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A METHODOLOGICAL FRAMEWORK FOR MEASURING HOUSEHOLD FINANCIAL VULNERABILITY WITH A FOCUS ON MORTGAGE DEBT: THE CASE OF KAZAKHSTAN

Abstract
This paper proposes a methodological framework for constructing a Household Financial Vulnerability Index (HFVI) for emerging market economies, with Kazakhstan as an illustrative case. Unlike approaches that track isolated indicators (e.g., DSTI or LTV), HFVI integrates three dimensions – liquidity (buffer months, liquidity-to-assets), solvency (DSTI, debt-to-assets) and mortgage-housing risk (mortgage's share of debt and payments, LTV) – into a single composite. Indicators are rescaled to [0,1] and aggregated with equal within-block and block weights. Robustness is assessed via sensitivity to normalization bounds and indicator inclusion (leave-one-out). In Kazakhstan, where fixed-rate loans predominate, the share of floating-rate loans (FRL) is not used; in floating-rate markets, FRL can be used as a meso-level modifier in interest rate scenarios. Given the credit structure of Kazakhstan, where unsecured consumer lending is the dominant source of short-term stress, consumer credit risk is determined mainly through the solvency component. HFVI supports macroprudential policy by calibrating borrower-oriented tools, informative stress testing, and improving early warning systems in line with SDGs 10 and 11.

Keywords: mortgage channel; composite index; methodological framework; macroprudential policy; systemic resilience

INTRODUCTION

Household financial vulnerability has become a central issue for both academics and policy makers, especially in the context of recurring financial crises and the growing role of household lending in macro-financial dynamics. Rising debt, income volatility, and housing market turmoil have exposed the vulnerability of households as both recipients and reinforcers of systemic risks. This problem is particularly acute in emerging markets: households are increasingly exposed to debt, while the institutional structure remains undeveloped and macroeconomic conditions are unstable.

While mortgage exposures represent a structural and long-horizon channel of vulnerability—closely linked to housing prices, collateral values, and balance-sheet stability—the recent dynamics in Kazakhstan demonstrate that unsecured consumer lending has become the primary short-term transmission mechanism of household financial stress. Therefore, in the extended HFVI configuration, consumer credit risk is predominantly captured through the solvency and liquidity blocks, whereas the mortgage-housing dimension preserves its role as a structural component reflecting collateralized long-term obligations.

Existing international approaches have attempted to assess vulnerability using indicators such as debt service to income ratio (DSTI), loan to collateral value ratio (LTV), or solvency indicators. The IMF (Leika M. & Marchettini D., 2017), the ECB/ESRB (European Systemic Risk Board, 2016; European Central Bank, 2019), the Bank of France (Bove G. et al., 2020) and the Bank of Italy (Attinà C.A. et al., 2019) have developed tools for assessing household

and housing risks. However, these approaches often consider mortgage risk as an isolated indicator or as part of a scenario analysis rather than embedding it in a consistent composite index.

Over the past decade, rapid urbanization, government-backed mortgage schemes and favorable credit conditions have led to a sharp increase in household debt in Kazakhstan. At the same time, income inequality, macroeconomic volatility, low levels of financial literacy, and the rapid growth of unsecured consumer lending have increased household exposure to shocks. Despite the scale of these changes, there is no systematic index in Kazakhstan that jointly captures liquidity constraints, consumer-credit-driven solvency stress, and mortgage-housing risks within a single framework for assessing household vulnerability.

The scientific significance of this study lies in advancing the measurement of household financial vulnerability by formalizing a reproducible composite index that jointly captures short-horizon consumer-credit stress and long-horizon mortgage-housing risk within a single macro–meso–micro transmission framework. Unlike widely used indicator dashboards (e.g., DSTI, LTV, standalone solvency metrics) and scenario-only treatments of mortgage risk, HFVI embeds mortgage exposures as a structural block alongside liquidity and solvency, enabling internally consistent aggregation, comparability across time and contexts, and direct linkage to macro-financial transmission mechanisms. This design strengthens the analytical basis for cross-study replication and for translating household-level vulnerabilities into macroprudential monitoring and policy calibration.

This paper addresses this gap by proposing the Household Financial Vulnerability Index (HFVI), which conceptually and operationally integrates both consumer credit and mortgage exposures into a unified structure linking macro-level shocks, meso-level financial institutions, and micro-level household balance sheets. HFVI is designed as a three-block architecture — liquidity, solvency and mortgage-housing risk — with transparent normalization and additive aggregation. Short-term stress arising from unsecured consumer loans is primarily reflected in the liquidity and solvency blocks, while the mortgage component captures long-term, collateralized exposure to housing markets and interest-rate shocks. Unlike fragmented indicator-based approaches, the index can be used both for diagnostic assessment and for regulatory purposes.

This study makes three contributions. First, it develops a unified methodological framework that integrates mortgage-housing exposures into a composite vulnerability index together with liquidity constraints and consumer-credit-driven solvency stress, thereby resolving a common fragmentation in existing measurement strategies. Second, it positions HFVI within the international methodological landscape by clarifying how the proposed architecture complements established toolkits used by major institutions (IMF, ECB/ESRB, World Bank) established a parsimonious, index-based alternative suitable for monitoring and cross-sectional comparison. Third, using Kazakhstan as an emerging-market case, it demonstrates how the framework remains valid under rapid credit deepening and institutional constraints, and how the resulting index can function both as an early-warning indicator and as an input into macroprudential policy design.

LITERATURE REVIEW

The concept of financial vulnerability has become a cornerstone in analysis of household resilience to economic shocks. Early studies often equated vulnerability with low income or limited liquidity, emphasizing households' ability to smooth consumption during crises (Townsend R.M, 1994; Morduch J., 1995; Leclaire J., 2021). Over time, this narrow focus shifted towards a multidimensional approach that considers debt levels, asset structures, and institutional context (Townsend R.M, 1994; Bialowolski P., Weziak-Bialowolska D., 2014; Röhn O, et. al, 2015; Apergis N., 2019; Samad K.A. et. al, 2022; Singh, K.N., Malik, S., 2022).

This broader concept reflects the recognition that financial instability cannot be reduced to current income alone. A household with high income but excessive debt or illiquid assets may be just as vulnerable as one with low income (Noerhidajati, S. et al, 2021; Islam, K., Chowdhury, M., 2025). Moreover, vulnerability is shaped by wider institutional and macroeconomic conditions, including regulatory regimes and access to financial markets (Larson, E., 2016; Claessens, S. et. al, 2014; De Haan, J. et. al, 2020).

At the macroeconomic level, household financial vulnerability is driven by systemic shocks such as inflation, interest-rate fluctuations, income volatility and housing-price instability (Aldashev, A., & Batkeyev, B., 2023; Impavido, G., 2024). The IMF proposes a generalized framework with three core dimensions: liquidity, solvency and shock sensitivity (Leika M. & Marchettini D., 2017), applicable to both advanced and emerging economies, including those with limited micro-data.

A parallel intellectual tradition, rooted in theories of financial instability (Minsky, H. P., & Kaufman, H., 2008; Geanakoplos, J., 2010), conceptualizes vulnerability as cyclical – linked to phases of credit expansion, speculative lending and asset-price booms. From this perspective, households are not merely passive recipients of macroeconomic conditions, but active transmission agents within macro-financial dynamics. The global financial crisis of 2007–2008 demonstrated how mortgage booms can evolve into systemic stress, with households simultaneously acting as amplifiers and casualties of instability (Morrow R. A, 2010; Kamin, S.B., & DeMarco, L.P., 2012; Keys, B.J. et. al, 2012).

In OECD countries, household financial insecurity has become a central policy concern. Nearly half of low-income households did not have emergency savings before the COVID-19 pandemic, and debt levels in the lower part of the wealth distribution remain critically high. OECD analysis shows that systemic shocks disproportionately affect households with limited buffers, deepening inequality and eroding resilience (OECD, 2021).

Taken together, macro-level approaches converge on the view that financial vulnerability is not solely a function of income or aggregate debt, but reflects deeper structural imbalances, institutional frameworks and expectations. This underscores the need for models that can jointly capture the effects of unsecured consumer credit and housing-related exposures as key channels through which macro shocks are transmitted to households.

At the meso level, the interaction between financial markets and institutional frameworks plays a decisive role in shaping household vulnerability. Banks, non-bank lenders, and credit systems provide access to borrowing, defining both opportunities for asset accumulation and risks of over-indebtedness (Jappelli, T. et. al, 2013; Koomson, I., & Peprah, J.A., 2018; Mertens, D., & Metz, C., 2022).

Empirical studies show that credit systems are heavily reliant on household borrowing (Johnston, A. et al., 2021) more prone to crisis dynamics. For example, in the eurozone, research by D'Alessio & Iezzi (2013) and Ampudia et al. (2016) demonstrates that household solvency is closely tied to macroeconomic conditions (Wiedemann, A., 2023) such as interest rate fluctuations and housing market volatility. These findings emphasize that vulnerability is not merely the result of poor financial decisions by households but is embedded in lending practices and regulatory frameworks (Anderloni, L. et. al, 2012; European Systemic Risk Board, 2016; Singh, K.N., Malik, S., 2012).

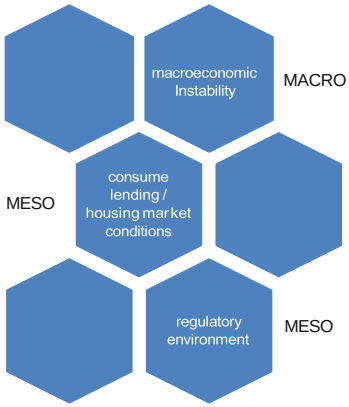
This perspective is particularly relevant for emerging market economies, where institutional oversight is often weaker, consumer credit grows rapidly, and regulatory innovations lag market developments. In such contexts, incentives to expand unsecured consumer lending and mortgages can heighten systemic vulnerability, while gaps in supervision encourage credit migration towards less regulated segments, including microfinance organizations.

The literature shows that financial vulnerability is multidimensional (Xie, B., Tao, J., 2025) and context-dependent, influenced simultaneously by macroeconomic shocks, institutional frameworks, and household behavior. While classical indicators such as debt-to-income ratio or overdue debt remain useful, they fail to capture the full complexity of vulnerability.

The main research gap lies in the systematic integration of mortgage-related risks into models of financial vulnerability in developing countries (Leika M. & Marchettini D., 2017; Fernández-López, S. et. al, 2023). In Kazakhstan, where the growth of mortgage lending is combined with economic instability and social inequality, this omission is particularly acute. Solving this problem requires both conceptual innovations — a revision of the definition of vulnerability to clearly take into consideration of mortgage loans — and methodological progress using composite indexes reflecting liquidity, solvency and risks associated with housing.

Figure 1 illustrates the conceptual transmission of financial vulnerability across macro-, meso-, and micro-levels, with mortgage debt acting as the channel. Macroeconomic shocks (e.g., inflation, interest rate hikes) are transmitted through institutional and market structures to household balance sheets, where vulnerability is expressed through liquidity, solvency, and housing-related risks.

Figure 1 – Conceptual Framework of Household Financial Vulnerability



Context and institutional environment mortgage channel

Thus, the identified problems in existing approaches require the integration of the mortgage channel into a systemic vulnerability assessment model. Figure 1 shows a conceptual diagram illustrating the interaction of macro, meso, and micro-level factors, where the mortgage acts as the transmission channel.

Macro Level: Monetary conditions and shocks. There is increased macro volatility in Kazakhstan, where the level of key interest rates and bank loan rates directly affects mortgage availability and household debt burden. In 2025, the National Bank of Kazakhstan (NBRK) kept the base rate (Trading Economics, 2025) at an increased level (16.5% as of April), which translates into the cost of market loans and ensures household sensitivity to growth through the DSTI (debt service to income) indicator. Meso Level: Program Control and Detection (HFVI Meso-Modifier). The Agency for Regulation and Development of the Financial Market (ARDFR) acts as the regulator and supervisory authority of the financial market, while the NBK is responsible for monetary policy and macro stability. This "two-tier" architecture determines the distribution of macroprudential policy and risk monitoring tools.
Public housing programs have historically played a crucial role in reducing interest rates and down payment requirements related to market conditions. The most significant of them are:

- "7-20-25" fixed rate of 7%, initial payment of 20%, maturity up to 25 years; implemented under the auspices of the NBK and development institutions (National Bank of Kazakhstan, 2025).
- Shanyrak/5-10-20 — targeted preferential products for certain categories of citizens were previously offered, but the program was discontinued.
- Otbasy Bank is currently the central specialized institute for housing savings and mortgage programs (part of the Baiterek Holding), which operates current republican and regional initiatives, including the planned launch of Islamic mortgages in 2025 (Otbasy Bank, 2025).

For HFVI, the structure of government-supported products and the type of interest rate (fixed or floating) are considered as meso-level modifiers that shape household sensitivity to rate shocks.

The Asian Development Bank (2024) notes that the growth of consumer and mortgage lending in 2023-2024 was supported by the prolongation of preferential programs, which reduces borrowers' "price sensitivity" to the current base rate and redistributes risks over time (budget/development institutions → banking sector).

Public data on the share of floating-rate mortgages in Kazakhstan are fragmentary; government programs are usually fixed (e.g., 7% on "7-20-25"), while market products may have a higher variability of conditions. For the purposes of the index, it is more correct to interpret the "floating rate share" as a risk modifier based on available reporting on banks' product lines and the regulator's notes, avoiding point estimates without official ranks (National Bank of Kazakhstan, 2025).

Micro Level: Household Balance and Mortgage Burden. At the household level, the mortgage channel is manifested through (i) *DSTI* — the share of debt payments in income, (ii) *DTA* — debt/assets, (iii) *LTV* — loan/housing cost, (iv) the structure of payments (the share of mortgage payments in total debt service). Considering government programs and institutional features, mortgages are becoming a central channel for transmitting macro shocks to household financial vulnerability. This emphasis is consistent with the recommendations of the macroprudential framework for emerging markets.

Table 1. Institutional parameters of the mortgage market in Kazakhstan

Parameter	Current institutional characteristics	Potential impact on vulnerability
Regulator/Supervision	ARDFR – regulation and supervision NBRK – monetary policy and macro stability	Separation of functions affects the settings of macroprudential buffers and monitoring of mortgage risks (Singh, K.N., Malik, S., 2022, International Monetary Fund, 2023)
Base rate/monetary conditions	Increased levels in 2024–2025; impact on market mortgage rates and refinancing	DSTI growth at market rates; increased sensitivity of families to rate shock [Trading Economics, 2025; CEIC Data, 2025)
State mortgage programs	"7-20-25" (fixed 7%, 20% fee, up to 25 years old); Otbasy Bank	They reduce the cost of credit and entry barriers; mitigate the shock of interest rates, but create dependence on budget support (National Bank of Kazakhstan, 2025)
Specialized Institute	Otbasy Bank – operator of state/regional programs; housing savings system; Islamic mortgage plan in 2025	Targeted subsidies and product innovations are changing the risk structure and borrower profiles (Otbasy Bank, 2025)
The growth rate of the mortgage portfolio	Growth was supported by preferential programs in 2023–2024	Strengthening of the "mortgage channel" in the vulnerability index; concentration risk (Asian Development Bank, 2024)
The share of floating rates	There are no consolidated public ranks by share; preferential programs are mostly fixed	With fixed rates dominating, the sensitivity to rate shocks is lower; market-based products increase risks, especially in refinancing (National Bank of Kazakhstan, 2025)

Institutional mapping of Kazakhstan's mortgage market at macro, meso, and micro levels demonstrates how systemic shocks are transmitted to household balance sheets. Increased interest rates affect the debt service burden (DSTI), while the regulatory framework and government programs build borrowers' resilience through subsidized fixed-rate products and targeted compliance rules. At the micro level, indicators such as DTA, LTV and debt payment structure reflect the vulnerability aspect of households. These contextual data form the empirical basis for the Household Financial Vulnerability Index (HFVI), where the mortgage channel acts as the central transmission mechanism. The next section describes the methodological basis for constructing the HFVI with a detailed description of its parameters, indicators, and aggregation procedures.

METHODOLOGY

Methodology for Constructing the Household Financial Vulnerability Index. Objective and Operationalization of the Index

The Household Financial Vulnerability Index (HFVI) is designed as a multidimensional composite indicator that reflects the degree to which households are approaching a financial crisis in the context of macroeconomic shocks. Its conceptual novelty lies in the explicit integration of the mortgage channel as a central transmission mechanism linking macroeconomic conditions (inflation, interest rates, employment), mesoinstitutional features (lending standards, regulatory oversight, public housing programs and, where appropriate, the share of floating-rate loans) and household balance sheets to at the micro level. This scheme addresses a documented gap: existing indexes often emphasize short-term liquidity or long-term solvency but rarely address housing and mortgage risks in a systemically consistent manner. Thus, HFVI combines three blocks — liquidity, solvency, and residential mortgage risk – into a single system, and the share of floating-rate loans (FRL) is introduced as a modifier at the meso level for economies where floating-rate mortgages enhance monetary transmission. In emerging markets such as Kazakhstan, where fixed-rate lending prevails, the HFVI indicator is calculated without considering the FRL coefficient, but the system can be adapted to economies with different mortgage structures.

Architecture: measurements and indicators

The HFVI integrates three sub-indexes - liquidity, solvency, and mortgage-housing risk — to provide a multidimensional measure of household financial fragility. Each indicator is specified with a consistent "worst" direction to ensure interpretability.

Table 2. The structure of the financial vulnerability index: measurements and key indicators

Dimension	Indicator	Definition/Formula	Worse	Note
Liquidity	Buffer months (BM)	$BM = \frac{LIQ}{BLC}$ (1)	↓	*LIQ*: Liquid assets. *BLC*: basic monthly costs
Liquidity	Liquidity-to-assets (LAS)	$LAS = \frac{LIQ}{A}$ (2)	↓	*A*: total household assets
Solvency	Debt-service-to-income (*DSTI*)	$DSTI = \frac{DP}{I}$ (3)	↑	*DP*: total debt payments. *I*: income
Solvency	Debt-to-assets (*DTA*)	$DTA = \frac{D}{A}$ (4)	↑	*D:* total debt; valuation sensitive
Mortgage	Mortgage share in debt *(MSD)*	$MSD = \frac{M}{D}$ (5)	↑	M: mortgage debt
Mortgage	Mortgage share in payments *(MSP)*	$MSP = \frac{MP}{DP}$ (6)	↑	MP: mortgage payment
Mortgage	Loan-to-value *(LTV)* (if available)	$LTV = \frac{M}{V}$ (7)	↑	V: housing value
Meso-modifier*	Floating-rate loan share *(FRL)*	$FRL = \frac{Loans\ float}{Loans\ mort}$ (8)	↑	Excluded from headline; used for rate-shock scenarios

Note: FRL is applied only in countries with a considerable proportion of floating-rate mortgage loans (ECB, Bank of France, Bank of Italy); in Kazakhstan, where fixed-rate loans predominate, FRL is excluded from the main HFVI indicator.

This architecture is based on international practice (IMF, ECB, Bank of France, Bank of Italy, OECD, BIS) but adapted to the institutional and information context of Kazakhstan.

Normalization and Aggregation

To ensure comparability of heterogeneous indicators, all indicators are scaled in a single interval [0,1] n accordance with the "worst" direction of vulnerability.

- Higher = worse (DSTI, DTA, MSD, MSP, LTV):

$$x_i^* = \frac{x_i - a_i}{b_i - a_i} \tag{9}$$

- Lower = worse (BM, LAS):

$$x_i^* = \frac{b_i - x_i}{b_i - a_i} \tag{10}$$

where a_i, b_i are the lower and upper bounds, determined either based on an available sample (for example, from the 5th to 95th percentiles), or through transparent calibration by experts/regulators. All normalized values are truncated to stay within [0,1], which prevents distortion of the index due to outliers. Alternative standardization (for example, z-scores) can be used as a reliability check in sensitivity analysis.

Additive aggregation

Let $b \in \{Liqu, Solv, Mort\}$ denote the three blocks (liquidity, solvency, mortgage-housing).

- Block sub-index:

$$I_b = \sum_{i \in b} w_i x_i^*, \qquad \sum_{i \in b} w_i = 1. \tag{11}$$

- Headline index:

$$HFVI = \alpha_{Liq} I_{Liq} + \alpha_{Sokv} I_{Solv} + \alpha_{Moet} I_{Mort}, \qquad \sum_b a_b = 1. \tag{12}$$

Baseline weights

- Within-block weights:

$$w_i = \frac{1}{n_b} \tag{13}$$

where n_b is the number of indicators in block b.

- Across blocks:

$$a_b = \frac{1}{3} \tag{14}$$

General form of HFVI

The Household Financial Vulnerability Index is thus the equally weighted average of the three block indices:

$$HFVI = 1/3\ (I_{Liq} + I_{Solv} + I_{Mort}) \tag{15}$$

or equivalently:

$$HFVI = \frac{1}{3} \sum_{b \in \{Liq,\ Solv,\ Mort\}} \frac{1}{n_b} \sum_{j=1}^{n_b} x_{bj}^*, \tag{16}$$

Operationally, the Household Financial Vulnerability Index (HFVI) is flexible and adapts to the structure of national credit markets. In Kazakhstan, where government programs such as 7-20-25 provide fixed-rate mortgages and floating-rate contracts remain insignificant, HFVI is assessed without the floating-rate loan modifier (FRL). Thus, the basic specification combines three blocks – liquidity, solvency, and housing mortgage risk – together with equal block weights:

$$HFVI_{kaz} = 1/3\ (I_{Liq} + I_{Solv} + I_{Mort}) \tag{17}$$

On the contrary, in many emerging market and advanced economies (for example, in the euro area countries studied by the ECB: Georgarakos et al., 2010; Ampudia et al., 2016), in France (Beauvais et al., 2020) and in Italy (Attina et al., 2019; D'Alessio & Iezzi, 2013), mortgage loans with a floating interest rate or with the possibility of repayment are widespread, which directly affect the shocks of monetary policy in servicing household debt. In such circumstances, FRL is used as a meso-level modifier in scenario analysis, increasing the impact of interest rate hikes on DSTI, MSP, and MSD:

$$HFVI_{EM} = 1/3\ I_{Liq} + 1/3\ I_{Solv} + 1/3\ I_{Mort} \tag{18}$$
with FRL applied in rate-shock scenarios

This dual specification ensures both contextual accuracy (Kazakhstan's fixed-rate environment) and country-by-country comparability with frameworks where floating-rate loans are a structural feature of vulnerability. In this sense, HFVI goes beyond the information panels of the IMF (International Monetary Fund, 2023; Leika M. & Marchettini D., 2017) or the ECB (2019)/ESRB (2016), integrating the mortgage channel into a reproducible index and allowing it to be adapted to the heterogeneity of products at the national level.

Model Validation and Sensitivity Testing

Objective. Demonstrate internal consistency, rank/tail stability, and robustness to design choice.

Internal consistency. Expected signs within blocks; to single-indicator dominance (share of block variance/ contribution < 50%). Optionally, report first-component variance share (PCA) within each block.

Variable selection & representation (primary sensitivity).

- Leave-one-out by indicators; jackknife by blocks.
- Alternative coding (continuous vs bins/thresholds).
- Stability metrics:

$$\Delta I = I^{(alt)} - I^{(base)} \tag{19}$$
$$\Delta rank_j = rank_j^{(alt)} - rank_j^{(base)} \tag{20}$$
$$\tau = Kenfall\ (rank^{(alt)}, rank^{(base)}) \tag{21}$$
$$\rho = Spearman\ (\cdot) \tag{22}$$

$$J = \frac{|T^{(alt)} \cap T^{(base)}|}{|T^{(alt)} \cup T^{(base)}|} \tag{23}$$

where T is the top-risk tail (e.g., top decile).

Weights (moderate sensitivity). Min-max vs z-score vs rank-based; document effects on levels/ranks.

Scenario sensitivity (policy relevance).

Shocks $r\uparrow$, $\pi\uparrow$, $I\downarrow$, house-price drop; track change in the "red-zone" share:

$$S_q = \frac{1}{N} \sum_{j=1}^{N} 1\{I_j \geq Q_q\} \tag{24}$$

$$\Delta S_q = S_q^{(shock)} - S_q^{(base)} \tag{25}$$

with Q_q as a quantile threshold.

Interpretation rule. High τ, ρ and large J with predictable ΔS_q imply robust conclusions; large shifts under variable-choice changes warrant respecification.

Limitations and Scope of Applicability

Consistent with (Jones, B. & Andrey, J., 2007) outcomes of vulnerability indices are highly sensitivity to variable selection and representation, moderately sensitivity to weights, and minimally affected by scaling. Therefore, we treat equal weights as the baseline, apply PCA/FA only as robustness checks, and prioritize rigorous indicator coding overweight engineering.

Additivity improves interpretability but may miss thresholds/non-linear interactions (e.g., *high LTV* × *floating rate*). Cross-country comparability requires explicit calibration to product and regulatory heterogeneity; intertemporal comparability depends on stable normalization bounds. In data-constrained settings, HFVI is applied descriptively (distributions, tails, scenarios) until micro-data allows statistical validation (e.g., AUROC/ logit).

DISCUSSION

Policy implications and macroprudential tools.

The Household Financial Vulnerability Index is designed as an early-warning and calibration tool for macroprudential policy. Its primary objective is to reduce the proportion of vulnerable households and slow the accumulation of systemic risk without undermining housing affordability for solvent groups. Policy responses are proportional: borrower-based limits target new lending, while capital-based buffers address accumulated risks and cyclicality.

The scheme of the HFVI policy by blocks

- Liquidity: minimum liquidity buffers, lock-in stress tests, prohibition of interest-only loans without amortization.
- Solvency: DSTI/DTI caps, maximum loan maturities, graduated amortization schedules.
- Risk: LTV limits, stricter requirements for investors than for first-time buyers, restrictions on floating-rate contracts, stress tests for refinancing.
- System-wide buffers: Countercyclical capital buffer (CCyB), sectoral systemic risk buffer (SyRB), higher risk weights for high LTV/DSTI loans, dynamic provisioning.

Verification and sensitivity

Equal weights and strict coding of indicators are used as the basis. Reliability is tested using alternative weights (PCA/FA), variable encoding, and rank/tail stability measures. Thresholds are refined through sensitivity analysis and policy feedback.

Table 3. Comparative Positioning of HFVI vs International Frameworks

Framework	Focus	Limitations	HVFI contribution
ECB/ESRB (2016); ECB, (2019)	Household mortgage vulnerability dashboard	Expert/scoreboard, no scalar index	Adds composite mortgage block, quantile calibration
World Bank (2016, 2020)	Corporate/sovereign vulnerability (CVI, DSA)	No households mortgage focus	Adapts index to household's credit risk
IMF (Leika & Marchettini, 2017; IMF FSAP, 2023)	Household vulnerability in FSAP stress scenario	No single index; scenario-only	Creates salar index + policy map
HFVI (this paper)	Household-mortgage composite	Needs sensitivity checks	Transparent, reproducible, mortgage-centric index

Sources: (Leika & Marchettini, 2017;, IMF, 2023; ESRB, 2016; ECB, 2019; World Bank, 2016, 2020)

In addition to the framework shown in Table 3, national experience shows the diversity of mortgage structures. France is an example of a fixed-rate market in which household debt servicing is protected from short-term monetary shocks (Bove et al., 2020). In contrast, Italy has a much higher proportion of floating-rate and repayable mortgages, making households more sensitive to rising interest rates (Attinà, C.A. et. al, 2019; D'Alessio, G., & Iezzi, S., 2013). This contrast illustrates the flexibility of the HFVI system: in countries with fixed interest rates (Kazakhstan, France), the index is calculated without the FRL modifier, while in countries with floating interest rates (Italy and some eurozone countries) FRL is becoming a key factor influencing the meso-level.

CONCLUSION

This paper proposes a reproducible Household Financial Vulnerability Index (HFVI) that integrates the mortgage channel as a transmission mechanism between macroeconomic conditions, meso-level institutions, and household balance at the micro level. The methodological novelty lies in its three-block architecture -

liquidity, solvency, and risk of residential mortgage lending — with clearly defined "worse/better" directions, normalization of indicators on a scale of [0,1] and summation into a general index. This approach aims to eliminate the fragmentation of existing approaches, which usually focus on either liquidity or solvency separately, thereby underestimating the vulnerability of household portfolios dominated by mortgages.

Comparison with international systems (ECB/ESRB, World Bank, IMF) shows that HFVI occupies a unique niche: it combines the interpretability of the composite index with the applicability of borrower-oriented standards (LTV, DSTI, DTI) and the IMF's scenario-based stress testing logic. In practice, HFVI turns into a direct policy scheme, ranging from measures on the part of the borrower (increased underwriting rates, LTV/DSTI/DTI limits, restrictions on floating-rate products) to systemic tools (countercyclical buffers, industry surcharges, and risk weight adjustments for high-risk loans). This dual diagnostic and policy role makes the index both analytically rigorous and relevant.

Methodological reliability is ensured through a validation protocol that verifies internal consistency, rating stability, and sensitivity to indicator selection, weighting, and shock scenarios. According to the research of Jones and Andrew (Jones, B., Andrey, J., 2007), the results are most sensitive to variational representation, moderately sensitive to weighting schemes, and minimally affected by scaling. Thus, equal weights serve as a transparent baseline, and PCA/FA are used only for reliability testing. Stress scenarios are considered conceptually, and their practical implementation depends on the availability of microdata at the household level and longer time series.

The limitations of this approach stem from additive aggregation (which may not consider non-linear thresholds) and problems with cross-country portability (heterogeneity of mortgage products and regulations). However, these limitations point to a future research program: (i) empirical testing of HFVI using microdata and risk assessment results, (ii) cross-country comparisons and dynamic extensions using panel and factor models, and (iii) integration with borrower-based sustainability assessments.

In Kazakhstan, where rapid credit growth and institutional features make mortgages the main channel of systemic risk, HFVI offers a transparent and important policy tool for early warning and calibration of macroprudential measures. More broadly, the system provides the academic community and policy makers with a flexible and applicable approach that integrates indicator dashboards and scenario models, uses the mortgage channel as a key risk vector, and adapts to fixed and floating interest rate environments. In this sense, HFVI contributes both to national regulatory practice and to the global comparative financial stability research program.

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МЕТОДОЛОГИЧЕСКАЯ ОСНОВА ДЛЯ ИЗМЕРЕНИЯ ФИНАНСОВОЙ УЯЗВИМОСТИ ДОМАШНИХ ХОЗЯЙСТВ С АКЦЕНТОМ НА ИПОТЕЧНУЮ ЗАДОЛЖЕННОСТЬ: НА ПРИМЕРЕ КАЗАХСТАНА

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Аннотация
В настоящем документе предлагается методологическая основа для расчета Индекса финансовой уязвимости домашних хозяйств (HFVI) для стран с формирующимся рынком, на примере Казахстана. В отличие от подходов, которые отслеживают отдельные показатели (например, DSTI или LTV), HFVI объединяет три аспекта – ликвидность (буферные месяцы, соотношение ликвидности к активам), платежеспособность (DSTI, соотношение долга к активам) и ипотечный жилищный риск (доля ипотечного кредита в долге и платежах, LTV) - в единый композит. Индикаторы масштабируются до [0,1] и агрегируются с равными весами внутри блока и по блокам. Надежность оценивается по чувствительности к границам нормализации и включению индикаторов (исключая один). В Казахстане, где преобладают кредиты с фиксированной процентной ставкой, доля кредитов с плавающей процентной ставкой (FRL) не используется; на рынках с плавающей процентной ставкой FRL может использоваться в качестве модификатора мезоуровня в сценариях процентных ставок. Учитывая кредитную структуру Казахстана, где необеспеченное потребительское кредитование является доминирующим источником краткосрочного стресса, риск потребительского кредитования определяется в основном через компонент платежеспособности. HFVI поддерживает макропруденциальную политику путем калибровки инструментов, ориентированных на

заемщиков, информативного стресс-тестирования и совершенствования систем раннего предупреждения в соответствии с ЦУР 10 и 11.

Ключевые слова: ипотечный канал; сводный индекс; методологическая основа; макропруденциальная политика; устойчивость системы.

ИПОТЕКАЛЫҚ ҚАРЫЗҒА БАСА НАЗАР АУДАРА ОТЫРЫП, ҮЙ ШАРУАШЫЛЫҒЫНЫҢ ҚАРЖЫЛЫҚ ОСАЛДЫҒЫН ӨЛШЕУДІҢ ӘДІСТЕМЕЛІК НЕГІЗІ: ҚАЗАҚСТАН ЖАҒДАЙЫ

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Аңдатпа

Осы құжатта Қазақстан мысалында дамушы нарығы бар елдер үшін үй шаруашылықтарының қаржылық осалдығы индексін (HFVI) есептеу үшін әдіснамалық негіз ұсынылады. Жеке көрсеткіштерді (мысалы, DSTI немесе LTV) бақылайтын тәсілдерден айырмашылығы, HFVI үш аспектіні біріктіреді – өтімділік (буферлік айлар, активтерге өтімділік коэффициенті), төлем қабілеттілігі (DSTI, активтерге қарыз коэффициенті) және ипотекалық тұрғын үй тәуекелі (қарыздар мен төлемдердегі ипотекалық несие үлесі, LTV) - бірыңғай композит. Индикаторлар [0,1] дейін масштабталады және блок ішінде және блоктарда бірдей салмақпен біріктіріледі. Сенімділік қалыпқа келтіру шекараларына және индикаторларды қосуға сезімталдық бойынша бағаланады (біреуін қоспағанда). Белгіленген пайыздық мөлшерлемемен кредиттер басым болатын Қазақстанда өзгермелі пайыздық мөлшерлемемен (FRL) кредиттердің үлесі пайдаланылмайды; өзгермелі пайыздық мөлшерлемемен нарықтарда FRL пайыздық мөлшерлеме сценарийлерінде мезо деңгей модификаторы ретінде пайдаланылуы мүмкін. Қамтамасыз етілмеген тұтынушылық кредиттеу қысқа мерзімді стресстің басым көзі болып табылатын Қазақстанның кредиттік құрылымын ескере отырып, тұтынушылық кредиттеу тәуекелі негізінен төлем қабілеттілігінің құрамдас бөлігі арқылы айқындалады. HFVI қарыз алушыларға бағытталған құралдарды калибрлеу, ақпараттық стресс-тестілеу және SDG 10 және 11 сәйкес ерте ескерту жүйелерін жетілдіру арқылы макропруденциалды саясатты қолдайды.

Түйін сөздер: ипотекалық канал; жиынтық индекс; әдістемелік негіз; макропруденциалдық саясат; жүйенің тұрақтылығы.