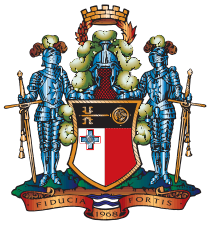

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ASSESSING THE VULNERABILITY OF MALTESE INDEBTED HOUSEHOLDS TO INFLATION AND INTEREST RATE SHOCKS BASED ON THE HOUSEHOLD STRESS TESTING FRAMEWORK

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BOX 5: ASSESSING THE VULNERABILITY OF MALTESE INDEBTED HOUSEHOLDS TO INFLATION AND INTEREST RATE SHOCKS BASED ON THE HOUSEHOLD STRESS TESTING FRAMEWORK[1]

This box presents the results from the second iteration of the Household Stress Testing Framework (Abela & Georgakopoulus, 2022) and makes use of micro data from the fourth wave of the Maltese Household Finance and Consumption Survey (HFCS).

The framework simulates interest rates hikes and high inflation scenarios to gauge their effect on households' financial vulnerabilities and how prone Maltese indebted households are to these factors. Other factors are considered, such as an increase in the unemployment rate and potential drop in property prices. In addition, shocks are also quantified in terms of their impact on banks.

This study complements a similar in-depth analysis published as a Special feature in the 2022 *Interim FSR*, considering granular loan data available in the recently updated Bank's Real Estate Data Template. The study finds that overall, households are resilient to increases in interest rates of up to 250 basis points but identifies pockets of vulnerabilities depending on the level of income and other household characteristics including stretched borrower metrics on new loans.

Data and methodology

Micro-data from the fourth wave of the HFCS survey was collected for 2020 from a sample of Maltese households. To note that data collection coincided with the inception of COVID-19 pandemic and the implementation of COVID-19 lockdown measures, which impacted household consumption, saving patterns and wages, albeit more limited, due to the wage supplement. The data contain household specific balance sheet data for Maltese households as well as detailed households' characteristics, on which the stress test scenarios are applied. As in the previous iteration, this box is based on the financial margin (FM) approach given by the below equation, where each household's PD is based on the difference between the household's income and expenditure and considers the extent of its holdings of liquid assets.

$$FM_i = DI_i - DS_i - R_i - PT_i - BLC_i$$

where DI_i captures the household's disposable income after considering taxation and social security contribution.[2] DS_i represents the monthly debt-servicing costs, including both mortgage and non-mortgage debt. R_i includes the household's rental payment (if any), PT_i relates to monthly private transfers (such as child support and maintenance and other regular payments), while BLC_i measures the basic living cost for a specific household.

Weights are assigned to each individual household to ensure that these households are representative of the whole population. As the objective is to analyse the vulnerability of indebted households, the study eliminates all households without any form of debt. From a total of 206,868 (weighted) households in the HFCS survey, the study considers 67,626 (weighted) households.[3]

The exposure at default (EAD) and LGD are in turn given by:[4]

[1] Prepared by Mr Ian Debattista, Senior Economist and Ms Christine Balzan, Manager within the Policy, Crisis Management and Stress Testing Department. The authors would like to thank Mr David Stephen Law, Principal Quantitative Analyst within the Policy, Crisis Management and Stress Testing Department and Mr Alan Cassar, Chief Officer Financial Stability and Statistics Division, for their valuable suggestions.

[2] To note that the tax brackets and social security rates have been updated to the year 2020, as these coincide with the year of data collection.

[3] This corresponds to 276 households considered in this analysis, out of the 1,018 households interviewed.

[4] Where D_i is the total outstanding debt and A_i is the value of real estate assets that banks can recover in case of default.

$$EAD = \frac{\sum_i PD_i * D_i}{\sum_i D_i};$$

$$LGD = \frac{\sum_i PD_i * (D_i - A_i)}{\sum_i D_i}$$

Preliminary data analysis for Maltese indebted households

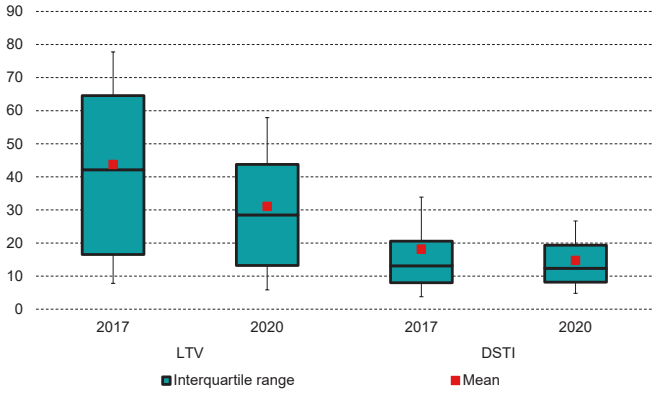
Households with a negative FM are not assumed to automatically default if they have sufficient liquid assets to resort to. The specific number of months (M), by which households can survive a negative FM is calibrated such that the EAD would be equal to mortgage NPL. The average amount of liquid assets for each household stood at €30,343, whilst that of households with an initial negative FM margin stood at €10,933. The latter reflects the constraints faced by the more vulnerable households to fund their financial shortfalls. Nonetheless, despite the level of liquid assets has deteriorated between the 2020 and 2017 iterations, the number of households having a negative FM and who are thus dissaving is still relatively lower. This indicates an improved income to expenditure ratio, mainly driven by higher income levels.

The more stringent the survival criterion (i.e., the number of months a household must be able to sustain its dissaving), the bigger the share of households with insufficient liquid assets. Additionally, the average EAD ratio closest to the resident mortgage NPL ratio of 2.2% (as of 2020) is obtained when $M = 30$.[5] In comparison to the previous iteration, although the resident mortgage NPL ratio has marginally decreased, the calibrated number for M has decreased from 36 to 30. This is partially driven by the reduction in liquid assets between iterations for households with a negative FM. Despite this, in comparison to other countries, the level of liquid assets for indebted households remains elevated.

Chart 1 presents the LTV and DSTI distributions of Maltese indebted households using the third (2017) and fourth (2020) wave of the HFCS data for ease of comparison between the iterations.[6]

As can be seen, there has been a prominent downward shift in both the LTV and DSTI distributions between the third and fourth waves, more pronounced for the LTV. The reasons behind this shift can be numerous and it is quite challenging

Chart 1
BOX PLOT OF THE LOAN-TO-VALUE AND DEBT SERVICE-TO-INCOME RATIOS
(per cent)



Source: HFCS, Central Bank of Malta. Data are multiply imputed and weighted.
Notes: The majority of the sample consists of mortgage indebted households.

[5] The calibration of *M* based on NPLs follows Merikull and Room (2017), Ampudia et al. (2016) and Giordana and Ziehelmeyer (2018).

[6] It is important to distinguish between the calculated LTV and DSTI ratios and the DSTI-O and LTV-O ratios as stipulated in the Central Bank of Malta's Directive No. 16. The calculated ratios represent the current LTV and DSTI limits and not at loan origination, thereby clarifying the significantly lower rates when compared to the rates at loan origination.

to narrow down. This is because a lot of factors are at play including the fact that the information relates to a stock position and represents a subjective interpretation of the property value reported by the respondent, and limited information on the borrower and loan characteristics. Nonetheless, hard data gathered from the ESRB data template show that LTVs for newly granted loans have marginally decreased for RRE first time buyers between 2017 and 2020 and even further for residential buy-to-let (BTL) loans.

Simulated shocks

This analysis is based on the four different shocks presented in the first iteration of this framework and is run on the same methodological framework. The shocks simulate a rise in interest rates, an increase in the unemployment rate, a decline in the valuation of real estate and a fall in the value of liquid assets. This vintage introduces two additional shocks, namely a simulated increase in rental payments, as well as an increase in the basic living cost, with the latter being influenced by rising inflationary pressures. Apart from the impact on households, the shocks will also be assessed in terms of their impact on banks' EAD and LGD.

The simulated shocks will initially be applied individually and subsequently combined under three different intensity scales – low, medium, and high. Table 1 presents the assumed magnitude of the shocks in each intensity scale for each individual shock. The combined shock, example the "low-scale" shock applies the individual shocks (listed in the first column) simultaneously. Results focus on the individual highest magnitude shocks, the baseline and high-scale combined shocks.

An increase in interest rates would directly impinge negatively on households' debt servicing costs, thereby impacting the FM for each household. In such scenario, it is assumed that the increase in interest is fully reflected in the monthly repayments and does not lead to further extensions in the maturity of the loan.[7]

The shock to the unemployment rate is determined by the probability of the reference person becoming unemployed based on their gender, age, highest educational attainment, and gross income. A random real number is generated from a uniform distribution for each household, whereby if this is lower than the probability of unemployment of the reference person, then the income of one working adult is deducted and replaced by the unemployment benefit.

Table 1
STRESS TEST SCENARIOS

Individual shocks			
Interest rate	+2 pps	+3 pps	+4 pps
Unemployment rate	+1 pps	+2 pps	+3 pps
Real estate prices	-10%	-20%	-30%
Rental payment	+12 pps	+14 pps	+16 pps
Basic living cost	+12 pps	+16 pps	+20 pps
Value of liquid assets (Stocks, bonds, and less liquid assets, respectively)	-10%, -10%, -20%	-20%, -20%, -40%	-30%, -30%, -60%
Combined shocks	Low-scale	Medium-scale	High-scale

Source: Central Bank of Malta.

[7] Based on data from the Bank's CCR, borrowers on average have around two years gap between maturity of loans and their retirement age. Thus, on average, there isn't enough flexibility for banks to grant an extension in the term to maturity of a loan.

Upon simulating a decline in the valuation of real estate, this reduction is assumed to be identical across different types of real estate assets (houses, apartments, non-residential property) and across different regions. The magnitude of the shock is applied on the value of property reported by the respondents as at the reference date, i.e., end 2020. Thus, the shocks disregard any possible increases in valuation to date since 2020, which effectively increases the overall magnitude and severity of the simulated decline. By negatively impinging on the value of collateral held by banks in the eventuality of a default, this shock affects the LGD.

An increase in the rental payments and basic living costs, similar to the interest rate shock, would increase the expenditure aspect of the FM for each household, and subsequently affect the banks' PD, EAD and LGD. These shocks do not incorporate the feedback of increases in income associated with higher inflation through the COLA mechanism. Therefore, the results for these shocks are more conservative, especially for lower income households as COLA is a partial wage indexation mechanism that is relatively more beneficial to the lower income households. The shock to rental payments affects a very small portion of households, as only approximately 5% of the sampled indebted households have any form of rental payment. Moreover, the magnitude of the shock on basic living costs considers the inflationary pressures that had in actual fact been experienced by households between March 2021 and December 2022.[8] During this period, the HICP index for Malta grew by 9.96%. Thereby, these shocks were designed to capture the household's vulnerabilities against a further increase of 2 percentage points, 6 percentage points and 10 percentage points, respectively, over and above the increase already experienced from data collection till end of 2022.

Finally, a shock to the value of liquid assets would directly affect the estimation of PD, as previously referenced. The value of stocks and bonds are assumed to decline by 10%, 20% and 30% whilst the value of less liquid assets is assumed to decline at a higher rate of 20%, 40% and 60%. This shock does not consider a case of bank failures and thereby the value of deposits are not affected.

Results

This section presents the effect of the hypothetical sensitivity shocks through their impact on household vulnerability as well as the impact on banks via the PD, EAD and LGD.

Consistent with the findings of the previous vintage, the results demonstrate that household vulnerabilities are most sensitive to simulated increases in interest rates and basic living cost. Nonetheless, when compared to the preceding iteration, both the average households' PD and the number of households with negative FM improved in the current version of results following the shock to interest rates. In this case, the simulated increase in rental payments does not lead to a significant impact given that this shock only affects a small fraction of the indebted households.

Table 2 presents the impact of the simulated shocks through the mean PD, EAD and LGD, with the latter two risk factors expressed as a ratio of total debt. This table shows the baseline results obtained prior to applying any shock, and the results for each individual shock, as well as the combined shocks thereafter. The low LGD ratio in the baseline already shows that most households are well collateralised, especially for households with mortgage related indebtedness.[9]

Similar to the results expressed in terms of FM, the simulated increase in interest rates and inflationary pressures have a higher impact also in terms of PD and EAD. Through an overall increase of 4 percentage points in interest rates, the average PD and EAD ratios as a percentage of debt increases

[8] Data collection for the 2020 HFCS wave was conducted between November 2020 and February 2021. (Antonaroli V., Deguara W. & Muscat A., 2022).

[9] A similar analysis was conducted by employing only the subsample of households who have outstanding mortgage debts. In such case, the LGD would become positive only following a hypothetical 30% decrease in the valuation of real estate and in the combined scenarios.

Table 2
STRESS TEST RESULTS

Shock	Magnitude of shock	Mean PD	EAD in % of debt	LGD in % of debt	Growth of LGD relative to baseline
Baseline		**4.19**	**2.26**	**0.08**	
Interest rate	+2 pps	4.68	2.85	0.08	1.00
	+3 pps	4.80	2.99	0.08	1.00
	+4 pps	4.95	3.13	0.08	1.00
Basic living cost	+12 pps	5.93	4.19	0.08	1.10
	+16 pps	6.21	4.52	0.09	1.12
	+20 pps	6.43	4.78	0.09	1.14
Combined shocks	Low-scale	6.36	4.70	0.09	1.22
	Medium-scale	6.90	5.40	0.11	1.50
	High-scale	8.33	6.45	0.32	4.16

Source: HFCS, Central Bank of Malta calculations. Data are multiply imputed and weighted.

by around 18% and 39% respectively in comparison to the baseline results. Notwithstanding, despite such increases in PD and EAD, the interest rate shock has not resulted in an increase in the LGD given that the LGD factor is affected by shocks that directly hit the risk mitigation factors of banks; i.e., house price shock on collateral value.

Similarly, simulating inflationary pressures on households through an increase in the basic living cost, has led to the largest increase in households with negative FM, as well as the largest increase in the average PD and EAD as a percentage of total debt, amongst all individual shocks. In fact, the mean PD and EAD ratio increased by 53% and 112% respectively under the most adverse magnitude of a 20 percentage points increase in basic living costs. The effect on the LGD ratio is again much more conservative in relative terms, increasing by 14% via heightened household vulnerability and higher PDs and EAD. Indebted households are also rather resilient to the simulated unemployment shock, with contained increases in the average PD, EAD and LGD ratios. In the most adverse scenario of a 3 percentage point increase in the unemployment rate, the PD, EAD and LGD increase by 14%, 32% and 5%, respectively, compared to the baseline scenario. The impact of the simulated decline in the value of real estate affects only the LGD ratio as it directly effects the value of collateral held by banks. The impact of this shock is only visible under the most adverse magnitude where the LGD ratio increases to 0.17%.

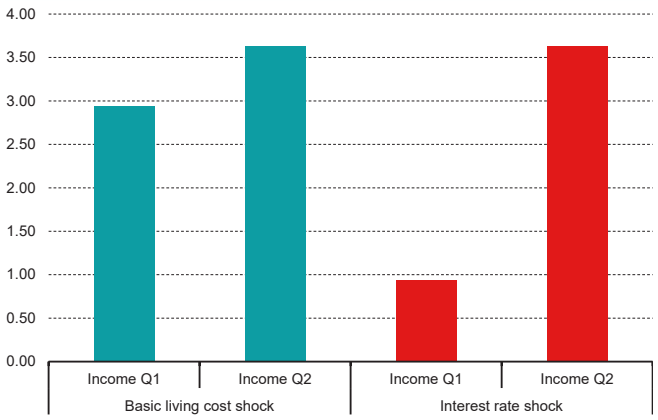
Following a hypothetical decline in the value of liquid assets, results show a rather conservative increase in the PD and EAD, and no effect on the LGD ratio. The results may be driven by the fact that deposits, which constitute 62% of all liquid assets, are assumed to remain unaffected by this shock.

As one would expect, the three combined scenarios show a more pronounced impact and more visible increases in the mean PD and EAD ratio. With respect to the LGD, increases are rather contained for the low-scale and medium-scale scenarios, but the effect is considerable in the high-scale scenario, mainly driven by the assumed 30% drop in the valuation of real estate property. The LGD ratio in the most adverse scenario is 0.32% of all total debt and therefore indicates that even in the aftermath of a strong negative economic shock targeted on the household sector, bank losses appear to remain contained.

The results are analysed further by looking into the profile of households, to identify those which are more vulnerable and more susceptible to the shocks applied. In this regard, the analysis focuses on those households which register a positive PD following the application of individual shocks, i.e., those households which had a 0% PD prior to the application of shocks given by ample liquid assets to sustain their dissaving, but which became positive post-shocks. These pertain to 1.74% and 1.21% of total indebted households for the shock to basic living cost and interest rates respectively. Indeed, these households are examined further and compared with the entire sample group by delving deeper into their FM including its composition of income and expenditure, as well as their average DSTI and LTV ratios before the occurrence of these shocks. The aim of this analysis is to shed light on the underlying factors that make such households more susceptible to these individual shocks.

Chart 2 depicts the share of households having registered a positive PD by their income distribution as a result of the increase to the basic living cost and interest rate. These impacted households pertain exclusively to the lower two income quartiles with income levels given by €23,500 at the 25th percentile (first quartile) and up to €33,300 at the 50th percentile (2nd quartile).[10]

Chart 2
SHARE OF IMPACTED HOUSEHOLDS BY INCOME QUARTILE
(per cent)



Source: HFCS, Central Bank of Malta. Data are multiply imputed and weighted.
Note: No households within the third and fourth quartile were impacted by either shock.

The shock to the basic living cost via inflation led to an increase in the share of households with positive PD to 2.94% within the lower income quartile, in comparison to the pre-shock condition. The increase in interest rates had a more limited effect on households within the same quartile which led to an increase in this share of households by 0.94%. Furthermore, these shocks also led to an increase in such share of impacted households to 3.63% within the second income quartile. This is driven by the fact that while in level terms, the number of vulnerable households in the lower quartile was higher prior to the application of such shocks, the share of households (weighted and thus upscaled to population) impacted by the shocks, increased by a higher magnitude in the 2nd quartile. In other words, 21% of households impacted by the interest rate shock are in the lower income quartile, whilst the remaining 79% are in the second quartile. On the other hand, 45% of vulnerable households to the basic living shock are in the lower income quartile, and the remaining 55% in the second income quartile.

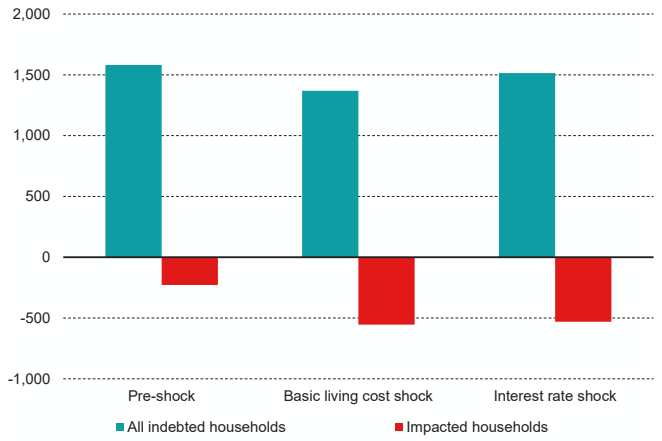
Charts 3 and 4 delve deeper into the FM and its components for all indebted households as well as those which are more impacted by the shocks (i.e., those registering a positive PD post shocks) to better comprehend the financial position of these households both pre – (baseline) and post- interest and basic living cost shocks.

This chart indicates that even before applying any shock, these households were already experiencing a negative FM, and therefore were dissaving. In the baseline, the average monthly household

[10] As previously referenced, the effects of these shocks are more pronounced towards the lower income households as fiscal incentives that increases income to counter inflationary pressures, such as COLA, are not considered within the framework.

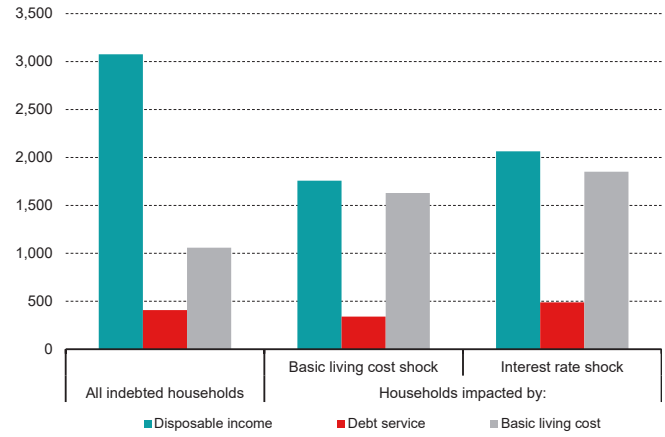
FM for all indebted households stood at €1,580 whilst for the subset of impacted households, this stood at a negative €228. Each of the shocks has exacerbated this difference, with the average FM decreasing to negative €554 and negative €530 post the shock to basic living cost and interest rate respectively. These shocks increase the household's dissaving rate such that this exceeds the amount of dissaving such households could finance through their liquid assets for a duration of 30 months, thereby registering an increase in their PD rate.

Chart 3
AVERAGE FINANCIAL MARGIN
(EUR)



Source: HFCS, Central Bank of Malta. Data are multiply imputed and weighted.

Chart 4
MAIN COMPONENTS OF FINANCIAL MARGIN
(EUR)



Source: HFCS, Central Bank of Malta. Data are multiply imputed and weighted.

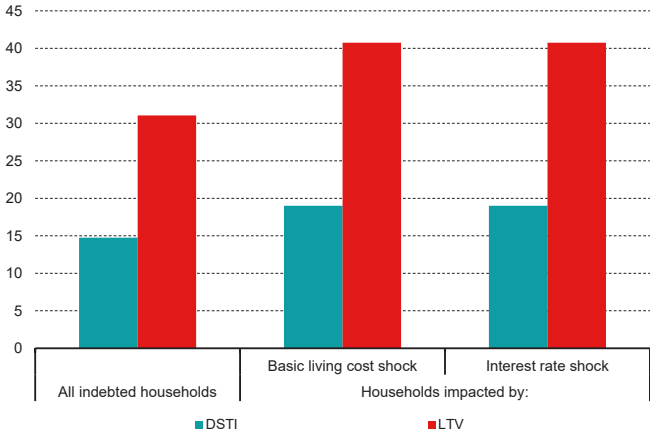
Chart 4 compares the three main components in the FM, namely the disposable income, debt service and basic living cost, for the impacted households, against all indebted households, before the application of any shock. Overall, households impacted by either of the shocks had lower monthly disposable income compared to the average of all indebted households. The average disposable income for the impacted households is 42.8% (impacted by shock to basic living cost) and 32.9% (impacted by shock to Interest rate) lower than the average disposable income of all indebted households, respectively.

Average monthly debt service is 16.6% lower for households impacted by the shock to the basic living cost compared to all indebted households. On the other hand, the average monthly debt service is 20% higher for households impacted by the interest rate shock, in comparison to all indebted households.

Chart 4 also illustrates that impacted households had higher consumption patterns (in absolute terms; as indicated by the basic living cost) compared to the average of all indebted households. The average basic living costs for the impacted households following the application of basic living costs and interest rate shocks respectively, were 53.8% and 74.8% higher than of all indebted households. All in all, impacted households had both higher levels of consumption and as well as lower disposable income, making them more susceptible to dissave.

Chart 5 shows that households impacted by the shock to basic living costs and interest rates also have a higher DSTI and LTV ratio prior to the application of any shock, compared to the average ratios for all indebted households. The average DSTI ratio for all indebted households stood at 14.74%, whilst households vulnerable to the interest rate and basic living cost shock had an average DSTI ratio of 19%.[11] The average LTV ratio of the impacted households is also higher at 40.74%, compared to the LTV ratio for all indebted households, which stood at 31.06%. In this regard, households which have relatively higher DSTI and LTV ratios are more susceptible to interest rate shocks and inflationary pressures.

Chart 5
AVERAGE DSTI AND LTV OF IMPACTED HOUSEHOLDS
(per cent)



Source: HFCS, Central Bank of Malta. Data are multiply imputed and weighted.

Conclusions

The objective of the stress testing framework is to assess the resilience of the Maltese household sector to a series of shocks that target specific risks, thereby detecting any possible vulnerabilities. The framework also includes reference to the potential losses that banks may incur in the event of defaults under unfavourable macro financial conditions. The shocks considered relate to hypothetical increases in interest rates, basic living costs, unemployment rates, rental payments, and decreases in the value of real estate property and liquid assets; with the former two receiving more attention given the prevailing environment.

The simulation results show that shocks to basic living costs, and to a lesser extent, interest rates, have the most significant impact on the household's FM and PD, as well as on the EAD. Households having a negative FM, representing 9.8% of the population, are more susceptible to adverse shocks given that their income falls short of their overall consumption, even before any of the shocks are applied. In addition, compared to the previous iteration, households have a much lower share of reported liquid assets, although still high, leading to a higher extent of vulnerable households.

A further deep dive into households whose PD became positive (i.e., from a 0% PD to a positive rate) following shocks to basic living costs and interest rates, revealed that before the application of any shock, these households had a lower and thus more stretched FM, compared to the sample of indebted households. Their vulnerability, given by their dissaving pattern is predominantly the result of a combination of lower disposable income and higher consumption expenditure. Furthermore, the analysis also indicates that both the average DSTI and LTV ratios were elevated, in comparison to the sample of indebted households. These weaknesses were further exacerbated by the two aforementioned shocks applied.

[11] The DSTI is based on reported values of debt servicing and income and is not indicative of the DSTI at loan origination. Furthermore, this estimate pertains only to those households with a positive PD (i.e., the number of households whose PD increased from 0% to a positive value) following a shock to interest rates and basic living costs.

In terms of banks, the most substantial impact arises from the LGD linked to the reduction in collateral values held by banks, associated with the highest shock to the value of real estate property. The second largest impact arises from the shock in the value of liquid assets which has only a marginal effect on bank losses, as deposits represent a substantial portion of liquid assets that remain unaffected by the shock. The combined shocks lead to the strongest increases in defaults and bank losses, although their impacts remain contained.

The analysis corroborates findings from other analyses in that pockets of vulnerabilities exist especially for households at the lower end of the income distribution and stretched borrower metrics. However, after introducing the liquidity dimension, through the FM, the overall analysis indicates that the Maltese household sector appears to be more resilient to adverse economic shocks, primarily due to its general ability to tap into its ample liquidity buffers.

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