Stress testing of households using micro-data: evidence from a developing country

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Abstract: We assess the impact of income, consumption, and asset price shocks on the financial vulnerability of Pakistani households. We find 47.4% and 58.5% of households as financially vulnerable under basic living costs (BLC) and consumption-based criteria respectively. We note greater changes in the proportion of household financial vulnerability in the consumption-based approach as compared to BLC even for the same magnitude of the shock. We also note the severer impact of income rather than consumption shocks and add new dimensions to the financial vulnerability analysis by reporting results against various socio-economic characteristics of the households. Our stress testing results can be used for the development of targeted, community-specific social safety net programs and emergency cash support initiatives taken under a macroeconomic policy framework aiming at mitigating the effects of the COVID-19 external shocks. We recommend the use of household-level actual consumption expenditures in the analysis of household financial vulnerability instead of BLCs in developing countries like Pakistan.

Keywords: credit risk indicators; household financial vulnerability; stress testing; Pakistan.

JEL codes: C40, D10, J16, G00.

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1   Introduction

Financial vulnerability (FV), also termed as financial fragility or financial distress (Brunetti et al., 2016), is defined as the household's inability to repay its debt (Poh and Sabri, 2017). Abid and Shafiai (2018) define FV as the situation that designates the capability of a household to recover from surprising financial shocks. According to Leika and Marchettini (2017), household FV is a situation where a household is unable to meet its financial obligations completely and timely. Some researchers e.g., Anderloni et al. (2012) also include households' inability to balance the budget, difficulties in managing expenses on food items, and problems in paying house rent and other utilities in the category of financial fragility.

The household's FV has become a popular research topic because of various reasons i.e.,

1   its contribution to poverty reduction and economic growth

2   its role in the improvement of financial management of households (Poh and Sabri, 2017)

3 households hold most of the wealth in a country (Ampudia et al., 2016)

4 households play a crucial role in the determination of overall financial stability in a country through savings and consumption (Azzopardi et al., 2019; Bettocchi et al., 2018)

5 the assessment of vulnerability at the household level is of great interest to policymakers as they help devise community-specific targeting programs and devise appropriate social protection policies (Feeny and McDonald, 2016).

Further, a household's resilience against economic shocks depends largely on effective and efficient cash flow management (Xu et al., 2017), and a failure, in this regard, may lead them toward an undesirable condition of financial fragility (Xu et al., 2017). The research area of household FV is growing rapidly because of the changing global financial environment with higher associated costs of financial mistakes (Poh and Sabri, 2017) and its usefulness for direct policy interventions (Notenbaert et al., 2013). Hence, the maintenance of financial stability and economic development at the macro level requires an assessment of factors of domestic sustainability and their shock-absorbing ability including households (Bettocchi et al., 2018).

FV is one of the various dimensions of poverty. It can affect equally the poor and wealthy, the uneducated and educated (O'Connor et al., 2019), and can cause a reduction in economic opportunities for vulnerable individuals (He et al., 2020). FV has become a special challenge for countries, organisations, households, and individuals in the aftermath of COVID-19 (Mogaji, 2020) due to the loss of the main source of employment and income (Arellano and Cámara, 2020). Particularly, households with low financial assets such as savings (Messacar and Morissette, 2020), cash (Cantor and Stephanie, 2020), or wealth (Zabai, 2020) are likely to face higher income vulnerability (Arellano and Cámara, 2020; Blanc, 2020) due to temporary work stoppages in case of COVID-19 like shocks (Ricketts and Boshara, 2020). Such households can be highly vulnerable financially in the absence of government transfers (Messacar and Morissette, 2020). Therefore, its early detection is essential for the formulation of targeted intervention policies aiming at the maintenance and promotion of economic well-being, quality of life, and financial stability. Specifically, the identification of households with higher FV has also been linked to the development of intervention policies such as social safety nets, minimum wage laws (O'Connor et al., 2019), and the need for just-in-time financial education (Arellano and Cámara, 2020; Demertzis et al., 2020; O'Connor et al., 2019).

Households face two types of shocks i.e., household-specific (idiosyncratic) and community-specific (covariate) shocks (Feeny and McDonald, 2016; Feeny et al., 2013). The shocks such as falls in income, unemployment, diseases, and divorce make households with limited savings vulnerable (Brown et al., 2014; Sugawara and Zalduendo, 2011) and they are likely to face financial hardships and difficulties (Brown et al., 2014). In a developing country like Pakistan, households face both idiosyncratic and covariate shocks. The idiosyncratic shocks include injury, illness, job loss, death, loss of transfers, crop failure, lack of formal insurance and financial intermediation, and weak infrastructure. The covariate shocks include adverse weather and market fluctuations. Their higher frequency can cause a loss in the household's level of welfare (Haq, 2015). The assessment of the household's resilience to such types of shocks is common in the literature on household finance. The process is called stress testing of households. Several researchers have performed stress testing of households e.g., Fuenzalida and Ruiz-Tagle

(2009) in Chile, Albacete and Fessler (2010) in Austria, Georgarakos et al. (2010) in 12 European countries for the period 1994 to 2001, Sugawara and Zalduendo (2011) for Croatian Households, Giarda (2013) and Michelangeli and Pietrunti (2014) for Italian households, Galuscak et al. (2016) and Malovaná et al. (2017) in the Czech Republic, Herceg and Nestić (2014) for Croatian households, Bilston et al. (2015) in Australia, Ampudia et al. (2016) for households of 14 Euro area countries, Bhutta et al. (2019) for US household debt, and Giordana and Ziegelmeye (2019) in Luxembourg.

Our study has particular relevance in the context of Pakistan which is the 5th largest country in the world in terms of the population having more than 32 million households. One-fifth of households in Pakistan are indebted (Javed et al., 2019) and consume 30% or more of their income to repay their debts. The excessive debt accumulation by households, in turn, makes them financially vulnerable (Anderloni et al., 2012; Vandone, 2009). However, the research area of household FV is yet to be fully explored in Pakistan with few exceptions e.g., Ali et al. (2020a, 2020b). In one of the studies, the authors assessed the link between the education of the head and the household's FV. In another study, the authors studied the household's FV using financial ratios, financial margins (FMs), and credit risk indicators as analytical tools. Our study differs from the earlier ones in many aspects. First, we use the actual consumption expenditure of households in the derivation of FMs instead of basic living costs (BLC). Second, we assess the impact of income and consumption shocks on the household's FV. Third, contrary to Ali et al. (2020b), we derive credit risk indicators using consumption-based FMs. Fourth, we add new dimensions to the FV analysis by reporting results against various socio-economic characteristics of the household including income quintiles, education, age, family size, marital and employment status, and diversification in the income sources.

With this background, we aim to stress test Pakistani households through the FM approach and credit risk indicators including the probability of default (PD), exposure at default (EAD), and loss given default (LGD). We assess the resilience of households to income, consumption, and asset price shocks. We contribute to the literature by calculating FMs and conducting stress tests of households by incorporating actual consumption expenditures. Our stress testing analysis provides useful insights for policymakers as it not only identifies the percentage of financially vulnerable households at aggregate and group levels but also quantifies the impact of macroeconomic shocks on potential losses for the banking sector under various scenarios. Our findings can be used for the development of targeted, community-specific social safety net programs and emergency cash support initiatives taken under a macroeconomic policy framework aiming at mitigating the effects of COVID-19-like external shocks.

2   Methodology and data

The FM approach is the most widely used method for the analysis of household FV (Arins et al., 2014) because of its broader applicability (Bettocchi et al., 2018). The FM is the residual between a household's liquid assets after the deduction of borrowing costs and ordinary living expenses (Leika and Marchettini, 2017; Vatne, 2006). Albacete et al. (2014), Ampudia et al. (2016), and Bettocchi et al. (2018) propose a measure of financial distress whose modified form can be expressed as:

$$FM_i = Y_{di} - DP_i - BLC \tag{1}$$

where FM_i is the financial margin of a household, Y_{di}, T_i and DP_i are household disposable income, taxes, and debt payments respectively. BLC is BLC estimated through the poverty line following the literature e.g., (Ampudia et al., 2016).

However, in developing countries like Pakistan, poverty lines are available only at national and sub-national levels with the urban-rural break-up but not at the household level. For example, in the case of Pakistan, Jamal (2017) presents the poverty line for urban and rural areas at the national level and each province of Pakistan including Khyber Pakhtunkhwa (KP), Baluchistan, Sindh, and Punjab. These poverty lines are then adjusted for household size in the analysis of the household's FV e.g., Ali et al. (2020a). However, FMs based on BLCs may not be able to reflect a true picture of the financial condition of the household as they are indifferent to variations in household consumption expenditure owing to socio-economic and cultural differences in a developing country like Pakistan. Therefore, we use a modified measure of FM based on household-level actual consumption expenditure incurred on non-durable goods and services following the literature e.g., Leika and Marchettini (2017). Our modified measure of FM can be written as under:

$$FM_i = Y_{di} - DP_i - LC_i \tag{2}$$

where LC_i is household-level living costs[1] Estimated consumption expenditure incurred on non-durable goods and services. We measure LC_i as household expenditure incurred on food, beverages, tobacco, housing, water, electricity, gas, clothing and footwear, repair and maintenance, health, education, transport, and communication reported in Household Integrated Economic Survey (HIES) 2015–2016.

The FMs described above indicate the resilience of households to changes in income like macroeconomic conditions (Abubakar et al., 2018). Therefore, we use FMs as analytical tools in our stress testing exercise. Following the literature, e.g., Ali et al. (2020b), we conducted stress testing of households by incorporating income shocks at 10%, 20%, and 30% for BLC-based FMs. We further extend the stress testing analysis and apply the income as well as consumption shocks on consumption-based FMs at 10%, 20%, and 30%.

In the FM approach, households with negative FMs are assigned the value of '1' assuming that they will default (Abubakar et al., 2018; Bilston et al., 2015) but practically households with enough financial resources can still avoid default despite having negative FMs (Giordana and Ziegelmeye, 2019). Therefore, the consideration of their financial resources in the analysis of FV becomes necessary. Empirically, this is done through the computation of PD, EAD, and LGD e.g., Persson (2009) in Sweden, Albacete et al. (2014) and Albacete and Fessler (2010) in Austria, Arins et al. (2014) in Latvia, Bilston et al. (2015) in Australia, Ampudia et al. (2016) in Euro area countries, Bettocchi et al. (2018) in Italy, Giordana and Ziegelmeye (2019) in Luxembourg, and Ali et al. (2020b) in Pakistan. We use the methodology of Ali et al. (2020b) and extent it to calculate credit risk indicators using consumption-based PDs, EAD, and LGD. We define a wider measure of FV, Δ_i, of the ith household as under:

$$\Delta_i = \begin{cases} 1 \Leftrightarrow FM_i < 0 \wedge \sum_{t=1}^{M} FM_{t,i} + LIQ_i < 0 \\ 0 \Leftrightarrow FM_i \geq 0 \vee \sum_{t=1}^{M} FM_{t,i} + LIQ_i \geq 0 \end{cases} \tag{3}$$

where *LIQ* is the ith household liquid assets. We measure liquid assets through financial assets including savings, profits on savings, the present value of bonds, stocks, shares, and money received by households from provident funds available in HIES. The households lacking liquid assets to cover their negative FMs are considered vulnerable financially.

In the next step, following Bilston et al. (2015), we compute household-level PDs using BLC and consumption-based FMs as inputs between '0' and '1' depending on the fact whether the household has no chance to default or certain to default respectively. For households falling in between these two extreme conditions we first obtained absolute values of the monthly negative FM following Ampudia et al. (2016). We then divide liquid financial assets by monthly FM to obtain the numbers of the month's liquid assets that are enough to finance the negative FM. We then use these BLC and consumption-based PDs to derive two separate measures of EAD, which represent the gross amount of debt being held by vulnerable households. We followed Ampudiaa et al. (2016), Bettocchi et al. (2018), and Giordana and Ziegelmeye (2019) to write EAD as under:

$$EAD = \frac{\sum_{i=2}^{N} p_i D_i}{\sum_{i=1}^{N} D_i} \tag{4}$$

where D_i and p_i are the household debt and PD respectively.

LGD is the proportion of debt held by distressed households but not covered by the value of collateral such as real estate wealth and financial wealth (Albacete et al., 2014; Albacete and Fessler, 2010; Giordana and Ziegelmeye, 2019). Recently, Ali et al. (2020b) have introduced a broader measure of LGD including household valuables e.g., jewelry, precious stones, etc. We write LGD as:

$$LGD = \frac{\sum_{i=2}^{N} p_i \left(D_i - R_i - V_i - FW_i \right) C_i}{\sum_{i=2}^{N} D_i} \tag{5}$$

where p_i, D_i, R_i, V_i, and FW_i are the household-level PD, debt, real estate wealth, valuables, and financial wealth respectively. C_i is assumed to be equal to '1' for households whose real estate wealth falls short of their debt and 0 otherwise. $\sum_{i=1}^{N} D_i$ is the total debt of all households. We compile two separate measures of LGD i.e., one using BLC-based PDs and the other using consumption-based PDs. We then assess the impact of asset price shocks on LGDs assuming a constant rate of decline in prices of financial assets, real estate, and valuables at 10%, 20%, and 30% following the literature e.g., Ampudia et al. (2016), Bilston et al. (2015), and Giordana and Ziegelmeye (2019).

The use of survey data for the analysis of household FV is common in recent years (Bilston et al., 2015; Leika and Marchettini, 2017). The stress testing on such data allows the quantification of household financial resilience and their reactions to macroeconomic shocks (Bilston et al., 2015; Malovaná et al., 2017). Another reason behind using micro-data is that it complements analyses based on macro data (Giordana and Ziegelmeye, 2019; Malovaná et al., 2017), which alone is unable to account for heterogeneity in the distribution of income, debt, and collateral among households (Giordana and Ziegelmeye, 2019).

Therefore, we used household-level microdata from 2015–2016 HIES conducted by the Pakistan Bureau of Statistics (PBS) for our analysis. The HIES data is publicly available for researchers at the official website of PBS (https://www.pbs.gov.pk/content/hies-hiics-2015-16-microdata). In 2015–2016 HIES, data was originally collected from 24,238 households. However, our analysis is based on 17,031 households because the information was missing on key variables e.g., income and debt. The majority of households i.e.42.8% in the final sample belong to Punjab province followed by 28.5% in Sindh, 18.9% in Khyber Pakhtunkhwa, and 9.7% in Balochistan. Further, 62.8% of households live in urban areas, and the remaining 37.2% belong to rural areas.

3   Results

Quantification of household financial resilience and assessment of vulnerability is a basic requirement before applying shocks (Bilston et al., 2015; Sugawara and Zalduendo, 2011). Following Bilston et al. (2015) and Galuscak et al. (2016), we define vulnerable households as those with negative FMs. We present pre-stress results obtained through BLC and consumption-based FMs i.e., equations (1) and (2) under columns (2) and (6) respectively in Table 1. Results suggest that the proportion of household FV in Pakistan stands at 47.4% and 58.5% in BLC and consumption-based FMs respectively. In the presence of non-negligible endogeneity arising from measurement errors and unobserved heterogeneity, a separate calibration of household FV for each group is required where sources of estimation bias and size are expected to be the same (Leika and Marchettini, 2017). So, we report all of our results against various household characteristics such as income quintiles, education, age, marital status, number of sources of income of a household, province, family size, and employment status following the literature e.g., Galuscak et al. (2016). We observed higher FV under consumption-based FMs across various household characteristics as compared to BLC-based measures except for households with no formal education, 4 or more sources of income, belonging to KP province, and those with family size 10 and above. Both, BLC and consumption-based measures identify households at the bottom of the income distribution (79.7% and 81.7%), with no formal education (63.5% and 62.3%), in the age group 31–40 (52.5% and 63.3%) and currently married (48.2% and 58.8%) as the most financially vulnerable groups. Further, BLC-based measures identify households with 5 and more income sources (48.6%), those belonging to KP (59.3%), having family size 10 and above (68.5%), and other employees (55.6%) as the most vulnerable groups in comparison to those with 2 or more sources of income (64.2%), belonging to Sindh province (68.1%), family size between 7 and 9 (60.3%) and paid employees (60.2%) in consumption-based measures (Table 1).

Now we turn to the stress testing of households through FMs. We quantified the impact of shocks in the model by taking the difference between the pre-and post-stress results following Bilston et al. (2015). We implement a uniform reduction in income for all households i.e., a nominal wage cut in case of crisis as done by Giordana and Ziegelmeye (2019) by 5%, 10%, and 20% in Luxembourg. But we use 10%, 20%, and 30% as income shocks for BLC-based FMs, expressed as Δ_1, Δ_2, and Δ_3, and present the results under columns (3) through (5) in Table 1.

Table 1 Financial margins based on BLC and consumption and impact of shocks

Variables	BLC-based FM and income shocks				Consumption-based FM and income shocks				Consumption-based FM and consumption shocks		
	Baseline	Δ_1	Δ_2	Δ_3	Baseline	Δ_1	Δ_2	Δ_3	Δ_1	Δ_2	Δ_3
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Overall	47.41%	7.19%	14.56%	22.06%	58.53%	13.18%	20.81%	26.01%	12.44%	19.01%	23.18%
Income quintiles											
Bottom 20%	79.68%	4.62%	8.83%	12.05%	81.73%	8.09%	11.88%	14.02%	7.58%	11.26%	13.14%
20%–40%	69.86%	7.61%	13.56%	18.43%	70.34%	12.29%	18.68%	22.37%	11.65%	17.35%	20.37%
40%–60%	53.57%	10.51%	19.17%	26.83%	61.88%	13.28%	21.63%	26.88%	12.62%	19.81%	24.69%
60%–80%	24.90%	8.99%	20.52%	33.75%	48.59%	15.46%	24.84%	31.83%	14.50%	22.64%	27.56%
80% and above	10.27%	4.17%	10.45%	18.70%	30.42%	16.78%	26.99%	34.83%	15.86%	24.00%	30.10%
Education											
No Edu	63.46%	6.81%	14.13%	20.16%	62.29%	11.76%	19.14%	24.33%	10.97%	17.36%	21.36%
Prim	53.74%	8.34%	16.57%	24.01%	61.32%	13.62%	20.44%	25.21%	12.89%	18.75%	22.61%
Sec	40.02%	8.02%	15.53%	24.64%	57.97%	13.38%	21.36%	26.17%	12.65%	19.85%	23.77%
HSec	25.42%	7.13%	14.43%	23.57%	53.44%	15.02%	22.65%	28.19%	14.51%	19.80%	24.66%
Grad	12.82%	5.31%	12.01%	19.28%	46.19%	17.67%	26.10%	31.64%	16.63%	24.25%	29.10%
PG	11.24%	3.06%	7.66%	15.20%	42.53%	14.30%	23.75%	32.05%	13.79%	21.33%	27.71%
Age											
Age 30 and below	48.95%	8.62%	16.12%	23.58%	63.15%	11.58%	18.19%	22.93%	10.83%	16.36%	20.35%
Age 31–40	52.47%	6.47%	13.61%	20.89%	63.34%	13.57%	21.09%	25.47%	12.83%	19.16%	23.07%
Age 41–50	47.74%	7.29%	14.14%	21.47%	59.00%	13.34%	20.88%	26.09%	12.73%	19.43%	23.57%
Age 51–60	40.92%	6.63%	14.58%	22.68%	51.95%	13.00%	21.65%	27.93%	12.09%	19.24%	24.17%
Age 60 and above	45.08%	7.86%	15.77%	23.24%	53.65%	13.84%	21.31%	26.89%	13.09%	19.99%	23.77%
Marital status											
Unmarried	27.64%	7.05%	14.09%	21.14%	53.93%	11.92%	20.60%	26.29%	10.57%	19.78%	23.85%
Currently married	48.20%	7.23%	14.50%	21.93%	58.79%	13.26%	20.83%	26.01%	12.52%	18.97%	23.19%
Widow/widower	43.75%	6.61%	15.40%	23.73%	56.79%	12.23%	20.57%	25.46%	11.69%	19.21%	22.56%
Divorced	30.19%	5.66%	16.98%	32.07%	49.06%	18.86%	22.64%	35.85%	16.98%	22.64%	30.19%

Notes: Δ_1, Δ_2, Δ_3 show the impact of shocks on the proportion of FV at 10%, 20%, and 30% in corresponding categories respectively. BLC is the basic living costs, FM is the financial margins, No Edu is the no formal education, Prim is the primary education, Sec is the secondary education, Hsec is the higher secondary, Grad is the graduate, PG is the postgraduate, and KP is the Khyber Pakhtunkhwa.

Source: Author's calculations

Table 1   Financial margins based on BLC and consumption and impact of shocks (continued)

Variables		BLC-based FM and income shocks				Consumption-based FM and income shocks				Consumption-based FM and consumption shocks		
		Baseline	Δ_1	Δ_2	Δ_3	Baseline	Δ_1	Δ_2	Δ_3	Δ_1	Δ_2	Δ_3
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Number of income sources	2	47.79%	6.82%	13.51%	20.82%	64.18%	12.13%	18.75%	23.26%	11.58%	17.33%	21.06%
	3	47.25%	7.29%	14.65%	22.28%	55.44%	13.50%	21.89%	27.22%	12.60%	19.57%	23.98%
	4	45.13%	8.31%	18.00%	25.21%	45.02%	16.95%	26.69%	34.12%	15.74%	24.49%	29.99%
	5 and above	48.63%	8.12%	17.71%	27.10%	43.25%	14.77%	24.85%	31.90%	13.80%	22.50%	27.40%
Province	KP	59.30%	6.23%	12.71%	18.63%	58.15%	12.71%	21.39%	27.59%	11.94%	19.41%	24.06%
	Punjab	43.30%	7.07%	14.34%	22.23%	52.51%	13.70%	22.65%	28.27%	12.76%	20.43%	25.28%
	Sindh	43.71%	8.01%	16.16%	24.32%	68.09%	12.60%	17.37%	21.27%	12.04%	16.49%	19.35%
	Baluchistan	53.20%	7.14%	14.39%	21.35%	57.74%	13.48%	21.64%	26.84%	13.12%	19.41%	23.46%
Family size	1–2	12.58%	4.37%	11.13%	19.34%	50.07%	12.71%	20.26%	26.09%	11.78%	18.14%	22.65%
	3–4	27.29%	8.44%	17.21%	25.98%	56.66%	13.25%	20.83%	26.40%	12.48%	18.94%	23.82%
	5–6	44.13%	7.36%	15.06%	23.13%	59.31%	13.07%	20.57%	25.95%	12.23%	18.84%	23.17%
	7–9	59.69%	6.80%	13.54%	20.29%	60.30%	12.95%	20.76%	25.48%	12.34%	18.96%	22.72%
	10 and above	68.50%	6.76%	12.91%	18.63%	58.13%	14.01%	21.66%	26.71%	13.31%	19.95%	23.50%
Employment status	Employer	15.70%	7.17%	10.24%	21.50%	48.12%	21.50%	29.01%	34.82%	19.80%	27.31%	31.74%
	Self-employed	39.09%	6.99%	15.72%	25.26%	54.33%	16.95%	26.22%	31.42%	16.05%	24.01%	28.44%
	Paid employee	47.03%	7.67%	15.16%	22.63%	60.19%	12.79%	20.21%	25.66%	12.12%	18.29%	22.79%
	Others	55.60%	6.40%	12.91%	18.91%	58.81%	10.89%	17.84%	22.52%	10.19%	16.55%	19.91%

Notes: Δ_1, Δ_2, Δ_3 show the impact of shocks on the proportion of FV at 10%, 20%, and 30% in corresponding categories respectively. BLC is the basic living costs, FM is the financial margins, No Edu is the no formal education, Prim is the primary education, Sec is the secondary education, Hsec is the higher secondary, Grad is the graduate, PG is the postgraduate, and KP is the Khyber Pakhtunkhwa.

Source: Author's calculations

Table 2   PD and EAD

Variables		Probability of default		Exposure at default	
		BLC	Consumption	BLC	Consumption
(1)		(2)	(3)	(4)	(5)
Overall		46.74%	57.84%	62.79%	76.00%
Income quintiles	Bottom 20%	78.76%	80.84%	21.23%	20.88%
	20%–40%	68.94%	69.86%	14.79%	14.93%
	40%–60%	52.74%	61.46%	14.05%	16.03%
	60%–80%	24.39%	47.73%	9.38%	14.72%
	80% and above	10.11%	29.66%	3.34%	9.43%
Education	No Edu	62.55%	61.70%	32.22%	32.65%
	Prim	53.09%	60.91%	9.59%	12.03%
	Sec	39.36%	57.28%	17.06%	22.78%
	HSec	25.22%	52.80%	2.01%	4.16%
	Grad	12.75%	44.66%	0.91%	1.95%
	PG	11.01%	40.98%	0.99%	2.42%
Age	Age 30 and below	48.39%	62.70%	7.18%	8.17%
	Age 31–40	51.98%	62.84%	15.91%	18.81%
	Age 41–50	47.01%	58.29%	17.58%	22.62%
	Age 51–60	40.17%	51.01%	13.13%	16.48%
	Age 60 and above	44.23%	52.81%	8.98%	9.92%
Marital status	Unmarried	27.48%	52.90%	0.83%	1.28%
	Currently married	47.54%	58.13%	58.58%	70.29%
	Widow/widower	42.82%	55.92%	3.32%	4.27%
	Divorced	30.19%	49.06%	0.06%	0.16%
Number of income sources	2	47.08%	63.37%	33.89%	43.02%
	3	46.74%	54.76%	17.56%	20.97%
	4	44.33%	44.68%	6.70%	7.17%
	5 and above	47.85%	43.08%	4.63%	4.84%
Province	KP	58.15%	56.63%	24.57%	25.39%
	Punjab	42.67%	52.24%	24.86%	31.21%
	Sindh	43.29%	67.20%	6.83%	9.20%
	Balochistan	52.61%	57.44%	6.53%	10.20%
Family size	1–2	12.44%	49.71%	0.25%	1.17%
	3–4	27.10%	56.12%	4.87%	9.35%
	5–6	43.61%	58.47%	16.57%	21.07%
	7–9	58.78%	59.54%	23.79%	26.28%
	10 and above	67.18%	57.67%	17.31%	18.14%
Employment status	Employer	15.70%	46.05%	0.59%	1.61%
	Self-employed	38.71%	53.81%	10.52%	15.03%
	Paid employee	46.53%	59.66%	27.50%	32.80%
	Others	54.41%	57.81%	24.18%	26.57%

Note: See Table 1 for the description of abbreviations.

Source: Author's calculations

Table 3   LGDs and the impact of asset price shocks

Variables		Using BLC-based probabilities of default				Using consumption-based probabilities of default			
		Baseline	10% shock	20% shock	30% shock	Baseline	10% shock	20% shock	30% shock
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Overall		4.41%	5.03%	5.72%	6.55%	5.12%	5.87%	6.70%	7.67%
Income quintiles	Bottom 20%	1.35%	1.59%	1.86%	2.17%	1.25%	1.49%	1.76%	2.08%
	20%–40%	0.88%	1.05%	1.24%	1.46%	0.91%	1.08%	1.26%	1.45%
	40%–60%	1.13%	1.23%	1.34%	1.49%	1.41%	1.53%	1.67%	1.86%
	60%–80%	0.65%	0.73%	0.82%	0.94%	1.06%	1.19%	1.33%	1.50%
	80% and above	0.41%	0.43%	0.46%	0.49%	0.49%	0.58%	0.67%	0.77%
Education	No Edu	2.43%	2.81%	3.22%	3.74%	2.16%	2.54%	2.97%	3.48%
	Prim	0.80%	0.88%	0.98%	1.11%	0.91%	1.01%	1.12%	1.23%
	Sec	0.79%	0.89%	1.00%	1.12%	1.32%	1.47%	1.62%	1.78%
	HSec	0.23%	0.26%	0.30%	0.34%	0.47%	0.53%	0.61%	0.72%
	Grad	0.02%	0.02%	0.02%	0.03%	0.03%	0.06%	0.09%	0.12%
	PG	0.14%	0.16%	0.19%	0.22%	0.23%	0.25%	0.29%	0.33%
Age	Age 30 and below	0.59%	0.68%	0.77%	0.88%	0.71%	0.81%	0.92%	1.05%
	Age 31–40	1.14%	1.34%	1.58%	1.86%	1.38%	1.60%	1.84%	2.12%
	Age 41–50	1.20%	1.32%	1.46%	1.64%	1.67%	1.87%	2.11%	2.39%
	Age 51–60	0.78%	0.91%	1.04%	1.20%	0.74%	0.86%	1.00%	1.18%
	Age 60 and above	0.69%	0.78%	0.87%	0.97%	0.63%	0.73%	0.83%	0.94%
Marital status	Unmarried	0.00%	0.01%	0.02%	0.03%	0.01%	0.03%	0.04%	0.06%
	Currently married	4.30%	4.88%	5.52%	6.30%	4.88%	5.56%	6.32%	7.22%
	Widow/widower	0.11%	0.14%	0.17%	0.22%	0.23%	0.27%	0.31%	0.36%
	Divorced	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%

Note: See Table 1 for the description of abbreviations.
Source: Author's calculations

Table 3   LGDs and the impact of asset price shocks (continued)

Variables		Using BLC-based probabilities of default				Using consumption-based probabilities of default			
		Baseline	*10% shock*	*20% shock*	*30% shock*	*Baseline*	*10% shock*	*20% shock*	*30% shock*
(1)		*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Number of income sources	2	2.14%	2.42%	2.72%	3.06%	2.72%	3.10%	3.50%	3.97%
	3	1.30%	1.53%	1.79%	2.10%	1.66%	1.92%	2.21%	2.53%
	4	0.45%	0.51%	0.59%	0.69%	0.48%	0.54%	0.64%	0.75%
	5 and above	0.52%	0.56%	0.62%	0.70%	0.26%	0.30%	0.35%	0.42%
Province	KP	1.96%	2.14%	2.34%	2.57%	1.76%	1.95%	2.15%	2.38%
	Punjab	1.10%	1.32%	1.58%	1.88%	1.37%	1.62%	1.90%	2.23%
	Sindh	0.60%	0.72%	0.86%	1.03%	0.89%	1.05%	1.23%	1.45%
	Balochistan	0.76%	0.85%	0.94%	1.06%	1.09%	1.25%	1.41%	1.61%
Family size	1–2	0.01%	0.01%	0.01%	0.01%	0.21%	0.24%	0.26%	0.28%
	3–4	0.29%	0.35%	0.41%	0.47%	0.57%	0.66%	0.76%	0.89%
	5–6	0.95%	1.08%	1.21%	1.40%	1.15%	1.31%	1.48%	1.70%
	7–9	1.61%	1.86%	2.15%	2.49%	1.85%	2.13%	2.44%	2.79%
	10 and above	1.55%	1.74%	1.94%	2.18%	1.33%	1.54%	1.76%	2.00%
Employment status	Employer	0.06%	0.06%	0.07%	0.08%	0.06%	0.09%	0.11%	0.15%
	Self-employed	0.64%	0.73%	0.83%	0.95%	0.93%	1.06%	1.19%	1.34%
	Paid employee	2.14%	2.37%	2.65%	2.98%	2.59%	2.89%	3.22%	3.61%
	Others	1.58%	1.86%	2.17%	2.54%	1.53%	1.83%	2.17%	2.57%

Note: See Table 1 for the description of abbreviations.
    Source: Author's calculations

Results show that the proportion of vulnerable households increases by 7.2%, 14.6%, and 22.1% in absolute terms in response to 10%, 20%, and 30% income shocks respectively. We observe the highest impact of income shocks at 10% for households in the middle of the income distribution i.e., 3rd quintile (10.5%) whereas the impact of income shocks at 20% and 30% is highest for households falling in the 4th quintile. We note a higher impact of income shock on households with a primary level of education, age 30 and below, currently married at 10% shock (7.2%), divorced (17.0% and 32.1% due to 20% and 30% shocks), 4 or more sources of income at 10% and 20% shocks, those belonging to Sindh province (8.0% to 24.3%), with a family size of 3–4, paid employee (7.7% due to 10% shock), and self-employed (15.7% and 25.3% due to 20% and 30% shocks) (Table 1).

We present the impact of income shocks on consumption-based FMs due to a decline in income at 10%, 20%, and 30%, expressed as Δ_1, Δ_2, and Δ_3, under columns (7) through (9). We report the impact of consumption shocks at the aforementioned rates on consumption-based FMs, expressed as Δ_1, Δ_2, and Δ_3, under columns (10) through (12). We observed an increase of 13.2%, 20.8%, 26.0% and 12.4%, 19.0%, and 23.2% in the proportion of vulnerable households as a result of 10%, 20%, and 30% income and consumption shocks respectively. We note the highest absolute changes in the proportion of FV due to income and consumption shocks for households in the 5th income quintile (15.9% to 34.8%), graduates (17.7% to 31.6%), age group 51 and above, divorced (17.0% to 35.9%), 4 sources of income (15.7% to 34.1%), Punjab (12.8% to 28.3%), 10 and more family members, and employers (19.8% to 34.8%) (Table 1).

We report PDs derived by using equation (3) under columns (2) and (3) in Table 2. We note that the overall BLC-based PD is 46.7% which is significantly lower than the consumption-based PD (57.8%). We also calculate two measures of EAD by using equation (5) and report the results under columns (4) and (5) in Table (2). The overall EAD under BLC and consumption-based specifications stood at 62.8% and 76.0% respectively. We note a monotonic decline in PDs and EAD along with an increase in income under both specifications. We find higher EADs for households with no formal education. We further note higher PDs for households in the age group 31–40 but higher EADs for those in the age group 41–50. We also observed higher PDs and EADs for those currently married and those with two sources of income. Further, the BLC-based PD is higher for households in KP whereas the consumption-based PD is higher for households in Sindh. However, the EAD is higher for households in Punjab province followed by those in KP under both specifications. We also note higher BLC-based PD for households with 10 and more family members and engaged as other employees but consumption-based PD and EAD are higher for those having 7–9 family members and engaged as paid employees. We further note that households in the 5th income quintile, graduate and above level of education, 5 and more sources of income, smaller family sizes (1–2), and employers have the lowest PDs and EADs (Table 2).

We report LGD results under two broad categories i.e.,

1   using BLC-based PDs under columns (2) through (5)

2   consumption-based PDs under columns (6) through (9) in Table 3.

Under the BLC specification, the overall baseline LGD stands at 4.4%, which rises to 5.0%, 5.7%, and 6.6% as a result of 10%, 20%, and 30% asset price shocks respectively. We note higher baseline measures of LGD in the consumption-based specification as

compared to BLC criteria i.e., 5.1% vs. 4.4% which rises to 5.8%, 6.7%, and 7.7% if asset prices fall at 10%, 20%, and 30% respectively (Table 3).

Concerning various household characteristics, we note higher LGDs for households in the 1st quintile in both BLC and consumption-based specifications except for baseline and LGD at 10% shock in consumption-based criteria in the 3rd quintile. We note higher pre- and post-stress LGDs for households with no formal education, age group i.e., 31–50 years, currently married, two sources of income, belonging to KP province, 7–9 family members, and paid employees. Conversely, we observe lower LGDs in pre- and post-stress scenarios for households in the 5th quintile, graduates, age groups 30 and below and 60 and above, headed by divorced, 4 and more sources of income, belonging to Sindh province, 1–2 family members, and employers (Table 3).

4   Discussion

We conducted stress testing of households by using a modified measure of FM based on actual household consumption in addition to conventional measures based on BLC. We assess the impact of income shocks on BLC and consumption-based FMs and consumption shocks on consumption-based FM. We then estimate PDs, EADs, and LGDs using BLC and consumption-based FMs. We also assess the impact of asset price shocks on these measures of LGDs. We use household-level micro-data from a survey for the year 2015–2016. As the survey data is subject to measurement errors and unobserved heterogeneity leading to non-negligible endogeneity issues, therefore, we calibrate distress thresholds separately for each household group with the assumption of uniform source and size of estimation bias (Leika and Marchettini, 2017). We present the results of stress testing exercises against various household characteristics including the income quintiles, level of education, age, number of sources of income, marital and employment status, province, and family size following Galuscak et al. (2016).

Although direct comparison of results with other studies is not appropriate due to differences in data sources, periods, and other socio-economic factors, we observe higher FV in Pakistan i.e., 47.4% and 58.5% under BLC and consumption-based criteria respectively, as compared to other studies e.g., 8% in Australia in 2010 (Bilston et al., 2015), 22.0% in Croatia (Herceg and Nestić, 2014; Sugawara and Zalduendo, 2011), and 11.6% in Luxembourg (Giordana and Ziegelmeye, 2019). We observe some interesting patterns of changes in FV concerning varying household attributes. For example, we note a universal decline in the proportion of financially vulnerable households along with movement across income distribution from 1st to 5th quintiles and improvement in the level of education under both the BLC and consumption-based specification (Table 1). Our results corroborate the findings of Ali et al. (2020) who found an inverse relationship between the education of the head and the FV of the household. Despite considerable differences in socioeconomic and demographic factors, our results roughly correspond to the findings of Michelangeli and Pietrunti (2014) for Italian households who found 36% of households with lower secondary education, 45.3% with upper secondary education, and 13.6% of undergraduate or post-graduate as financially vulnerable. Our results are also in line with Messacar and Morissette (2020) who recently, have found a higher risk of FV for those without a high school diploma in Canada due to COVID-19-like shocks. Further, based on data from US households, Ricketts and Boshara (2020) observe that those with a post-graduate degree have 31% less chance of becoming financially

vulnerable as compared to diploma holders due to income shocks arising from COVID-19. We have found an inverse relationship between a household's FV and the education level of their heads. Therefore, households, non-governmental organisations, and the government should enhance human capital investment to address the problem of FV in the long run. These investments can also increase households' resilience to COVID-19-like external shocks in the future.

As mentioned earlier, we compile two measures of FMs. But these measures provide mixed results. For example, we find the more comparable proportion of FV under BLC and consumption-based specifications for households in the 1st (79.7% vs. 81.7%) and 2nd (69.9% vs. 70.3%) income quintiles, no formal education (63.5% vs. 62.3%), four sources of income (45% each), KP province (59.3% vs. 58.2%), and other employees (55.6% vs. 58.8%). In contrast, we observe wide variations in the vulnerability proportions under two specifications for households in upper-income quintiles, secondary and above level of education, those headed by singles (27.6% vs. 53.9%), Sindh province (43.7% vs. 68.1%), households with family size up to six members, and employers (15.7% vs. 48.1%) (Table 1). The reason behind these differences is the use of uniform BLC in BLC criteria derived through poverty lines. The BLC criteria are unable to take into account the varying consumption patterns of households and differences in their standard of living. In consumption-based criteria, we use the actual consumption expenditure of households, which is likely to be higher for those having a higher average income. The use of actual consumption expenditure is justified in a developing and traditional country like Pakistan, where households are compelled to make higher consumption expenditures to maintain their standard of living and status quo.

Now we move towards the stress testing of households using FMs as analytical tools. Our stress testing results reveal that the proportion of financially vulnerable households, following BLC-based criteria, increases by 7.2%, 14.6%%, and 22.1% as a result of 10%, 20%, and 30% income shocks respectively. In other words, household FV increases by 0.7% on average for every one percent decrease in income (Table 1). Under consumption-based FMs, we observed an increase of 13.2%, 20.8%, and 26.0% and 12.4%, 19.0%, and 23.2% in the proportion of financially vulnerable households as a result of 10%, 20%, and 30% income and consumption shocks respectively (Table 1). We observe three important insights from this phenomenon. First, household FV is subject to greater changes in the consumption-based approach as compared to BLC-based criteria even for the same rate of decrease in income i.e., 13.2% vs. 7.2% for 10% shock, 20.8% vs. 14.6% for 20% shock, and 26.0% vs. 22.1% for 30% shock. Second, households are more sensitive to income shocks as compared to the similar magnitude of consumption shocks in consumption-based criteria. Third, the average impact of 10% income shocks (1.32%) and consumption shocks (1.24%) is higher as compared to the average impact of 20% and 30% shocks (Table 1).

Regarding various household characteristics, we observed the higher impact of income shocks for households in the middle of the income distribution at 10% shock and those in the 4th quintiles at 20% and 30% shocks in the BLC-based FMs. However, in consumption-based FMs, changes in vulnerability proportions are highest for those in the 5th quintile. This may be due to their higher average consumption expenditure as compared to the rest of the categories. This is also because of the use of household actual consumption instead of uniform BLCs. This makes the case for assessing the impact of income and consumption shocks on consumption at the household level. The same

reasoning applies to higher income and consumption shocks in the consumption-based criteria in other categories (Table 1).

Now we turn to the discussion of the results of the PDs. We find higher PDs i.e., 46.7% in BLC and 57.8% in consumption-based criteria (Table 2) as compared to other studies e.g., 3.1% in Luxembourg (Giordana and Ziegelmeye, 2019). However, we face limitations in comparing our results with other studies due to methodological and data differences. We note higher PDs under consumption-based criteria as compared to BLC-based criteria in most of the categories. This is in line with higher FMs in these categories. Like FMs, we observe a monotonic decline in PDs in both specifications along with improvement in income and education of the household's head. For the rest of the characteristics, PDs follow the same pattern as in the FMs (Table 2).

After the identification of the share of vulnerable households, the next step is to calculate the implications of these stress tests for financial stability by focusing on the total debt held by these households. In this regard, an important question is how important are vulnerable households for the loan portfolio of lenders i.e., banks (Sugawara and Zalduendo, 2011). We do this by calculating two measures of EAD i.e., one using BLC-based PDs and the other using consumption-based PDs. We find higher values of EAD i.e., 76.0% under consumption-based PDs as compared to 62.8% under BLC-based PDs (Table 2). Our EAD estimates are on the higher side as compared to other studies e.g., 27.2% in Croatia (Sugawara and Zalduendo, 2011), 3.5% in France, 4.3% in Spain, 7.2% in Italy, 9.1% in Cyprus, 9.3% in Greece (Ampudia et al., 2016), and 4.7% in Luxembourg (Giordana and Ziegelmeye, 2019). From financial stability and policy point of view, the groups of households having both higher PDs and EADs such as those at the bottom of the income distribution, no formal education, currently married, relying on two sources of income, having 7 or more family members, and paid employees need to be given special consideration.

To calculate LGDs, we assume that the lenders can recover their losses in case of default of households from real estate, valuables, and liquid assets following the literature e.g., Ampudia et al. (2016). Our baseline measures of LGDs stand at 4.41% and 5.12% in BLC and consumption-based criteria respectively as compared to other studies e.g., 5.4% in Croatia (Sugawara and Zalduendo, 2011), 0.36% in Belgium, 2.46% in Greece, 2.07% in Cyprus (Ampudia et al., 2016), 0.51% in Luxembourg (Giordana and Ziegelmeye, 2019). It is worth mentioning that the comparison of our measures of LGDs with other studies is difficult due to differences in data collection methodologies and socio-economic conditions (Table 3).

We calculate the impact of the shocks on the LGD due to possible losses for the banking sector in the aftermath of household default. Thus, LGD identifies a potential threat to the banking sector because of changes in the prices of assets (Ampudia et al., 2016). It is important to note that the share of distressed households and EAD is not affected by changes in asset prices (Bilston et al., 2015). The price changes affect only the LGDs which use these assets as collateral (Ampudia et al., 2016). We assume a uniform reduction in the prices of assets for all households. We note a higher impact of asset price shocks under consumption-based criteria i.e., 0.75%, 1.58%, and 2.55% as compared to 0.62%, 1.31%, and 2.14% in BLC-based criteria respectively as a result of 10%, 20%, and 30% asset price shocks (Table 3). In comparison, Sugawara and Zalduendo (2011) estimated a 1.5% change in LGD from 5.4% to 6.9% for Croatian households. Bilston et al. (2015) noted a 0.4% increase in LGD due to a 10% decrease in asset prices for Australian households. Recently, Giordana and Ziegelmeye (2019)

estimated a 0.71%, 0.99%, and 1.37% increase in LGDs as a result of 10%, 20%, and 30% simulated shocks in real estate for households in Luxembourg. We note higher LGDs for households at the bottom of the income distribution, who have no formal education, are currently married, rely on two sources of income, have seven or more family members, and are paid employees. These findings support our earlier results for FMs, PDs, and EADs.

From a policy point of view, it is important to note that LGDs presented under various scenarios represent only extreme cases. The restructuring of loans, the inclusion of assets not covered in the surveys (Sugawara and Zalduendo, 2011), and the re-valuation of household assets can alter the potential losses for the banking sector in case of household default. Further, the shocks in a real-world scenario are likely to occur differently as assumed in household credit risk models (Bilston et al., 2015). However, stress testing analysis still provides useful insights for policymakers as it not only identifies the percentage of financially vulnerable households at aggregate and household group levels but also quantifies the impact of macroeconomic shocks on potential losses for the banking sector.

Our study has some limitations. Our results are based on household survey data for the year 2015–2016. A more recent survey can better explain the latest developments. Second, we assume uniform income and asset price shocks for all households. But in real life, households react~~behave~~ differently to macroeconomic shocks depending on their socio-economic conditions. Third, we conducted stress testing under a static environment (Giordana and Ziegelmeye, 2019) as we were unable to model the households' adjustments to external shocks due to data limitations. The dynamic analysis of macroeconomic shocks on household FV and credit risk indicators based on primary data remains a topic of future research.

We recommend the use of household-level actual consumption expenditures on non-durables and essential services, instead of BLC estimated through poverty lines, in the estimation of FMs and subsequent compilation of PD, EAD, and LGD. The use of actual consumption expenditure is justified in a developing country like Pakistan, where households are compelled to make higher consumption expenditures to maintain their standard of living and status quo.

5 Conclusions

We have assessed the financial fragility of households using data from a survey in Pakistan. Our study is based on the actual consumption expenditure of households in the derivation of financial margins instead of poverty-driven BLC. We have used these measures of financial margins to derive probabilities of default, EAD, and loss-given default at the household level. We have found 47.4% and 58.5% of households as financially vulnerable under BLC and consumption-based criteria respectively. We have assessed the resilience of households to income, consumption, and asset price shocks at the household level. We have noted greater changes in the proportion of household FV in the consumption-based approach as compared to BLC even for the same magnitude of the shock. We have also observed the severer impact of income rather than consumption shocks. We have found a higher average impact of both income and consumption shocks at 10% as compared to the average impact of shocks at 20% and 30%. We contribute to

the literature by calculating financial margins and conducting stress tests by incorporating households' actual consumption expenditures. We have found households at the bottom of the income distribution, without formal education, currently married, relying on two sources of income, having seven or more family members, and paid employees as the most financially vulnerable groups in Pakistan. These households need the special attention of policymakers in the development of targeted, community-specific social safety net programs and emergency cash support initiatives under a macroeconomic framework aiming at mitigating the effects of the COVID-19 like external shocks. Our stress testing analysis provides useful insights for policymakers as it not only identifies the percentage of financially vulnerable households at aggregate and household group levels but also quantifies the impact of macroeconomic shocks on potential losses for the banking sector under various scenarios. We recommend the use of household-level actual consumption expenditures in the analysis of household FV instead of BLCs in developing countries like Pakistan.

References

Abid, A. and Shafiai, M.H.M. (2018) 'Determinants of household financial vulnerability in Malaysia and its effect on low-income groups', *Journal of Emerging Economies & Islamic Research*, Vol. 6, No. 1, pp.32–43.

Abubakar, A., Astuti, R.I. and Oktapiani, R. (2018) 'The analysis of risk profile and financial vulnerability of households in Indonesia', *Bulletin of Monetary Economics and Banking*, Vol. 20, No. 4, pp.443–474.

Albacete, N. and Fessler, P (2010) *Stress Testing Austrian Households*. Financial Stability Report 19, June, pp.72–91 [online] https://www.oenb.at/dam/jcr:b8160286.../fsr_19_report_01_tcm16-197939.pdf (accessed 17 November 2017).

Albacete, N., Eidenberger, J., Krenn, G., Lindner, P. and Sigmund, M. (2014) *Risk-bearing Capacity of Households-Linking Micro-Level Data to the Macroprudential Toolkit*, Oesterreichische National Bank, Financial Stability Report 27, June, pp.95–110.

Ali, L., Khan, M.K.N. and Ahmad, H. (2020a) 'Education of the head and financial vulnerability of households: evidence from a household's survey data in Pakistan', *Social Indicators Research*, Vol. 147, No. 2, pp.439–463.

Ali, L., Khan, M.K.N. and Ahmad, H. (2020b) 'Financial fragility of Pakistani household', *Journal of Family and Economic Issues*, 25 April, doi: 10.1007/s10834-020-09683-y.

Ampudia, M., Vlokhoven, H.V. and Zochowski, D. (2016) 'Financial fragility of euro area households', *Journal of Financial Stability*, December, Vol. 27, pp.250–262.

Anderloni, L., Bacchiocchi, E. and Vandone, D. (2012) 'Household financial vulnerability: an empirical analysis', *Research in Economics*, Vol. 66, pp.284–296, DOI:10.1016/j.rie.2012.03.001.

Arellano, A. and Cámara N (2020) *Financial Vulnerability of Households to COVID-19: A Global Perspective,* BBVA Research Report on Financial Systems, 1 September.

Arins, M., Sinenko, N. and Laube, L. (2014) *Survey-based Assessment of Household Borrowers' Financial Vulnerability*, Latvijas Banka, Working Paper No. 1.2014.

Azzopardi, D., Fareed, F., Lenain, P. and Sutherland, D. (2019) 'Assessing household financial vulnerability: empirical evidence from the U.S. using machine learning', *OECD Economic Survey of the United States: Key Research Findings*, OECD Publishing, Paris, https://doi.org/10.1787/75c63aa1-en, DOI: 10.1787/75c63aa1-en.

Bettocchi, A., Giarda, E., Moriconi, C., Orsini, F. and Romeo, R. (2018) 'Assessing and predicting the financial vulnerability of Italian households: a micro-macro approach', *Empirica*, Vol. 45, pp.587–605, DOI: 10.1007/s10663-017-9378-2.

Bhutta, N., Bricker, J., Dettling, L., Kelliher, J. and Laufer, S. (2019) *Stress Testing Household Debt*, Finance and Economics Discussion Series 2019-008, Board of Governors of the Federal Reserve System, Washington, DOI: 10.17016/FEDS.2019.008, https://doi.org/10.17016/FEDS.2019.008 (accessed 10 January2020).

Bilston, T., Johnson, R. and Read, M. (2015) *Stress Testing the Australian Household Sector Using the HILDA Survey*, Reserve Bank of Australia, Research Discussion Paper, RDP 2015-01.

Blanc, J.L. (2020) *Financial Buffers of Households in the Wake of the COVID-19 Crisis*, European Commission (EC), Joint Research Centre, Science for Policy Briefs, JRC 120733.

Brown, S., Ghosh, P. and Taylor, K. (2014) 'The existence and persistence of household financial hardship: a bayesian multivariate dynamic logit framework', *Journal of Banking and Finance*, Vol. 46, pp.285–298, DOI: 10.1016/j.jbankfin.2014.05.022.

Brunetti, M., Giarda, E. and Torricelli, C. (2016) 'Is financial fragility a matter of illiquidity? An appraisal for Italian households', *The Review of Income and Wealth*, Vol. 62, No. 4, pp.628–649.

Cantor, G. and Stephanie, L (2020) 'How are the most vulnerable households navigating the financial impact of COVID-19?', *Prosperity Now*, Article [online] https://prosperitynow.org/resources/how-are-most-vulnerable-households-navigating-financial-impact-covid-19 (accessed 12 October 2020).

Demertzis, M., Domínguez-Jiménez, M. and Lusardi, A. (2020) 'The financial fragility of European households in the time of COVID-19', *Bruegel, Policy Brief*, July [online] https://www.bruegel.org/policy-brief/financial-fragility-european-households-time-covid-19 (accessed 30 November 2020).

Feeny, S. and McDonald, L. (2016) 'Vulnerability to multidimensional poverty: findings from households in Melanesia', *The Journal of Development Studies*, Vol. 52, No. 3, pp.447–464, DOI: 10.1080/00220388.2015.1075974.

Feeny, S., Mcdonald, L., Miller-Dawkins, M., Donahue, J. and Posso, A. (2013) '*Household Vulnerability and Resilience to Shocks: Findings from the Solomon Islands and Vanuatu*. Australian National University, State, Society & Governance in Melanesia (SSGM) Discussion Paper 2013/2 [online] http://dpa.bellschool.anu.edu.au/sites/default/files/publications/attachments/2015-12/Feeny_Household2013_0.pdf (accessed 18 December 2017).

Fuenzalida, M. and Ruiz-Tagle, J. (2009) *Households' Financial Vulnerability*, Central Bank of Chile Working Papers No. 540, December [online] http://www.bcentral.cl/esp/estpub/estudios/dtbc (accessed 19 September 2018).

Galuscak, K., Hlavac, P. and Jakubık, P. (2016) 'Household resilience to adverse macroeconomic shocks: evidence from Czech micro-data', *International Review of Applied Economics*, Vol. 30, No. 3, pp.377–402.

Georgarakos, D., Lojschova, A. and Ward-Warmedinger, M. (2010) *Mortgage Indebtedness and Household Financial Distress*, European Central Bank, Working Paper Series, 1156/February.

Giarda, E (2013) 'Persistency of financial distress amongst Italian households: evidence from dynamic models for binary panel data', *Journal of Banking & Finance*, Vol. 37, pp.3425–3434, DOI: 10.1016/j.jbankfin.2013.05.005.

Giordana, G. and Ziegelmeye, M (2019) *Stress Testing Household Balance Sheets in Luxembourg*, European Central Bank (ECB), Working Paper Series, No 2254 / March 2019, http://dx.doi.org/10.2866/357791.

Haq, R. (2015) 'Shocks as a source of vulnerability: an empirical investigation from Pakistan', *The Pakistan Development Review*, Vol. 54, No. 3, pp.245–272.

He, T., Derfler-Rozin, R. and Pitsea, M. (2020) 'Financial vulnerability and the reproduction of disadvantage in economic exchanges', *Journal of Applied Psychology*, Vol. 105, No. 1, pp.80–96, DOI: 10.1037/apl0000427.

Herceg, I. and Nestić, D. (2014) 'A new cluster-based financial vulnerability indicator and its application to household stress testing in Croatia', *Emerging Markets Finance and Trade*, Vol. 50, No. 5, pp.60–77, DOI: 10.2753/REE1540-496X500504.

Jamal, H. (2017) *Poverty and Vulnerability Estimates: Pakistan-2016*, Social Policy and Development Centre (SPDC), Karachi, Pakistan, Research Report No.99, May [online] http://spdc.org.pk/Data/Publication/PDF/RR-99.pdf (accessed 18 June 2018).

Javed, S.A., Ali, W. and Baig, I. (2019) *Household Debt in Pakistan: Conflict, Borrowing, and Structural Indebtedness*, Secure Livelihoods Research Consortium (SLRC), Working Paper 86, October [online] https://securelivelihoods.org/wp-content/uploads/Pakistan-Debt-Report_Sajid-Amin_final-for-website.pdf (accessed 21 January 2020).

Leika, M. and Marchettini, D. (2017) *A Generalized Framework for the Assessment of Household Financial Vulnerability*, IMF Working Paper, WP/17/228, November [online] https://www.imf.org/en/Publications/WP/Issues/2017/11/07/A-Generalized-Framework-for-the-Assessment-of-Household-Financial-Vulnerability-45297 (accessed 10 January 2019).

Malovaná, S., Hlaváček, M. and Galuščák, K. (2017) 'Stress testing the Czech household sector using micro-data – practical applications in the policy-making process', Paper presented at the *IFC-National Bank of Belgium Workshop on Data needs and Statistics Compilation for Macroprudential Analysis*, 18–19 May, Brussels, Belgium.

Messacar, D. and Morissette, R. (2020) *Work Interruptions and Financial Vulnerability. Statistics Canada Report on 'STATCAN COVID-19: Data to Insights for a Better Canada'*, Catalogue No. 45280001, 6 May.

Michelangeli, V. and Pietrunti, M. (2014) 'A microsimulation model to evaluate Italian households' financial vulnerability', *International Journal of Microsimulation*, Vol. 7, No. 3, pp.53–79 [online] https://www.microsimulation.org/IJM/V7_3/4_IJM_7_3_Michelangeli_Pietrunti.pdf (accessed 15 January 2019).

Mogaji, E (2020) 'Financial vulnerability during a pandemic: Insights for coronavirus disease (COVID-19)', *Research Agenda Working Papers*, Vol. 5, pp.57–63, DOI: 10.2139/ssrn.3564702.

Notenbaert, A., Karanja, S.N., Herrero, M., Felisberto, M. and Moyo, S. (2013) 'Derivation of a household-level vulnerability index for empirically testing measures of adaptive capacity and vulnerability', *Reg Environ Change*, Vol. 13, pp.459–470, DOI: 10.1007/s10113-012-0368-4.

O'Connor, G.E., Newmeyerb, C.E., Wong, N.Y.C., Bayukd, J.B., Cooke, L.A., Komarovaa. Y. and Warmath, D. (2019) 'Conceptualizing the multiple dimensions of consumer financial vulnerability', *Journal of Business Research*, Vol. 100, pp.421–430, DOI: 10.1016/j.jbusres.2018.12.033.

Persson, M. (2009) *Household Indebtedness in Sweden and Implications for Financial Stability – The Use of Household-Level Data*, Bank for International Settlement, Papers No 46, 124-135 [online] https://core.ac.uk/download/pdf/6863818.pdf (accessed 26 December 2017).

Poh, L.M. and Sabri MF (2017) 'Review of financial vulnerability studies', *Archives of Business Research*, Vol. 5, pp.127–133, DOI: 10.14738/abr.52.2784.

Sugawara, N. and Zalduendo, J. (2011) *Stress-testing Croatian Households with Debt Implications for Financial Stability*, The World Bank, Policy Research Working Paper 5906, December [online] http://documents.worldbank.org/curated/en/926021468032936689/pdf/WPS5906.pdf (accessed 26 December 2017).

Vandone, D. (2009) *Consumer Credit in Europe. Opportunities and Risks of a Dynamic Industry*, Springer – Verlag, Berlin, ISBN: 978-3-7908-2100-0.

Vatne, B.H. (2006) 'How large is the financial margins of Norwegian households? An analysis of micro-data for the period 1987–2004', *Economic Bulletin*, Vol. 77, No. 4, pp.173–180.

Xu, Y., Briley, D.A., Brown, J.R. and Roberts, B.W. (2017) 'Genetic and environmental influences on household financial distress', *Journal of Economic Behavior & Organization*, Vol. 142, pp.404–424, DOI: 10.1016/j.jebo.2017.08.001.

Zabai, A. (2020) 'How are household finances holding up against the Covid-19 shock?', *Bank for International Settlements (BIS) Bulletin No. 22*, 15 June.

Notes

1   According to Leika and Marchettini (2017), living costs are basic consumption incurred by a household during a month, quarter, or year. These include expenses on essential items that a household cannot cut in case of FV. We measure expenditure on yearly basis.