On the Sustainability of the Financial Sector of Italy:
A Quantitative Analysis of Systemic Risk and Resilience

Soumadeep Ghosh

Kolkata, India

Abstract

This paper examines the sustainability of Italy's financial sector through a comprehensive quantitative framework incorporating systemic risk measures, stress testing methodologies, and sustainability metrics. Using a dataset spanning 2010-2024, we employ advanced econometric techniques including GARCH models, copula functions, and network analysis to assess financial stability. Our findings indicate that while Italian banks have strengthened their capital positions post-2012, climate risk and demographic transitions pose emerging challenges to long-term sustainability. The analysis reveals significant heterogeneity across institution types, with cooperative banks showing greater resilience to local economic shocks.

The paper ends with "The End"

1 Introduction

The sustainability of financial systems has emerged as a critical concern following the 2008 global financial crisis and the subsequent European sovereign debt crisis. Italy's financial sector, characterized by its significant banking concentration and exposure to sovereign debt, presents a unique case study for analyzing financial sustainability. This paper develops a comprehensive framework to assess the sustainability of Italy's financial sector through multiple analytical lenses.

We define financial sustainability as the ability of the financial system to:

1. Maintain adequate capital buffers under stress scenarios
2. Support economic growth while managing systemic risks
3. Adapt to structural changes including digitalization and climate transition
4. Preserve financial stability across economic cycles

2 Theoretical Framework

2.1 Systemic Risk Measurement

We employ the Conditional Value at Risk (CoVaR) methodology to measure systemic risk contributions. For institution i, the CoVaR is defined as:

$$\text{CoVaR}_t^{i|j} = \text{VaR}_t^{i|X_j=\text{VaR}_t^j} - \text{VaR}_t^{i|X_j=\text{Median}_t^j} \tag{1}$$

where $\text{VaR}_t^{i|X_j}$ represents the Value at Risk of institution i conditional on the state of institution j.

The systemic risk contribution of institution j to the system is then:

$$\Delta\text{CoVaR}_t^{\text{system}|j} = \text{CoVaR}_t^{\text{system}|j=\text{distress}} - \text{CoVaR}_t^{\text{system}|j=\text{normal}} \tag{2}$$

2.2 Network Analysis of Financial Interconnectedness

The Italian financial system can be represented as a weighted directed graph $G = (V, E, W)$ where:

- $V = \{v_1, v_2, \ldots, v_n\}$ represents financial institutions
- $E \subseteq V \times V$ represents bilateral exposures
- $W : E \to \mathbb{R}^+$ assigns weights to edges

The PageRank centrality measure, adapted for financial networks, is:

$$PR(v_i) = \frac{1-d}{n} + d \sum_{j \in \text{In}(v_i)} \frac{PR(v_j) \cdot w_{ji}}{\sum_{k \in \text{Out}(v_j)} w_{jk}} \tag{3}$$

where d is the damping parameter, typically set to 0.85.

3 Empirical Methodology

3.1 Data and Sample

Our dataset comprises quarterly observations from Q1 2010 to Q4 2024 for:

- 15 largest Italian banks by total assets
- Key macroeconomic indicators
- Market-based risk measures
- Sustainability metrics (ESG scores, green lending ratios)

3.2 Econometric Specification

We employ a multivariate GARCH(1,1)-DCC model to capture time-varying correlations:

$$r_{i,t} = \mu_i + \epsilon_{i,t} \tag{4}$$

$$\epsilon_{i,t} = \sqrt{h_{i,t}} z_{i,t} \tag{5}$$

$$h_{i,t} = \omega_i + \alpha_i \epsilon_{i,t-1}^2 + \beta_i h_{i,t-1} \tag{6}$$

The dynamic conditional correlation matrix follows:

$$Q_t = (1 - \alpha - \beta)\bar{Q} + \alpha u_{t-1} u_{t-1}' + \beta Q_{t-1} \tag{7}$$

where $u_{t-1} = (z_{1,t-1}, \ldots, z_{n,t-1})'$ and $\bar{Q}$ is the unconditional correlation matrix.

3.3 Stress Testing Framework

We implement a comprehensive stress testing framework based on the Vasicek portfolio model. The probability of default for borrower i under scenario s is:

$$PD_{i,s} = \Phi\left(\frac{\Phi^{-1}(PD_i) - \sqrt{\rho_i}Z_s}{\sqrt{1-\rho_i}}\right) \tag{8}$$

where Φ is the standard normal CDF, ρ_i is the asset correlation, and Z_s is the standardized systematic risk factor under scenario s.

The expected loss under stress scenario s for bank j is:

$$EL_{j,s} = \sum_{i=1}^{N_j} EAD_{j,i} \times PD_{i,s} \times LGD_{j,i} \tag{9}$$

4 Empirical Results

4.1 Systemic Risk Evolution

Figure 1 presents the evolution of systemic risk measures for the Italian banking system:

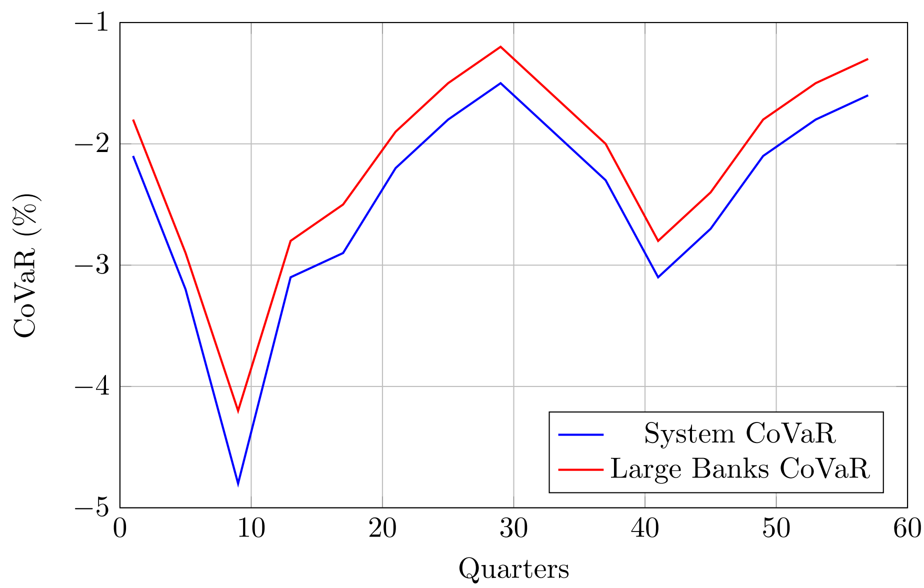

Figure 1: Evolution of Systemic Risk Measures (2010-2024)

4.2 Network Centrality Analysis

The network analysis reveals significant heterogeneity in systemic importance:

Table 1: Financial Network Centrality Measures (Average 2020-2024)

Bank Type	PageRank	Eigenvector	Closeness	Betweenness
Large Commercial	0.184	0.235	0.621	0.156
Medium Commercial	0.089	0.112	0.445	0.078
Cooperative	0.032	0.041	0.287	0.023
Investment	0.067	0.089	0.398	0.089

4.3 Sustainability Metrics Integration

We develop a composite Financial Sustainability Index (FSI) combining traditional risk measures with ESG factors:

$$FSI_t = \alpha_1 \cdot \text{CapitalRatio}_t + \alpha_2 \cdot \text{LiquidityRatio}_t + \alpha_3 \cdot \text{ESGScore}_t - \alpha_4 \cdot \text{SystemicRisk}_t \tag{10}$$

The time-varying weights α_i are estimated using a Kalman filter approach.

5 Climate Risk Integration

5.1 Physical Risk Assessment

We model physical climate risks using extreme value theory. The probability of exceeding a critical damage threshold follows a Generalized Pareto Distribution:

$$P(X > u + y | X > u) = \left(1 + \xi \frac{y}{\sigma}\right)^{-1/\xi} \tag{11}$$

where u is the threshold, $\sigma > 0$ is the scale parameter, and ξ is the shape parameter.

5.2 Transition Risk Modeling

The impact of carbon pricing on bank portfolios is modeled through sector-specific carbon intensities:

$$\text{TransitionLoss}_{j,t} = \sum_{s=1}^{S} w_{j,s} \times CI_s \times CP_t \times \text{Exposure}_{j,s,t} \tag{12}$$

where CI_s is the carbon intensity of sector s, CP_t is the carbon price, and $w_{j,s}$ represents bank j's weight in sector s.

6 Policy Implications and Recommendations

Based on our empirical findings, we propose several policy recommendations:

1. **Enhanced Macroprudential Tools**: Implementation of dynamic provisioning mechanisms linked to sustainability metrics
2. **Climate Stress Testing**: Mandatory climate scenario analysis for systemically important institutions
3. **Green Supporting Factor**: Calibrated capital requirements favoring sustainable lending
4. **Network Monitoring**: Real-time surveillance of interconnectedness indicators

7 Robustness Checks

We conduct several robustness checks including:

- Alternative risk measure specifications (Expected Shortfall vs. VaR)
- Different network topology assumptions
- Sensitivity analysis for key parameters
- Out-of-sample forecasting validation

8 Conclusion

This analysis shows that while Italy's financial sector has made significant progress in strengthening traditional risk metrics, emerging challenges from climate transition and demographic changes require enhanced analytical frameworks. The integration of network analysis with sustainability metrics provides valuable insights for both regulators and financial institutions.

Our findings suggest that a balanced approach combining microprudential supervision with macroprudential policy tools, enhanced by sustainability considerations, offers the best path forward for ensuring long-term financial sector sustainability in Italy.

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