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Gan-Ochir Doojav and Ariun-Erdene Bayarjargal*

**Abstract**

The present paper contains an outline of a simulation-model for stress-testing the household sector in Mongolia. The model uses data from the Household Socio-Economic Survey to assess the financial resilience of the household sector to macroeconomic shocks. The results suggest that the household sector of Mongolia is vulnerable to shocks associated with interest rates, cost of basic consumption, asset prices and unemployment. In particular, impacts of interest and consumer price shocks on household's debt at risk (or expected loan losses) are considerable. Furthermore, it is found that a substantial increase in household indebtedness has boosted the financial fragility of the household sector. Those results have important policy implications in mitigating the increasing financial fragility of the household sector and risks to financial stability.

*JEL classification:* C15, D14, D31, E17.

*Keywords:* Stress testing, household indebtedness, household surveys, Mongolia

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# I. Introduction

The recent global economic crisis has resulted in increased focus on the risk that vulnerabilities in the household sector can lead to financial instability, and consequently to a deeper and longer economic recession. High levels of household debt raise the vulnerability of household balance sheets to macroeconomic shocks, namely shocks related to income, asset prices, and interest rate. Adverse shocks deteriorate households' ability (or willingness) to pay their debts, and thereby may have a strong negative impact on the financial health of lenders. As a result, household debt may amplify cyclical downturns and weaken economic recoveries (IMF, 2012). Recent studies show that an increase in household debt boosts growth in the short term, however, increases macroeconomic and financial stability risks in the medium term (IMF, 2017).

The recent surge of household indebtedness has created concerns about the vulnerability of households to macroeconomic shocks and their impact on macrofinancial stability in Mongolia. Lending to households in the financial system accounts for a sizeable share of its total lending, averaging 40 per cent annually in the past six years. As the share of household indebtedness increases, stress in this sector – triggered by a rapid increase in interest rates and unemployment, a high level of inflation and a sharp decline in housing prices, or a combination thereof – may significantly weaken the banking sector.

Therefore, it is important to continuously assess (a) the banking sector's exposure to the household sector and (b) the household sector's financial resilience, which plays a critical role in the financial system, as mortgage loans dominate financial institutions' balance sheet. Stress testing is a useful tool for assessing the resilience of the financial system to various shocks, including those that result in more borrowers unable to pay their debts, such as adverse economic shocks to households. While the Bank of Mongolia and the International Monetary Fund (IMF) have conducted some formal stress tests on the Mongolian banking sector, no stress-testing framework for the Mongolian financial system has not yet been systematically developed by the authorities.

The objective of this present paper is to develop a simulation-based household stress-testing model that evaluates the financial resilience of the household sector to macroeconomic shocks using data from the Household Socio-Economic Survey of Mongolia. The model is characterized by specific features of Mongolian households and the banking sector, and fits with major components of the Household Socio-Economic Survey data. Though it is different from the formal stress testing, the model is able to (a) quantify household financial resilience and its exposure to shocks, and (b) estimate the banking sector's exposure to households that are more likely to default. With regard to the model, household survey data are preferred over aggregate data, namely the household debt-to-income ratio. This is because household surveys contain information on the distributions of household debt, assets, and income, and, as a result, provide more insights into households' ability to pay. As shown by Bilston, Johnson and Read (2015), aggregate measures of household indebtedness can be misleading indicators of the household sector's financial fragility. For instance, it is possible that even with rising levels of household indebtedness in aggregate, the distribution of household debt can be concentrated among those who are well placed to service their debts. In addition, aggregate data are of limited use in differentiating households who hold debt from those who do not, and do not identify households with riskier forms of debt or those who hold enough assets to cover their debts. The stress-testing model is based on a "financial margin approach". Each household is assigned a financial margin that is usually the difference between each household's income and estimated minimum expenses. The model also shares many features with the existing models for several countries, such Karasulu (2008) for the Republic of Korea, Albacete and Fessler (2010) for Austria, Sugawara and Zalduendo (2011) for Croatia, Djoudad (2012) for Canada, Galuščák, Hlaváč and Jakubík (2014) for the Czech Republic and Bilston and Rodgers (2013) and Bilston, Johnson and Read (2015) for Australia.

The authors believe that the present paper is the first attempt to test the financial soundness of the Mongolian household sector using the micro-simulation model, a popular tool for stress testing the household sector and assessing financial stability risks resulting from the household indebtedness. Accordingly, it contributes towards the development of a comprehensive stress-testing framework for the banking system even in a data-limited environment.

The remainder of the paper is structured as follows. In section II, the household and financial sector nexus in Mongolia are presented. Section III includes a description of the stress-testing model and section IV is centred on a discussion of the pre-stress and post-stress test results. Section V concludes.

## II. Household and financial sector linkages in Mongolia

Mongolia has an extensive amount of mineral resource wealth, which includes, among other minerals, coal, copper, and gold. Real gross domestic product (GDP) growth in Mongolia averaged 9 per cent annually over the past decade on the back of a large stock of resources and a large amount of foreign direct investment (FDI) inflows to the mining sector. Mongolia has 10 per cent of the world's known coal reserves; the Tavan Tolgoi coal mine is one of the world's largest untapped coking and thermal coal deposits. In 2009, the Government established a joint venture with Turquoise Hill Resources (a majority owned subsidiary of Rio Tinto) to develop the Oyu Tolgoi copper and gold deposit, which is the largest foreign-investment project ever in Mongolia and has attracted more than $6 billion (50 per cent of GDP) in FDI for the first-phase of the project. As a result, in 2015, Mongolia graduated from lower middle-income status to upper middle-income, a group with yearly income levels of $4,126 to $12,735 per person. The mining sector accounts for 20 per cent of the economy, and mineral exports account for up to 90 per cent of total exports. As a result of the country's narrow economic base, it is highly vulnerable to external shocks, namely commodity price fluctuations and volatility in FDI, and the lack of diversification has made the economy prone to repeated boom-bust cycles.

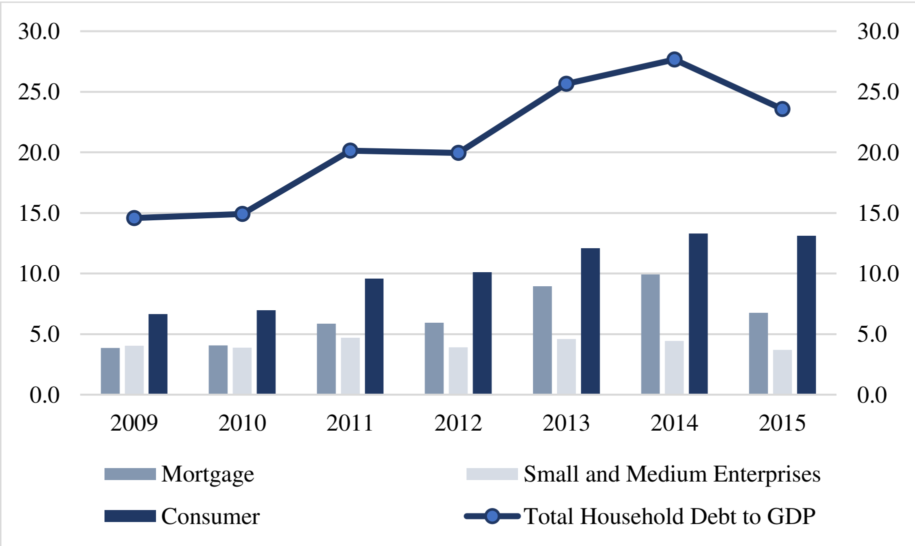
The Mongolian financial system is dominated by commercial banks. Currently, 14 registered commercial banks account for 96 per cent of the total financial system assets. The ratio of total bank loans to GDP is 52 per cent. Hence banks play a vital role in the creation of money supply and in the transmission of monetary policy. Banking sector lending is concentrated (in mining, construction, trading, and household sectors) as there are few investment opportunities available domestically. In recent years, the household sector's indebtedness has sharply increased, and the bank household loans have accounted for 45 per cent of the total bank loans. As a result, the ratio of bank household loans to GDP reached 24 per cent. Mortgage loans account for more than one third of total bank household loans. Under the current regulation set by Bank of Mongolia, the maximum loan to value ratio is 70 per cent, and maximum debt to income ratio is 45 per cent for household mortgage loans.

The Mongolian household sector's aggregate level of indebtedness has increased from 14 per cent to 25 per cent of GDP between 2009 and 2015. The ratio of household financial debt to disposable income has risen significantly, reaching as high as 28.2 per cent in 2014. This is close to the average of new European Union member countries and higher than the average of middle-income among the members of the Commonwealth of Independent States (Tiongson and others, 2010). In addition, more than one third of the Mongolian household debt consists of mortgage loans. The ratio of mortgage loan outstanding to GDP ratio peaked at 10.1 per cent in 2014, rising from 4.4 per cent in 2009.

As the result of the FDI flows for the first phase development of Oyu Tolgoi project and high commodity prices, loan growth was rapid between 2011 and 2012. During that period, central bank policy was not tight enough to control the growth of loans. As capital flows are free and the central bank does not use macroprudential tools, a rise in the policy rate to tighten monetary policy pulled more portfolio investments, which, in turn, led to higher growth of loans. As the economic condition was favorable, namely rising wages, housing price appreciation and excess liquidity in the banking sector, during that period, household credit rapidly increased, which resulted in an increase in the share of household loans in total loans of the banking sector (reaching 45 per cent).

The year 2013 is of particular significance, as household mortgage loans increased substantially following the introduction of a subsidized "mortgage programme" by the Government. As a result of the programme to establish sustainable mortgage financing, the outstanding level of households' mortgage debt has tripled to 3.4 trillion Mongolian tugrick ($1.39 billion) approximately half of the total household loans. Mongolia has also experienced a boom-bust cycle in the housing market. The annual growth of the housing price was 24 per cent in 2014, and since June 2014, the housing price has dropped by about 30 per cent. Figure 1 shows household debt, proxied by banks' loan to households, to GDP ratio.

**Figure 1. Household debt to gross domestic product ratio, by different types of loans**

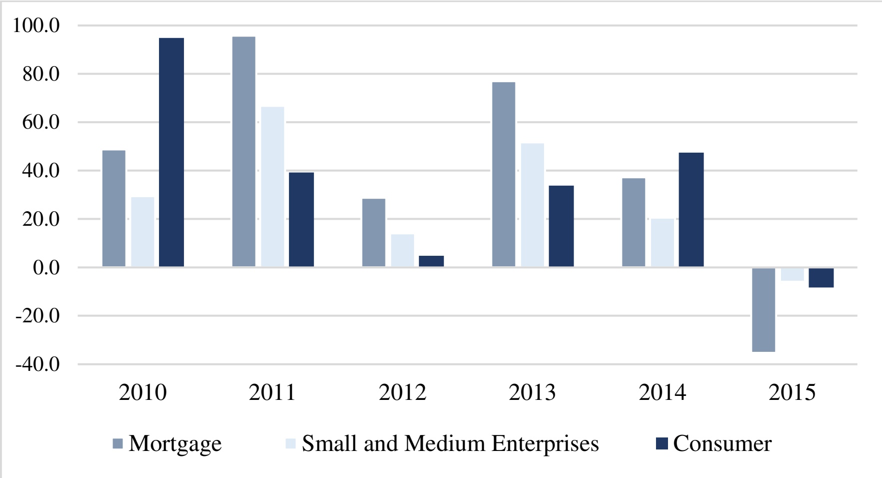



*Sources:* The Bank of Mongolia, Reports on Individual and SME loans issued by banks, 2010-2015; National Statistical Office, Statistical Yearbook, 2010-2015.

As a result of the programme, the percentage change of household mortgage 38.7 per cent had been growing more rapidly than any other type of loan between 2010 and 2014 (figure 2), and the average growth rate of household debt surpassed GDP growth during the period. However, growth rates of bank household loans were negative in 2015 because (a) as a part of the mortgage programme, banks issued and sold their mortgage-backed securities to the Mongolian Ipotek Corporation, which reduced mortgage loans on banks' balance sheet,[1] and (b) banks' non-performing loans started to increase significantly because of an economic recession driven by both domestic and external factors. Main external shocks were a decline in commodity prices and the sudden halt of FDI after the first phase of Oyu-Tolgoi copper and gold mining was completed. Government stimulus policies, namely expansionary fiscal and monetary policies based on external borrowings, in response to the adverse external shocks, led to macroeconomic and financial instabilities, including a decline in foreign reserves, a high level of government debt and deterioration of banks' asset quality. In particular, household consumption growth has been deteriorating since 2015 because (a) real income of households has been deteriorating and (b) households that borrowed from banks limit their consumption as they are obliged to make interest payments. In response to the economic recession, banks also have tightened their overall credit conditions, which have resulted in negative growth of small and medium enterprises and consumer loans.

[1] It should be noted that total amount of household debt/loans has not changed because of the issuance of mortgage-backed securities, and only mortgage loans at banks' balance sheet is reduced by the amount of the mortgage-backed securities The mortgage-backed securities issuance process began in 2015. Under the programme, Mongolian Ipotek Corporation must purchase the mortgage-backed securities from banks.

**Figure 2. Household debt (year-on-year per cent change)**




*Source:* Bank of Mongolia, Reports on Individual and SME loans issued by banks, 2010-2015.

With the problems becoming noticeable in 2015, the rapid increases in household indebtedness raises concerns of mortgage loan risk and financial instability. Before setting the necessary policies, policymakers need to understand the depth of the household indebtedness problem, which entails conducting a formal assessment on household sector vulnerability to evolving changes in the economy.

## III. The stress-testing model

The model is based on the financial margin approach employed by Albacete and Fessler (2010), and closely follows models formulated by Bilston and Rodgers (2013) and Bilston, Johnson and Read (2015). In this approach, households with negative financial margins are assumed to default on their debts. Household-level data are used to estimate loss given default and “debt at risk” (or expected loan losses) when combined with information on which households are assumed to default. In the stress testing, shocks to macroeconomic variables, such as asset prices, exchange rates, interest rates and the unemployment rate, are considered. Impacts of those shocks can be estimated by comparing pre- and post-shock default rates and loan losses. The steps of the model are detailed below.

### 3.1 Household-level data

In a preliminary step in developing the model, the household level data are need. In the model, data from the Household Socio-Economic Survey for Mongolia, a nationally representative, household-based survey, collected annually by the National Statistical Office since 2008. The surveyed households are randomly selected every year from a specified region. The survey contains information about households and individuals' characteristics, consumption behaviour, financial conditions, employment and well-being. Though the Household Socio-Economic Survey has been collected annually since 2007/08, only Household Socio-Economic Survey data for 2012 and 2014 are used in the analysis (a) because the Mongolian Household Socio-Economic Survey includes some questions, mainly about the household loans and deposits, only for even years, such as 2010, 2012 and 2014, and (b) in order to assess financial resilience of the household sector before and after the implementation of the Government mortgage programme.

The sample sizes are 12,811 and 16,174 households in 2012 and 2014, respectively, from the country's 21 provinces and Ulaanbaatar. Data on individual characteristics are used to estimate probabilities of unemployment, and the model of unemployment is based on a sample of more than 50,000 individuals (all members of surveyed households, including children under 16 years of age and people above 60 years of age) participated in the survey each year. The descriptive statistics of variables are detailed in table 1.

**Table 1. Descriptive statistics**

| | 2012 | | 2014 | |
|---|---|---|---|---|
| | Mean | Standard deviation | Mean | Standard deviation |
| **Household characteristics** | | | | |
| Household size | 3.6 | 1.6 | 3.5 | 1.6 |
| Number of children | 1.11 | 1.1 | 1.12 | 1.1 |
| **Household income and expenditures (in millions of Mongolian Tugrick)[2]** | | | | |
| Total income | 8.99 | 2.63 | 11.77 | 9.89 |
| out of which: wage | 7.28 | 6.01 | 9.27 | 6.83 |
| Remittance | 1.31 | 2.27 | 2.19 | 3.99 |
| Basic consumption expenditure | 4.22 | 2.51 | 5.70 | 2.85 |
| out of which: food expenditure | 2.48 | 1.47 | 3.31 | 1.67 |
| Debt servicing cost | 0.84 | 2.35 | 1.27 | 3.04 |
| Number of observations | 12 811 | | 16 174 | |

*Sources:* National Statistical Office, Household Socio-Economic Survey 2012 and 2014.

The majority of households' income comes from wages. The second largest component is remittances. The basic consumption expenditure is for food, transportation, energy, health and clothing. Share of food expenditures in total basic consumption is 58 per cent, on average. Data used in the present paper (including household income, debt and financial data) are reliable as they are open-source, official statistics published by the National Statistical Office and the Bank of Mongolia.

As the Mongolian Household Socio-Economic Survey does not include all the required information, namely household balance sheet items, for building the model, a number of extra assumptions have been used to overcome the data limitations. They are discussed in more detail below.

**3.2 Estimating households' financial margin**

The first step is to establish a pre-stress baseline. To this end, the financial margin, $FM_i$, of a household $i$ is estimated as

$$FM_i = Y_i - BC_i - DS_i - R_i \tag{1}$$

[2] An exchange rate was \$1 = 1888.95 Mongolian tugrick in 2014 and \$1= 1397.28 Mongolian tugrick in 2012.

where $Y_i = I_i - T_i$ is the $i$-th household disposable income, $I_i$ is household total income before tax, $T_i$ is tax amount paid by the household, $BC_i$ is basic consumption expenditure, $DS_i$ is minimum debt servicing cost (if any) and $R_i$ is rental payment (if any). All measures are in annual basis or annualized before estimation. While $Y_i$ and $R_i$ are reported in the Household Socio-Economic Survey, $BC_i$ is not directly available from the survey. In a scenario of financial distress, basic consumption is of greater relevance than actual consumption, as households can reduce discretionary spending to meet their debt obligations.

The basic consumption expenses are approximated by sum of expenses on food ($C_{F,i}$), transportation ($C_{T,i}$), energy ($C_{E,i}$), health ($C_{H,i}$) and clothing ($C_{C,i}$):

$$BC_i = C_{F,i} + C_{T,i} + C_{E,i} + C_{H,i} + C_{C,i} \tag{2}$$

The Household Socio-Economic Survey only contains information about annual payments on existing loans. Accordingly, minimum debt-servicing costs are estimated as:

$$DS_i = PM_i + PC_i + PO_i \tag{3}$$

where $PM_i$ is the annual mortgage payment, $PC_i$ and $PO_i$ are the annual payments on consumer debt, namely the sum of salary loan, pension loan, household consumption loan and herder loan and other debts, namely, the sum of business loan, leasing loan, car loan and other loan, respectively.

To estimate household's total debt, households' outstanding loan balances are required. Accordingly, the Household Socio-Economic Survey does not include information about households' outstanding loan balances. Fortunately, the Household Socio-Economic Survey consists of the original loan balance if the loan is taken within the past 12 months. For the loans taken within past 12 months, the end-of-period outstanding loan balances, $J_{12,i}$, are calculated as follows[3]:

[3] The calculation is based on the given information, namely monthly payment, interest rate and the original loan balance, and a credit-foncier model, namely a standard financial formula to calculate mortgage payments on amortizing loans.

$$J_{12,i} = \frac{\left((1+r_J)^{T_{Ji}} - (1+r_J)^{0+12}\right)}{\left((1+r_J)^{T_{Ji}} - 1\right)} J_{0i}, \qquad \text{for } J \in \{M, C, O\} \tag{4}$$

where $M, P$ and $O$, respectively, represent mortgage, consumer and other loans, $r_J$ is the (monthly) interest rate for $J$-type loan at the period, $J_{0i}$ is original balance for $J$-type loan of the household, and $T_{Ji}$ is the loan's term (in months) for $J$-type loan of the household calculated as follows:

$$T_{Ji} = \frac{\ln(pj_i/(pj_i - r_J J_{0i}))}{\ln(1+r_J)} \tag{5}$$

where $pj_i = PJ_i/12$ is the monthly payment for the $J$-type loan. If $T_{Ji}$ cannot be calculated due to the inconsistency among answers of the household, then the outstanding loan balance of the household is calculated as the loans which are not taken within past 12 months.

For the loans which are not taken within past 12 months, the end-of-period outstanding loan which is $k$ years old (in months) at the period, $J_{k,i}$, are approximated as follows (if the interest rate remains constant over time):

$$J_{k,i} = \frac{\left((1+r_J)^{T_J} - (1+r_J)^{k_J+12}\right)}{\left((1+r_J)^{T_J} - 1\right)} J_{0i}^e, \qquad \text{for } J \in \{M, C, O\} \tag{6}$$

where $T_J$ is the loan's average term (in months) for the $J$-type loan, $k_J$ is the average age (in months) of the $J$-type loan, and $J_{0i}^e$ is the estimated original balance for $J$-type loan calculated from the monthly mortgage payments using a credit-foncier model as follows:

$$J_{0i}^e = \frac{\left((1+r_J)^{T_J} - 1\right)}{r_J(1+r_J)^{T_J}} pj_i \tag{7}$$

If $J_{12,i}$ and $J_{k,i}$ give negative values due to the inconsistency among the answers of the household, the household's original loan balance is used for the outstanding loan balance.

After the outstanding balance for the $J$-type loan is attained, then each household's total debt, $D_i$ at the period is estimated as

$$D_i = M_{k,i} + C_{0i} + O_{0i} \tag{8}$$

### 3.3 Calculating probabilities of default, exposure at default and loss given default

The percentage of vulnerable households is the key measure to monitor the resilience of households under different shocks. Accordingly, in the second step, the financial margin is used to calculate each household's probability of default ($PD_i$) as follows:

$$PD_i = \begin{cases} 1 & \text{if } FM_i < 0 \\ 0 & \text{if } FM_i \geq 0 \end{cases} \tag{9}$$

In the model, households with negative financial margins (those not able to cover all their spending from income) are in financial distress and are considered as vulnerable households. It is important to note that only households who are in distress and unable to pay its debts are considered. Given the available data, it is not possible to consider households that are able, but unwilling to service their debt. Issues, such as strategic defaults, are beyond the scope of the present paper. Thus, households with $PD = 1$ are assumed to default with certainty. This is a simplification as some households could sell liquid assets or property to avoid default. A case without such an assumption is discussed and carried out by Ampudia and others (2014). This exercise is being left for future studies as there are currently no reliable data on the household liquid asset

To measure the losses under different stress scenarios, the share of total debt held by vulnerable households along with those households' assets are taken into account. In the third step, the following is calculated, the household sector's weighted average probability of default ($WPD$), measuring the percentage share of total debt held by vulnerable households and loss given default. WPD is calculated as

$$WPD = \frac{\sum_i^N PD_i D_i}{\sum_i^N D_i} \tag{10}$$

where $N$ is the total number of households.

The weighted average loss given default as a percentage of household debt in default ($LGD$) is the amount that lender are unable to recover on defaulted loans:

$$LGD = \frac{\sum_i^N PD_i L_i}{\sum_i^N PD_i D_i} \tag{11}$$

where $L_i = max(D_i - W_i, 0)$ is the value that is lost as a result of a household default, and $W_i$ is the value of a household's "eligible" collateral, which is the collateral that lenders would be able to make a claim on in the event of default. In the model, it is assumed that eligible collateral consists of real estate, namely apartment and house, only.

In step four, the $WPD$ and $LGD$ are combined to estimate the weighted average debt at risk as a share of total household debt ($DAR$). In other words, it is the expected loss on household debts in terms of per cent:

$$DAR = WPD \times LGD = \frac{\sum_i^N PD_i L_i}{\sum_i^N D_i} \times 100 \tag{12}$$

Once the pre-stress results are established, macroeconomic shocks are applied separately or in combination to obtain post-stress results. The difference between the pre-stress and post-stress results quantifies the impact of the shock in the model. The process is repeated for 2012 and 2014.

# IV. Calibration and results

## 4.1 Calibration

A small number of parameters in the model are calibrated based on the statistics of the Mongolian banking sector. As the Household Socio-Economic Survey for 2014 is used, the annual mortgage interest rate is calibrated as 8.0 per cent, which is the fixed rate set in July 2013 under the government programme to establish sustainable mortgage financing. The annual interest rates for consumer ($r_c$) and other ($r_o$) loans are calibrated equally at 19.0 per cent, which is the average lending rate for 2014. The mortgage loan's term, $T_M$, is calibrated as 16 years (192 months), which is the weighted average term of mortgage loan calculated from the Mortgage Loan Report, the Bank of Mongolia (as of February 2016). That calibration is also consistent with the sample average estimation of the mortgage loan's term,

$T_{Mi}$, calculated from the Household Socio-Economic Survey for 2014. The average age of the mortgage loan, $k_M$, is calibrated as 3.5 years (42 months), which is an approximation using the mortgage loans outstanding and the starting year of mortgage loan. The loan term for consumer ($T_C$) and other ($T_O$) loans are calibrated respectively as 45 months and 50 months, which are the sample average of loan terms, $T_{Ci}$ and $T_{Oi}$, calculated using the Household Socio-Economic Survey for 2014. The average age for consumer ($k_C$) and other ($k_O$) loans are calibrated as nine months, approximated as 25 per cent (3.5/16 for the mortgage loan) of the longest term for consumer and business loans (36 months).

## 4.2 Pre-stress results

Prior to applying shocks, the pre-stress results are reviewed and compared with those of other studies. The models used in pre-stress and post-stress scenarios are programmed in Stata software.

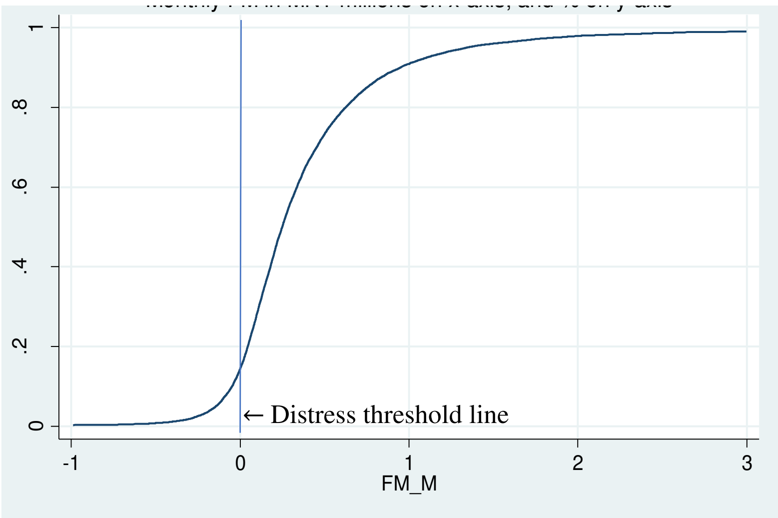
### *4.2.1* Financial margins

A cumulative distribution function of the household's financial margin is shown in figure 3. Households with a financial margin within the range of [-0.5, 0.5] million of Mongolian tugrick per month account for about 80 per cent of total households.

According to the model, the share of households with negative financial margins, namely below the threshold line) was 14.4 per cent in 2014. The result is similar to that of other countries. For instance, Herrala and Kauko (2007) estimate 13-19 per cent for Finland, Burke and others (2011) at least 14 per cent for Australia, Andersen and others (2008) 19 per cent for Norway, and Albacete and Fessler (2010) 9.2-16.5 per cent for Austria. It should be noted, however, that the estimate is sensitive to the definition of basic consumption expenditures.[4]

[4] When the clothing expenditure, similar to some other studies, is exclude, this share declines to 8.3 per cent. In this study, clothing expenditures is included.

**Figure 3. Cumulative distribution function of financial margin**

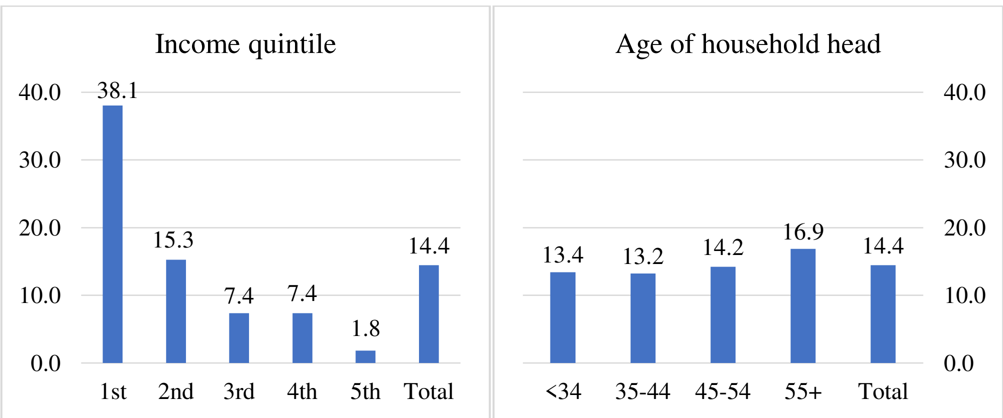



*Sources:* Household Socio-Economic Survey 2014 calculation. Monthly financial margin in millions of Mongolian Turgrick on the x-axis.
*Note:* Only includes households with debt. Outliers are excluded.

As noted in literature, low-income households are more likely to have negative financial margins than higher-income households. In contrast to other countries, households with older heads are more likely to have negative financial margins than households with younger heads (figure 4). This may imply that younger households in Mongolia have less ability or appetite to borrow compared to other countries (Austria and Australia).

**Figure 4. Pre-stress: household with negative financial margin**

*Share of households by characteristics*

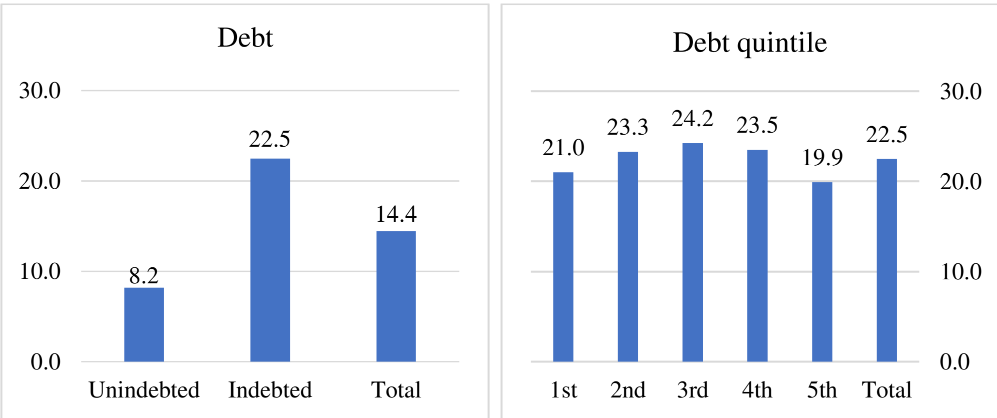



*Sources:* Household Socio-Economic Survey 2014, Authors' calculation.

Indebted households are more likely to have negative financial margins than those who are not. Interestingly, for the first three debt quantiles, the share of households with a negative financial margin tends to increase as debt increases. The share decreases for the highest two debt quintiles (figure 5). In addition, regardless of the debt quintile, the share of indebted households is considerably higher than that of the whole households. These results suggest that the probability of having negative financial margins is particularly high for households with debts. Moreover, this finding may indicate that loan applications assessment is less effective as lenders are able to predict whether potential borrowers would be able to pay back the loan comfortably given their income and other expenses.

**Figure 5. Pre-stress: households with negative financial margins**

*Share of households by characteristic*




*Sources:* Household Socio-Economic Survey 2014; Authors' calculation.

It should be noted that households with negative financial margins in the model would not necessarily default in reality as households often have assets that they can draw on; so, they may be in a sound financial position instead of having a negative financial margin. For example, 30 per cent of households with negative financial margins have assets – defined here as real estate – to avoid default.

### 4.2.2 Debt at risk stop

As discussed in equations (11) and (12), debt at risk depends on the collateral that is assumed to be recoverable by the lender in the event of default. In the present paper, it is assumed that this collateral consists of real estate only. According to the model, pre-stress debt at risk was 7.2 per cent in 2014. This estimate is quite high compared to similar literature. For example, Bilston, Johnson and Read (2015) estimated debt at risk to be 1.5 per cent in 2010 for Australia, while for Austria, the debt at risk is estimated to be 2.1-4.1 per cent by Albecete and Fessler (2010). Accordingly, lenders' exposure to households with negative financial margins appears significantly large in Mongolia.

The high estimate of debt at risk us also broadly consistent with reality. For example, the interest rate on banks' household loans, excluding mortgage loans, has been high (more than 18 per cent per annum) because of high non-performing loan ratio.

**Stress-testing scenarios**

To assess the impact of macroeconomic shocks on the financial resilience of households, stress testing is conducted using various types of scenarios. First, the effects of shocks to interest rates, the unemployment rate, cost of basic consumption and housing price are assessed individually. Then, the above shocks are applied in combination to examine household resilience. In this section, how each of those shocks operates is explained and household credit risk is assessed under different scenarios in the model.

### 4.2.3 Increase in interest rate

A household's debt service consists of amortization and interest payments. The interest payments are the part affected by rising interest rates.[5]The simulation of the interest rate shock (an increase in $r_J$) is conducted using the following formulas:

For the loans taken within past 12 months:

[5] In the short term, the shock affects indebted households with variable interest rate loans. In the long run, fixed interest rate loans are also affected by such shock, as interest rates are renegotiated.

$$pj_i = \frac{r_J(1+r_J)^{T_{Ji}}}{\left((1+r_J)^{T_{Ji}}-1\right)} J_{0i} \quad \text{for } J \in \{M, C, O\} \tag{13}$$

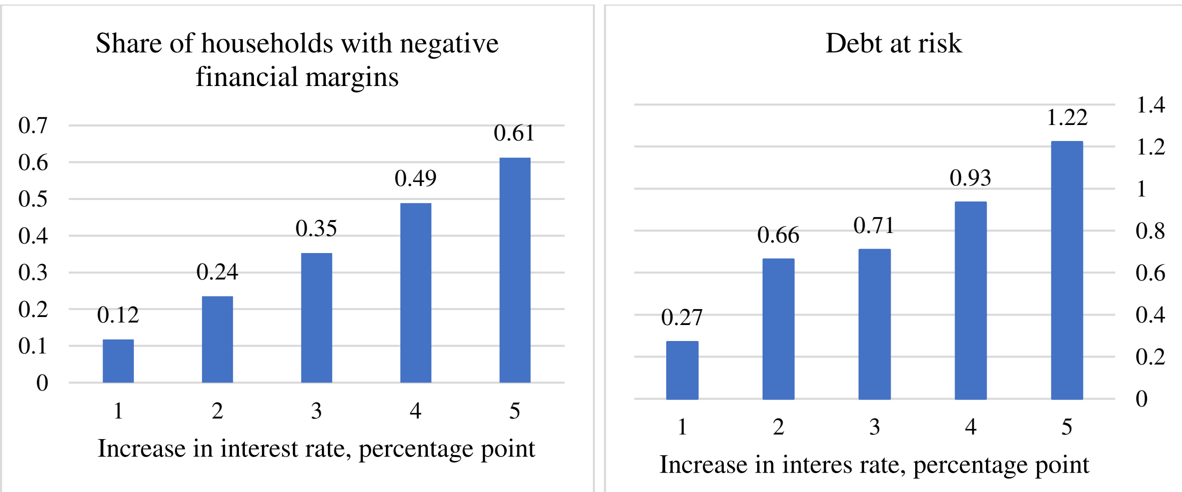
For the loans taken more than 12 months ago:

$$pj_i = \frac{r_J(1+r_J)^{T_J}}{\left((1+r_J)^{T_J}-1\right)} J_{0i}^{e} \tag{14}$$

Annual payment for the $J$-type loan is calculated as $PJ_i = 12 \cdot pj_i$. Thus, an increase in interest rate is a shock to the households' debt service, $DS_i$, and lowers their financial margins. Interest rate shocks lead to an increase in the share of households with negative financial margins and are assumed to default. The shock is assumed to pass through to all household loans equally. The debt service is increased in line with the rising interest rate shock; it is assumed that the loan (and interest) is still paid according to schedule (without expanding the maturity of the loan).

**Figure 6. Effect of increasing interest rates**

Changes relative to pre-stress results, 2014




*Sources:* Household Socio-Economic Survey 2014; Authors' calculation.

The result indicates that a one percentage point increase in the interest rate causes the share of households with negative financial margins to increase by 0.12 percentage points and the debt at risk to rise by 0.27 percentage points (figure 6). Changes in debt at risk increase non-linearly, with interest rate shocks depending on the probability of default and collateral value of the defaulted household loans. The debt at risk is relatively more responsive to the change in interest rate from one to two percentage points than further increases.

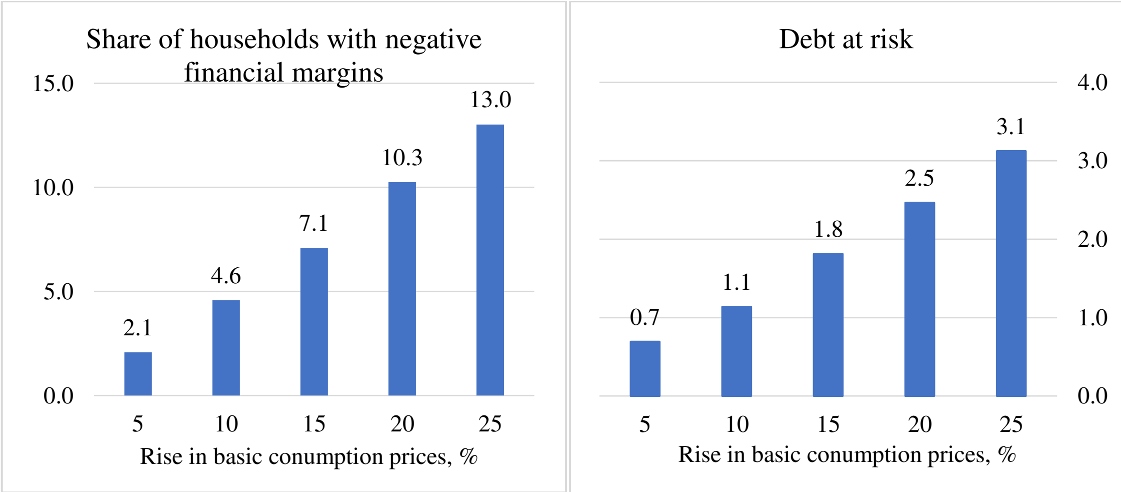
#### 4.2.4 Changes in cost of basic consumption

Changes in prices of the basic consumer goods basket items are shocks to households' spending on basic consumption items, $C_j$, for $j = F, T, E, H, C$. The demand for basic consumption items are assumed to be price inelastic. Though this assumption is realistic for the essential goods, this is a sort of a simplification, as some households could change their basic consumption basket when prices of essential goods change. For this version of the model, the inelasticity assumption is applied, as there are no preliminary studies on the price elasticities of essential goods in the case of Mongolia. It is also important to note that in this version of the model the effect of inflation on the value of nominal assets and liabilities are ignored. Thus, a higher price of the basic consumption item leads to an increase in $BC_i$, lowering the financial margins of the households.

A 5-per cent rise in prices of all basic consumption items causes the share of households with negative financial margins to increase by 2.1 percentage points and debt at risk to increase by 0.7 percentage points (figure 7). For larger changes in prices, the share of households with negative financial margins rises approximately linearly (increases by 2.5 percentage points for each extra increase of 5 per cent increase in prices), however, the effect on debt at risk is not linear.

**Figure 7. Effect of rise in basis consumption prices**

Changes relative to pre-stress results, 2014



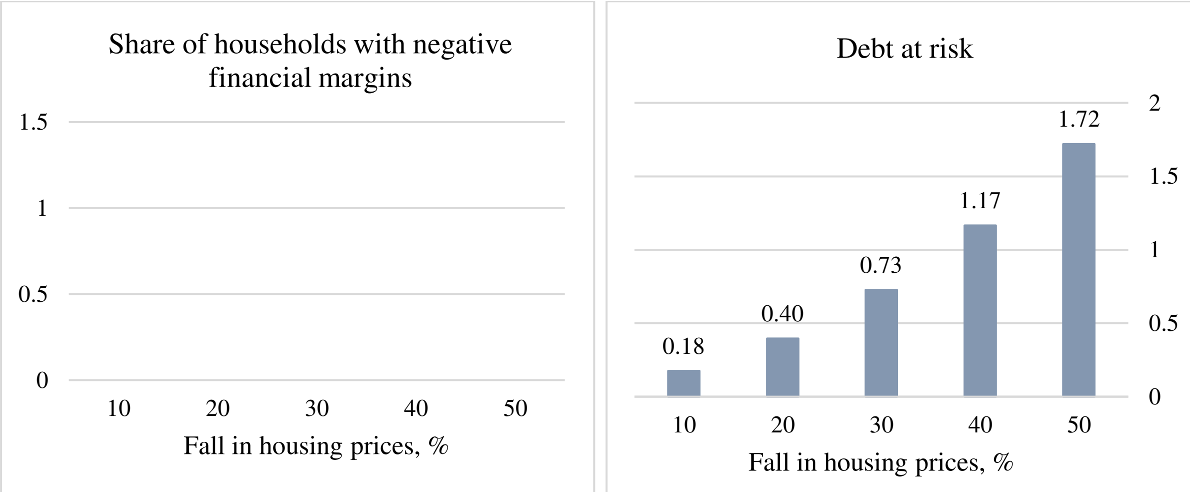

*Sources:* Household Socio-Economic Survey 2014; Authors' calculation.

### 4.2.5 Changes in housing prices

Changes in housing prices are shocks to households' real estate wealth, $W_i$. For instance, falling housing prices increases $LGD$, however, there is no impact on the share of households with negative financial margins. It is assumed that a given asset price shock applies to all households equally and that mortgagers are the most affected by this shock. A 30 per cent fall in housing prices causes debt at risk to increase by 0.73 percentage points. The impact is relatively small compared to other countries (Australia, Austria and Croatia) as the initial debt at risk is already too high in Mongolia, which can be partially explained by the possibility that banks may already consider such shock in setting the initial loan terms. However, a significant drop in housing price leads to even higher debt at risk, suggesting non-linearity.

**Figure 8. Effect of fall in housing prices**

*Changes relative to pre-stress results, 2014*




*Sources:* Household Socio-Economic Survey 2014; Authors' calculation.

### 4.2.6 Rising unemployment

There is a shock to the household's income $Y_i$, when an employed household member loses his or her job. For instance, rising unemployment reduces the income of individuals to an estimate of the unemployment benefits, thus lowers the financial margins of the affected households.

For the purpose of identifying unemployment shock, the adults in the survey are divided into three categories by economic activity: employed, unemployed and economically inactive. People outside the labour market, such as students, women on maternity leave and people suffering from a long-term sickness, are assumed to remain economically inactive over the time period considered. Thus, those individuals are not included in the sample for the simulation analysis.

Various approaches have been used to simulate unemployment shocks in the literature. Albacete and Fessler (2010) allow only homeowners (other persons in the same household do not enter in the analysis) to enter unemployment, where the probability that each homeowner becomes unemployed is estimated using a logit model. Fuenzalida and Rui-

Tagle (2009) consider individuals to become unemployed with probabilities estimated using survival analysis. Bilston, Johnson and Read (2015) use a logit model to estimate the probability of unemployment for each individual. However, Holló and Papp (2007) and Sveriges Riskbank (2009) use the assumption that each individual has an equal probability of becoming unemployed.

Following Bilston, Johnson and Read (2015), a logit model is used to estimate the probability of individuals becoming unemployed. As not every employed person in an economy has the same probability of becoming unemployed, the probability of becoming unemployed for each employed individual in the sample must be defined. The following logit model is estimated to get probabilities of unemployment for all individuals, $pu_j$:

$$pu_j = Pr\left(U_j = 1 \middle| \mathbf{x}_j\boldsymbol{\beta}\right) = F\left(\mathbf{x}_j\boldsymbol{\beta}\right) = \frac{1}{1+e^{-\mathbf{x}_j\boldsymbol{\beta}}} \tag{15}$$

where $U_j$ is an indicator variable equal to one if individual $j$ is unemployed and equal to zero otherwise, $\mathbf{x}_j$ is a vector of independent variables, including age, age squared, gender, educational attainment (completed high school, diploma and university), family structure (number of children, number of adults), household income, marital status, long-term health condition, and history of unemployment for at least one year, $\boldsymbol{\beta}$ is a vector of coefficients, and $F(\cdot)$ is the cumulative distribution function of the logistic distribution. To select the independent variables, a general-to-specific modelling approach is used, removing insignificant variables to arrive at a parsimonious model. The results are shown in table 2.

**Table 2. Logit model- Unemployment**

*Individuals in labour force*

| Variable | Marginal effects at sample mean | | |
|---|---|---|---|
| | Persons | Men | Women |
| Man | -0.126*** | | |
| Married | -0.211*** | -0.085*** | 0.034*** |
| Health condition | 0.068*** | 0.074** | 0.065* |
| Educational attainment | | | |
| Completed year 10/12 | 0.089*** | 0.067*** | 0.12*** |
| Diploma/certificate | 0.014** | 0.024*** | 0.007 |
| Bachelor's | -0.003 | 0.026** | -0.022* |
| Master's & PhD degree | -0.104*** | -0.078*** | -0.140*** |
| Demographic characteristics | | | |
| Age | -0.049*** | -0.036*** | -0.063*** |
| Age squared | 0.0007*** | 0.0005*** | 0.0009*** |
| Age 21-24 | 0.062*** | 0.022* | 0.118*** |
| Age 25-34 | 0.077*** | 0.040** | 0.122*** |
| Age 35-44 | 0.028 | 0.058*** | 0.004 |
| Age 45-54 | -0.027** | 0.003 | -0.070*** |
| Family structure | | | |
| Household size | 0.018*** | 0.010*** | 0.027*** |
| Single with dependent children (or member) | -0.024** | -0.017 | -0.006 |
| Housing type | | | |
| Ger | 0.010*** | 0.004 | 0.018** |
| Apartment | -0.031*** | -0.025*** | -0.037*** |
| Administrative units | | | |
| Ulaanbaatar | 0.012* | -0.026*** | 0.056*** |
| Aimag centre | 0.019*** | 0.015** | 0.024*** |
| Rural | -0.143*** | -0.098*** | -0.197*** |
| Geographical regions | | | |
| Western | -0.025*** | -0.016** | -0.034*** |
| Highlands | -0.026*** | -0.018*** | -0.033*** |
| Eastern | 0.004 | 0.014* | -0.009 |
| Predicted probability at means | 0.16 | 0.11 | 0.22 |
| Pseudo-$R^2$ | 0.12 | 0.12 | 0.11 |
| Number of observation[6] | 28 895 | 14 466 | 14 429 |
| Kog-likelihood | -12 609.1 | -5 142.8 | -7 315.6 |

*Sources:* Household Socio-Economic Survey; Authors' calculation.
*Notes:* *, **, *** denote significance at the 10, 5 and 1 per cent levels, respectively, for the test of underlying coefficient being zero. Marginal effects calculated for dummy variables as a discrete change from 0 to 1 and for continuous variables as a one-unit change.

[6] Total number of observations in the estimated model is 28,895, which is the number of all adults who are eligible to work, meaning that people outside the labour market, such as students, women on maternity leave and people with long-term sickness, are not included in the sample.

All remaining variables are significant, or for categorical variables, jointly significant at the 5 per cent level. In general, the signs of each marginal effect are in line with expectations. Characteristics, such as being male, not married, not in poor health condition, less educated, younger than 45, a member of large household, living in ger, being in an aimag centre, and or living in the Eastern region increase the probability if being unemployed. Furthermore, married men are more likely to be unemployed compared to married women. A man with bachelor's/degree or is older than 45 is more likely to be unemployed compared to women with the same characteristics.

Examining the size of each marginal effect gives the possibility of which variables have the greatest power of predicting unemployment. A baseline case, in which all categorical and dummy variables are set to the sample mode and continuous variables to the sample mean, shows that many variables in the regression have a sizeable effect on unemployment. For instance, under the baseline case an individual who lives in an aimag centre has 1.5 to 2.4 percentage points greater probability of being unemployed, compared to its counterpart. Conversely, a master's or PhD degree education reduces such probability by 10.4 percentage points.

Using the logit model, the probability of individuals becoming unemployed is estimated. This means that unemployment shocks in the model will most likely affect individuals with characteristics that have historically been associated with a greater likelihood of being unemployed. The unemployment probabilities are used to yield unemployment rate shocks. The constant of the model is increased until the rate of unemployment matches the required level. The simulation of changes in unemployment assumes transitions from employment to unemployment and vice versa.

After a probability of unemployment is assigned to each individual ($pu_j$), a uniform distribution a random real number, $\eta_j \in [0; 1]$ for each single individual[7] is drawn. If $pu_j \geq \eta_j$, the individual is selected as unemployed. In the case of becoming unemployed, it assumed that the individual's income is replaced by unemployment benefit while the income of other household members remain constant. Under the Mongolian law on distributing unemployment benefits from social insurance fund, the amount of unemployment benefit is determined by previous work income and years of employment. For instance, the amount of unemployment benefit is 45 per cent, 50 per cent, 60 per cent and 70 per cent of the monthly salary for the person who has worked for less than 5 years, 5-10 years, 10-15 years, and more than 15 years, respectively. The unemployment shock changes the household total income before tax, $I_{ub,i}$. However, we nee the household disposable income, $Y_{ub,i}$ after the shock is needed, and it cannot be assumed that the tax amount paid by the household is the same, as the tax amount changes following the income levels. Thus, $Y_{ub,i}$ is estimated as

$$Y_{ub,i} = ETR_i I_{ub,i} \tag{16}$$

where $ETR_i = T_i / I_i$ is the effective tax rate. These steps are repeated 1,000 times using Monte Carlo simulation. Each time the vulnerability indicators is calculated and finally the mean of each indicator is taken over all simulated draws.

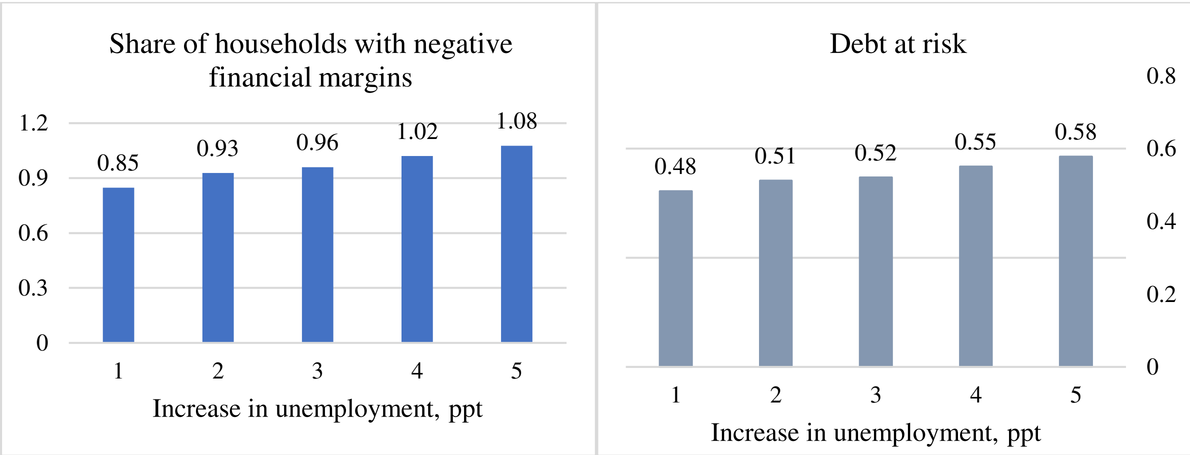
Base rate of unemployment for the simulation is 16 per cent, which is predicted probability from the estimated logit model at means. A one percentage point increment in unemployment rate (from 16 per cent to 17 per cent) increases the share of households with negative financial margins by 0.85 percentage points, and a five-percentage points shock in unemployment increases the share by 1.08 percentage points (figure 9). The impact of a one percentage point increase in the unemployment rate on debt at risk is 0.48 percentage points.

[7] The draws from the [0,1] uniform distribution for each single individual are not same for all the simulated levels of unemployment in order to ensure the randomized simulation.

The marginal impacts of a change in unemployment on the share of households with negative financial margins and debt at risk are relatively small compared to other shocks.

**Figure 9. Effect of rising unemployment**

*Changes relative to pre-stress results, 2014*




*Sources:* Household Socio-Economic Survey 2014; Authors' calculation.

### 4.2.7 Combined scenarios stop

This section contains a discussion of the findings after shocks in combination to examine households' resilience are applies under two scenarios, labelled "historical" and "hypothetical". The magnitudes of the shocks under each of the scenarios are shown in table 3.

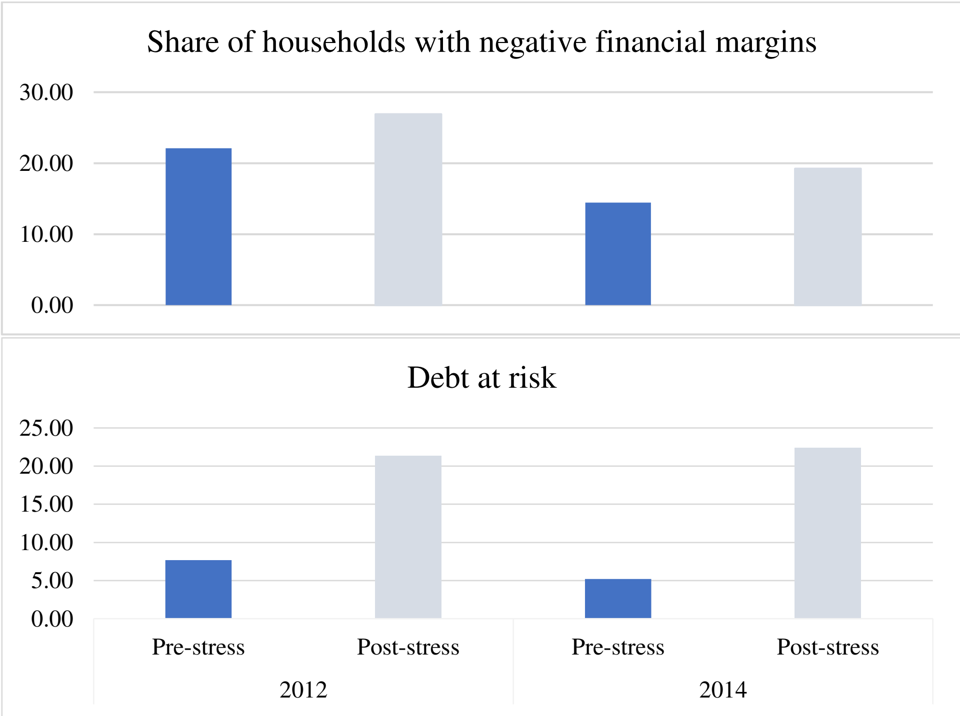
**Table 3. "Historical" and "hypothetical" Scenarios**

| | Historical | Hypothetical |
|---|---|---|
| Change in housing prices (per cent) | -11.5 (2014-2015) | -20.0 |
| Change in interest rate (percentage points) | 2.25 (2009-2011) | 4.0 |
| Change in basic consumption prices (per cent): | 11.6 (2009-2011) | 10.0 |

The "historical" scenario is designed to replicate the changes in macroeconomic conditions that occurred in Mongolia during the 2009-2011 economic recession, except for the fall in housing prices. This scenario includes a significant rise in inflation, a decrease in housing prices and an increase in short-term interest rates. The "hypothetical" scenario is much more severe than the historical scenario and calibrated by taking recent macroeconomic changes into account.

Under the historical scenario, share of households with negative financial margins increased by 4.79 and 4.80 percentage points in 2012 and 2014 relative to the pre-stress baseline, respectively (figure 10). Compared to other countries, Australia in this case, the historical scenario leads to a significantly greater share of households with negative financial margins. This is mainly the result of the higher interest rate, as the monetary policy was tightened in response to the rapid exchange rate depreciation during the economic recession (or to the high inflation before the recession). In other countries, interest rates declined as the exchange rate risk is managed using hedging instruments, and there is room for expansionary monetary policy to offset the effects of other shocks on household loan losses by reducing debt-servicing costs. In terms of debt at risk, there is larger increase in the share of households with debt at risk, as all the shocks have effects that decrease households' financial margins. The effect of macroeconomic shocks on debt at risk appears to have increased over the period 2012-2014.

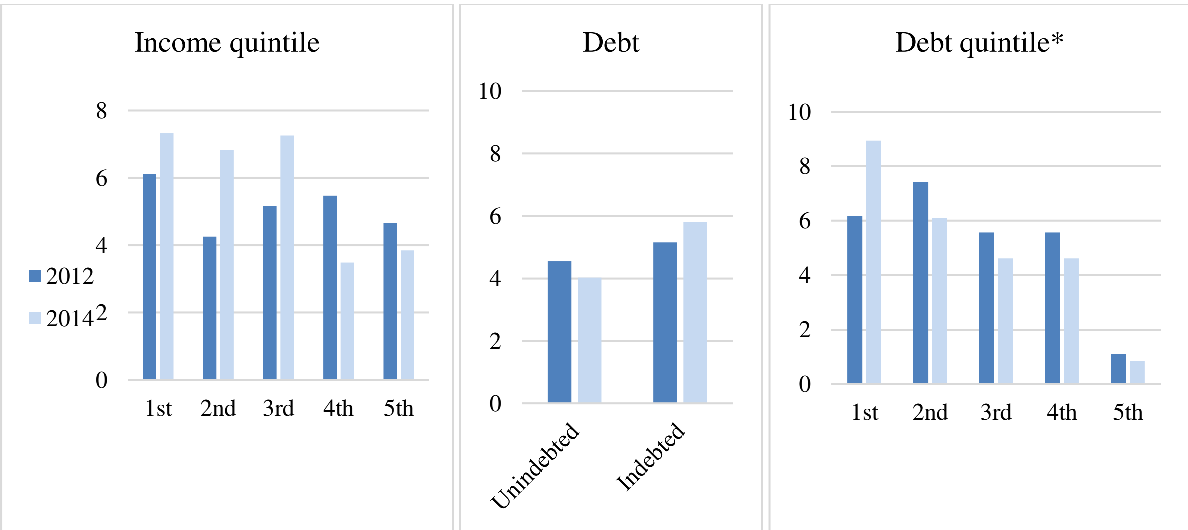
**Figure 10. "Historical" scenario**




*Sources:* Household Socio-Economic Survey 2012 and 2014, Authors' calculation.

**Figure 11. "Historical" scenario Share of households with negative financial margins**

Change relative to pre-stress



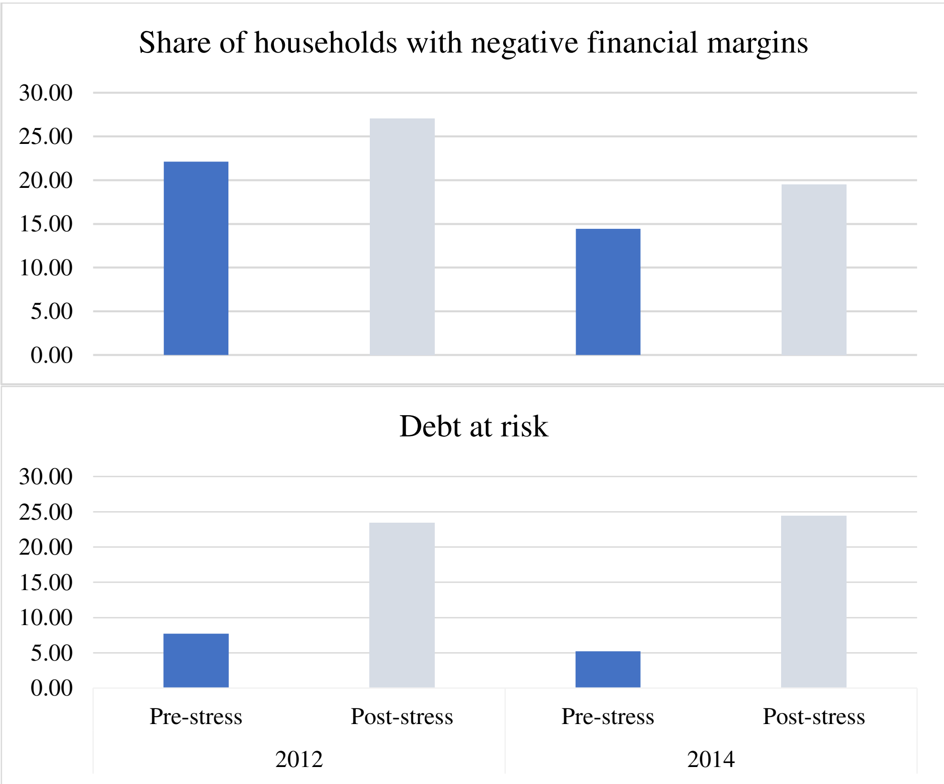

*Source:* Authors' calculation

*Note:* [a]-Indebted households only.

The rise in the share of households with negative financial margins is largest for less indebted and/or low-income households.

Under the "hypothetical" scenario, the share of households with negative financial margins rose by about five percentage points in each year, to a total of 27.1 per cent in 2012 and 19.5 per cent in 2014. As end of 2014, debt at risk is expected to reach 25 per cent if the hypothetical shocks occur simultaneously (figure 12).

**Figure 12. "Hypothetical" scenario**



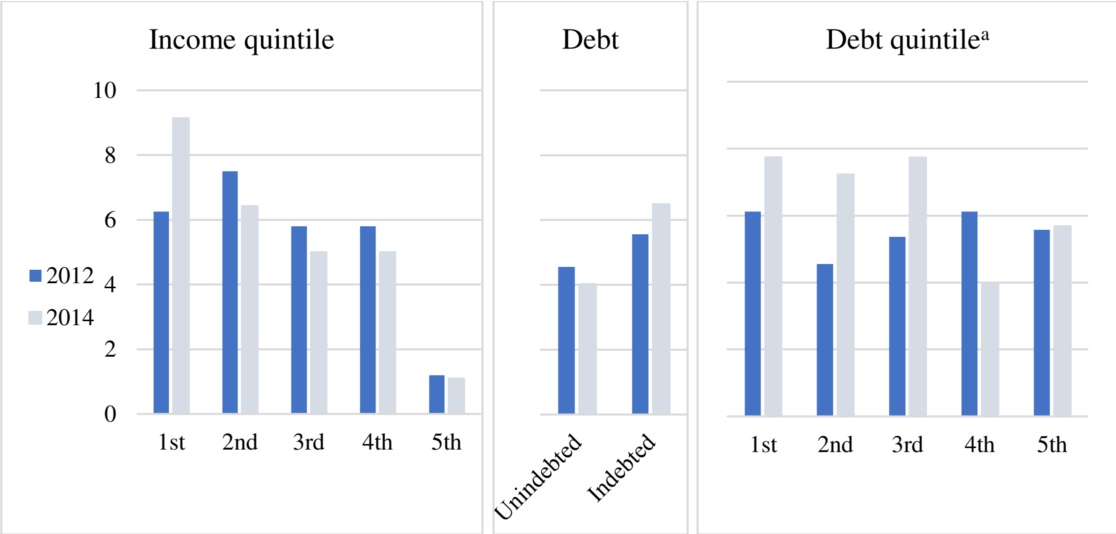

*Source:* Authors' calculation.

*Note:* [a]-Indebted households only.

The rise in the share of households with negative financial margins is largest for the most indebted households (figure 13). The indebted households were severely affected by the shocks in 2014 compared to 2012.

**Figure 13. "Hypothetical" scenario  Share of households with negative financial margins**

Change relative to pre-stress



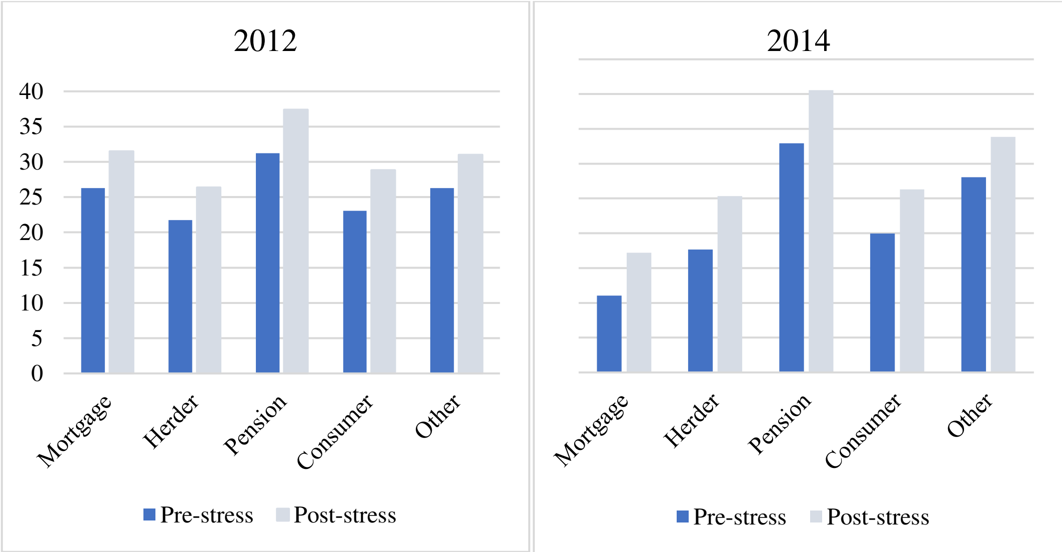

*Sources:* Household Socio-Economic Survey 2012 and 2014; Authors' calculation.

*Note:* [a]-Indebted households only.

Under the "hypothetical" scenario, the share of households with negative financial margins increased each year. Households with herder and pension loans were the most vulnerable groups to financial risks compared to other groups. The share of mortgagers with negative financial margins declined from 2012 to 2014 as the annual mortgage interest rate fell to 8 per cent (figure 14). The results from the hypothetical scenario suggest that the household sector had been extremely vulnerable to macroeconomic shocks. In particular, the households who held the bulk of the debt tended to face debt-servicing problems in times of macroeconomic shocks.

**Figure 14. “Hypothetical” scenario  share of households with negative financial margins**

(by type of loans)




*Sources:* Household Socio-Economic Survey 2012 and 2014; Authors’ calculation.

## V. Conclusion

The indebtedness of the Mongolian household sector has increased substantially in recent years. The sharp increase in household debt has raised concerns about the sustainability of this debt and possible risks for the banking sector. For the present paper, a simulation-based model for stress testing the household sector in Mongolia was developed, and the resilience of the household sector using micro data from Household Socio-Economic Survey survey. This paper also provides a useful starting point for developing a more holistic stress-testing framework for the Mongolian banking system.

Results shown in the paper have yielded significant insights about financial fragility of indebted households in Mongolia. Lenders’ exposure to households with negative financial margins appears to be large in Mongolia despite a declining share of households with negative financial margins over the 2012-2014 periods. For instance, pre-stress debt at risk is 7.2 per cent in 2014, which is quite high compared to other countries (Australia, Austria and Croatia). The shares of households with negative financial margin declined from 22.1 per cent in 2012 to 14.4 per cent in 2014. Indebted households are more likely to have negative financial margins than those who are not. Households with older heads are more likely to have negative financial margins than households with younger heads. Shocks to interest rate and costs of basic consumption have harmful effects on financial wellness of households. A 5 per cent rise in prices of all basic consumption goods leads to 0.7 percentage points increase in debt at risk, while a five-percentage point increase in interest rate causes debt at risk to rise by 1.22 percentage points. Under both the "historical" and "hypothetical" scenarios, the effect of macroeconomic shocks on debt at risk appears to be amplified over the 2012-2014 period. This suggests that a substantial increase in aggregate household indebtedness has led to the financial fragility of the household sector.

These results have important policy implications in mitigating the increasing financial fragility of the household sector and risks to financial stability. The increase in the financial fragility of the household sector adds risks to the banking sector, which is already experiencing high non-performing loans driven by the economic recession. The Government should consider a combination of ensuring sound institutions, regulations, and policies to avoid risks of financial instability associated with rising household debt. As indebted households are more financially vulnerable to adverse shocks, such as inflation or interest rate increases, macroeconomic policy authorities should focus on keeping inflation low, stable, and predictable, which would provide an environment that is more favorable to low bank lending rates, job creation and real household income growth. In addition, better financial regulation, and supervision, rising household income and lower income inequality would mitigate the impact of rising household debt on risks to financial stability. A response to mitigate financial risks in the household sector may rely on macroprudential tools that target credit demand, such as restrictions on debt-to-income ratio, loan-to-value ratio and risk weight in loan classification. The policy response lowers the financial and economic risks related to household over-indebtedness but may also lead to a rise in lending rates and a contraction in supply for household loans, which, in turn, may increase non-performing household loans in the short term. Accordingly, policymakers should carefully weigh the benefits and adverse consequences of alternative measures before taking actions. In addition, policymakers may consider focusing on preventive and alleviative measures, including financial education and debt advisory services, namely improving communication on financial literacy and debt management strategies: households should take on debts that are necessary and that they can pay back.

As with all stress-testing models, the one used in this paper has some limitations that are critical to its interpretation. First, the existing household survey in Mongolia may not adequately identify households with negative financial margins as households may tend to understate their debt and income. In addition, higher-income households who possibly hold higher debts are less likely to be included in the survey, and do not disclose their financial positions. To build up the database for this type of modelling, it is more constructive to add new questions about household balance sheets and financial statements into the existing survey questionnaire. Second, as emphasized by many other papers, such as Bilston, Johnson and Read (2015), the predictive ability of household microsimulation has not been adequately tested. Thus, the stress-testing results should be frequently updated and compared with actual changes in the banking sector equity. Third, the one-period nature of the model may not be realistic in the real world as the assumptions leads to a strong and instantaneous response of loan losses to macroeconomics shocks, namely "jump to default" in a single period because of negative financial margin. The economic downturn involving a multi-period of shocks leads to loan losses that would be spread over time. The model can be further extended to relax assumptions about the probability of default and include a multiple-period nature, which could potentially improve the model fit. Finally, the model needs to be further developed to assess the effect of exchange rate risk on household debt repayment as the share of foreign currency loans is relatively high in Mongolia.

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