterogeneity of different products, the author of [13] finds that insurance products have nothing to do with the variation of interest rates in Germany, partly because households purchase insurance products for security reasons, which is in stark contrast to other assets that are statistically related to the interest rate, for instance, stocks as well as bonds. With regard to EMEs, the authors of [14] use a national dataset of Thailand starting from 2009, with a yearly interval, until 2013, as well as the probit model approach to examine the response of households to interest rate shocks. The empirical results indicate that consumption growth is possibly hampered when the debt servicing ratio snowballs over a period of time, in both low-income and medium-income households.

3. Households with Debt Repayment Vulnerabilities

3.1. Conditional Forecasts Using Bayesian VAR

In this section, we investigate the potential changes in the proportion of vulnerable households following a shock in which the U.S. policy rate would change for upcoming years. This paper uses the effects on the domestic call rate instead of the bank household lending rate. This has two implications. First, it enables us to deal directly with the transmission channel between an exogenous U.S. policy rate and the domestic policy rate. Second, the call rate as the basis interest rate can have effects not only on bank lending rates, but also on nonbank financial sector lending rates. In addition, the limited availability for the interest rate data of the nonbank financial sector is another reason for focusing on the policy-related call rate. The changes in balance sheet of the U.S. Federal Reserve known as quantitative easing can affect global financial markets. Under zero interest rates, the changes in the federal funds rate are unlikely to reflect the financial situation, but since the normalization of the interest rate in December 2015, the U.S. policy rate reflects this.

For this analysis, we first construct a Bayesian VAR model incorporating the U.S. policy rate and domestic macro and financial variables. The reason for adopting the Bayesian VAR model comes from its well-known superior performance in forecasting. Second, we execute the forecasts for domestic variables including the call rate conditional on the U.S. policy rate's path, which is exogenously imposed. Finally, we conduct projections for households that are vulnerable in their debt repayments, given various macroeconomic scenarios associated with the conditional forecasts for domestic interest rates.

The endogenous variables in our Bayesian VAR model are displayed in Table 1. The most exogenous and shock-generating variable is the effective federal funds rate in the United States, denoted by *funds rate*. The other endogenous variables are all domestic variables related to the Korean economy: Korean Won/US \$ foreign exchange rate, denoted by *fxr*; the real gross domestic product (GDP) growth rate, denoted by *y*; the rate of consumer price index (CPI) increase, that is, inflation,

denoted by p ; and the call rate, a typical overnight interest rate in the interbank money market, denoted by *call rate*.

Table 1. Endogenous variables in the Bayesian vector autoregression (VAR) model. GDP, gross domestic product; CPI, consumer price index.

| Variable | Description |
|-------------------|--|
| <i>funds rate</i> | U.S. effective federal funds rate |
| <i>fxr</i> | Korean Won/U.S. \$ exchange rate |
| <i>y</i> | Real GDP growth rate in Korea |
| <i>p</i> | CPI growth rate in Korea |
| <i>call rate</i> | Call rate, overnight interbank lending rate in Korea |

Sources: Funds rate from FRED of Federal Reserve Bank of St. Louis; all other data from the Bank of Korea ECOS.

The causal flow in the VAR model indicates that a shock from the federal funds rate can ultimately affect the call rate via transmission channels through factors in both the external and internal sectors such as the foreign exchange market and internal real economic conditions. The former includes the foreign exchange rate, and the latter includes GDP growth and inflation. The foreign exchange rate related to external shocks is assumed to have a greater degree of exogeneity than internal variables such as economic growth and inflation, as displayed in Table 1. This causal flow represents that the central bank's policy for the interest rate would be implemented after observing domestic economic activities indicated by GDP growth and inflation. In addition, the interest rate can affect domestic economic variables in advance. Whether the call rate would be in advance or follow in the VAR structure does not make any critical differences in forecasts of the call rate responding to projected path of the federal funds rate.

The data sample is from 2000 Q1 to 2017 Q4, thus excluding the periods of the 1997 Asian Crisis and the years of sharp rebound from the crisis through 1999. We use quarterly frequency basis data in this section, however, rather than monthly, on the grounds that quarterly frequency data can be more stable for drawing economic implications under the conditional forecasting setup using the Bayesian VAR model. The four lags of the endogenous variables are used in the VAR framework, which indicates that one year of lagged variables is allowed in the quarterly frequency data. The conventional Choleski decomposition is adopted for the VAR identification, where the ordering of the degrees of exogeneity from top to bottom is just the same as that displayed in Table 1.

The typical Minnesota prior [15] is adopted for the Bayesian VAR model. The use of Minnesota prior implies that the distributions for the dynamic coefficients are set so that the lower the effects of the lagged variables, the more the lags in the endogenous variables. More specifically, the distributions from which the dynamic coefficients are drawn are set to be more tightly condensed around zero as the lags grow. The Bayesian VAR model is estimated by Gibbs sampling, a numerical method in which a posterior density can be estimated from conditional posterior densities using zigzag random sampling across each conditional density. Finally, the VAR equation is written as shown in Equation (1).

$$B_0 Y_t = A + B_1 Y_{t-1} + B_2 Y_{t-2} + B_3 Y_{t-3} + B_4 Y_{t-4} + E_t, \quad (1)$$

where A is a constant vector, the B s are dynamic coefficient matrices, and E is an error term vector. Y is the data matrix for endogenous variables reflecting the degree of exogeneity, such as *funds rate*, *fxr*, *y*, *p*, or *call rate*, and B_0 is the lower triangular matrix for the Choleski decomposition. The conditional forecasts for the upcoming years are conducted using the method from the authors of [16]. The conditional forecast can be described as similar to estimating the response functions of the endogenous variables of interest to continue impulses from an exogenously fixed path. In this

paper, the variable of interest is the call rate, the base interest rate for all interest rates in Korea, and the exogenously fixed path is the trend of increase in the U.S. federal funds rate.

The previous literature exploring the mechanism of transmission from U.S. to Korean interest rates has focused heavily on term structure approaches [1,2]. Here, we are more interested in the historical responses of domestic macro variables such as the call rate to shocks from the U.S. policy rate. Korean monetary policy is likely to consider not only domestic growth and inflation, but also changes in external conditions including global interest rates and the foreign exchange market.

On the basis of the projection for the federal funds rate as of 19 June 2019 [17], the latest updated projection as of today, a realistic scenario for the path of the effective federal funds rate from 2018 Q2 to 2020 Q4, can be set as follows:

- Q2 2018: 1.70%
- Q4 2018: 2.20%
- Q4 2019: 2.40%
- Q4 2020: 2.10%

Under this scenario, the policy rate would increase by approximately 2.40%p, in a gradual manner, over the four years from 2016 to 2019, and then the projected rate for 2020 was reversed to decline to 2.10% recently, reflecting the heightened uncertainty for the upcoming world economic situation. The magnitude of increment in the rate is slightly lower than that of the average among the three cases of tightening phases in the U.S. policy rate since 1990. During the periods, the rate had increased by 3.07%p on average within a year and a half. In contrast, the speed of the increase in the U.S. policy rate for the current tightening phase is definitely slower than that in the previous three cases, in that the U.S. policy rate would be increasing approximately 0.8%p on average for a year and a half from 2016 to 2019.

The forecasts for the domestic macro variables conditional on the three-year U.S. rate path are shown in Figure 1. The red lines are the forecast means, and the dotted lines are the 68% boundaries of the respective forecast distributions. For the U.S. federal funds rate, only a single mean value exists, as its conditional path is exogenously imposed. Expectedly, the call rate, on which open market operations in Korea are conducted, is closely linked with the movements of the U.S. policy rate. The forecasts for the increase in the call rate following increases in the U.S. rates are as follows:

- Q4 2018: 1.56 < 2.17 < 2.78
- Q4 2019: 1.94 < 2.73 < 3.51
- Q4 2020: 2.05 < 2.87 < 3.69

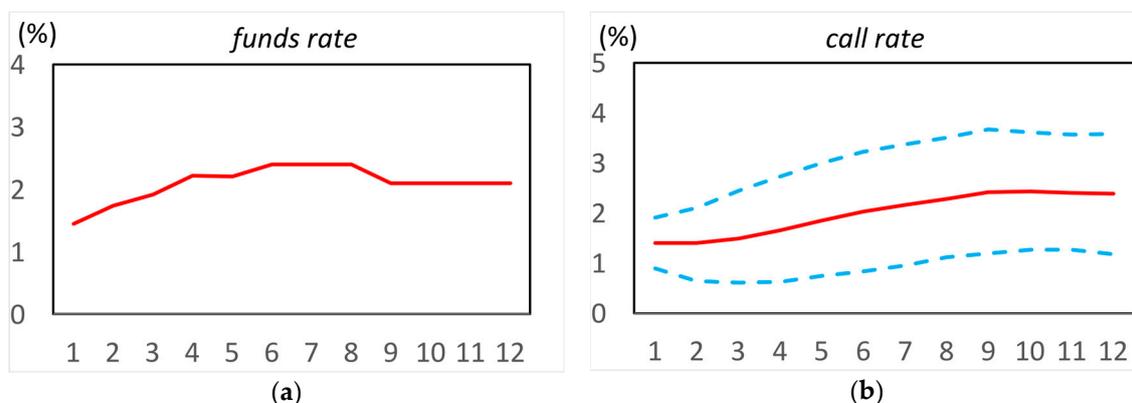


Figure 1. Forecasts conditional on the federal funds rate path. (a) Conditional forecasts for the federal funds rate; (b) conditional forecasts for the call rate. The red lines are the means, and the dotted lines are the probability bands of one standard deviation, that is, 68% of the respective forecast distributions.

The lower values indicate the lower ends of the 68% distributions, and the upper values indicate the upper ends. The lower end of the forecasted call rate distribution would increase a little to approximately 2.05% in Q4 2020 from 1.94% in Q4 2019, given that the projection for U.S. interest rates would decrease in 2020. The upper end of the forecast distribution turns out above 3%, a scenario that seems less likely given the current sluggish economic conditions in Korea and the heightened sensitivity of economic participants who have become accustomed to a long period of low interest rates. The mean forecast is below 2% at the end of 2020, conditional upon the U.S. rate path. The approximately 1.6%p increment in domestic interest rates, from 1.25%, a historically low level, in Q1 2018 to 2.87% in Q4 2020 would amount to 77.1% of the total increment of 2.10%p in the U.S. federal funds rate, which has increased from the zero lower bound. An enhanced synchronization among international interest rates is also found in recent studies such as the works of [18,19].

3.2. Identifying Households with Debt Repayment Vulnerabilities

In this section, issues related to the identification of households that are vulnerable in their debt repayments are discussed, and we apply novel identification methodologies using household-level panel data. For this task, balanced household-level panel data are constructed using the Household Finance and Living Conditions Panels from 2012 to 2017. After some relevant treatment for missing subitems, the balanced panel data include annual amounts of 6151 households for the common panels and approximately 3100 households for the finance panels. The common panels originally had approximately 20,000 households annually, but have been cut by more than two-thirds because of natural attrition and missing variables in the process of balanced panel construction. In addition, the finance panels began with approximately 10,000 households, but have similarly been reduced to approximately one-third of that.

Following the work of [20], a new debt service ratio (DSR) methodology is applied based upon gross income in place of disposable income, because disposable income has many weaknesses as an indicator including its less solid definition and numerous missing variables. There can be a sizable negative disposable income-based DSR thanks to a negative denominator, that is, a negative disposable income that can occur after subtracting social contributions, taxes, and principal plus interest repayments from gross income. Cases of negative disposable incomes can easily come to be deleted, which can consequently lead to a smaller estimate of vulnerable households than the true value. The concept of disposable income can also vary across countries. Nordic countries can, for example, have relatively smaller disposable incomes because of their large social contributions, which may, as a result, mean high DSRs in terms of disposable income that do not, however, necessarily indicate deteriorations in the debt repayment capacities of households. Therefore, here we attempt to investigate households that are vulnerable in their debt repayments using their DSRs based on gross income, as shown in Equation (2).

$$A1 = \frac{\max(0, D - FA)}{D} \times \frac{R}{(Y - FI)} > 30\%, \quad (2)$$

where D indicates total debt including financial debt and residential deposits; FA, financial assets; R, repayments for principal and interest; Y, gross income; and FI, financial income. Equation (2) implies that a household with a DSR of more than 30% could be excluded from the vulnerable households' category if the household has sufficient financial assets to cancel out its current debt. Moreover, financial income should be deducted from the gross income because of the disposals of the financial assets. The cutoff rule of 30% is adopted following the work of [20], which is quite reasonable in that the households having more than 30% of their gross income being used for principal or interest payments are likely to undergo decline in their debt sustainability.

Next, we can consider debt repayments through disposals of real assets as well as financial assets, as shown in Equation (3). Here, real assets excluding owners' personal dwellings can be easily converted into liquid assets to repay debt.

$$A2 = \frac{\max(0, D - FA - RA2)}{D} \times \frac{R}{(Y - FI - RAI)} > 30\%, \quad (3)$$

where RA2 indicates real assets except the owner's residential house and RAI is real asset income.

Finally, an indebted household can reduce its total volume of debt through the disposal even of its own dwelling, as specified in Equation (4). However, after disposals of their own dwellings, the households must pay rents throughout their lifetimes. They should only utilize their residual life estate values (f) after reserving future expected rental payments. Therefore, a certain percentage of the market value of a household's own dwelling should be secured for its future payments of rent. We apply the reverse mortgage valuations of the Korea Housing Finance Corporation, which depend on the ages of the households' heads such that the residual life estate value is 0.4 (or 40% of the housing price) if the age of household head is between 20 and 35 years, 0.5 if it is between 36 and 45 years, 0.6 if between 46 and 55 years, 0.7 if between 56 and 65 years, 0.8 if between 66 and 75 years, and 0.9 for a household head aged 76 years or above. As the age of the household head grows, the residual life estate value (f) increases.

$$A3 = \frac{\max(0, D - FA - RA2 - RA1*f)}{D} \times \frac{R}{(Y - FI - RAI)} > 30\%, \quad (4)$$

where RA1 indicates the owner's residential house, and f is the residential life estate value for debt repayments.

In addition, two indicators of the Bank of Korea—the traditionally used marginal households (Kim et al., 2014) and a newly introduced indicator of households at risk of default (BOK, 2015)—are also reviewed together. These indicators are defined in Equations (5) and (6).

$$\text{Marginal households: } DSR > 40\% \text{ and net assets} < 0, \quad (5)$$

$$\text{Households at risk of default: } HRD > 100\%, \quad (6)$$

where HRD is defined as $(1 + (DSR - 40\%)) \times (1 + (\text{liabilities/assets} - 100) \times 100)$.

The DSRs in the two indices defined in Equations (5) and (6) are based on disposable incomes including interest payments. The original definition of disposable income does not include interest payments, but a revised disposable income is needed for DSR calculation. Sometimes there can be confusion as to whether households are paying interest only or interest plus principal. This is another potential weakness of using a DSR based on disposable income.

Marginal households indicate that even households with a DSR of more than 40% are not included in the category if they have sufficient financial and real assets to settle their current debts. The concept of the HRD index is basically similar to the marginal households, but its coverage could expand as a result of the multiplication restriction between the DSR and the net asset condition instead of the additional restriction in the marginal households in Equation (5). We do not apply real asset valuations differentiated in accordance with the degrees of liquidity in our calculation of households at risk of default, owing to the absence of information on that.

The results of estimation to identify over-indebted households are displayed in Table 2. Two more indicators, *Households under the poverty line* and *Households borrowing from noninstitutional lenders*, are also introduced. The former indicates households that have less than 60% of the median levels of equalized disposable incomes after their interest and principal repayments, where equalized disposable income is disposable income adjusted for the number of household members. The latter comprises

households that are indebted to Daebu money lenders and credit-specialized financial companies, among others, which charge very high rates of interest in their household lending.

Table 2. Trends of households ¹ with debt repayment vulnerabilities (% , %p).

| Categories for Households | 2012 (A) | 2013 | 2014 | 2015 | 2016 | 2017 (B) | B – A | (B – A)/5 |
|---|----------|------|------|------|------|----------|-------|-----------|
| Over-indebted households (A3) | 1.3 | 1.4 | 1.9 | 2.6 | 3.5 | 3.2 | 1.9 | 0.38 |
| Marginal households | 1.7 | 1.9 | 3.0 | 3.8 | 4.6 | 4.4 | 2.7 | 0.54 |
| Households at risk of default | 10.3 | 10.2 | 11.3 | 12.4 | 13.7 | 14.9 | 4.6 | 0.92 |
| Households under poverty line ² | 13.8 | 14.4 | 14.3 | 14.1 | 13.6 | 14.4 | 0.6 | 0.12 |
| Households borrowing from noninstitutional lenders ³ | 2.9 | 4.3 | 3.7 | 3.3 | 4.1 | 2.8 | −0.1 | −0.02 |

¹ Shares in total indebted households. ² Households whose equalized disposable incomes after their debt repayments are less than 60% of the median equalized disposable income of indebted households as a whole. ³ Daebu money lenders and credit-specialized financial companies.

Table 2 indicates that the values of the three major indices—over-indebted households with A3 in Equation (4), marginal households, and households at risk of default—rose continuously from 2012 to 2017, from 1.9%p to more than 4.5%p. The strong policy encouragement of amortized mortgage lending since 2012 presumably also contributed to these trends, in part by reducing the share in total mortgage loans of those on which interest only is paid. In addition, the annual average increases in the three indicators ranged from 0.38%p to 0.92%p, very high speeds compared with those in other countries in Organization for Economic Cooperation and Development (OECD) whose household debts have been deleveraged or stagnated since the 2008 global financial crisis.

The share of total indebted households of households at risk of default in 2014 is 11.3%, slightly higher than the 10.3% value published by the Bank of Korea (2015). As discussed earlier, this difference can result from several sources—differences in treatment for missing items, whether balanced panels are used or not, and whether real asset valuation in terms of liquidity is applied or not. At any rate, the gap is relatively small, and the estimated indicators are good enough to be trusted in the identification of vulnerable households. Moreover, the corresponding value for over-indebted households with A3 is a mere 1.1% in Italy, discussed in the work of [20], and the corresponding value for households under the poverty line in Italy is only 6.2%, indicating that the problem of households having debt repayment vulnerabilities could be more critical in Korea.

4. Examining the Sustainability of Household Debt

4.1. Specifications for Overindebted Households under the Poverty Line

The characteristics of the over-indebted households can be easily understood by comparisons with other indebted households. As shown in Table 3, over-indebted households with A3 > 30% had average negative net assets of 140.9 million won in 2017. Gross income itself was bit lower among over-indebted households, at 49.3 million won compared with 58.3 million won among all other indebted households. The debt repayment burdens of over-indebted households were, however, approximately five times greater than those of other indebted households. The average DSR in terms of gross income was just 1.0% for other indebted households, with its median being zero, in stark contrast to the case among over-indebted households of 114.1% with a median of 55.2%.

Table 3. Indebted vs. over-indebted households, as of 2017 (million won). DSR, debt service ratio.

| Variable | Averages of Other Indebted Households | Averages of Over-Indebted Households (A3 > 30%) |
|---------------------------------|---------------------------------------|---|
| No. of households in panels | 3688 | 122 |
| Total assets (A) | 240.6 | 72.8 |
| Total liabilities (B) | 78.2 | 213.7 |
| Financial liabilities | 58.9 | 169.0 |
| Net assets (A – B) | 162.5 | –140.9 |
| Principal and interest payments | 11.0 | 55.6 |
| Interest payments | 0.26 | 0.81 |
| DSR_A3 (mean, %) | 1.0 | 114.1 |
| DSR_A3 (median, %) | 0.0 | 55.2 |
| Gross income | 58.3 | 49.3 |

We now investigate those over-indebted households under the poverty line, as displayed in Table 4. The share of total indebted households for those that are under the poverty line has been growing since 2012, when it was 0.48%, and stood at 0.87% as of 2017. Over-indebted households under the poverty line can be quite vulnerable to increased debt repayment burdens and external shocks. The share of those households is estimated to be approximately one-third of total over-indebted households. After making their debt payments using their gross incomes, they cannot support their livelihoods without borrowing further for necessary living expenses, as their interest and principal repayments have been consistently greater than their gross incomes. Their effective interest rates have been approximately 10% since 2014, with high volatility, and stood at 8.0% in 2017. These facts indicate that this household group could be devastated by a heightened interest rate shock.

Table 4. Over-indebted households (A3) under the poverty line (% , %p, million won).

| Variable | 2012 (A) | 2013 | 2014 | 2015 | 2016 | 2017 (B) | B – A |
|---|----------|------|------|------|------|----------|-------|
| Share of over-indebted households in total indebted households | 1.3 | 1.4 | 1.9 | 2.6 | 3.5 | 3.2 | +1.9 |
| Share of households under poverty line ¹ among total indebted households | 13.8 | 14.4 | 14.3 | 14.1 | 13.6 | 14.4 | +0.6 |
| Over-indebted households under poverty line | | | | | | | |
| Share among total indebted households | 0.48 | 0.30 | 0.64 | 0.62 | 0.80 | 0.87 | +0.39 |
| Share among over-indebted households | 35.8 | 21.8 | 32.9 | 23.5 | 23.0 | 27.0 | –8.8 |
| Poverty line criteria (60% of median in equalized disposable income ²) | 11.2 | 9.9 | 13.7 | 14.1 | 18.3 | 10.5 | –0.7 |
| Gross income | 14.7 | 7.3 | 14.8 | 17.1 | 17.9 | 15.1 | +0.4 |
| Interest and principal payments | 15.5 | 12.9 | 43.2 | 26.8 | 17.9 | 28.9 | +13.4 |
| Effective interest rate | 14.9 | 7.8 | 10.7 | 10.1 | 17.0 | 8.0 | –6.9 |

¹ Households whose equalized disposable incomes after their debt repayments are less than 60% of the median in equalized disposable income of total indebted households. ² Disposable incomes are standardized by numbers of family members.

Further investigation into the over-indebted households under the poverty line as of 2017 indicates that more than 90% of this group belongs to the first and second lower income quintiles. In addition, almost 90% of the group has unstable job positions such as being unemployed, temporary workers, poor self-employed business operators without an employee, and so on. Moreover, more than two-thirds of the heads of these households are, therefore, 51 years of age or more, reflecting the rapid pace of population aging in the Korean economy. The poor job statuses and advanced ages of this group as a whole imply the likelihood that debt restructuring will be essential, through active interventions by the authorities including the lowering of effective interest rates, debt write-offs, and payment rescheduling.

4.2. Projections for Vulnerable Households under Various Scenarios

In this section, projections for over-indebted households over the next three years are conducted based on scenarios for the future path of the U.S. federal funds rate. More specifically, projections for 2018 through 2020 are executed given the assumption that the economic features in 2017 with realized values in the household panel will be replicated for the three years, with variations reflecting the different specified scenarios. A baseline scenario for the Korean economy associated with household debt in the projected years is, therefore, assumed as follows, mainly in consideration of the trends in the household panel data observed between 2014 and 2017 as well as the new government's policy directions:

- Increments in interest payments in line with the forecast increases in the call rate are added to the historical interest payments as of 2017.
- Gross income grows by 3.8% per year, given that the average values in the household panel grew by 3.8% annually between 2012 and 2017.
- There are no changes in the nominal housing price level as of 2017.
- There are no changes in financial assets or financial liabilities from those in 2017, given that the average values for net financial assets in the household panel have been stagnant (having grown by close to zero percent (+0.2%) annually between 2014 and 2017).
- Principal repayment schedules: (i) principal repayments grow by 10% per year, based upon the realized rates of growth in the household panel between 2014 and 2017; (ii) principal repayments from 2018 to 2020 are applied by an amortization schedule for 20-year loans plus 5% growth annually in principal repayments from the base year of 2017.

Making a relevant evaluation of the principal repayments schedule is a very challenging task, given the variety of underlying factors such as the intensity of the government policy promoting amortization, interest rate developments, variations in households' individual decisions, and so on. In this paper, we assume two schedules. First, principal repayments can follow the very recent trend seen between 2014 and 2017, during which principal repayments grew by an annual average of approximately 10.0%. Second, we also consider a relatively mild debt repayment schedule in which the average amortization period for already borrowed mortgages is set at 20 years for all indebted households for the next three years. This reflects an assumption that the direction of the government policy to extend the amortization period for home mortgage loans will be sustained and that the recent trends in principal repayments will persist over the next three years. The cases at the lower and upper boundaries for the call rate path in response to U.S. interest rate shocks are also reviewed.

Table 5 shows the projections for the shares of those that are vulnerable in their debt repayments among all indebted households under the forecast mean path of the call rate from 2018 through 2020, such as 2.17% → 2.73% → 2.87%, as well as 10% increases in principal repayments each year from 2018. The shares increase moderately, from 3.2%p to 3.5%p for over-indebted households, from 4.4% to 5.1% for marginal households, and from 14.9% to 15.6% for households at risk of default. The annual average changes in the three indices range from 0.10%p to 0.23%p, slower than the realized values between 2012 and 2017, which varied from 0.38%p to 0.92%p, as shown in Table 2. The period from 2012 through 2017 can be characterized as downward trends in interest rates and modest increases in

housing prices nationwide. Even assuming a stable economic situation, with the two macroeconomic circumstances of gradually rising interest rates and stagnating housing prices, the shares of households having debt repayment vulnerabilities would be projected to increase mildly and stand at from 3.5% to 15.6% of the total indebted households when compared with those in 2017. Particularly, the shares show little increase from 2019 to 2020, in line with few changes in the projected path of the call rate, given that the U.S. policy interest rate has recently been projected to reverse or decrease.

Table 5. Projections for households ¹ with debt payment vulnerabilities ² given the mean path of the call rate ³ plus a 10% annual increase in principal payments from 2018 to 2020: baseline scenario (% , %p).

| Categories for Households | 2017 (A) | 2018 | 2019 | 2020 (B) | B – A | (B – A)/3 |
|-------------------------------|----------|------|------|----------|-------|-----------|
| Over-indebted households (A3) | 3.2 | 3.2 | 3.5 | 3.5 | 0.3 | 0.10 |
| Marginal households | 4.4 | 4.7 | 4.9 | 5.1 | 0.7 | 0.23 |
| Households at risk of default | 14.9 | 15.2 | 15.5 | 15.6 | 0.7 | 0.23 |

¹ Shares in total indebted households. ² Scenario where household principal repayments increase by 10.0% annually from 2018 to 2020. ³ Mean path of the forecasted call rate conditional on the U.S. policy rate from 2018 to 2020: 2.17% → 2.73% → 2.87%.

The cases of the lower- and upper-bound paths of future interest rates are displayed in Tables 6 and 7, respectively. The speed of interest rate developments even in the upper-bound path can cause the shares of households vulnerable in their debt repayments to increase to certain limited extents, from 0.5%p to 1.0%p, not driving any dramatic differences as in Table 7. Assuming stable economic performances, shocks to interest rates alone can have limited effects on indebted households. This implies that the government and the central bank can have room for policy implementation for dealing with households on the brink of default, by preventing any negative spiral triggering a financial crisis or a critical deterioration in macroprudential soundness. However, continuing and expanding numbers of over-indebted, marginal, and at-risk-of-default households can be a drag on consumption growth for a considerable time and impair subsequent economic growth, as discussed in the work of [21].

Table 6. Projections for households ¹ with debt payment vulnerabilities ² given the lower-bound path of the call rate ³ plus a 10% annual increase in principal payments from 2018 to 2020: baseline scenario (% , %p).

| Categories for Households | 2017 (A) | 2018 | 2019 | 2020 (B) | B – A | (B – A)/3 |
|-------------------------------|----------|------|------|----------|-------|-----------|
| Over-indebted households (A3) | 3.2 | 3.1 | 3.3 | 3.3 | 0.1 | 0.03 |
| Marginal households | 4.4 | 4.6 | 4.7 | 4.9 | 0.5 | 0.17 |
| Households at risk of default | 14.9 | 15.1 | 15.3 | 15.6 | 0.7 | 0.23 |

¹ Shares in total indebted households. ² Scenario where household principal repayments increase by 10.0% annually from 2018 to 2020. ³ Path of the forecasted call rate one standard deviation lower than mean path from 2018 to 2020: 1.56% → 1.94% → 2.05%.

Table 7. Projections for households ¹ with debt payment vulnerabilities ² given the higher-bound path of the call rate ³ plus a 10% annual increase in principal payments from 2018 to 2020: baseline scenario (% , %p).

| Categories for Households | 2017 (A) | 2018 | 2019 | 2020 (B) | B – A | (B – A)/3 |
|-------------------------------|----------|------|------|----------|-------|-----------|
| Over-indebted households (A3) | 3.2 | 3.4 | 3.6 | 3.7 | 0.5 | 0.17 |
| Marginal households | 4.4 | 4.8 | 5.1 | 5.3 | 0.9 | 0.30 |
| Households at risk of default | 14.9 | 15.3 | 15.6 | 15.9 | 1.0 | 0.33 |

¹ Shares in total indebted households. ² Scenario where household principal repayments increase by 10.0% annually from 2018 to 2020. ³ Path of the forecasted call rate one standard deviation higher than mean path from 2018 to 2020: 2.78% → 3.51% → 3.69%.

Other simulations are executed for the case of a principal payment schedule (ii) in which the principal repayments from 2018 to 2020 are applied by the rule of an amortization schedule for 20-year loans, plus 5% annual growth in principal repayments from the base year of 2017. Table 8 displays the projection results indicating more substantial increments in the shares than those for the case of 10% annual increases in principal payments in Table 5. The share of households having debt payment vulnerabilities increases much more under repayment schedule (ii), revealing a very sensitive response to the principal repayment schedule.

Table 8. Projections for households ¹ with debt payment vulnerabilities ² given the mean path of the call rate ³ plus an amortization schedule for 20-year loans (% , %p).

| Categories for Households | 2017 (A) | 2018 | 2019 | 2020 (B) | B – A | (B – A)/3 |
|-------------------------------|----------|------|------|----------|-------|-----------|
| Over-indebted households (A3) | 3.2 | 4.65 | 4.5 | 4.4 | 1.2 | 0.40 |
| Marginal households | 4.4 | 6.9 | 6.9 | 6.8 | 2.4 | 0.80 |
| Households at risk of default | 14.9 | 16.6 | 16.6 | 16.6 | 1.7 | 0.57 |

¹ Shares in total indebted households. ² Scenario where principal payments from 2018 to 2020 would be applied by an amortization schedule for 20-year loans. ³ Mean path of the forecasted call rate conditional on the U.S. policy rate from 2018 to 2020: 2.17% → 2.73% → 2.87%.

Until now, the projections have been based largely on two assumptions, concerning the interest rate and the principal repayment schedule. To obtain the effects on the share of vulnerable households due to higher interest rates only, the projections need to hold the principal repayment schedule and economic status as in 2017. The projections are executed under the assumption that the Korean economy will continue as it is in 2017 up through 2020, and that only the interest rate will change following the forecasted paths conditional on the U.S. federal funds rates. Table 9 displays the projection results, showing that a gradual increase in interest rates only, with all other variables held at their values as of 2017, can lead the shares of vulnerable households to increase by 0.07%p to 0.13%p between 2017 and 2020 on annual average, which are quite small changes, like the case in Table 3.

Table 9. Projections for households ¹ with debt payment vulnerabilities ² under a scenario of changes in the interest rate only ³ with 2017 economic conditions continuing through 2020 (% , %p).

| Categories for Households | 2017 (A) | 2018 | 2019 | 2020 (B) | B – A | (B – A)/3 |
|-------------------------------|----------|------|------|----------|-------|-----------|
| Over-indebted households (A3) | 3.2 | 3.3 | 3.4 | 3.4 | 0.2 | 0.07 |
| Marginal households | 4.4 | 4.6 | 4.8 | 4.8 | 0.4 | 0.13 |
| Households at risk of default | 14.9 | 15.0 | 15.0 | 15.1 | 0.2 | 0.07 |

¹ Shares in total indebted households. ² Principal payments remain the same from 2016 through 2020. ³ Mean path of the forecasted call rate conditional on the U.S. policy rate from 2018 to 2020: 2.17% → 2.73% → 2.87%.

Two further simulations are introduced based on two negative scenarios for nominal housing prices: (i) a modest decline, that is, of 1% annually from 2018 to 2020; and (ii) a sharp decline, of 5% annually from 2018 to 2020. Table 10 displays the case under the scenario of a modest decline in housing prices, where the shares of vulnerable households increase by from 0.3%p to 0.9%p, which is from 0.1%p to 0.2%p more when compared with the case of the baseline scenario in Table 5. Table 11 shows the results for the sharp decline scenario, in which the shares jump by from 0.6 to 1.5%p, which is from 0.3 to 0.8%p more when compared with the case of the baseline scenario. Of particular note, the indicator of households at risk of default turns out to be most sensitive to housing price changes.

Table 10. Projections for households¹ with debt repayment vulnerabilities² given baseline scenario³ and modest housing price decline⁴ (% , %p).

| Categories for Households | 2017 (A) | 2018 | 2019 | 2020 (B) | B – A | (B – A)/3 |
|-------------------------------|----------|------|------|----------|-------|-----------|
| Over-indebted households (A3) | 3.2 | 3.3 | 3.5 | 3.5 | 0.3 | 0.10 |
| Marginal households | 4.4 | 4.7 | 5.0 | 5.2 | 0.8 | 0.27 |
| Households at risk of default | 14.9 | 15.2 | 15.5 | 15.8 | 0.9 | 0.30 |

¹ Shares in total indebted households. ² Scenario where household principal repayments increase by 10.0% annually from 2018 to 2020. ³ Mean path of the forecasted call rate conditional on the U.S. policy rate from 2018 to 2020: 2.17% → 2.73% → 2.87%. ⁴ Declines of 1% annually from 2018 to 2020.

Table 11. Projections for households¹ with debt payment vulnerabilities² given baseline scenario³ and sharp housing price decline⁴ (% , %p).

| Categories for Households | 2017 (A) | 2018 | 2019 | 2020 (B) | B – A | (B – A)/3 |
|-------------------------------|----------|------|------|----------|-------|-----------|
| Over-indebted households (A3) | 3.2 | 3.3 | 3.6 | 3.8 | 0.6 | 0.20 |
| Marginal households | 4.4 | 4.9 | 5.2 | 5.5 | 1.1 | 0.37 |
| Households at risk of default | 14.9 | 15.5 | 16.0 | 16.4 | 1.5 | 0.50 |

¹ Shares in total indebted households. ² Scenario where household principal repayments increase by 10.0% annually from 2018 to 2020. ³ Mean path of the forecasted call rate conditional on the U.S. policy rate from 2018 to 2020: 2.17% → 2.73% → 2.87%. ⁴ Declines of 5% annually from 2018 to 2020.

Finally, simulations under two historical crisis scenarios are conducted—duplicating the 1997 Asian Currency Crisis and the 2008 Global Financial Crisis. The authors in [3] estimated the magnitudes of these shocks by subtracting the maximum realized economic variables from the minimum realized economic variables during the crisis periods, from 1997 to 1998 and from 2008 to 2009, respectively. According to their study, the shocks' magnitudes can be summarized as follows:

- 2008 crisis shock magnitudes: 1.1%p interest rate increase, 0.2% decrease in gross disposable income, 1.1% housing price decline
- 1997 crisis shock magnitudes: 4.4%p interest rate increase, 6.4% decrease in gross disposable income, 13.1% housing price decline

Table 12 shows the projections for the two crisis cases given the baseline scenario with two principal payment schedules. If the Korean economy were hit by a shock of the same magnitude as the 2008 crisis, the share of households at risk of default would climb rapidly by approximately 0.5%p within one year, given 10% annual increases in their principal repayments. However, if the same principal repayments as in 2017 are assumed, the share would exhibit small changes. Realization of the effects would be faster in a case of crisis, usually around six months, which can impose time limits on the authorities in their policy responses with appropriate measures. The projection results for the 1997 crisis case show that the statuses of vulnerable households would deteriorate much further, with their shares expanding significantly by even 1.7%p beyond those in a case like the 2008 crisis.

Table 12. Projections for households¹ with debt repayment vulnerabilities, for two crisis cases under the baseline scenario (% , %p).

| Categories for Households | Current Status | 2008 Global Financial Crisis | | 1997 Asian Crisis | |
|-------------------------------|----------------|--------------------------------|------------------------------------|--------------------------------|------------------------------------|
| | | Baseline Scenario ² | Same Principal Payments as in 2017 | Baseline Scenario ² | Same Principal Payments as in 2017 |
| Over-indebted households (A3) | 3.2 | 3.5 | 3.3 | 5.0 | 4.8 |
| Marginal households | 4.4 | 4.9 | 4.7 | 6.7 | 6.4 |
| Households at risk of default | 14.9 | 15.4 | 15.0 | 16.9 | 16.6 |

¹ Shares in total indebted households. ² Scenario where household principal repayments increase by 10.0% annually from 2018 to 2020.

5. Concluding Remarks

The speed of increase in the household debt level in Korea has been faster than the averages in other major OECD countries, accompanied by a constant trend of an expanding share of vulnerable households since 2014. In addition, as Korea is a small open economy, its macro and financial variables such as domestic interest rates, economic growth, foreign exchange rates, and housing prices are all quite flexible in response to external shocks. However, there have been few studies on household debt sustainability in relation to external shocks. Against this background, this paper revisits household debt sustainability in Korea in view of the upward and stagnating or slightly reversing trend of global interest rates expected during the next couple of years. More specifically, we investigate the transmission channels from U.S. to domestic interest rates using a Bayesian VAR model. We also identify households that are vulnerable in terms of their debt repayments and execute projections for potential changes in the ratios of vulnerable households over total indebted households for the upcoming years given conditional forecasts and various macroeconomic scenarios.

The results of our estimations can be summarized as follows. First, the ratio of over-indebted households under the poverty line has also been growing since 2012, and their debt repayments appear unsustainable. Second, the domestic policy interest rate is likely to increase and then stay conditional on the upward path of U.S. interest rates. Third, the ratios of vulnerable households have been growing since 2012 and would expand slightly more given an approximately 1.6%p gradual increase and stagnating scenario in interest rates during the upcoming years, along with stable macroeconomic conditions, such as a long-term distribution of principal repayments and robust growth in household income flows. Finally, the trend of rising domestic interest rates, however, can cause a rapid increase in the ratios of vulnerable households if the trend is accompanied by a series of combined negative shocks, such as accelerated principal repayment schedules, a sharp decline in housing prices, and the outbreak of a severe crisis.

Our research has a comparative advantage against the previous literature [1–4] in terms of incorporating more realistic and long-term scenarios when evaluating household debt sustainability in response to external shocks. Previous literature has been heavily focused on unrealistic or excessively abnormal situations such as crisis scenarios or one-time shocks to sharply increase interest rates. For the crisis simulations, the estimation results of this paper are consistent, overall, with those in the works of [3,4]. Hence, this paper can fill the gap in the literature by investigating the linkages from the external shock to the degree of domestic household debt sustainability in a relatively longer-term perspective.

In conclusion, the share of vulnerable households is not highly sensitive to gradual changes in interest rates alone. However, the trend of heightened interest rates in conjunction with adverse macroeconomic scenarios can lead to a significant expansion in the share of households with debt repayment vulnerabilities. This can result in a subsequent serious deterioration of macroprudential soundness. Comprehensive policy interventions, such as the stabilization of asset prices, a consistent lengthening of mortgage durations, and preemptive blocking of any rapid expansion in external

imbalances, can be timely and relevant to support sustainable economic growth through minimizing the negative shocks from the external shocks. Moreover, additional increments in debt repayments in line with increases in the interest rates could be crucial, given the dampened consumption among indebted households overall. This indicates that appropriate measures to manage the households with vulnerabilities in their debt repayments can be one step to facilitating a robust rebound in domestic consumption.

The limitations of this research mostly come from the degree of robustness of upcoming macroeconomic scenarios related to real economic activities including housing markets. More specifically, the household debt repayment schedule or average amortization period could be highly policy dependent, and it would be better to be cautious in its interpretation of the estimation results for forecasts and the understanding of the various macro and financial economic propositions embedded in the scenarios. Second, as discussed previously, this paper could not deal with direct household lending interest rates covering both the banking and nonbanking sectors as a result of limited availability for the dataset.

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