



# A Five-Step Approach to Stress Testing Your Portfolio

## How to Prepare Your Portfolio for Dynamic Times

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With the continuing financial markets tumult, regulators are requiring assurances that portfolios can withstand economic downturns. Stress testing to measure and mitigate your portfolio's risk is both a savvy risk management strategy for US companies and an absolute mandate for international businesses.

*Fair Isaac has created a rich, analytically driven stress-testing methodology to help satisfy regulatory compliance and to help you better understand the risks you face.*

Stress testing can help you navigate your portfolio through rough times, turn less-than-ideal data into positive findings, assess portfolio vulnerabilities, prepare for events that interrupt your ability to execute business as usual, and recognize the warning signs of unexpected risk.

This paper provides insights into stress testing and addresses:

- Asking the right questions during stress testing
- Balancing industry-wide data with your portfolio's specific characteristics
- Selecting macro-economic variables
- Selecting scenarios for stress testing

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» **Focusing on the Real Stress-Testing Questions**

*“An IRB bank must have in place sound stress testing processes for use in the assessment of capital adequacy. Stress testing must involve identifying possible events of future changes in economic conditions that could have favorable effects on a bank’s credit exposures and assessment of the bank’s ability to withstand such changes...”*

—Basel II: 434

What is the biggest business problem risk managers face today? Is it determining the vulnerabilities in your portfolios? Knowing how to react to a perfect storm of decreasing liquidity, dropping equity, major financial company meltdowns and panicked consumers? Knowing when to act to reshape your portfolio?

The answer is all of the above. That’s why it’s so important to integrate stress testing into your standard practice to assess and address your portfolio’s risk. And while stress testing is wise within any organization, the Basel II accord makes stress testing mandatory to satisfy regulatory compliance in many countries.

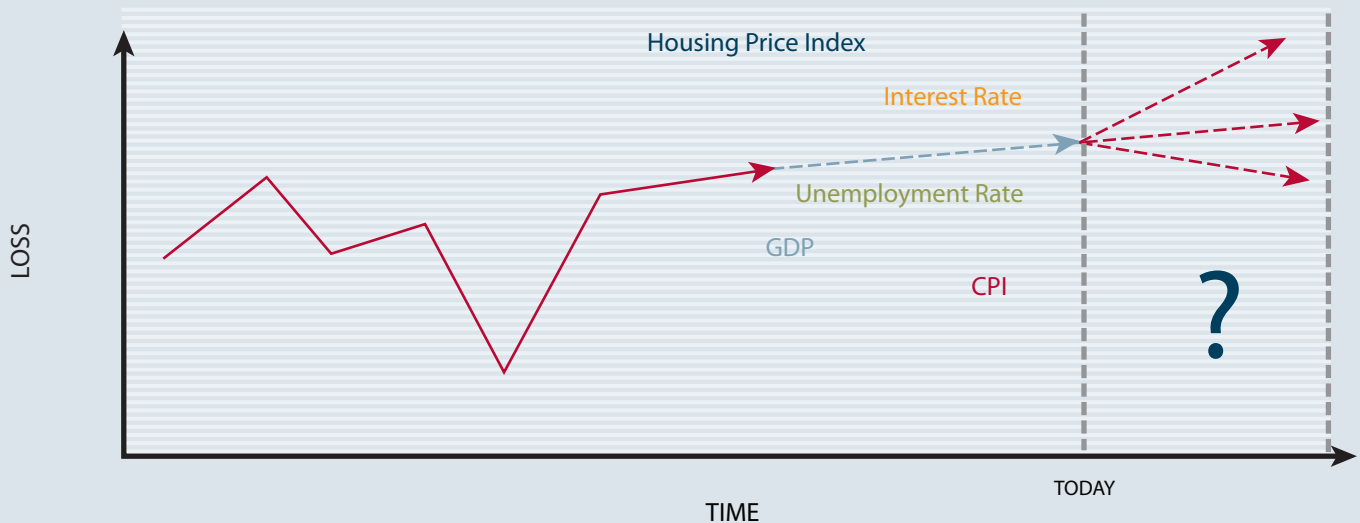
Fair Isaac recommends that risk managers proactively integrate stress testing into day-to-day risk management as a policy of best practice. This action can provide an organization with sound assessments and solid risk mitigation capabilities.

Environmentally, risk managers should be aware that stress on their portfolios is happening all the time. But, what happens if there’s a recession, a dip or an economic crash? How much can your liquidity and equity shift after a day like 9/11 or the financial market crisis of 2008?

You are in a better place to manage your capitalization if you’re fully aware of risk through stress testing. You can start by asking yourself a few questions to analyze your portfolio’s behavior under a variety of economic conditions:

- How might the risk in my portfolio shift under changing economic conditions?
- What is the risk in my portfolio under these conditions?
- What factors may signal these conditions, alerting me to a need for change?
- How should I adjust my capital reserves in these economic conditions?
- How should I adjust my acquisition and portfolio management strategies?

Figure 1: Measure for Unexpected Risk via Portfolio Stress Testing



Analyze your portfolio’s behavior across time and under a variety of economic conditions.

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### Real-World Challenges for Real-World Results

Stress testing is difficult in part because most portfolios have insufficient data to model both an economic expansion and contraction cycle. In addition, many analytic groups lack expertise in required analytic techniques.

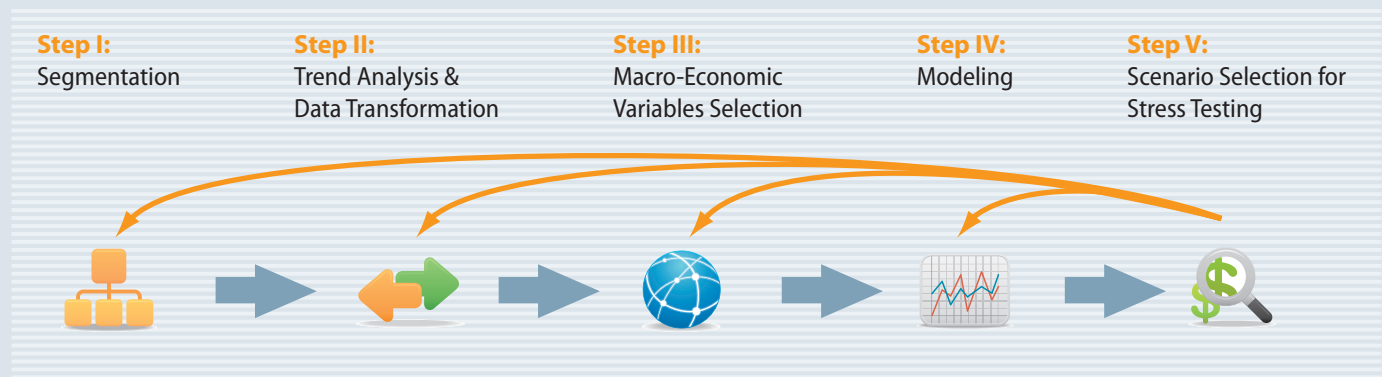
Fair Isaac’s best practices approach to this challenge includes:

- **Leveraging industry-wide data, when available, to enhance portfolio-level analysis.** This helps to fully capture the macro-economic effects that impact up and down cycles, and compensate for portfolio-level data that often covers a shorter time horizon. In addition, pooled industry data can also reduce the portfolio bias in your data.
- **Customizing models to your portfolio.** For example, you can model sensitivity using your bank’s specific portfolio data.
- **Using user-friendly simulation tools.** This allows you to conduct “what if” analyses on different scenarios, such as the recent housing downturn when liquidity dried up and equity declined.
- **Performing rigorous data evaluation and transformation.** Experienced modelers are essential to create the most effective solution.

### » The Five-Step Approach to Stress Testing

Fair Isaac recommends the following five steps for stress testing, and in this section, we offer some observations and recommendations related to each.

Figure 2: Steps I–V



The key steps in the Fair Isaac stress testing approach.

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### Step I: Segmentation Analysis

Economic conditions may not impact all people in the same way—some may be more sensitive to changing economic conditions than others. The Basel II Capital Accord expects finance institutions to be able to identify and understand sensitivities within homogenous and heterogeneous consumer pools, and capitalize accordingly.

For example, different regions within the same country may have different unemployment rates, and sensitivities to economic conditions. Thus, a model relating macro-economic conditions to default rates would not work well in all regions if it is not developed on a segmented population.

Additionally, different retail lending products, such as mortgages and credit cards, frequently exhibit different sensitivities to macroeconomic factors. Even within a specific loan type like mortgages, there can be different degrees of sensitivity to the economic conditions. Variable-rate products will be much more sensitive to lending rate changes than long-term fixed-rate products.

When selecting variables for segmentation, you should ensure that these variables are both implementable and intuitive. Implementable means that they are robust, stable and readily available for use in production. Intuitive means most parties can agree the variables are somehow related to the metric you are trying to predict. For example, if you are segmenting for credit risk, segmenting by FICO® score band makes sense, in that it is both available for use and an intuitive factor for risk segmentation.

### Step II: Trend Analysis and Data Transformation

When building time-series models, it's important to analyze trends in your variables, because a trend may cause two variables that are actually uncorrelated to appear correlated. For example, GDP tends to increase over time, and your portfolio volume may tend to increase over time. A simplistic analysis might reveal a correlation between these variables, where none really exists. To correct for this, you can remove trend by examining the rate change of GDP versus the rate change of your portfolio growth. This kind of trend analysis can help to reduce the noise on your data and help build more robust models.

To increase the predictive power of your models, another analytic step is transforming your data. Logarithmic transformations, for example, tend to be powerful tools that help remove non-linear effects in many models. Here, you would want to consider taking a log transformation of both your performance variable, such as your portfolio default rates, as well as your predictor variables, such as GDP.

Trend analysis and data transformations are frequently used together. For example, when modeling how your portfolio default rate changes with regard to economic conditions, you might consider building models with the following performance definitions:

- Untransformed portfolio default rate
- Change in portfolio default rate
  - i.e., This quarter's default rate minus last quarter's default rate
- Log of default rate
- Change in log of default rate
  - i.e., the log of this quarter's default rate minus the log of last quarter's default rate

We frequently find that this final metric, the log difference, yields the most effective models.

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### Step III: Selecting Macro-Economic Variables

There are many considerations to take into account when building time-series models.

As noted before, it's critical that the variables you use in stress-testing models are both implementable and intuitive. Here, implementable means that the variables are available during production, and are ones that you have the ability to forecast in your scenario testing. Intuitive means that the relationship between the macro-economic variables and your target variables makes sense.

Another key decision is to select proper time lags for relating the signal and the outcome, because the effects of macro-economic changes often take time to impact a portfolio. For example, you may correlate delinquencies with the unemployment rate, but the time lag could be two to three months from the loss of a job to the resulting delinquency. There is a trade-off here: The earlier the signal, the more opportunity you have to act on the information and shift your portfolio's risk exposure, but the earlier signals may be less robust as predictors.

It is important to consider a myriad of indices and macroeconomic variables—from unemployment to vehicle sales to Gross Domestic Product—to determine which ones are best to model your performance in terms of relevance, actionability, predictability and robustness.

Finally, there is frequently a correlation between default rates in one month and the default rate in the following month. This phenomenon is called *auto-correlation*, and you may need to consider including the previous month's information as a predictor in your model.

#### Figure 3: Consider Multiple Variables

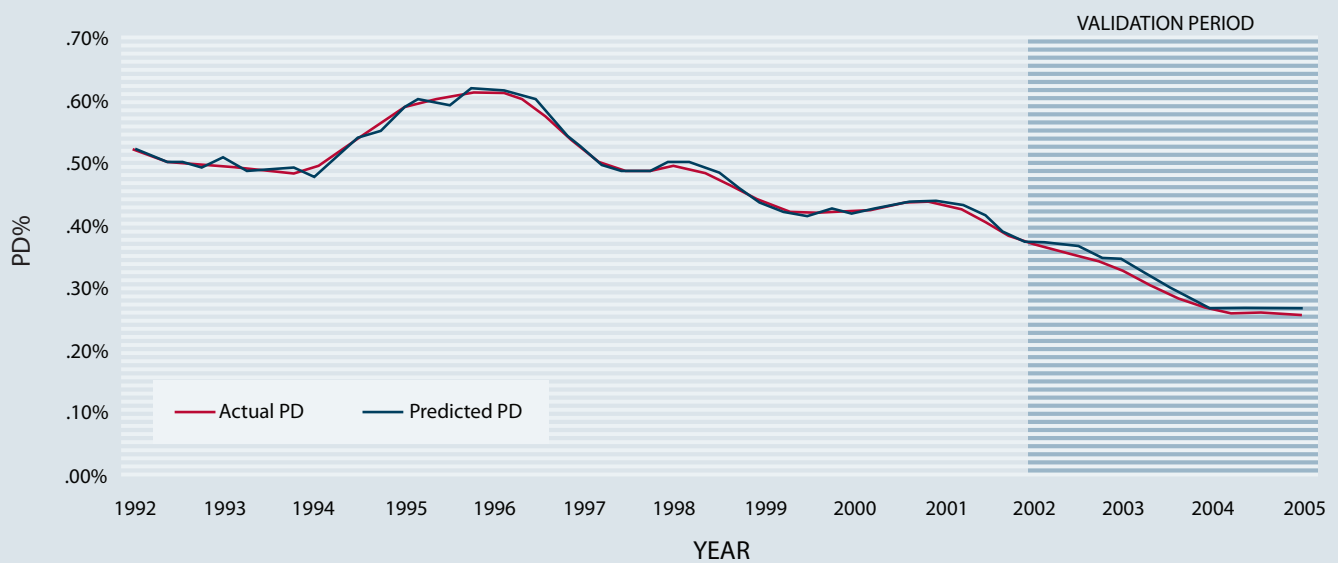
- ✓ Consumer Conditions (t-1)
- ✓ Employment Growth Rate (t)
- ✓ Car Sales (t-5)
- ✓ Outstanding Revolving Balance (t-3)
- ✓ Unemployment Rate (t-1)
- ✓ GDP (t-2)

Each of these variables can have a major impact on your stress test.

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**Step IV: Modeling**

A key challenge in building stress-testing models can be obtaining a long enough time series of data as the development base. For example, you may have a portfolio that was created only a few years ago, where ideally you should have two full economic cycles upon which to build the stress model. Your portfolio data alone may be insufficient to build a robust model, given the need to hold out some data for validation.

In this case, Fair Isaac recommends building an econometric model on a combination of industry-wide data and your own portfolio data.

**Figure 4: Actual vs. Predicted Probability of Default**


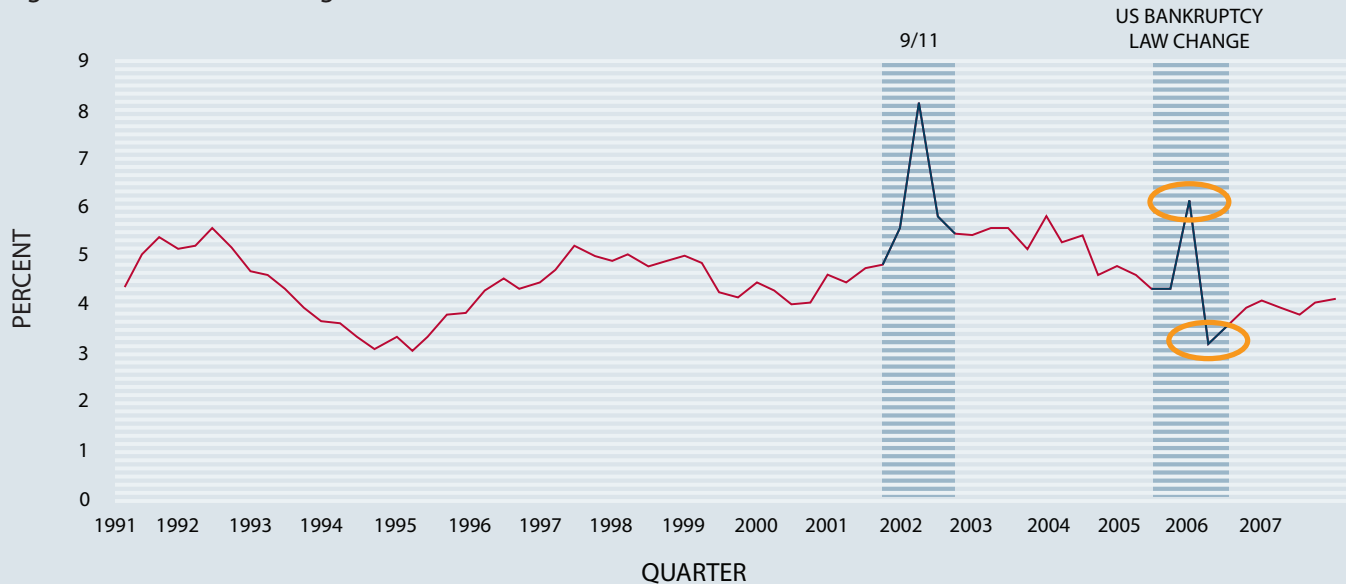
By following the best practices described, it is possible to build very accurate models. This shows the tight correlation between actual probability of default and a models' prediction of probability of default.

Combining industry and portfolio data for modeling can be performed in one of two ways:

- Identify the relationship between industry-wide and your own default rates, and use that relationship in the final model.
- Append your portfolio data to the industry-wide data where the portfolio data history begins, then retrain the econometric model to obtain new modeling parameters.

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Figure 5: Credit Card Charge-Off Rate (\$)



Data Source: Federal Reserve.

Dummy event indicators with proper lags should be included in the stress-testing models, in order to simulate the effects of unique, unexpected events.

Another issue is illustrated in Figure 5: Spikes due to unique events may interrupt long-term trends. This example includes 9/11, which affected global financial markets and contracted the money supply, and the US bankruptcy law change of 2006, which made it harder for consumers to file for bankruptcy, and thus caused bankruptcy filings to accelerate before the law changed. The change in the bankruptcy law led to a spike in charge-off rates in one quarter and a trough in the next quarter. It is important to recognize and appropriately handle events like these so that the end model more accurately captures the actual relationship between macroeconomic conditions and your portfolio default rates.

Fair Isaac advises that you add “dummy” variables in your model to adjust for these types of special events. But take care when adding dummy variables. For instance, an event like 9/11 can have “trickle down” effects: The event causes an unexpected jump in, for example, unemployment, which then goes on to increase your portfolio default rates. A model relating unemployment rates to portfolio default rates should correctly handle this kind of spike.

However, the bankruptcy law change is not the result of a trickle-down impact. Including this variable helps to reduce noise in the model: Without it, the model will attempt to fit the spike in default rates to macroeconomic variables, and this will likely lead to poor models. You can investigate this by comparing the variables in your model that are most predictive with the variable you are trying to predict: Frequently, you will see that they have similar patterns. You can then choose to add a dummy variable if there is a spike in your data that matches none of your macroeconomic variables, and it makes intuitive sense to do so.

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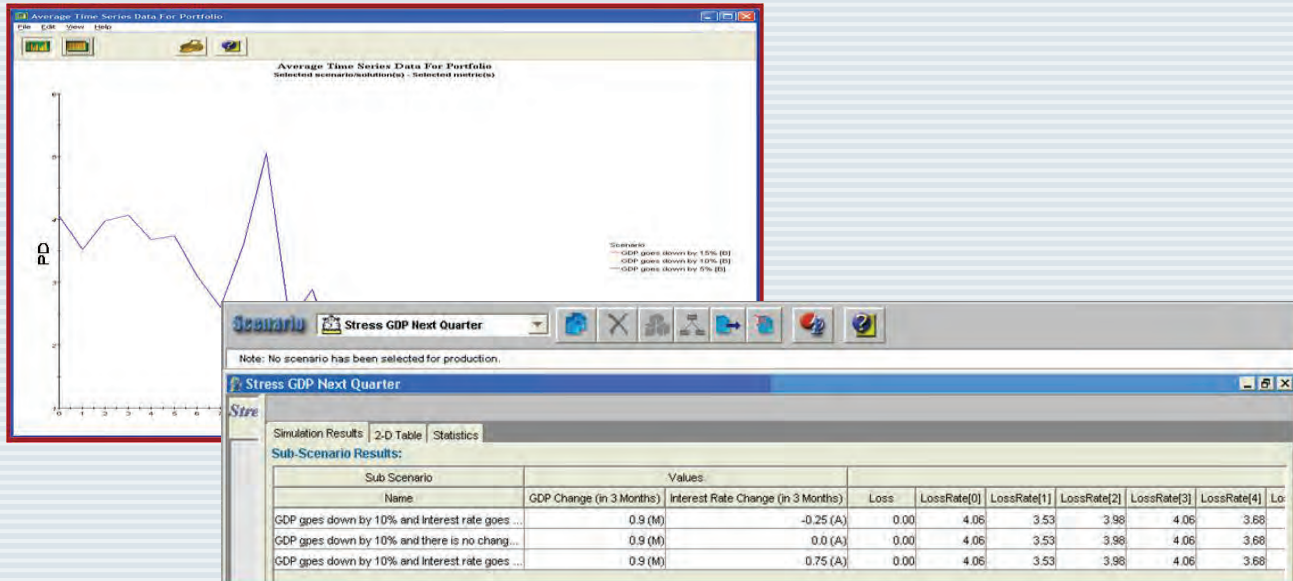
Crafting a “good” model requires that you consider both statistical and business concerns:

- **Statistical Concerns:** You should have sufficient development data that covers at least one whole economic cycle, ensure that the coefficients of the economic variables are statistically significant, and perform either an out-of-time validation or cross-validation.
- **Business Concerns:** The macroeconomic variables that you select in the model should be representative, robust and intuitive. It is wise to include in the model the leading economic index that is most relevant to the current and forward-looking business environment.

**Step V: Scenario Selection for Stress Testing**

Finally, you will want to consider a variety of future hypothetical economic situations, to ensure that your strategies will hold up in all of these situations. By using Fair Isaac’s Decision Optimizer software, you can perform a variety of these “What If” analyses for proper stress-testing analysis. For example, you can determine whether you are appropriately reserved under reasonable economic downturn scenarios.

Figure 6: Visualize What-If Analysis



Fair Isaac’s Decision Optimizer software can help you perform a myriad of “What If” analyses.

As shown in Figure 6, you can perform as many “What If” scenarios as desired for your stress test to yield the most robust results, including how your portfolio’s performance would be affected by changes in stock indexes, a 1% shift in unemployment rates, or even a historic event like 9/11 or the dot.com crash.



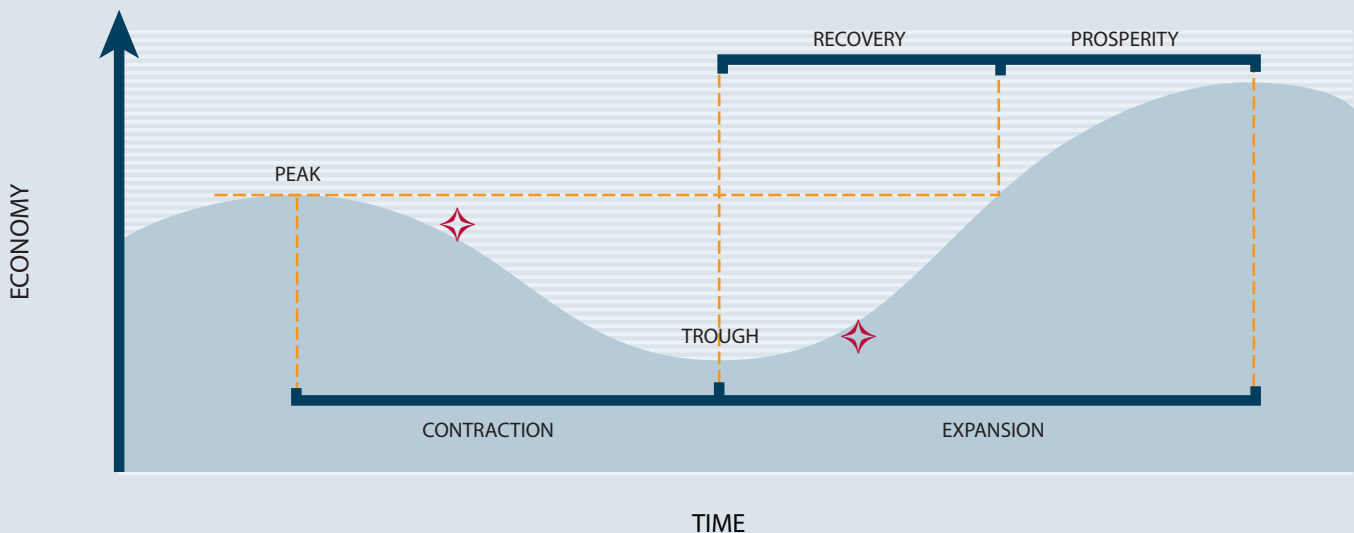
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## » Conclusions

Here are some general recommendations that can help you manage your portfolio and mitigate risk:

- **Be proactive about stress testing.** It's both a smart risk management strategy for companies and mandated internationally for Basel II compliance.
- **Perform stress tests at all times, from peaks to the troughs of economic cycles.** This can help not only navigate your portfolio through rough times, but capitalize on good times as well.
- **Supplement your own portfolio's data when necessary.** You can supplement your company data with industry-wide data, because performing any stress test is better than doing nothing at all.
- **Know that the future never truly mimics the past.** It's important to know not just how but *when* to act; proper stress testing will give you 12 to 18 months to respond to higher risk. Learn your portfolio's vulnerabilities. Seek warning signs for unexpected risk. Don't have a knee-jerk reaction to a downturn.
- **Today's actions create tomorrow's portfolio.** A severe contraction of credit availability now will impact tomorrow's profits. Continue to lend within proven and predictable segments.

Figure 7: The Opportunity to Act and Guide Your Portfolio Always Exists



It's important to stress test during economic peaks as well as troughs.

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