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FINANCIAL VULNERABILITY OF SLOVAK HOUSEHOLDS: EVIDENCE FROM HOUSEHOLD BALANCE SHEET STRESS TESTS USING HFCS MICRODATA

Abstract:

The increase in indebtedness of Slovak households, combined with the recent significant rise in interest rates and high inflation, will result in greater pressure on households to fulfil all their debt obligations. In our thesis, we utilised microeconomic data from the last available Household Financing and Consumption Survey (HFCS). We identify financially vulnerable households based on the concept of financial margin. Furthermore, we conducted microsimulations stress tests to assess households' resilience against interest rate and inflation shocks. These tests were designed to investigate the impact of these shocks on household vulnerability and subsequently on financial stability. Our findings show that inflation shocks have a more pronounced impact on the growth rate of indebted households with negative financial margin and the probability of default compared to interest rate shocks. In contrast, the impact of interest rate shocks on aggregate debt amount at risk is greater than that of inflation shocks. It is important to note that while an interest rate shock has a more pronounced effect on debt at risk, the actual bank losses are not affected by the change in interest rates. The increase in bank actual loan losses, caused by households defaulting on their loan payments, is caused only by inflation shocks. Furthermore, the entirety of the loan losses incurred by the banks can be attributed to non-mortgage loans, with no actual loan losses resulting from mortgage loans prior to and even after the application of the shocks. The results of the stress testing analysis indicate that the credit risk associated with the Slovak household sector does not represent a significant threat to the stability of the financial system. This is due to the fact that the majority of Slovak household liabilities are covered by substantial real assets held by households.

Keywords:

Slovak household indebtedness, HFCS, household vulnerability, stress tests

JEL Classification: D14, E43, G21

1   Introduction[1]

The recent surge in inflation and interest rates, coupled with the elevated level of household indebtedness, has prompted concerns among prudential supervisors and other authorities regarding the financial vulnerability of households. Those households that are financially vulnerable are becoming increasingly exposed to adverse economic shocks such as interest rate shock or inflation shock, which could result in substantial credit losses for the financial sector. Subsequently, the effects of such a situation can be felt throughout the entire economic system, given the highly interconnected and leveraged nature of the financial sector.

The analysis of the impact of interest rates and inflation shocks on financially vulnerable households was selected based on recent economic developments. The rising prices of gas, energy and food are placing significant pressure on households to maintain their standard of living. The inflation observed in Slovakia over recent years reached record levels, with the primary contributing factor being an unfavourable external environment, including adverse health and geopolitical conditions. The employed inflation shock in our paper were based on the development of the inflation rate in Slovakia, which peaked in February 2023 at 15.4%. The average inflation rate in Slovakia in 2021 was 2.8%, in 2022 it was 12.8%, and in 2023 it was 10.5% (NBS). Therefore, we have decided to stress test households with three hypothetical increases of price levels at 5%, 7% and 15% increase from the baseline. In order to address the elevated inflation rates observed across the euro area, the European Central Bank (ECB) has implemented a series of increases in the monetary policy rate. The interest rate on the main refinancing operations was increased from 0 basis points in June 2022 to 450 basis points in September 2023. This has given rise to concerns that households may encounter challenges in meeting their debt obligations.

Before the GFC the Slovak households were among the least indebted households compare to other Central and Eastern European (CEE) countries. However, between 2014 and 2018, Slovak households exhibited the highest annual increase in mortgage and non-mortgage debt among European Union countries. As a consequence, the debt-to-GDP ratio has risen from 21% in 2008 to 49.2% in 2022, while the debt-to-gross-income ratio of households has increased from 43.3% in 2012 to 72.6% in 2022. (Eurostat, 2022). The consequence of this is that households in Slovakia have become one of the most indebted households in Central and Eastern Europe (CEE), approaching the median debt values of developed European Union countries (Cesnak et al., 2023; Richtárik, 2017).

The financial vulnerability of households has typically been analysed using aggregated data. However, the scope of aggregate data for the analysis of the characteristics of household financial vulnerability is constrained. The significant disadvantage of aggregated data is the inability to ascertain the distribution of debt among various socioeconomic or demographic groups, which limits the ability to identify the most vulnerable group of households (Albacete and Fessler, 2010;

Jaanika and Room, 2020). In response to this, central banks and authorities with responsibility for financial stability initiated the collection of household survey "micro-level" data with the objective of analysing the risk to financial stability posed by indebted households. In this paper, we employ the most recent Household Financial and Consumption Survey (HFCS) data, which was collected from Slovak households in 2021.

The objective of this study is to identify financially vulnerable households in Slovakia and to analyse the magnitude of the impact of selected adverse economic shocks on these households. The identification of financially vulnerable households is based on the concept of financial margin, which considers the household's disposable liquid financial assets. A negative financial margin is defined as a situation in which a household's disposable income is less than the amount required for essential consumption and debt-service payments. The financial fragility of each individual household is evaluated based on the probability of default, calibrated to meet the aggregate household sector non-performing loans ratio (Ampudia, van Vlokhoven and Zochowski, 2016; Merikull and Room, 2020). Furthermore, our thesis will employ three shocks: (i) an increase in interest rates, (ii) an increase in price levels, and (iii) a combination of both shocks to analyse the severity of their impact on financially vulnerable households and the amount of debt at risk.

The rest of this paper is organised as follows. Section 1 presents a literature review. Section 2 introduces the HFCS microdata used in our study. Section 3 outlines the methodology employed in our study, followed by Section 4, which presents the results. Finally, Section 4 concludes.

2   Literature Review

Prudential supervisors and other regulatory authorities typically employ stress tests to quantify the impact of various adverse shocks on financial stability (Johnson and Read, 2015). The accessibility of household micro-level data has increased the popularity of household micro-simulation-based stress tests as a tool for assessing the household's ability to repay its debts after exposure to adverse shocks and its impact on financial stability. The term 'household financial vulnerability' is defined as a situation where an indebted household is exposed to the risk of failure to meet its financial obligations promptly and entirely after adverse shocks occur, thus incurring financial distress (Leika and Marchettini, 2017). Anderloni et al. (2012) posits that instances of financial vulnerability can be attributed to unsound or unsustainable borrowing practices, which result in households contracting debt levels that are excessively high relative to their current and future earnings capacity. Consequently, debt can be considered a significant contributing factor to the phenomenon of financial vulnerability.

The extent of a household's indebtedness is not a comprehensive indicator of its debt sustainability. It is crucial to assess the debt in relation to the household's available resources to manage it, in order to determine whether the household has a low or high debt burden. One of the method used in the previous studies to identify financially vulnerable households relies on the concept of "financial margin" (FM). Financial margin is defined as the difference between a household's monthly disposable (net) income from which the sum of basic living costs and loan servicing costs are deducted. Typically all households with a negative financial margin are considered financially vulnerable leading to financial distress and ultimately assumed to default on their loan payments. This financial margin approach follows the "binary default" interpretation (Giordana and

Ziegelmeyer, 2020) meaning that all households with a negative financial margin (below a defined threshold, typically zero) are assigned with a probability of default one and zero otherwise. This approach is used in the following studies (Johansson and Persson, 2006; Holló and Papp, 2007; Albacete and Fessler, 2010; Albacete et al., 2014; Bilston, Johnson and Read, 2015; Galuscak and Jakubik, 2016).

The more sophisticated method used to identify financially vulnerable households also relies on the concept of financial margin. However, the households' liquid financial buffers are introduced in this case. In the previous studies using the second method, households with a negative financial margin are considered financially distressed households and their PD equal to one. However, in practice, a household with a current negative financial margin does not immediately default on loans since the probability of default also depends on its liquid assets. Households with a substantial level of liquid assets may be able to sell part of their liquid assets to cover the negative financial margin for some time until they exhaust their financial assets or restore their income to avoid default (Giordana and Ziegelmeyer, 2020; Jaanika and Room, 2020). This approach follows the "*continuous default*" interpretation, which considers the amount of liquid assets of households, causing the probability of default to take any value between zero and one. This approach is also used in the following studies (Herrale and Kauko, 2007; Ampudia, van Vlokhoven and Zochowski, 2016; Bettocchi et al., 2018). In our paper we will use the "continuous default" interpretation, which take into account the amount of liquid assets of households.

A number of studies have examined the impact of various adverse economic shocks on financially vulnerable households and their substantial effect on the stability of the wider financial system. These studies utilise micro-level stress testing. (Johansson and Persson, 2006 for Sweden; Herrale and Kauko, 2007 for Finland; Holló and Papp, 2007 for Hungary; Albacete and Fessler, 2010 for Austria; Michalengeli and Pietrunti, 2014 for Italy; Ampudia, van Vlokhoven and Zochowski, 2016 for Euro Area; Galuscak and Jakubik, 2016 for Czechia; Jaanika and Room, 2020 for Estonia; Giordana and Ziegelmeyer, 2020 for Luxembourg; Abela and Georgakopoulus, 2022 for Malta). Studies concerning non-European countries (Faruqui, Liu and Robert, 2012 for Canada; Martinez et al., 2013 for Chile; Bilston, Johnson and Read, 2015 for Australia; Funke, Sun and Zhu, 2021 for China).

Previous literature has concentrated on the impact of different economic shocks on households' loan servicing capability and their subsequent effect on the stability of the financial system. In particular, three selected shocks have been analysed: (i) a rise in interest rates; (ii) a rise in unemployment; (iii) fall in real estate prices (Johansson and Persson, 2006; Herrale and Kauko, 2007; Albacete and Fessler, 2010; Jaanika and Room, 2020). Analyses employing the HFCS database or a combination of the HFCS database with other administrative register data have yielded valuable insights into credit risk associated with household debt to the financial sector (Ampudia, van Vlokhoven and Zochowski, 2016; Jaanika and Room, 2020; and Giordana and Ziegelmeyer 2020). The interest rate shock in previous studies was either tested on the assumption of hypothetical increases in the interest rates ranging from 100 to 400 basic points (Ampudia, van Vlokhoven and Zochowski, 2016; Giordana and Ziegelmeyer 2020) or on the standardised shock

defined as one, two or three standard deviations in the base interest rate, e.g. the six-month EURIBOR Jaanika and Room, 2020).

The findings of the previous studies suggest that in the study by Ampudia et al.(2016) and Giordana and Ziegelmeyer (2020), households are more sensitive to interest rate shock than unemployment shock. According to Ampudia et al.(2016), the interest rate shock has the most substantial impact in countries with a high share of households with adjustable-rate mortgages. Jaanika and Room (2020) find that contrary to the previous two studies, Estonian households are more sensitive to unemployment shock. This finding is in line with previous studies (Holló and Papp, 2007; Galuscak and Jakubik, 2016) suggesting that in Central and Eastern European countries, the unemployment shock has a more substantial adverse effect on the ability of households to service their loans than interest rate shock. Also, socioeconomic characteristics are important determinants influencing the probability of default. The studies find that households with low income, low net wealth, low education, with more dependent children, or unemployed heads of household were the most vulnerable and had the highest probability of default.

The final shock to be considered is the real estate price shock, which is expected to have a significant impact on the loss given default (LGD). Ampudia et al. (2016) found that following a two-standard deviation decline in real estate prices, the total LGD (across 10 Euro Area countries) increased from a baseline value of 1.12% to 1.21%, representing an increase of 7.8%. In the case of Luxembourg, Giordana and Ziegelmeyer (2020) demonstrate that following a 30 percentage point simulated decline in real estate prices, the baseline mean of PD for all indebted households and (exposure at default) EAD will remain unchanged from the baseline value. However, the baseline LGD ratio will change from 0.51% to 1.37%. In the case of Estonia, Jaanika and Room (2020) demonstrate that following a three-standard deviation decline in the real estate price index, the baseline LGD ratio changes from 0.4% to 1.9% according to the HFCS data. However, when the register data is considered, the baseline LGD ratio changes from 1.1% to 3.5%. It is evident that the banking sector's most considerable losses result from the real estate price shock.

Our contribution to the literature lies in the utilisation of the most recent Slovak HFCS microdata to identify financially vulnerable indebted households based on the concept of financial margin and calculated their probability of default, taking into account their liquid financial buffers. In addition, we employed a microsimulation-based stress test to assess the sensitivity of a financially vulnerable household's loan servicing capability to various adverse macroeconomic shocks. In light of the recent increase in interest rates and high inflation in the euro area, we conducted a microsimulation stress test of the Slovak households' resilience against various increases in interest rates and price levels. The main objective of the microsimulation stress test is to evaluate the impact of the selected shock on financially vulnerable households, identify the most vulnerable groups of households and determine whether there is a potential threat to financial stability posed by the amount of debt at risk own by the financially vulnerable households that default on their loan payments in the event of occurrence of selected adverse shocks.

3   Data

We utilised cross-sectional household-level microdata collected for the fourth wave of the Household Finance and Consumption Survey (HFCS). The HFCS is an ex ante harmonised survey

coordinated by the European Central Bank (ECB). Since 2010, the national central banks and statistical offices for each participating euro area country and some Eurosystem countries have been collecting data at approximately three-year intervals. In Slovakia, the HFCS survey has been conducted on four occasions: in 2011, 2014, 2017 and 2021. The National Bank of Slovakia (NBS) is responsible for administering the survey, while the Statistical Office of the Slovak Republic is tasked with conducting the fieldwork. The final sample of HFCS in 2021 comprises 10,870 observations, representing 2,174 survey households (10,870/5). It should be noted that the missing values in the HFCS dataset have been imputed five times.

The primary objective of the HFCS survey is to collect detailed microdata on the financial situation of households. The HFCS contains a comprehensive set of data relating to different sections of the household balance sheet, including real assets, financial assets, net wealth, mortgage debt, non-mortgage debt, income and expenditure. Furthermore, the various items of the household balance sheet are merged with relevant socio-demographic and economic characteristics, including gender, age, education, employment status, household size, and so forth. The HFCS data provides a comprehensive understanding of households' financial circumstances and helps us identify various aspects of households' financial decision-making.

The sampling design of the 4. wave of HFCS in Slovakia is based on two-stage stratified random probability sampling (based on census data). The survey intentionally oversampled wealthy households in order to improve the coverage of household wealth. The HFCS dataset incorporates multiple imputed observations, along with survey and replicated weights. These factors are of crucial importance during various calculations and regressions, as they serve to guarantee the accuracy and representativeness of the analysis.

Our research is particularly focused on household indebtedness and the level of financially vulnerable households in Slovakia. Furthermore, the availability of HFCS microdata enables us to conduct a comprehensive analysis of the indebted Slovak households' financial situation and an in-depth description of the distribution of debt levels and debt ownership across selected socio-demographic categories. Additionally, the HFCS data enables the identification of the change in the number of financially distressed indebted households before and after adverse economic shocks. This information offers significant insights into the evolution of the number of households with non-performing loans (NPLs) before and after the occurrence of the adverse economic shock

Following the primary objective of the paper, we direct our attention mainly to the liability side of the household balance sheet. This encompasses information regarding the outstanding amount of mortgage and non-mortgage debts, as well as the monthly debt payments for mortgage and non-mortgage debts.

Table 1: Debt Participation
As a percentage of all Slovak households

	All households	Median	Mean
	%	EUR	EUR
Household type			
No debt	61.15		
Any debt	38.85	18,400	33,918

Mortgage debt	25.39	35,249	48,289
Nonmortgage debt	17.56	3,000	5,226
Mortgage and nonmortgage debt	4.10	52,120	53,472

Source: Own calculation based on HFCS 2021, ECB & NBS

Table 1 presents an analysis of debt participation among Slovak households. A majority, 61.15% of Slovak households, do not hold any form of debt. Approximately 38.85% of households have some form of debt, while the majority of households (25.39%) have mortgage debt, with an average debt load (mean 53,472€; median 52,120€). This reflects the significant investment in real estate and property as primary assets. Non-mortgage debt represents a smaller proportion of the overall debt structure, with 17.56% of households having non-mortgage debt and only 4.10% of households carry both mortgage and nonmortgage debt simultaneously.

4   Methodology

This section outlines the methodologies methodology used in deriving the indicators of households' financial vulnerability utilised in the microsimulation stress tests. Firstly, the household financial margin (FM) is defined. Subsequently, we demonstrate how the probability of default for a household is calculated on the basis of the FM and liquid assets. The probability of default is calibrated to correspond with the aggregate household sector ratio of non-performing loans.

The household FM can be expressed as follows:

$$FM_i = Y_i - DP_i - C_i \tag{1}$$

where FM_i is the monthly financial margin of household i, Y_i is monthly net income, DP_i refers to total debt service costs and C_i is the essential consumption. The monthly net income was calculated by adjusting the annual gross income for taxes and social security contributions. All tax levy rates and tax credits were taken into account during the calculation. Regarding the total debt service costs DP_i, households can pay monthly payments from either for mortgage or non-mortgage debt. The term "*payments for household debt*" refers to the monthly payments made by a household to a lender in order to repay a loan. The total payments made by the household include those for mortgages and other loans, such as car loans, consumer and instalment loans, and loans from relatives, friends, and employers. It should be noted that the total debt service costs do not include credit card debt, credit lines, or overdrafts. This is because the HFCS dataset does not contain information about the monthly payments from these types of debts[1].

Nevertheless, these types of debts are included within the liquid assets formula, as the amount of liquid assets available to households is reduced by these types of debts. The measure to express the monthly essential consumption of a household was the living income, calculated by the National Bank of Slovakia (NBS). The concept of living income is defined as the amount of money required

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[1] It should be noted that the data on monthly payments for leases, credit card debt, and bank account overdrafts are not available in the Household Finance and Consumption Survey. The exclusion of these loans is unlikely to have a significant impact on the results, given that only a small proportion of Slovak households hold these types of loans in relatively small amounts.

by a household to secure all essential needs, but not necessarily all wants. The concept of "*essential needs*" is influenced by the level of economic development and a variety of social and cultural determinants. Consequently, the concept of living income for Slovakia can be defined as the minimum income required to meet the basic needs of a specified household in 2021. The individual amount of living income is calculated for a single adult household (referred to as 1 + 0) and also for a household consisting of two economically active adults and two dependent children (referred to as 2 + 2). The calculation of their living income is based on data from multiple sources and takes into account the costs of a nutritious diet, adequate housing, basic clothing and footwear, transport, education, healthcare, and a budget for communication, recreation, and other miscellaneous goods. The detailed characteristics of the calculation of the Slovak living income can be found in the NBS Occasional Paper 1/2022, The living income for Slovak households (Fabo B., Guzi M., Šofranková B., 2022)[1]. Our estimation will be based on the living income for two model households, which are owner-occupiers of their main residence. The living income for a single adult household is 335€, and for a household comprising two adults and two dependent children, it is 847€. For those households that do not fall into any of the aforementioned categories, the living income is calculated by multiplying the amount of living income for a single adult household by the sum of consumption weights taken from the OECD equivalence scale[2]. Furthermore, the total monthly rent is included in the calculation of households' living incomes if they live in rented accommodation.

After comprehensively characterising each component of the financial margin formula, we will proceed to describe the calculation of the probability of default. Once the FM has been calculated, then it is possible to identify the proportion of households with a negative FM $(FM < 0)$. The PD each of household *i* is defined in accordance with the methodology proposed by Jaanika and Room (2020):

$$If\ FM_i \geq 0\ then\ pd_i = 0 \tag{2}$$

$$FM_i < 0\ \wedge\ LIQ_i \geq |FM_i| \times M\ then\ pd_i = 0 \tag{3}$$

$$If\ FM_i < 0\ \wedge\ 0 < LIQ_i < |FM_i| \times M\ then\ pd_i = 1 - \frac{LIQ_i}{|FM_i|} \times \frac{1}{M} \tag{4}$$

$$If\ FM_i < 0\ \wedge\ LIQ_i = 0\ then\ pd_i = 1 \tag{5}$$

pd_i is the probability of default of household *i, FM_i* is the financial margin of household *i*, LIQ_i are financial assets of household *i* (e.g. the sum of deposits, mutual funds, bonds, non-self-employment private business wealth, publicly traded shares, and managed accounts minus the amount of non-collateralised debt such as credit card, credit line and overdrafts). *M* represents the number of months required by the household to restore its non-negative financial margin or the number of months a negative FM needs to be covered by exhausting household liquid assets. Accordingly, we define financially vulnerable households as those that do not possess sufficient liquid assets to

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[1]   National Bank of Slovakia (NBS). Available on: https://nbs.sk/dokument/bb6917d7-e827-4495-877d-00d85db0aa5a/stiahnut/?force=false

[2] The first adult member of the household is assigned a weight of 1, with each subsequent member aged at least 14 assigned a weight of 0.5, and each additional member aged less than 14 assigned a weight of 0.3.

bridge the gap between their disposable income and necessary monthly expenses for a minimum of defined M months. Equation (2) sets the pd_i to zero for each households i with a positive FM_i. Equation (3) sets the pd_i to zero for each households i with a negative FM_i, but enough liquid assets LIQ_i to cover the negative FM_i for more than calibrated M months (assumes that M is greater than zero). In Equation (4), the pd_i is set to one for households with insufficient liquid assets to cover the calibrated M months of the negative financial margin. For households with a certain amount of liquid assets LIQ_i available to cover only a specific period of calibrated M months of the negative financial margin, the pd_i is defined as a decreasing linear function of the ratio of liquid assets LIQ_i to the absolute value of the financial margin. Equation (5) sets the pd_i to one for each household i with negative FM_i and without any liquid assets at their disposal. The methodology employed in our research follows that of Ampudia et al. (2016), Jaanika and Room (2020) and Giordana and Ziegelmeyer (2020). The objective is to calibrate the value of M in order to achieve an estimated ratio of exposure at default (EAD) that is consistent with the aggregated ratio of non-performing loans (NPL) from households' loans across the entire banking system. The NPL ratio was calculated as the proportion of household loans that were past due for more than 90 days to the total loan stock between July and October 2021. This figure was 2.6% during the survey period. Following the calibration of the value of M to align with the NPL ratio in Slovakia, it was determined that the value of M is 2. The value of M in Slovakia is relatively low, suggesting that households may be able to restore their financial solvency relatively quickly. Once the financial margin has been calculated and the probability of default has been derived for each household, the potential banks' loan losses are assessed by calculating the total share of household loans exposed to default (EAD) and the total share of actual defaulted loans. This is done by calculating the loss given default (LGD) before microsimulation-based stress tests are conducted. The same ratios are then reassessed after the application of adverse economic scenarios.

4.1   Exposed to default (EAD) & Loss given default (LGD)

Once the estimated pd_i for each household I has been determined, the bank's exposure at default (EAD) can be calculated. In order to calculate the possible bank losses from household loans under different stress scenarios, it is necessary to take into account the share of total debt held by indebted vulnerable households with negative financial margin (FM < 0) and with (PD > 0), as well as total debt stock D_i across all indebted households in HFCS. We follow the idea of Ampudia et al. (2016), Jaanika and Room (2020) and Giordana and Ziegelmeyer (2020) to calculate EAD. We define the EAD as follows:

$$EAD = \frac{\sum_{i=1}^{N} pd_i D_i}{\sum_{i=1}^{N} D_i} \qquad (6)$$

where EAD is the exposure at default and D_i is the total aggregated debt stock of household in the survey. The value of M is calibrated in such a way that the EAD would meet the aggregated ratio of non-performing loans (NPLs) in the banking sector as a whole at the time of the survey. The EAD is a metric that quantifies the proportion of household debt with a negative financial margin relative to the overall aggregated debt stock in the HFCS survey.

The ultimate objective is to calculate the loss given default (LGD). LGD represents the proportion of debt held by a household with a negative financial margin that is not covered by the household's

collateral (real or financial assets). Following the idea of Herrale and Kauko (2007) and Jaanika and Room (2020) for calculating LGD. We define LGD as follows:

$$LGD = \frac{\sum_{i=1}^{N} pd_i [(D_i^M - W_i^M)c_i^M + D_i^{NC}]}{\sum_{i=1}^{N} D_i} \tag{7}$$

where LGD is the loss given default, D_i is debt, superscript *M* stands for mortgage loans, superscript *NC* stands for non-collateralised loans, W_i stands for the assets that the bank can liquidate in case of a default of household *i*. C_i is a binary variable that equals one if the debt of the household *i* is higher than its collateral (real or financial assets) that can cover the outstanding value of its loan and 0 otherwise.

4.2   Microsimulation stress test scenarios

In our paper we employ three shocks: (i) an increase in interest rates and (ii) an increase in price levels (iii) combination of both shocks. The interest rate shock has an immediate impact on household loan payments with adjustable interest rates. In contrast, for those households with fixed interest rates, the effect of the interest rate shock is postponed until the loans have been renegotiated. The HFCS data reveals that 55.5% of households with an (household main residence) HMR and 80.9% of households with mortgages on other properties have adjustable interest rates contracts. In our analysis, we assume that increases in interest rates affect only mortgage loan payments with adjustable interest rates. In contrast, mortgage loan payments with fixed interest rates and non-mortgage loan payments are assumed to remain unaffected by interest rate shocks.

Table 2 outlines the scenarios of interest rates, price levels and combined adverse economic shocks. Furthermore, Furthermore, Table 2 illustrates the extent to which each scenario has been implemented, indicating which variables and vulnerability indicators are most affected by the selected economic shocks.

Table 2: Overview of interest rate and inflation shock simulations

		Baseline	Scenario 1	Scenario 2	Scenario 3
Interest rate shock	**Magnitude**	+0 basis points	+300 basis points	+500 basis points	+700 basis points
	Affected loans	Mortgage loans with adjustable interest rates	Mortgage loans with adjustable interest rates	Mortgage loans with adjustable interest rates	Mortgage loans with adjustable interest rates
	For the following measures	FM, pd, EAD, LGD	FM, pd, EAD, LGD	FM, pd, EAD, LGD	FM, pd, EAD, LGD
Inflation shock	**Magnitude**	0%	5%	7%	15%
	Types of essential consumption affected	Living income	Living income	Living income	Living income
	For the following measures	FM, pd, EAD, LGD	FM, pd, EAD, LGD	FM, pd, EAD, LGD	FM, pd, EAD, LGD
Combined shock	**Magnitude**	+0 basis points & 0%	+300 basis points & 5%	+300 basis points & 10%	+500 basis points & 10%

	Affected variables	Mortgage loans with adj. interest rates & Living income	Mortgage loans with adj. interest rates & Living income	Mortgage loans with adj. interest rates & Living income	Mortgage loans with adj. interest rates & Living income
	For the following measures	FM, pd, EAD, LGD	FM, pd, EAD, LGD	FM, pd, EAD, LGD	FM, pd, EAD, LGD

Source: Own calculation

5   Results

The following subsection presents an analysis of the impact of interest rate and inflation shocks on the financial vulnerability of Slovak households and on debt at risk in 2021. Table 3 illustrates the influence of rising interest rates on the financial vulnerability on various financially vulnerable indicators.

Table 1: The impact of a change in interest rates on indicators of the financial vulnerability of households and the estimated loan losses for banks

	baseline	3% increase of interest rates	5% increase of interest rates	7% increase of interest rates
	living income	living income	living income	living income
Negative financial margin, %	**10.1**	**11.1**	**11.8**	**12.7**
Probability of default, %	**4.6**	**4.9**	**5.0**	**5.2**
Exposure at default, %	**2.6**	**3.4**	**3.5**	**4.0**
..EAD mortgages, %	2.3	3.2	3.3	3.9
..EAD non-collateralised loans, %	6.3	6.3	6.3	6.3
Exposure at default, ml EUR	**623.8**	**825.3**	**860.7**	**983.6**
..EAD mortgages, ml EUR	520.0	721.9	757.3	880.1
..EAD non-collateralised loans, ml EUR	103.8	103.4	103.4	103.4
Loss given default, %	**0.4**	**0.4**	**0.4**	**0.4**
…LGD mortgages, %	0.0	0.0	0.0	0.0
…LGD non-collateralised loans, %	6.3	6.3	6.3	6.3
Loss given default , ml EUR	**103.8**	**103.4**	**103.4**	**103.4**
…LGD mortgages, ml EUR	0.0	0.0	0.0	0.0
…LGD non-collateralised loans, ml EUR	103.8	103.4	103.4	103.4
No of observations	**541**	**541**	**541**	**541**

Source: Own calculation based on HFCS 2021, ECB & NBS

The results of the interest rate shocks are presented in Table 3. The key findings indicate that as interest rates rise, the share of households with negative financial margins and the probability of default increase. The share of households with negative FM increased from 10.1% to 12.7%, representing a 26% increase. The probability of default increased from 4.6% to 5.2%, which represents a 13% increase. The more substantial impact of interest rate shock on negative FM than on the probability of default suggest that households with a higher negative financial margin in its absolute terms have sufficient liquid assets and can overcome financial difficulties without a substantial increase in the probability of default. The EAD reacts stronger to the interest rate shock than the probability of default, as a 7% increase in the interest rate increases the EAD rate from 2.6% to 4.0%, which represents a 67% increase. The value of loans at risk of default has increased from 623.8 million euros to 983.6 million euros. A significant proportion of this increase is attributable to mortgage loans. Nevertheless, despite the considerable increase in loans at risk of default, the potential losses from these loans remain relatively limited. The total loss is entirely attributable to non-mortgage loans, which are unaffected by the interest rate changes. Conversely, the increase in mortgage losses is not influenced by changes in interest rates. The effects of inflation shocks on the probability of households defaulting and on potential and actual bank loan losses will continue to be examined in the in Table 4.

Table 4. The impact of a change in price levels on indicators of the financial vulnerability of households and the estimated loan losses for banks

	baseline	5% increase of price levels	10% increase of price levels	15% increase of price levels
	living income	living income	living income	living income
Negative financial margin, %	10.1	11.6	12.8	13.7
Probability of default, %	4.6	6.0	6.4	7.0
Exposure at default, %	2.6	3.3	3.4	3.6
..EAD mortgages, %	2.3	2.9	3.0	3.2
..EAD non-collateralised loans, %	6.3	8.7	9.4	10.5
Exposure at default, ml EUR	623.8	804.9	836.5	887.9
..EAD mortgages, ml EUR	520.0	661.8	682.4	716.4
..EAD non-collateralised loans, ml EUR	103.8	143.1	154.0	171.5
Loss given default, %	0.4	0.6	0.6	0.7
…LGD mortgages, %	0.0	0.0	0.0	0.0
…LGD non-collateralised loans, %	6.3	8.7	9.4	10.5
Loss given default , ml EUR	103.8	143.1	154.0	171.5
…LGD mortgages, ml EUR	0.0	0.0	0.0	0.0

…LGD non-collateralised loans, ml EUR	103.8	143.1	154.0	171.5
No of observations	**541**	**541**	**541**	**541**

Source: Own calculation based on HFCS 2021, ECB & NBS

Table 4 examines the impact of price level changes on households' financial vulnerability and banks' potential loan losses, detailing how increasing costs affect various measures of vulnerability. As price levels increase by 5%, 10%, and 15%, the percentage of households with a negative financial margin rises steadily from the baseline of 10.1% to 13.7%, which corresponds to 36% increase. This indicates a growing number of households facing financial difficulties as living costs rise. The probability of households defaulting on their loans also increases with rising price levels. This is evidenced by the fact that the probability moves from 4.6% at baseline to 7.0% with a 15% price increase, which represents 52% increase. This highlights the increased risk of default as economic conditions tighten. This finding is interesting as it indicates that the Slovak household's budget is more sensitive to increases in price levels. A lower percentage of households with negative FM in absolute terms due to inflation shock can cover it with their disposable liquid assets, thus increasing the probability of default. The total EAD for banks increases significantly, from €623.8 million euros at baseline to €887.9 million euros with a 15% increase in price levels. The EAD due to mortgages grows more notably (from €520 million euros to €716.4 million euros) compared to non-mortgage loans (from €103.8 million euros to €171.5 million euros). This suggests that mortgage loans constitute a larger risk pool for banks under inflationary pressure. Nevertheless, LGD for mortgages remains at 0.0% across all scenarios (baseline, 5%, 10%, and 15% price increases). In the case of non-collateralised loans, the LGD remains relatively stable, ranging from 6.3% to 10.5%. In monetary terms, the loss given default increases with rising price levels from €103.8 million at the baseline to €171.5 million with a 15% increase in prices reflecting a partial loss but a relatively stable expectation across different price inflation scenarios. The following Table 5 presents an analysis of the impact of combined shocks on vulnerability indicators, as in the real world, households simultaneously experience the combined effects of these shocks. Therefore, we have simulated three scenarios, which combined both shocks at the same time at different levels, from the modest scenario 1 to the more severe scenario 3. Table 5 illustrates the impact of combined shocks

Table 5. The impact of combined shocks on indicators of the financial vulnerability of households and the estimated loan losses for banks

	Scenario 0	Scenario 1	Scenario 2	Scenario 3
	baseline	3% increase in interest rates & 5% increase of price levels	3% increase in interest rates & 10% increase of price levels	5% increase in interest rates & 10% increase of price levels
	living income	living income	living income	living income
Negative financial margin, %	10.1	12.5	14.0	15.2
Probability of default, %	4.6	6.2	6.7	6.8
Exposure at default, %	2.6	3.8	4.0	4.1
..EAD mortgages, %	2.3	3.4	3.6	3.8

..EAD non-collateralised loans, %	6.3	8.7	9.4	9.4
Exposure at default, ml EUR	**623.8**	**921.8**	**971.0**	**1,009.3**
..EAD mortgages, ml EUR	520.0	779.1	817.5	855.7
..EAD non-collateralised loans, ml EUR	103.8	142.6	153.6	153.6
Loss given default, %	0.4	0.6	0.6	0.6
…LGD mortgages, %	0.0	0.0	0.0	0.0
…LGD non-collateralised loans, %	6.3	8.7	9.4	9.4
Loss given default , ml EUR	**103.8**	**142.6**	**153.6**	**153.6**
…LGD mortgages, ml EUR	0.0	0.0	0.0	0.0
…LGD non-collateralised loans, ml EUR	103.8	142.6	153.6	153.6
No of observations	**541**	**541**	**541**	**541**

Source: Own calculation based on HFCS 2021, ECB & NBS

Table 5 presents the impact of combined economic shocks on households' financial vulnerability and the associated estimated and actual loan losses for banks. As previously discussed, the negative impact of combined shocks on the share of indebted households with negative FM was already described above. The probability of default also increases with each scenario, starting at 4.6% and moving up to 6.8% by Scenario 3. This suggests that as economic conditions worsen, a higher percentage of indebted households are likely to fail in meeting their debt obligations. The overall EAD, which quantifies the total amount of debt at risk, increases across scenarios for both mortgages and non-mortgage loans. From €623.8 million at baseline, total EAD rises to over €1 billion in Scenario 3, with mortgages constituting the larger part of this increase. The LGD percentages remain consistent for mortgages at 0.0% across all scenarios, indicating no expected loss from defaulted mortgages due to good collateral security and constant real estate price appreciation. For non-mortgage loans, LGD increases from 6.3% at baseline to 9.4% in the more severe scenarios, reflecting higher potential losses from these types of loans when defaults occur. The monetary LGD for non-mortgage loans mirrors the increase in LGD percentage, growing from €103.8 million at baseline to €153.6 million by Scenario 3, indicating a modest financial impact on banks due to defaults on these unsecured loans. The increasing LGD for non-collateralised loans highlights the greater risk associated with unsecured lending, especially under stressful economic conditions. The zero LGD for mortgages across all scenarios serves to reaffirm the security that collateral provides, thereby cushioning the financial system against potential losses from these loans even under adverse scenarios.

These findings underscore the critical need for effective risk management strategies within financial institutions, especially concerning the portfolio composition and the terms of non-collateralised

lending. For policymakers, these insights emphasize the importance of monitoring economic indicators closely and potentially adjusting monetary policy and macroprudential measures to mitigate the adverse effects on household financial stability and banking sector health.

6   Conclusion

Slovak households have experienced the most substantial annual debt growth among Euro Union countries for several consecutive years, with double-digit annual debt growth between 2014 and 2018. Firs, we have identified households with a financial vulnerability based on the concept of financial margin. Prior to the application of any adverse economic shocks, the proportion of households with a negative financial margin ranged was 10.12%. Although the proportion of households experiencing financial difficulties was considerable, the estimated loan losses of the banks were not significant. It is noteworthy that the entirety of the loan losses incurred by the banks can be attributed to non-mortgage loans, with no actual loan losses resulting from mortgage loans prior to and even after the application of the shocks.

Following the application of interest rates and inflation shocks at various levels, the following results were observed. The proportion of indebted households with negative FM after the inflation shock increased from 10.1% to 13.7%, representing a relative increase of 36%. In contrast, the share of households with negative FM after the interest rates shock increased from 10.1% to 12.7%, which corresponds to a 26% increase. The same development was observed when we considered the impact on household probability of default. Inflation has a more substantial impact, with a steeper ascent in the percentage change, particularly in the later scenarios. The following indicates that as inflation intensifies, the growth rate in the percentage of indebted households with negative FM and households' probability of default is more significant compared to changes caused by rising interest rates.

Conversely, we observe that debt at risk rises from 2.6% to 3.6% following the inflation shock, representing a 38% increase, while after the interest rate shock, it climbs from 2.6% to 4%, representing a 54% surge. Accordingly, the impact of a change in interest rates on the aggregate level of debt at risk is greater than that of an inflation shock. This result can be attributed to the fact that interest rate changes have a more pronounced impact on those households who hold mortgage loans with larger outstanding balances. In contrast, the inflation shock has a broad impact on the entire population. This could have particularly adverse effects on households with smaller amounts of outstanding debt, particularly those that have a relatively low level of non-mortgage debt. These households could potentially become more vulnerable to the negative effects of inflation. Nevertheless, while the interest rate shock exerts a more pronounced influence on debt at risk, the actual bank losses are not affected by the change in interest rates. The increase in bank actual loan losses, caused by households defaulting on their loan payments, is caused only by the increase in price levels.

The combined shocks scenario demonstrates the most pronounced increase, indicating that when both interest rates and inflation rise simultaneously, the resulting economic environment significantly increases the probability of household defaults, leading to a greater proportion of the debt becoming at risk. The results suggest that indebted households are particularly vulnerable to a simultaneous occurrence of interest rates and inflation shock, which can significantly reduce their

capacity to service debts. The combined shocks scenario demonstrates the highest percentage increase in EAD and LGD. This indicates that when both interest rates and inflation rates rise together, the debt at risk and actual losses increase to a greater extent.

The rising level of LGD for unsecured loans is a clear indication of the heightened risk associated with such lending, particularly in the context of challenging economic conditions. The zero LGD for mortgages across all scenarios serves to reinforce the protective effect of collateral, thereby cushioning the financial system against potential losses from these loans, even in the face of adverse scenarios.

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