



---

## **A Practical Approach to Firmwide Stress Testing**



---

## Table of Contents

---

<b>Background and Overview .....</b>	<b>1</b>
<b>The Need for Stress Testing .....</b>	<b>1</b>
<b>Building Stress Capability .....</b>	<b>2</b>
<b>Benefits of a Firmwide Stress Testing Framework .....</b>	<b>3</b>
<b>SAS® High-Performance Computing for Stress Testing.....</b>	<b>3</b>
<b>SAS Has Been at the Forefront of Stress Testing .....</b>	<b>6</b>

## Background and Overview

Stress tests have been used in the past by risk practitioners in larger banks to assess the impact of a scenario on the value of its portfolio. However, the global financial crisis that began in 2007 generated new interest in stress testing. The financial crisis revealed weaknesses in the organizational aspects of current stress testing programs. Prior to the crisis, stress testing was performed mainly as an isolated exercise by the risk function within a bank, and results were manually reported to regulators. Further, differing stress events and assumptions used in each model also meant that the outputs could not be easily aggregated into a meaningful, combined result. Results of each model were reviewed independently, making comparison across risk types or assets impossible. The financial crisis also highlighted the use of macroeconomic stress testing as an important part of any stress testing framework.

The limitations of prior stress testing frameworks, and the unprecedented adverse impact of the financial crisis, have highlighted the need for a new comprehensive stress testing framework that will allow organizations to aggregate information across the firm and to assess vulnerability to interrelated events across all risk and asset types. In addition, there is also strong interest in making stress testing solutions more accessible to teams outside the risk management function.

SAS® High-Performance Computing for stress testing, which addresses many of the past difficulties that firms experienced with firmwide stress testing, has a flexible infrastructure that lets organizations adapt to future requirements as they evolve.

## The Need for Stress Testing

The need and usefulness of stress tests have been identified by regulators globally, and through efforts to meet Basel II and Basel III requirements, most banks have recognized this as well. Further, banks anticipate an increase in regulatory stress testing to determine standards for regulatory capital and the health of the financial services industry.

As part of the US Federal Reserve System's Supervisory Capital Assessment Program, all banks within the US and globally have been required by their regulatory agencies and their boards to greatly enhance their stress testing processes.

Firmwide stress testing across asset classes, positions and business lines must improve to ensure appropriate risk capture and to aggregate stress test/risk calculation results more consistently and effectively.

- Supervisors should consider complementary supervisory stress test exercises, based on common scenarios for banks in their jurisdiction. These may be used to assess risk across banks at a range of levels (from the portfolio level to aggregate firm-wide exposures). Supervisory determined stress scenarios can enhance the ability of supervisors and banks to assess the impact of specific stress events.

*Principles for Sound Stress Testing  
Practices and Supervision  
BIS, January 2009*

Stress testing provides benefits above the tenets of Basel II and Basel III by going beyond individual bank assessments. An assessment incorporating cross-firm analyses using consistent scenarios, loss rates and data will enable a consistent evaluation of bank quality and sensitivity to key risk factors.

The introduction of stress testing to the existing collection of regulatory reports has also triggered the need for more granularity in each asset class at the individual position level within each bank. If banks and regulators alike were able to capture all positions at the most granular level, a comprehensive analytic platform for both stress testing and other regulatory inquiries could be developed. A question arises, though, as to the cost of this platform. While this platform could increase accuracy, consistency and responsiveness of a systematic stress testing process, it may increase the initial cost of compliance for banks and regulators even if the long-term costs may be reduced.

### Building Stress Capability

The Supervisory Capital Assessment Program test required designing a valid and meaningful stress test, compiling results, comparing bank submissions, adjusting values and interpreting the findings. This process took three to four months.

Developing an integrated approach to risk evaluation, especially under stress scenarios, is needed to understand events that have effects across risk types, which, when combined, could result in exposure beyond isolated test results.

Coverage and consistency are currently the largest barriers in many firms. Coverage is hindered as disparate information prohibits a consolidated view of all assets. Consistency has not been realized as multiple versions of data, valuation methods and models persist.

To build standardized, firmwide stress testing capability, coverage of all assets within banks will be needed. The Bank Call Report (FFIEC 041) collects all positions in an equivalent manner for all banks. Using the report categories as a baseline of positions establishes the universe of asset classes.

Consistency is critical. Building standardized risk and valuation calculations for the entire firm ensures a consistent foundation for calculations. Setting standards for calculations will help remove subjectivity from valuation and provide guidance for functionality.

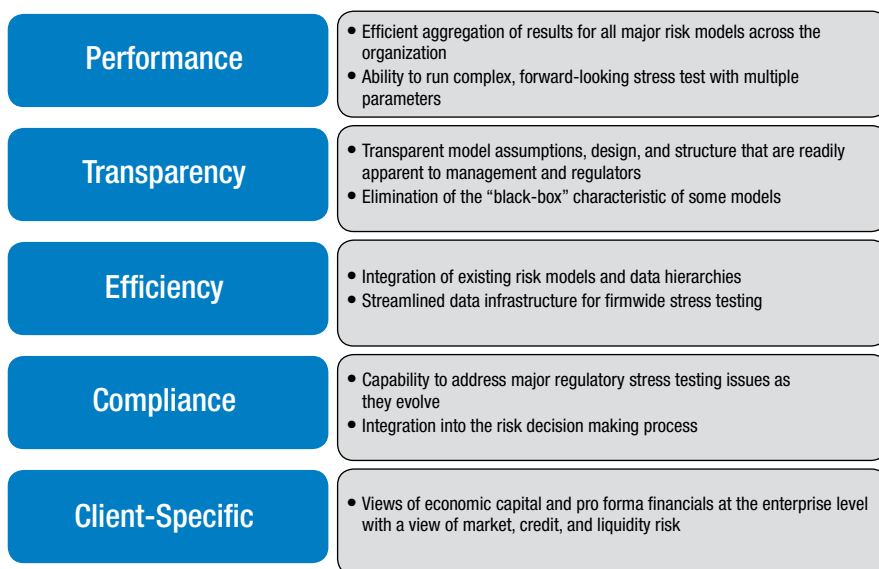
With a foundation of individual position data, more complex or ad hoc stress tests can be run to address specific risks in rapidly changing markets. For example, regulators could stress test specific asset classes (e.g., mortgages), specific regions, specific companies or specific counterparties.

■ “We’ve learned important lessons in the capital assessment process that will inform our supervisory efforts in the future. Notably, the process of comprehensively evaluating 19 major firms represented an important step forward in consolidated supervision, as it gave us insights into the challenges posed in understanding risks and exposures across complex organizations.”

**Ben Bernanke**  
*Chairman, Federal Reserve Bank  
Financial Markets Conference  
May 2009*

## Benefits of a Firmwide Stress Testing Framework

With an increased commitment to stress testing, there is a need to improve flexibility and efficiency around the process. Building this flexible stress testing capability within each of the banks would dramatically reduce the manual rework costs involved in creating timely stress tests. Banks, as well as regulators, would receive the benefits gained from best practices and from access to shared research, expertise and learning. A standard framework within the financial institution would provide many benefits:

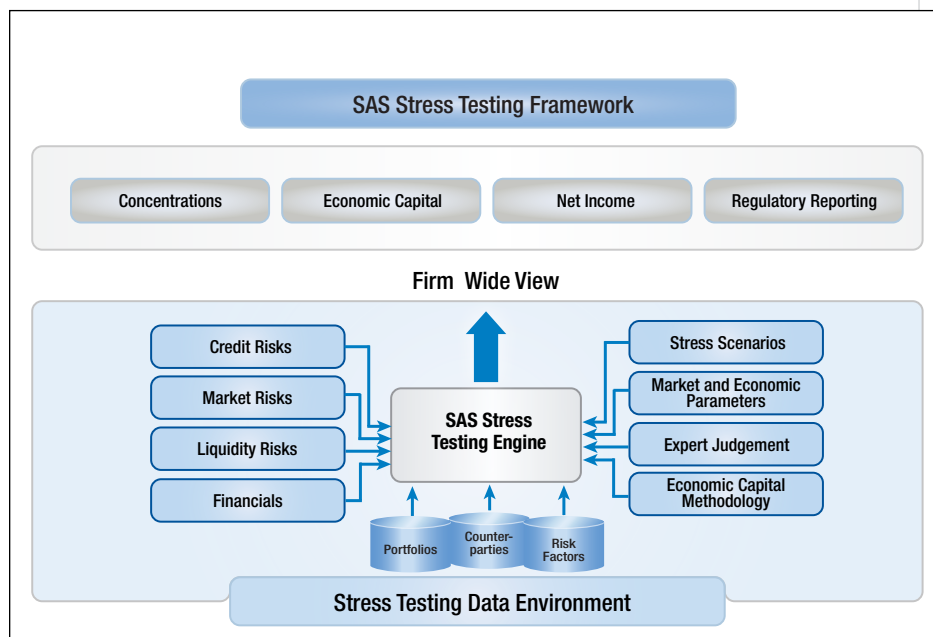


## SAS® High-Performance Computing for Stress Testing

Stress testing is a collective term that describes techniques that can be used to estimate a portfolio’s potential losses when subjected to exceptional or extreme events. To perform stress testing, shocks are applied to risk factors, such as interest rates or foreign exchange rates that, in turn, drive the value or cash flows of instruments in the portfolio. In this way, portfolio performance can be examined assuming extreme movements in the underlying risk factors. Ideally, this information is used by decision makers to either hedge or diversify a portfolio so that an extreme event will not wipe it out.

Successfully executing an enterprise stress testing program requires a technology framework that enables data, scenarios, analytics and reports to be integrated across the organization. Stress testing platforms should be flexible enough to enable lines of business, trading desk and corporate risk management groups to generate multifactor stress tests and store the information for later use.

The SAS High-Performance Computing for stress testing solution incorporates both technology and business consulting that assists risk management departments, lines of business and trading desks in enhancing their stress testing process. The offering provides an end-to-end framework for managing all aspects of the stress testing environment, including data, pricing model integration, exposure calculations and reporting.



The SAS solution enables financial institutions to aggregate both the bank book and trading book in one stress test environment so that a common set of stress scenarios and stress factors can be applied. SAS advanced analytics are then used to stress the firmwide portfolio and perform the exposure and capital calculations. Additionally, SAS can also integrate most existing firmwide models that may be in use today, eliminating the need to rewrite existing models that have been developed for stress testing. The SAS platform can support not only SAS models, but C, C++, R and a number of other formats. Risk factor data, such as macroeconomic variables, credit behavior data, financial information and others, can be easily integrated via the data integration environment provided with the solution.

By integrating portfolio data and risk measurements into a single environment, the solution enables a firmwide view of risk that not only accelerates the process of stress testing, but also reduces the complexity and time needed to comply with regulatory requirements. The following are key features of the SAS High-Performance Computing for stress testing solution:

- **Analytic Data Hub for Risk Management**

Many trading desks and risk management groups conduct stress tests to supplement their risk analysis. However, these stress tests are often done in silos by individual analysts in each area of the institution. The integrated SAS solution enables you to integrate data from multiple sources and verify that assumptions are consistent.

- **Data Integration Environment for Stress Testing**

SAS has created a very compelling data environment to remove the complexity and manual efforts typically required with stress testing by creating an integrated platform that allows banks and other financial services firms to rapidly aggregate portfolio data in conjunction with creating a standardized set of stress scenarios. Factors for stress testing can be easily integrated from both internal and external sources via an integrated data landing environment.

- **Broad Coverage of Instruments and Risk Factors**

The SAS risk analytics engine, on which the solution is built, provides the ability to run complex shock and recovery scenarios. The platform is configurable with respect to instrument types, risk factors and scenarios. As such, it supports a wide variety of financial instruments such as equities, fixed income, commodities, foreign exchange, structured finance, loans and OTC derivatives.

- **Common Scenario Repository**

SAS supports an advanced scenario builder functionality with support for both predefined and ad hoc scenarios. The predefined scenarios, as well as risk factors and reference data, can be approved for use across the organization and stored in a common repository so that stress results for every portfolio can be compared in a standardized way. Second, each portfolio is subject to custom, ad hoc scenarios specific to that portfolio. All results are stored in a common repository to enable consolidated reporting.

- **User Interface for Stress Testing**

Existing stress testing environments often require programming skills to use. While these types of systems work well for quantitative analysts, they tend to exclude business users from the process. The SAS solution includes a customizable, user-friendly interface that enables stress testing and scenario analysis for both quantitative analysts and business users. Capabilities include the ability to create ad hoc scenarios, define subportfolios, compare scenario results, and build reports.

- **Flexible Analytics Engine for Stress Testing**

The SAS Analytics engine used for stress testing is a flexible, open environment. Analysts can configure new instruments, develop new pricing functions, add new risk factors, create new stress scenarios and produce custom reports as needed.

## SAS Has Been at the Forefront of Stress Testing

Regulators around the world continue to emphasize that firmwide stress testing will be a major element of risk management for financial services. In the US, the first round of government-mandated stress tests provided useful capital adequacy insights, but was limited to approximating the capital buffer needed by the 19 largest US banks under highly generalized scenarios. Likewise, the recent stress tests in Europe were conducted using a set of equally generalized scenarios and simplifying assumptions.

In the future, government-mandated requirements for stress testing will become more comprehensive. In the US, the Dodd-Frank Wall Street Reform and Consumer Protection Act, signed into law in July 2010, requires the Federal Reserve to ensure that large and midsized financial institutions perform annual or semiannual stress testing. The act reinforces the need for comprehensive and transparent risk analysis across the firm. Regulators will specify processes and methodologies for financial institutions to assess capital adequacy under baseline, adverse and severely adverse scenarios.

Similarly, regulators in the EU will be implementing new stress testing procedures that will be required of most financial institutions in that region. These stress tests will be more comprehensive in nature than in the past and will be required on an annual basis at a minimum.

Banks will need to respond to the stress tests quickly while clarifying relevant risk factors and guidelines. Both the US SCAP and EU stress tests provided an unprecedented view of bank assets, but required weeks of manual position aggregation on spreadsheets. Given the short time frame, neither of these stress testing initiatives addressed the creation of repeatable processes or persistent infrastructure. Moreover, consistency of test results was not guaranteed, as multiple versions of disparate data, valuation methods and stress testing models persisted within and across institutions.

The stress testing capability of SAS is designed to speed the process of stress testing, while also being flexible enough to address future regulatory requirements. The SAS stress testing platform can enable firms to streamline the firmwide stress testing process by facilitating the integration of data and analytics into one stress testing environment. In previous engagements, SAS has seen customers realize up to a 50 percent reduction in stress testing costs while improving system performance dramatically. By using SAS for stress testing, many groups within an organization – including IT, risk management and lines of business – can realize significant benefits.





**SAS Institute Inc. World Headquarters +1 919 677 8000**

To contact your local SAS office, please visit: **[www.sas.com/offices](http://www.sas.com/offices)**

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.  
Copyright © 2010, SAS Institute Inc. All rights reserved. 104810\_63887.1210