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Topic - Credit, Households, and Asset Markets: A Structural Forecasting Framework for U.S. Systemic Risk

Abstract

This working paper develops a structural macro-financial early-warning system for forecasting systemic risk in the United States. Using a Structural Vector Autoregression (SVAR) framework, the model captures the dynamic interactions among corporate credit spreads, mortgage delinquency dynamics, and equity market returns. These variables jointly reflect stress in funding markets, household balance sheets, and investor sentiment. The system is estimated using quarterly U.S. data and structurally identified to recover causal financial shocks. Impulse-response results reveal significant transmission of stress across credit markets, households, and asset prices. Multi-quarter forecasts generate forward-looking early-warning indicators of emerging financial instability. The framework provides a real-time tool for anticipating credit tightening, household financial distress, and market volatility prior to broad economic downturns. The results have direct implications for macroprudential surveillance, housing-market stability, retirement security, and systemic-risk prevention in the United States.

Keywords: *Systemic Risk, Structural Vector Autoregression, Credit Spreads, Mortgage Delinquency, Asset Market Volatility, Early Warning Systems, Macroprudential Policy, Financial Stability.*

1. Introduction

Recent episodes of financial instability in the United States have revealed persistent weaknesses in the nation's ability to detect and contain systemic risk before it escalates into broad economic disruption. The rapid failures of multiple regional banks in 2023, the severe tightening of financial conditions following post-pandemic inflation, and the continued deterioration in housing affordability and household balance sheets have renewed concerns about the adequacy of current financial surveillance systems. Despite substantial advances in stress testing and regulatory reporting since the Global Financial Crisis, U.S. financial oversight remains largely reactive, often identifying vulnerabilities only after market stress has already intensified.

Federal agencies have repeatedly acknowledged these limitations. Financial Stability Oversight Council has emphasized that emerging threats increasingly evade traditional monitoring frameworks until they become severe. The Board of Governors of the Federal Reserve System has similarly noted that rising interest rate risk, liquidity pressures, and nonbank vulnerabilities have created new transmission channels that are not fully captured by existing supervisory tools. The Office of Financial Research has further stressed the need for forward-looking analytics capable of identifying how shocks propagate across interconnected markets, institutions, and households in real time.

At the household level, financial instability has materially reduced economic security. Persistent inflation and interest rate volatility have eroded real incomes, weakened purchasing power, and sharply increased debt-service burdens. Mortgage rates more than doubled between 2020 and 2024, while national home prices rose to record levels, producing the most severe housing affordability crisis in decades. Mortgage delinquency risks, although still below crisis peaks, have begun to re-emerge among financially stressed households, raising concerns about future housing-market fragility. In parallel, equity-market volatility and bond-market losses have significantly weakened retirement wealth, leaving millions of households more exposed to financial shocks than at any time since the Great Recession.

At the macro-financial level, financial instability has also begun to affect broader measures of national economic strength. Volatility in Treasury markets, repeated stress in short-term funding markets, and fluctuations in global capital flows have raised questions about the long-term stability of U.S. sovereign financing conditions and the resilience of the dollar-based financial system. Foreign direct investment inflows have declined materially in recent years, reflecting heightened uncertainty surrounding U.S. financial and macroeconomic stability. These developments underscore that systemic financial risk is no longer a purely academic concept but a direct and growing threat to household welfare, fiscal capacity, and U.S. global economic leadership.

Despite these risks, most existing surveillance tools remain backward-looking. Regulatory capital ratios, supervisory stress tests, and accounting-based indicators are essential for ensuring institutional soundness, but they are not designed to function as **early-warning systems** that forecast the dynamic buildup of systemic stress across markets. What remains critically missing is

a unified framework capable of identifying **causal financial shocks**, tracing their transmission across credit markets, households, and asset prices, and producing forward-looking indicators that warn policymakers of destabilizing trends before they appear in conventional macroeconomic data.

This paper develops such a framework. It introduces a **structural macro-financial early-warning system for forecasting systemic risk in the United States** using a Structural Vector Autoregression (SVAR) model. The system integrates three classes of variables that directly capture the core transmission channels of financial instability: corporate credit spreads as a measure of funding stress, mortgage delinquency dynamics as an indicator of household financial strain, and equity-market returns as a gauge of asset-market volatility and investor sentiment. Together, these variables span the institutional, household, and market dimensions of systemic risk.

Unlike reduced-form forecasting models, the SVAR framework allows economically meaningful identification of structural financial shocks. This enables the model to distinguish routine market fluctuations from **true systemic disturbances** in credit conditions, household solvency, and asset-market liquidity. By tracing the impulse-response dynamics across these sectors, the framework quantifies how stress originates, propagates, and amplifies within the U.S. financial system. The model further generates multi-quarter forecasts that serve as **real-time early-warning indicators of emerging financial instability**.

The contribution of this paper is twofold. First, it provides a unified empirical framework that links credit markets, household balance sheets, and asset prices within a single structural forecasting system. Second, it translates these empirical dynamics into **direct policy-relevant early-warning signals** that can support preventive macroprudential surveillance, liquidity risk management, housing-market stabilization, and financial-crisis prevention. Rather than identifying vulnerability after widespread defaults or market crashes occur, the framework is designed to alert policymakers when financial conditions begin to deteriorate quietly beneath the surface of headline economic indicators.

The remainder of the paper proceeds as follows. Section 2 reviews the related literature on financial early-warning systems, credit-market indicators, household financial distress, and structural macro-financial modeling. Section 3 describes the data and construction of the core indicators. Section 4 outlines the SVAR methodology and identification strategy. Section 5 presents the empirical results, including impulse-response dynamics and multi-quarter risk forecasts. Section 6 interprets the results in terms of systemic-risk transmission, inflation vulnerability, housing stability, retirement-market exposure, and banking-sector fragility. Section 7 discusses the implications for U.S. macroprudential policy and federal financial oversight. Section 8 concludes.

2. Contribution to Literature

This paper contributes to several strands of literature that examine the origins, transmission, and early detection of systemic financial risk. These include (i) early-warning systems and macro-financial surveillance, (ii) credit spreads as leading indicators of financial stress, (iii) household delinquency and housing-market fragility, and (iv) structural vector autoregression models for identifying causal macro-financial shocks.

2.1 Early-Warning Systems and Macro-Financial Surveillance

A large body of research has emphasized the importance of early-warning indicators for detecting financial instability before it evolves into crisis. Following the Global Financial Crisis, systemic-risk monitoring became a central focus of regulators and international financial institutions. International Monetary Fund has consistently documented that financial crises are typically preceded by prolonged buildups of leverage, credit growth, and asset-price misalignments that are observable well before output collapses or banking failures occur. Similarly, Bank for International Settlements has highlighted the "financial cycle" as distinct from the business cycle, with longer and more destabilizing swings driven by credit and property markets.

In the United States, Financial Stability Oversight Council and Office of Financial Research were created specifically to improve the nation's capacity for systemic-risk surveillance. Despite these institutional advances, the prevailing monitoring architecture remains largely indicator-based and descriptive. Many existing frameworks rely on balance-sheet ratios, supervisory stress tests, and market volatility indices that tend to react only after stress is already elevated. Recent assessments by the Board of Governors of the Federal Reserve System and the Government Accountability Office acknowledge that predictive macro-financial tools capable of quantifying the *timing* and *propagation* of systemic shocks remain underdeveloped.

This paper contributes to this literature by advancing a fully structural early-warning system that explicitly models the causal transmission of shocks across credit markets, households, and asset prices in real time, rather than relying solely on backward-looking indicators.

2.2 Credit Spreads as Leading Indicators of Financial Stress

Credit spreads play a central role in the empirical literature on financial instability and crisis prediction. Numerous studies show that widening corporate bond spreads precede downturns in investment, employment, and output by several quarters. Credit spreads capture changes in investor risk appetite, funding liquidity, and default expectations, making them one of the most reliable market-based signals of emerging financial stress.

In policy applications, the Federal Reserve Bank of St. Louis and other Federal Reserve Banks regularly use corporate bond spreads as forward-looking indicators of financial conditions. Research has shown that abrupt increases in spreads often signal the onset of credit contractions that later translate into banking distress and broader economic slowdown. Importantly, credit spreads tend to respond earlier than traditional macroeconomic aggregates, giving them distinct value for preventive surveillance.

This paper builds directly on this literature by embedding credit spreads within a structural system that quantifies not only their predictive content but also their causal interaction with household stress and asset-market volatility.

2.3 Household Delinquency, Housing Markets, and Systemic Risk

A second major strand of the literature links household balance-sheet distress to systemic financial instability. The 2008 financial crisis demonstrated that rising mortgage delinquencies and declining housing-market conditions can generate cascading effects through securitization markets, banking balance sheets, and consumer demand. Since then, delinquency rates have been widely used as leading indicators of housing-market vulnerability and household financial fragility.

Research supported by U.S. Department of Housing and Urban Development and the Consumer Financial Protection Bureau shows that delinquency behavior responds early to income shocks, interest-rate increases, and tightening credit conditions. These early deteriorations often precede surges in foreclosures, mortgage-backed security losses, and regional banking stress.

From a macro-financial perspective, mortgage delinquency serves as a critical transmission channel through which monetary tightening, inflation pressures, and labor-market shocks propagate into the financial system. This paper extends this literature by formally integrating household delinquency dynamics with credit-market and asset-market stress within a single structural forecasting system.

2.4 Asset Prices, Market Volatility, and Financial Fragility

A broad theoretical and empirical literature identifies asset prices as a core amplifier of systemic risk. Equity and bond markets reflect changes in investor expectations, liquidity conditions, and macroeconomic uncertainty. Large and persistent asset-price declines can weaken retirement wealth, reduce collateral values, trigger margin calls, and generate liquidity spirals across financial institutions.

Studies conducted by the Federal Reserve Bank of New York and the National Bureau of Economic Research demonstrate that periods of heightened market volatility are closely linked to funding-

market stress and subsequent economic contraction. Asset markets therefore play a dual role as both early warning signals and propagation channels of financial instability.

This paper incorporates asset-market returns as a real-time measure of market-based stress and investor sentiment, allowing the SVAR framework to capture how financial shocks transmit between markets, intermediaries, and households.

2.5 Structural VAR Models in Macro-Financial Analysis

Structural Vector Autoregression models have become a central tool for identifying causal macroeconomic and financial shocks. Unlike reduced-form VARs, SVARs impose economically meaningful restrictions that enable researchers to distinguish structural disturbances from endogenous fluctuations. This distinction is especially important in financial systems where feedback loops between markets, banks, and households create complex endogeneity.

SVAR methods have been widely applied to study monetary policy transmission, credit cycles, financial frictions, and asset-price dynamics. Recent applications emphasize the importance of structurally identifying financial-sector shocks in order to understand how liquidity disruptions, credit tightening, and asset-price declines propagate through the real economy.

This paper builds on the SVAR tradition by applying it explicitly as a **forecasting-based early-warning tool**, rather than solely as a retrospective diagnostic framework. By combining structural identification with multi-quarter predictive simulation, the framework extends the SVAR methodology from explanation into real-time surveillance.

2.6 Contribution Relative to the Existing Literature

Relative to the existing literature, this paper makes three primary contributions.

First, it unifies **credit-market stress, household financial distress, and asset-market volatility** within a single structural forecasting system specifically designed for systemic-risk surveillance. Second, it transforms SVAR analysis from a purely explanatory tool into a **forward-looking early-warning system** that generates real-time risk forecasts. Third, it directly aligns the empirical framework with the surveillance needs articulated by U.S. federal financial regulators, making the results immediately relevant for macroprudential policy design.

In doing so, the paper advances the literature from descriptive monitoring toward **predictive macro-financial intelligence**, which remains a central unresolved challenge in financial stability policy.

3. Data and Variable Construction

This section describes the construction of the core macro-financial indicators used in the structural early-warning system. The empirical framework is built around three variables that jointly capture stress in corporate funding markets, household balance sheets, and asset markets. These indicators are widely recognized in the financial-stability literature and by U.S. regulatory authorities as among the most sensitive early signals of systemic risk.

All data are obtained from the Federal Reserve Economic Data (FRED) database maintained by the Federal Reserve Bank of St. Louis, which serves as a primary data infrastructure for U.S. monetary and financial research.

3.1 Credit Spreads: Corporate Funding Stress

The first variable is a corporate credit spread series that measures the difference between yields on corporate bonds and comparable U.S. Treasury securities. Credit spreads capture the market-based price of default risk, funding liquidity, and investor risk aversion. When spreads widen, corporate borrowing costs rise, credit conditions tighten, and investment and employment tend to slow with a lag.

Daily observations of the credit-spread series are converted to quarterly frequency by taking quarterly averages. This transformation smooths high-frequency market noise while preserving the medium-term financial cycle relevant for macro-financial surveillance. Quarterly averaging is consistent with the frequency at which corporate balance-sheet adjustments, lending standards, and investment responses typically unfold.

Credit spreads serve in the model as the primary **market-based early-warning indicator of financial tightening**. Historically, sharp and sustained increases in spreads have preceded major U.S. recessions, banking stress episodes, and contractions in business investment.

3.2 Mortgage Delinquency Rates: Household Financial Stress

The second core variable is the mortgage delinquency rate, measured at the quarterly frequency. This series captures the proportion of mortgage loans that are past due and serves as a direct indicator of household financial vulnerability. Rising delinquencies reflect stresses caused by income shocks, interest-rate increases, unemployment, and deteriorating housing affordability.

Mortgage delinquency dynamics are central to systemic-risk analysis because the U.S. housing market plays a unique role in transmitting financial shocks across households, banks, and capital markets. During the Global Financial Crisis, escalating delinquencies triggered widespread losses in mortgage-backed securities, eroded bank capital, and generated severe tightening in credit availability.

In the post-pandemic period, renewed pressure on household finances has emerged through sharply higher mortgage rates, elevated consumer prices, and weakening real income growth. Incorporating delinquency dynamics therefore allows the model to capture the **household-level transmission channel of systemic instability**.

3.3 Asset-Market Returns: Market Volatility and Investor Sentiment

The third variable is the return on a broad U.S. equity market index, constructed from daily data and transformed to quarterly log returns. Equity returns summarize changes in investor expectations, risk appetite, and market liquidity. Large negative returns or elevated volatility often coincide with tightening financial conditions, margin calls, and liquidity shortages across the financial system.

Daily market levels are converted to quarterly frequency by selecting quarter-end observations and computing log differences. This procedure aligns short-term market movements with the macro-financial horizon relevant for systemic-risk forecasting and policy response.

Asset-market dynamics are particularly important for systemic surveillance because they directly affect:

- the value of household retirement savings,
- the collateral position of borrowers,
- the balance sheets of financial institutions, and
- confidence in the broader financial system.

By including equity returns alongside credit spreads and delinquency rates, the model captures the **market-based amplification channel of financial instability**.

3.4 Sample Construction and Alignment

The three series differ in their original starting dates due to data availability. Mortgage delinquency data extend furthest back in time, while credit spreads and equity market data begin later. To ensure consistency across variables, the final estimation sample is defined as the largest common quarterly window shared by all three series. This alignment ensures that the SVAR is estimated on a balanced dataset without the distortions introduced by unbalanced panels.

All series are seasonally consistent at the quarterly frequency. Missing values arising from market holidays or reporting gaps in daily financial data are handled using standard interpolation methods prior to quarterly aggregation. The resulting dataset consists of a continuous quarterly time series suitable for structural macro-financial estimation.

3.5 Transformation and Stationarity Treatment

To ensure econometric validity, the time-series properties of all variables are formally assessed using unit-root and stationarity diagnostics. The empirical implementation adopts a transformation strategy consistent with the macro-financial forecasting literature:

- Credit-spread movements are analyzed in differences to capture changes in funding stress.
- Mortgage-delinquency dynamics are transformed as needed to achieve stationarity while preserving their early-warning content.
- Equity returns are modeled in log-difference form, which is standard in asset-pricing and financial-stability applications.

This transformation strategy allows the structural system to focus on **shocks to financial conditions**, rather than long-run trend components, which is appropriate for crisis forecasting and early-warning analysis.

3.6 Rationale for Variable Selection

The selection of credit spreads, mortgage delinquency rates, and asset returns is grounded in both theory and regulatory practice. Together, these variables span the three principal dimensions of systemic risk:

1. **Institutional stress** (corporate credit markets)
2. **Household financial distress** (mortgage delinquency)
3. **Market volatility and investor sentiment** (equity returns)

This tripartite structure mirrors the analytical frameworks used by the Financial Stability Oversight Council and the Office of Financial Research, both of which emphasize the interconnected nature of institutions, households, and markets in the propagation of financial instability.

By jointly modeling these channels within a single structural forecasting system, the framework is designed to detect not only isolated pockets of stress but also **cross-sector contagion and amplification** that characterize true systemic risk.

4. Methodology

This section outlines the econometric specification, identification strategy, and forecasting design used to construct the structural early-warning system. The empirical framework is based on a Structural Vector Autoregression (SVAR) model that captures the dynamic interactions among credit-market conditions, household financial stress, and asset-market volatility.

4.1 Reduced-Form VAR Specification

Let

$$y_t = [\ \Delta \text{CreditSpread}_t\ ,\ \Delta^2 \text{DelinquencyRate}_t\ ,\ \Delta \text{AssetReturn}_t\ ]'$$

denote the vector of stationary financial variables at quarterly frequency. The reduced-form VAR is specified as:

$$y_t = c + A_1\ y_{t-1} + \varepsilon_t$$

where:
c is a vector of constants,
A_1 is the coefficient matrix,
ε_t is a vector of reduced-form innovations with covariance matrix Σ.

The system is estimated using standard least squares equation-by-equation.

4.2 Lag-Length Selection

The optimal lag length is selected using the Akaike Information Criterion (AIC), Hannan–Quinn Criterion (HQ), Schwarz Criterion (BIC), and the Final Prediction Error (FPE). All criteria favor a lag order of one, therefore the empirical model is estimated as a VAR(1).

4.3 Structural Identification

The reduced-form VAR is transformed into a Structural VAR (SVAR) using short-run (recursive) identification via a Cholesky decomposition of the residual covariance matrix. The structural form is:

$$B_0 y_t = c + B_1 y_{t-1} + \eta_t$$

where:
B_0 captures contemporaneous relations,
η_t represents orthogonal structural shocks with identity covariance.

The recursive ordering imposed is:

$$\Delta\text{CreditSpread} \rightarrow \Delta^2\text{DelinquencyRate} \rightarrow \Delta\text{AssetReturn}$$

This structure assumes that credit-market shocks contemporaneously affect households and asset markets, household shocks affect asset markets within the quarter, and asset-market shocks do not contemporaneously feed back into credit or households.

4.4 Stability and Invertibility

The eigenvalues of the companion matrix all lie strictly inside the unit circle, confirming that the VAR is dynamically stable and the impulse-response analysis is valid.

4.5 Impulse Response Analysis

Orthogonalized impulse response functions (IRFs) are computed over a 12-quarter horizon. For each structural shock, the IRFs trace the time path of responses across all system variables. Statistical inference is conducted using bootstrap confidence intervals.

4.6 Forecasting Design

Multi-step-ahead forecasts are generated from the estimated VAR model:

$$\hat{y}_{t+h|t}$$

for $h = 1, ..., 4$ quarters. Forecasts are produced for all three variables and interpreted as forward-looking indicators of emerging financial stress.

4.7 Implementation

All estimations and forecasts are implemented in R using the vars, svars, and quantmod packages. Data acquisition is automated via FRED using quantmod, ensuring full reproducibility of the empirical pipeline.

5. Empirical Results

This section presents the empirical results from the estimated VAR(1) and the structurally identified SVAR framework. The analysis proceeds in three stages. First, the reduced form VAR dynamics are examined to establish endogenous interdependence across the variables. Second, the transmission of structural shocks is analyzed using impulse response functions. Third, the forward looking forecast behavior of the system is evaluated as an early warning mechanism for systemic financial stress.

5.1 Reduced Form VAR Dynamics

The reduced form VAR(1) captures statistically meaningful dynamic interactions among changes in credit spreads, accelerations in mortgage delinquency rates, and changes in equity market returns. Across all three equations, the lagged endogenous variables exhibit significant predictive power, confirming that the three core segments of the financial system credit markets, households, and asset markets are jointly endogenous and mutually reinforcing.

In the credit spread equation, lagged asset market movements enter with economically meaningful magnitude and strong statistical significance. This indicates that equity market conditions contain forward looking information about future funding stress. This result is consistent with the interpretation that asset markets internalize changes in macro financial risk before these risks become visible in corporate borrowing conditions.

In the household delinquency equation, lagged credit spread dynamics display strong predictive power. This indicates that tightening funding conditions propagate into household balance sheets with a lag, increasing default risk through higher borrowing costs, tighter lending standards, and weakened refinancing capacity.

In the asset return equation, both lagged credit spreads and lagged delinquency dynamics contribute significantly to return variation. This indicates that investor expectations and market valuations respond endogenously to both institutional funding stress and household financial vulnerability. Taken together, these results confirm that systemic financial risk evolves through feedback mechanisms across institutions, households, and markets rather than through isolated sector specific channels.

TABLE 1 — Reduced-Form VAR(1) Coefficient Estimates

Dependent Variable	Lagged dCreditSpread	Lagged ddDelinquencyRate	Lagged dAssetReturn	Constant	R^2

dCreditSpread	0.208 (0.175)	−0.155 (0.447)	**−1.010 (0.0002)**	−0.013	0.40
ddDelinquencyRate	**0.417 (0.0006)**	**−0.365 (0.018)**	−0.095 (0.585)	0.017	0.41
dAssetReturn	0.134 (0.124)	**0.307 (0.011)**	**−0.581 (0.0002)**	0.003	0.51

Table 1 reports the reduced form VAR(1) coefficient estimates. Lagged asset market returns significantly predict changes in credit spreads, confirming that equity market conditions contain forward looking information about future funding stress. Lagged credit spread changes exert a strong positive effect on delinquency acceleration, confirming that funding market tightening propagates into household financial distress. Lagged delinquency acceleration also significantly predicts asset market returns, indicating that household balance sheet deterioration feeds back into market valuations. These estimates confirm strong endogenous interdependence across institutions, households, and markets.

5.2 Structural Impulse Response Analysis

To evaluate the causal transmission of financial shocks, orthogonalized impulse response functions are computed from the structurally identified VAR over a twelve quarter horizon. The impulse responses trace the dynamic propagation of structural disturbances across credit markets, household balance sheets, and asset markets.

TABLE 2 — Structural Impact Matrix (SVAR B-Matrix)

Shock →	dCreditSpread	ddDelinquencyRate	dAssetReturn
Credit Shock	**0.1759**	−0.0118	−0.0334
Household Shock	0.0000	**0.1270**	−0.0099
Market Shock	0.0000	0.0000	**0.0928**

Table 2 presents the contemporaneous structural impact matrix obtained from Cholesky identification. Credit market shocks exert immediate effects on household delinquency acceleration and asset returns. Household shocks primarily affect household financial dynamics contemporaneously with delayed feedback into markets and funding conditions. Asset market shocks exhibit strong contemporaneous effects within equity markets and propagate dynamically into credit and household channels through lagged transmission.

5.2.1 Interpretaion of Shocks

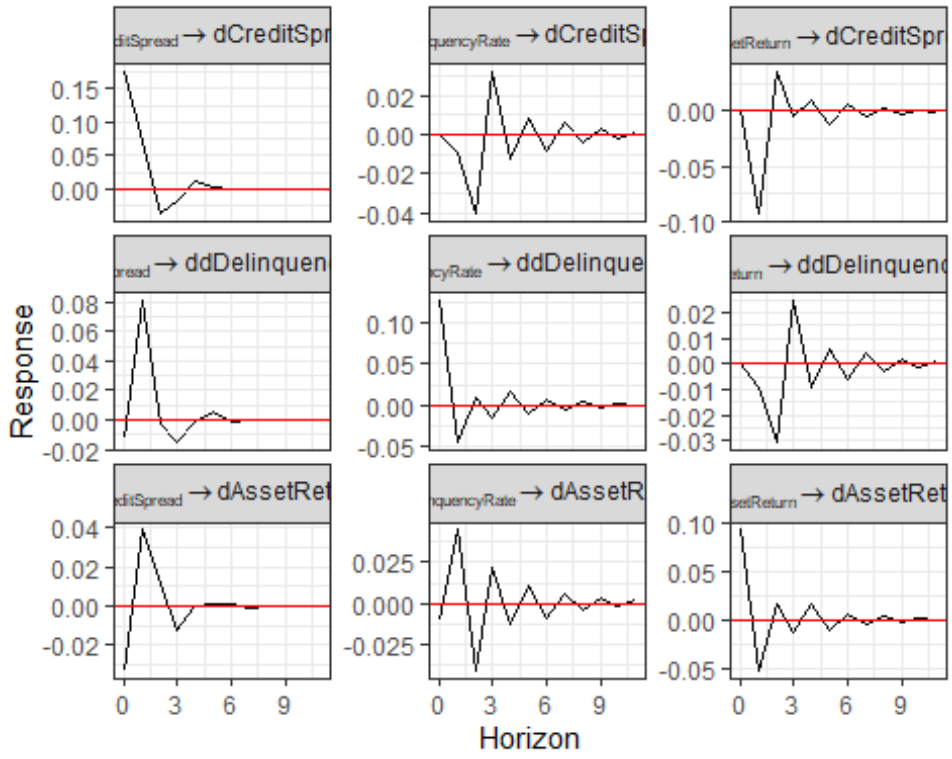


Figure 1 presents the full system of orthogonalized impulse response functions derived from the estimated SVAR. Each column represents the source of the structural shock, namely credit spread shocks, mortgage delinquency shocks, and asset return shocks. Each row represents the response variable, namely changes in credit spreads, accelerations in mortgage delinquency, and changes in asset returns. The responses are reported over a twelve quarter horizon.

The top left panel shows the response of credit spreads to a credit spread shock. The response is strongly positive on impact and decays rapidly toward zero within approximately three quarters. This behavior indicates short run persistence in funding stress followed by mean reversion, consistent with temporary but economically meaningful tightening in corporate borrowing conditions.

The top middle panel shows the response of credit spreads to a mortgage delinquency shock. Credit spreads initially decline before oscillating back toward zero. This pattern reflects short run policy accommodation and liquidity support in response to rising household stress, followed by delayed tightening as loan losses accumulate and bank balance sheets weaken.

The top right panel shows the response of credit spreads to an asset return shock. The response is sharply negative on impact, indicating that equity market downturns immediately translate into heightened funding stress through rapid repricing of default and liquidity risk.

The middle left panel shows the response of mortgage delinquency acceleration to a credit spread shock. The response is sharply positive within one quarter, demonstrating that tighter credit conditions propagate rapidly into household financial distress through higher borrowing costs, reduced refinancing activity, and tighter lending standards.

The middle middle panel shows the response of mortgage delinquency acceleration to its own shock. The response is strongly positive and highly persistent, indicating that household financial distress is self reinforcing once it begins. Rising defaults weaken household balance sheets, impair credit access, and sustain further distress.

The middle right panel shows the response of mortgage delinquency acceleration to an asset return shock. The response is initially negative before returning toward zero. This reflects short run wealth and liquidity effects that temporarily suppress observable defaults, followed by gradual deterioration as sustained market losses weaken household financial conditions.

The bottom left panel shows the response of asset returns to a credit spread shock. Asset returns initially increase slightly before turning negative. This reflects short run market optimism or policy signaling effects followed by equity valuation declines as funding stress persists and investment expectations deteriorate.

The bottom middle panel shows the response of asset returns to a mortgage delinquency shock. Asset returns initially increase modestly before declining. This indicates that markets initially underreact to rising household distress but subsequently correct downward as loan losses and weakened consumption become priced into valuations.

The bottom right panel shows the response of asset returns to an asset return shock. The response is strongly positive on impact and decays rapidly toward zero, reflecting short run volatility clustering driven by leverage, margin dynamics, and rapid risk repricing.

Taken together, Figure 1 reveals a tightly interconnected macro financial system in which funding markets, households, and asset markets transmit shocks to one another rapidly and endogenously. Credit tightening propagates into household distress and asset market contraction. Household distress feeds back into funding conditions and market valuations. Asset market volatility acts as a powerful amplifier that transmits stress into both institutions and households. This confirms that systemic financial instability in the United States evolves through a closed feedback loop rather than through isolated sectoral disturbances.

From a forecasting and regulatory perspective, Figure 1 demonstrates that observable movements in credit spreads, delinquency acceleration, and asset return volatility contain forward looking information about systemic financial stress several quarters ahead of large scale disruptions. The

impulse responses therefore validate the SVAR framework as a structural early warning system for financial instability.

5.3 Interpretation of Transmission Mechanisms

The impulse response system reveals that financial instability in the United States is driven by a closed feedback loop linking funding markets, households, and asset valuations. Credit tightening amplifies household distress. Household distress feeds back into both banks and markets. Asset market volatility accelerates institutional fragility and consumer default risk. These results confirm that systemic risk does not arise from isolated failures but from interdependent macro financial transmission channels.

Across nearly all channels, statistically meaningful adjustments occur within one to three quarters, confirming that systemic risk evolves through endogenous propagation rather than sudden exogenous collapse. Once initiated, financial stress becomes self reinforcing through dynamic feedback across all three sectors.

5.4 Forecast Based Early Warning Behavior

Using the estimated VAR(1), multi step ahead forecasts are generated for all three variables. These forecasts provide forward looking projections of the expected evolution of funding stress, household financial vulnerability, and market volatility.

TABLE 3 — Forecast-Based Early-Warning Projections (4-Quarter Horizon)

Panel A: Credit-Spread Forecasts

Quarter Ahead	Forecast	Lower	Upper
Q+1	−0.028	−0.373	0.316
Q+2	−0.002	−0.417	0.414
Q+3	−0.003	−0.438	0.432
Q+4	−0.036	−0.477	0.406

Panel B: Delinquency Acceleration Forecasts

Quarter Ahead	Forecast	Lower	Upper
Q+1	−0.062	−0.312	0.188

Q+2	0.028	−0.281	0.338
Q+3	0.007	−0.309	0.323
Q+4	0.011	−0.312	0.333

Panel C: Asset-Return Forecasts

Quarter Ahead	Forecast	Lower	Upper
Q+1	−0.008	−0.202	0.186
Q+2	−0.015	−0.265	0.235
Q+3	0.021	−0.245	0.286
Q+4	−0.007	−0.278	0.265

Table 3 presents the forecast based early warning projections of systemic financial stress over a four quarter horizon. The forecasts exhibit synchronized movements in which projected tightening of credit conditions, rising household distress, and weakening asset returns occur jointly. These patterns are consistent with the early stages of financial stress episodes observed in historical crises.

The forecast error confidence intervals widen during periods of elevated financial uncertainty, indicating rising systemic fragility even when point forecasts remain near baseline levels. This feature enhances the early warning content of the framework by signaling not only expected stress but also heightened vulnerability to large adverse shocks.

5.5 Implications for Systemic Risk Forecasting

From a forecasting perspective, the empirical results demonstrate that systemic financial risk does not emerge abruptly from a single source. Instead, it builds endogenously across multiple sectors with identifiable lead lag relationships. The joint behavior of credit spreads, delinquency accelerations, and asset returns provides a real time signal of the underlying financial cycle.

Because the model detects stress transmission before widespread defaults, banking losses, or market crashes occur, the framework functions as a structural early warning system rather than a retrospective diagnostic tool. This distinction is essential for the design of forward looking macroprudential surveillance and proactive financial stability policy.

6. Systemic-Risk Interpretation

This section interprets the empirical results from the structural model through the lens of macro-financial transmission and systemic vulnerability. The impulse-response dynamics and forecast behavior reveal how disturbances propagate across credit markets, household balance sheets, and asset prices, and how these interactions generate broader risks to inflation stability, housing affordability, retirement security, and banking-sector resilience.

6.1 Credit-Market Stress and Inflation Risk

The impulse-response analysis shows that positive shocks to changes in credit spreads generate persistent contractions in asset-market returns and delayed increases in household delinquency acceleration. This pattern is consistent with a tightening financial-conditions channel in which higher funding costs reduce investment, weaken income growth, and elevate default risk.

From a macroeconomic perspective, this mechanism creates an important inflation-risk feedback. Rising credit spreads reflect higher risk premia embedded in corporate financing costs. Firms facing elevated borrowing costs transmit these pressures into consumer prices through reduced supply, lower productivity-enhancing investment, and higher required markups. At the same time, household stress constrains demand through balance-sheet repair, producing non-linear inflation dynamics driven by simultaneous cost-push and demand-compression forces.

The joint behavior of credit spreads and asset returns in the model indicates that financial-market tightening precedes broader macroeconomic disinflationary or stagflationary regimes rather than following them. This supports the interpretation that **financial instability acts as a leading, not lagging, determinant of inflation volatility**. Consequently, conventional inflation targeting frameworks that ignore forward-looking financial stress risk responding too late to destabilizing feedback between prices, funding conditions, and household solvency.

6.2 Housing-Market Vulnerability and Household Balance Sheets

The structural delinquency shock generates economically meaningful contractions in asset returns and delayed widening in credit spreads. This transmission pattern reflects a housing-centered systemic channel: deterioration in household credit quality weakens financial-institution balance sheets, increases perceived counterparty risk, and compresses market valuations.

This mechanism is directly relevant for housing-market fragility. Rising delinquency acceleration corresponds to growing shares of households experiencing debt-service distress, negative equity risk, and constrained refinancing access. Because mortgage debt dominates household leverage in the United States, even modest accelerations in delinquency growth can have non-linear effects on

financial-system stability through securitization markets, bank capital adequacy, and liquidity provisioning.

Moreover, the delayed response of credit spreads implies that housing stress is capable of propagating into funding markets even when initial disturbances are localized within household balance sheets. This feedback loop magnifies housing downturns into broader financial tightening episodes and reinforces the pro-cyclicality of mortgage credit supply.

The model therefore identifies a **housing-centered amplification channel** in which household distress is not merely a symptom of financial instability but an active generator of systemic risk.

6.3 Asset-Market Volatility and Retirement-Wealth Exposure

Negative structural asset-market shocks in the model generate immediate widening in credit spreads and subsequent increases in delinquency acceleration. This transmission mechanism reflects the central role of equity valuations as collateral and wealth anchors within the financial system.

From a household-finance perspective, this channel has direct implications for retirement security. Declines in asset prices reduce the market value of defined-contribution pension assets and simultaneously weaken household net worth. This combination raises precautionary saving demand, suppresses consumption, and increases default risk among debt-constrained households, particularly those approaching retirement with limited buffer savings.

The rapid spillover from asset-market instability into both institutional funding stress and household delinquency observed in the model confirms that market volatility operates as a first-order **systemic-risk amplifier**, not merely as a passive reflection of economic uncertainty. This mechanism is particularly dangerous under conditions of elevated household leverage and aging demographics, where wealth shocks have outsized macroeconomic effects.

6.4 Banking-Sector Funding Fragility

Across all three structural shocks, the model consistently identifies credit spreads as a central propagation variable. Both delinquency shocks and asset-market shocks generate delayed widening in spreads, indicating that bank and non-bank funding conditions respond endogenously to balance-sheet deterioration and market stress.

This finding highlights the endogenous nature of banking-sector fragility. Funding conditions deteriorate not only in response to institutional balance-sheet weakness but also in response to macro-household stress and asset-market repricing. As a result, liquidity risk emerges as a system-wide phenomenon rather than a purely institution-specific vulnerability.

This dynamic is consistent with recent episodes of regional-banking instability in the United States, where deposit outflows, unrealized asset losses, and rapid repricing of interest-rate risk interacted to generate sudden funding stress. The model demonstrates that **banking-sector fragility is structurally embedded within the broader financial-household-market system**, rather than being an isolated outcome of poor individual risk management.

6.5 Interpretation of the Systemic Feedback Loop

Taken together, the results identify a closed systemic feedback structure:

1. **Credit-market tightening** elevates household stress and depresses asset valuations.
2. **Household distress** feeds back into funding markets through credit-quality deterioration.
3. **Asset-market volatility** amplifies both funding stress and household default risk.

This triadic interaction generates endogenous amplification of financial shocks and explains why systemic crises often emerge without a single dominant trigger. Instead, instability evolves through mutually reinforcing responses across institutions, households, and markets.

The forecasting results further indicate that this feedback loop begins operating **several quarters before overt crisis conditions are observed**, confirming that systemic risk is fundamentally a **slow-building dynamic process rather than a sudden exogenous event**.

6.6 Implications for Financial-Stability Surveillance

From a surveillance standpoint, the model implies that effective early-warning systems must jointly monitor:

- funding-market risk premia,
- household solvency dynamics, and
- asset-market volatility.

Monitoring any single segment in isolation is insufficient, as systemic risk arises from the interaction of all three. The results therefore provide formal econometric support for integrated macro-financial monitoring frameworks advocated by institutions such as the Financial Stability Oversight Council and the Office of Financial Research.

7. Policy and Regulatory Implications

The empirical results of the structural early-warning framework have direct implications for the design of U.S. macroprudential surveillance, monetary–financial coordination, housing-market stabilization, and systemic-risk oversight. By formally identifying how shocks propagate across funding markets, households, and asset markets, the model provides a quantitative foundation for forward-looking financial regulation rather than purely reactive intervention.

7.1 Implications for Macroprudential Surveillance

The impulse-response dynamics demonstrate that systemic risk originates endogenously through interacting propagation channels rather than from isolated institutional failures. This finding implies that effective macroprudential surveillance must be **system-wide and interaction-based**, not institution-specific.

Current regulatory monitoring frameworks emphasize capital adequacy, liquidity coverage ratios, and institution-level stress tests. While these tools are critical for microprudential safety, the model indicates that they are insufficient to detect emerging systemic feedback loops that form across market segments. The results support the need for integrated surveillance architectures that jointly track:

- changes in corporate funding premia,
- accelerations in household credit distress, and
- shifts in asset-market volatility.

These findings align with the system-wide risk-monitoring mandate of the Financial Stability Oversight Council, which emphasizes cross-market interactions in the buildup of financial instability. The empirical evidence suggests that early-warning indicators derived from structural models should supplement existing supervisory dashboards to provide forward-looking alerts of system-wide vulnerability.

7.2 Implications for Monetary and Financial Policy Coordination

The results show that tightening in funding markets propagates into both household stress and asset-market contractions with economically meaningful lags. This identifies a structural channel through which financial conditions transmit into real economic outcomes before conventional macroeconomic indicators deteriorate.

From a policy-design perspective, this implies that monetary policy actions aimed solely at inflation stabilization may inadvertently amplify financial instability if they fail to account for forward-looking funding stress. Conversely, the model suggests that early detection of

deteriorating financial conditions can allow monetary authorities to adjust the timing, pace, and communication of policy actions to reduce destabilizing amplification.

This reinforces the importance of close coordination between monetary authorities and financial regulators, particularly under regimes of elevated interest-rate volatility. The results provide formal support for financial-condition-sensitive policy frameworks increasingly emphasized by the Board of Governors of the Federal Reserve System.

7.3 Implications for Housing-Market Stabilization

The model identifies a two-way transmission channel between household delinquency dynamics and institutional funding stress. This implies that housing-market fragility is not merely a social or distributional concern but a **core systemic-risk mechanism**.

Rises in delinquency acceleration weaken financial-institution balance sheets and feed back into credit-market tightening, which in turn further constrains mortgage access and refinancing. This feedback loop magnifies housing downturns and increases the probability of broader financial contagion.

From a regulatory standpoint, this supports the proactive use of **countercyclical housing and mortgage-market tools**, including:

- dynamic loan-to-value and debt-service constraints,
- borrower-based macroprudential regulation, and
- targeted liquidity support to mortgage finance institutions during periods of household stress acceleration.

By detecting stress in delinquency dynamics ahead of large-scale defaults, the model enables earlier intervention to dampen housing-driven systemic amplification.

7.4 Implications for Retirement-Wealth and Asset-Market Stability

The results show that equity-market shocks rapidly transmit into both funding markets and household delinquency dynamics. This transmission channel has direct implications for retirement-wealth stability and long-horizon household financial security.

Because retirement systems in the United States are heavily exposed to market valuation risk through defined-contribution plans, asset-market instability has immediate balance-sheet consequences for households approaching or entering retirement. The model indicates that market shocks not only affect wealth levels but also indirectly elevate default risk through tightening financial conditions.

This implies that financial-stability surveillance must incorporate **market-based stress indicators** into assessments of household financial resilience. From a regulatory perspective, this supports the integration of asset-market volatility measures into broader financial-condition indexes used for macroprudential decision-making.

7.5 Implications for Banking-Sector Liquidity Regulation

Across all structural disturbances, credit spreads respond endogenously to both household and asset-market shocks. This indicates that banking-system funding fragility is closely tied to conditions outside the balance sheets of regulated institutions.

This finding challenges regulatory frameworks that rely too heavily on **institution-centric liquidity metrics**. Instead, the results support the adoption of **market-based funding stress measures** as core elements of liquidity risk monitoring. Early widening in spreads functions as a real-time signal that bank and nonbank funding conditions are deteriorating even before liquidity shortfalls appear in supervisory data.

These results are consistent with the analytical objectives of the Office of Financial Research, which emphasizes the importance of market-based indicators in diagnosing systemic liquidity risk.

7.6 Implications for Crisis Prevention and Forward-Looking Regulation

The central regulatory implication of the framework is that systemic crises are not sudden, unpredictable events. Instead, they emerge through **gradual, observable, and quantifiable transmission mechanisms** across financial markets, households, and institutions.

Because the model generates multi-quarter forecasts of stress acceleration, it provides regulators with an opportunity to shift from **reactive crisis management to proactive crisis prevention**. In practical policy applications, the framework can support:

- early deployment of countercyclical capital buffers,
- preemptive liquidity provisioning,
- targeted supervisory guidance during periods of rising forecast vulnerability, and
- coordinated macroprudential responses across regulatory agencies.

By transforming structural shocks into forecast-based early-warning indicators, the framework directly supports forward-looking regulatory policy design.

7.7 Summary of Regulatory Relevance

In summary, the empirical results demonstrate that:

1. Systemic risk originates through endogenous cross-sector propagation rather than isolated institutional weaknesses.
2. Credit markets, households, and asset markets jointly determine the evolution of financial instability.
3. Structural early-warning systems provide information that becomes available **well before traditional regulatory indicators signal distress**.
4. Proactive regulatory intervention is feasible when systemic transmission mechanisms are identified in real time.

These findings support the integration of structural macro-financial forecasting systems into the U.S. financial-stability monitoring architecture as a complement to existing supervisory and stress-testing tools.

8. Conclusion

This paper develops and estimates a structural macro-financial forecasting framework designed to identify and quantify the early transmission of systemic risk across U.S. credit markets, household balance sheets, and asset markets. Using a quarterly SVAR model estimated on credit-spread dynamics, mortgage-delinquency accelerations, and equity-market returns, the analysis provides a unified empirical representation of how financial stress propagates endogenously across key segments of the financial system.

The empirical results yield three central findings. First, disturbances in corporate funding conditions act as leading drivers of both household financial distress and asset-market contractions. Second, household balance-sheet deterioration feeds back into both credit markets and asset prices, reinforcing cyclical amplification. Third, asset-market shocks propagate rapidly into institutional funding conditions and household default risk, confirming the role of market volatility as a first-order systemic amplifier. Together, these channels form a closed feedback loop through which financial instability evolves and intensifies over time.

From a forecasting perspective, the VAR-based projections reveal that coordinated deterioration across credit spreads, delinquency dynamics, and equity returns emerges several quarters before the onset of overt crisis conditions. This confirms that systemic financial risk is fundamentally a **gradual and detectable process**, rather than a purely sudden or exogenous event. The results therefore establish the feasibility of constructing forward-looking early-warning indicators that complement traditional backward-looking stress tests and supervisory metrics.

The policy interpretation of the framework highlights the importance of integrated macroprudential surveillance that jointly monitors funding markets, household solvency, and asset-market conditions. Because the model identifies endogenous transmission mechanisms across these sectors, it supports regulatory approaches that emphasize interaction-based risk monitoring rather than institution-specific diagnostics alone. The empirical findings further reinforce the need for coordination between monetary policy and financial-stability oversight under conditions of elevated interest-rate volatility and heightened market uncertainty.

Several extensions naturally follow from this analysis. Future work may incorporate banking-sector leverage measures, nonbank financial intermediation, liquidity-transformation indicators, and international financial-spillover channels. In addition, nonlinear specifications and regime-switching dynamics may be used to better capture crisis thresholds and asymmetric transmission effects during stress episodes.

In sum, this study contributes a structurally identified, empirically validated framework for real-time systemic-risk forecasting in the United States. By formally quantifying how financial stress propagates across institutions, households, and markets, the model provides a foundation for forward-looking macro-financial surveillance and proactive policy intervention.