

Designing an Economic Scenario Generator for Financial Risk Management of Low-Income Households in Sri Lanka: A Review

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Abstract

Low-income households in Sri Lanka face increasing financial vulnerabilities driven by unstable income, high dependence on essential goods, and exposure to inflation and external shocks. Economic Scenario Generators (ESGs), widely used in institutional risk management, offer a structured way to model uncertainty but have rarely been adapted for household-level applications. This review synthesizes literature on ESG methodologies, household financial risk in developing economies, and Sri Lanka's socio-economic realities. It highlights the need for a household-oriented ESG framework that integrates macroeconomic shocks with micro-level financial behavior to support budgeting, debt avoidance, and policy interventions.

Keywords: Economic Scenario Generator, Financial Resilience, Household Finance, Low-Income Households, Sri Lanka

Introduction

Financial stability at the household level is a critical component of overall economic resilience. In Sri Lanka, low-income households represent a significant share of the population and are particularly vulnerable to economic fluctuations. Irregular employment, dependence on remittances, and limited savings capacity make these households highly exposed to inflationary pressures and external shocks such as global commodity price volatility.

While ESGs are well established in actuarial science and financial institutions, their use in modeling household finances remains limited. Traditional ESGs project interest rates, inflation, and asset returns, supporting tasks such as solvency testing and portfolio management. Translating this approach to the household level can provide valuable insights: families could evaluate the risks of debt accumulation, identify optimal budget allocation strategies, and simulate resilience under adverse conditions.

The design of a household-oriented ESG in Sri Lanka is guided by several key objectives aimed at enhancing financial resilience among low-income households. First, ESG seeks to model realistic household financial scenarios by incorporating both macroeconomic shocks—such as inflation, currency fluctuations, and interest rate changes—and household-specific variables, including income volatility, essential expenditures, and debt obligations. Second, it aims to determine optimal income allocation strategies that allow households to meet essential needs, maintain savings, and manage debt obligations effectively. Third, the framework is designed to evaluate debt risk and avoidance

techniques by assessing the probability of households falling into over-indebtedness under different economic conditions. Finally, it aims to provide policy-oriented insights to support government and non-government interventions, including subsidy programs, social safety nets, and financial literacy initiatives.

Collectively, these objectives ensure that the ESG serves not only as a predictive tool for households but also as a decision-support framework for policymakers seeking to improve financial inclusion and resilience. This review explores ESG methodologies, examines household-level financial risks, situates the discussion within Sri Lanka's context, and highlights research gaps that motivate future work.

Methodology

This review followed a structured literature review approach, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) framework (Page et al., 2021). The search strategy was designed to identify studies on Economic Scenario Generators (ESGs), household financial vulnerability, and low-income household resilience, with a focus on applications relevant to Sri Lanka and comparable developing economies. Databases searched included Scopus, Web of Science, PubMed, Google Scholar, and the World Bank Open Knowledge Repository. The search strategy used combinations of the keywords "Economic Scenario Generator", "household finance", "financial resilience", "low-income households", and "Sri Lanka", linked with Boolean operators (AND, OR). The eligibility criteria for this review included peer-reviewed articles, working papers, and policy reports published between 1995 and 2024, with a focus on studies in English addressing Economic Scenario Generator (ESG) methodologies, household risk, financial vulnerability, or resilience. Studies were excluded if they concentrated solely on institutional ESG applications without household relevance, were published in non-English languages, or lacked sufficient methodological or empirical detail. The screening process began with an initial pool of 425 records identified through database searches. After duplicate removal and title and abstract screening, 124 articles were retained. A full-text review was then conducted, resulting in 58 publications that met the inclusion criteria and were considered in the final synthesis.

Economic Scenario Generators and Modeling Approach

Economic Scenario Generators are mathematical frameworks designed to simulate the future evolution of key financial and economic variables under uncertainty. They typically combine stochastic processes with calibration to historical and forward-looking data.

Different models serve different purposes. The Wilkie model (Wilkie, 1995) provides a comprehensive actuarial framework linking inflation, interest rates, and equity returns. The Hull-White model allows for flexible interest rate dynamics, while Vasicek and Cox-Ingersoll-Ross (CIR) models capture mean-reverting behavior often observed in bond markets. For volatility, GARCH models (Engle, 2001) are used to represent clustering and persistence in asset returns.

ESGs are powerful for institutional decision-making, particularly in insurance and pension fund management (Cairns, 2000; Hardy, 2001). However, their focus is largely macroeconomic and market-based. A household-level ESG requires re-thinking these structures, emphasizing cash-flow simulations, expenditure shocks, income variability, and debt dynamics rather than asset returns.

At the household level, modeling financial risk involves combining macroeconomic projections with micro-level behavior. Deaton (1997) emphasizes consumption smoothing and savings as key household responses to shocks, while agent-based modeling approaches (Tsfatsion & Judd, 2006) provide tools to simulate household decision-making under varying conditions. Monte Carlo simulations and

optimization techniques can be employed to identify strategies for income allocation that minimize the probability of debt accumulation.

A household-oriented ESG could simulate:

- Income variability: daily wage fluctuations, remittance shocks.
- Expenditure shocks: health emergencies, school fees, sudden price hikes.
- Debt dynamics: repayment schedules, interest burdens, defaults.

Stress-testing households against these shocks allows researchers and policymakers to identify resilience thresholds and design preventive strategies.

Household Financial Risk in Developing Countries and the Sri Lankan Context

Low-income households in developing countries face unique financial vulnerabilities. A major risk arises from the high proportion of income spent on essentials such as food, fuel, and rent; even minor increases in prices can sharply reduce disposable income (Ravallion, 2008; Ivanic & Martin, 2014). Income volatility, informal employment, and limited savings further constrain households' ability to cope with shocks (Dercon, 2002).

Microfinance, while intended to enhance financial inclusion, has shown mixed outcomes. Poorly regulated lending can lead to over-indebtedness, particularly in rural communities (Bateman & Chang, 2012). These realities highlight the need for tools that integrate both macroeconomic and household-level factors to assess financial resilience.

Sri Lanka's economic crisis of 2022–2023 illustrates these vulnerabilities. Inflation exceeded 50%, food and fuel prices rose sharply, and currency depreciation eroded real incomes. The Household Income and Expenditure Survey (HIES) indicates that the poorest quintile spends over 70% of income on essentials, leaving minimal room for savings or insurance. The microfinance sector, while expanding credit access, has contributed to cycles of over-indebtedness, especially among rural women (Gunewardena, 2010).

An ESG calibrated to Sri Lanka's socioeconomic data can simulate the impacts of inflation shocks, currency movements, and health-related expenditures on household stability, providing actionable insights for both families and policymakers.

International Household-Level Models

Although Economic Scenario Generators (ESGs) are mostly applied at the institutional level, several international studies provide valuable insights for household-level applications. For example, a cross-country study covering the US, France, Germany, the UK, Canada, and Italy analyzed household financial risk exposures, coping mechanisms, and short-term shocks, finding that a significant portion of households faced financial shocks requiring outlays within 30 days (Lusardi, Schneider, & Tufano, 2009). Such findings highlight the importance of scenario-based modeling for household decision-making.

In low- and lower-middle-income countries, research on catastrophic health expenditures (CHE) modeled the likelihood of households incurring severe medical costs, emphasizing the need for financial protection mechanisms to prevent impoverishment due to unexpected expenses (Harvard CID, 2021). Similarly, a study in China investigated how digital finance affects household risk-sharing, demonstrating that households facing income shocks increasingly rely on financial networks and digital platforms to enhance resilience (Li & Zhang, 2022).

These studies, while not formal ESGs, illustrate methods for simulating household-level financial risk and coping behavior. They underscore the importance of developing household-oriented ESGs that integrate macroeconomic shocks with micro-level financial behavior, enabling policymakers and households to anticipate risks, optimize budgeting strategies, and improve financial resilience.

Policy Recommendations

Policy interventions are essential for strengthening the financial resilience of low-income households. Targeted subsidies reduce the cost of essential goods and services, helping households maintain basic living standards without depleting savings or relying on high-interest debt. Financial literacy programs equip individuals with knowledge and skills for budgeting, saving, and borrowing wisely, enabling better management of irregular income and debt avoidance. Emergency financial assistance schemes, including cash transfers, low-interest loans, or micro-insurance programs, provide a safety net to cope with unforeseen shocks. By integrating these policy levers into a household-oriented ESG, researchers and policymakers can simulate the potential impacts of each intervention, evaluate household-level risk under different scenarios, and design strategies that promote sustainable financial management and long-term resilience.

Research Gaps and Future Directions

The literature highlights several gaps in household-level ESG applications. First, most ESGs are institution-focused, leaving a lack of tools addressing household decision-making. Second, models often isolate macroeconomic or microeconomic factors, but low-income households require integrated frameworks combining both. Third, while international ESG literature is extensive, Sri Lanka lacks applied research using local socioeconomic data. Future research should focus on developing hybrid ESG frameworks that integrate stochastic macroeconomic variables with household cash-flow models, incorporate stress-testing approaches to evaluate resilience under multiple shocks, and leverage results to inform policy, including targeted subsidies, financial literacy initiatives, and micro-insurance schemes.

Conclusions

Economic Scenario Generators, traditionally applied in institutional contexts, hold untapped potential for household-level financial risk management. By simulating income, expenditure, and debt dynamics, a household-focused ESG in Sri Lanka can provide actionable guidance to households and policymakers, supporting sustainable financial management, debt avoidance, and long-term resilience. When combined with policy interventions such as subsidies, financial literacy programs, and emergency assistance schemes, ESG insights can help reduce vulnerability among low-income households and promote broader financial inclusion.

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