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Defining Economic Scenarios With Constant Severities

Introduction

Alternative economic scenarios are invaluable for quantifying and managing forecast risk. Given uncertainty and volatility, any single economic forecast will invariably be wrong. Behavior is constantly evolving and changing, making a perfect forecast sound like an oxymoron. Even though there is no perfect foresight, it does not mean that there is not utility to econometric modeling and forecasting. On the contrary, that we are unable to forecast with certainty makes the process of forecasting more valuable. An understanding of upside and downside risks—with quantifiable probability distributions—enables us to make informed choices rather than simply resign ourselves to the winds of fate.

Defining Economic Scenarios With Constant Severities

CRISTIAN DERITIS, SENIOR DIRECTOR AND SOHINI CHOWDHURY, DIRECTOR

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One way of dealing with this uncertainty is to consider alternative outcomes. This is why Moody's Analytics produces a standard set of alternative economic scenarios every month to complement its baseline, or "most likely," view of the economy. The probabilities associated with these scenarios are fixed over time, but the scenarios themselves change in severity depending on where the economy is in the business cycle. Moody's Analytics has recently developed an alternative set of scenarios with the opposite feature: The scenario definitions and severities are held constant over time, while the probabilities are allowed to fluctuate. For some applications, this construct may prove to be easier to explain and manage. In this article, we define these constant severity scenarios and the models used to estimate their probabilities. We also discuss the use of these scenarios for complying with the new Current Expected Credit Loss accounting standard set to go into effect in 2020.

In a world without perfect foresight, alternative scenarios play a critical role

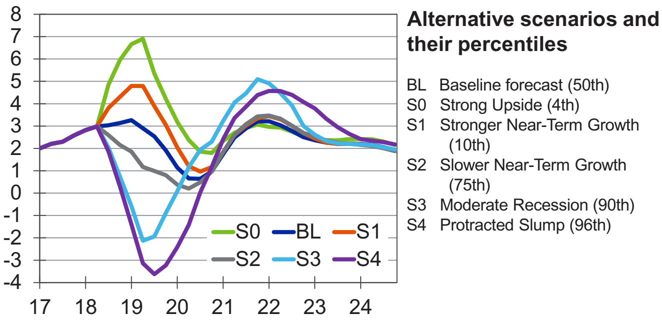
Some analysts may feel a sense of hopelessness in the face of uncertainty. What is the point of forecasting models if we cannot predict the future with perfect certainty? How can we possibly come up with forecasts that are "reasonable and supportable" if the future is unknowable? These are fair questions and ones that humanity has struggled with for thousands of years prior to the discovery of probability theory during the 17th century. Games of chance are instructive in this regard. While it is impossible to accurately predict the outcome of each spin of a fairly constructed roulette wheel, we do know that 47.4% of the time it will be red and 47.4% of the time it will be black (and 5.3% of the time it will land on the green 0 or 00). Far from shying away from the uncertainty of any single turn of the roulette wheel, casinos profitably embrace the odds and high rollers flock to the game tables in the hope that this time will be different. Of course, the economy is more complex than a simple game of chance. The forces influencing an economic outcome are nearly infinite, ranging from the daily decisions of the 8 billion people roaming the planet to the vagaries of the weather to the complex natural ecosystems that impact health and agricultural crops. Although the uncertainty may be larger and more nuanced than that faced by casinos, the risk management process itself is not all that different. If anything, the greater uncertainty in the outcomes argues for even more simulation testing and what-if sensitivity analysis—not less.

Lenders rely on probabilities in much the same way as casinos. Historical observation provides a basis for estimating performance under multiple conditions to borrowers with a variety of credit risk characteristics. Loss predictions under a variety of worst-case scenarios provide a range of plausible risks that lenders need to consider when setting their interest rates, while capital provides insurance against the tail risks or the known unknowns.

For this reason, Moody's Analytics has been producing alternative upside and downside economic scenarios to complement its baseline forecasts for the last 10 years. Using a fully endogenous, large-scale structural macroeconomic model along with a host of complementary dynamic stochastic general equilibrium and vector autoregressive models, Moody's Analytics is able to produce a full set of internally consistent scenarios for more than 100 countries on a monthly basis.

Chart 1: Various What-If Economic States

Real GDP, % change yr ago



Sources: BEA, Moody's Analytics

Trade flows, exchange rates, and financial market variables connect economies at the national and super-regional levels, leading to the forecasts of more than 15,000 variables over a 30-year time horizon each month.

More than one way of leveraging scenarios for CECL

The utility of alternative economic scenarios has been elevated recently by the introduction of new accounting standards intended to require banks, credit unions and other lenders to set aside loss reserves in advance of credit losses on their loan portfolios. International financial reporting standard IFRS 9 explicitly requires filers to consider both upside and downside scenarios when computing their projected losses. The CECL standard, which will go into effect at the beginning of 2020 for Securities and Exchange Commission-registered institutions in the U.S., does not require the explicit use of multiple economic scenarios but does impose the requirement that loss estimates be "reasonable and supportable." Given the nonlinearity of credit losses—with lenders experiencing few losses in favorable economic environments and disproportionately large losses when the economy turns—filers will want to consider a variety of scenarios, at least qualitatively, if not formally.

Institutions are adopting the formal incorporation of alternative scenarios in their CECL processes[1] in various ways. Some larger institutions are adopting loss forecasting models that formally attach probability weights to each of the loss estimates generated under alternative scenarios. This is especially the case for multinational banks that already must comply with IFRS 9 guidelines. Other institutions are opting to estimate their future credit losses under multiple scenarios to assess the range of potential outcomes, but are not taking the final step of attaching statistical probability weights to each scenario to compute an expected loss. Rather, they are choosing to use the scenario calculations to inform their judgment as they implement qualitative overrides up or down to their baseline loss estimates.

Some lenders have expressed concern that the use of forward-looking scenarios will likely introduce errors into the reserving process that are correlated with the economic cycle. That is, lenders may tend to underpredict loss expectations in good times and overpredict in bad times due to the tendency of econometric models—and forecasters—to place significant weight on recent conditions. This momentum effect could introduce procyclicality into the system, which would cause lenders to expand aggressively during expansions, given the perception that the good times will last forever, and restrict credit during downturns, based on the assumption that the economy will never get better. The extent of this effect depends heavily on the loss forecasting models, methods and assumptions used in developing a prediction, as described in detail in the Moody's Analytics study "Gauging CECL's Cyclicality." Regarding the choice of scenario, the use of multiple scenarios would significantly mitigate assumptions that are overly optimistic or pessimistic. By forecasting losses under several potential upside and downside scenarios at all points of the economic cycle, lenders will effectively address some of the volatility in their loss estimates that stems from forecast error. Over- and undershooting will still exist but should be significantly reduced relative to the current "incurred loss" standard, which does not rely on any formal consideration of forward-looking scenarios.

Moody's Analytics alternative scenarios

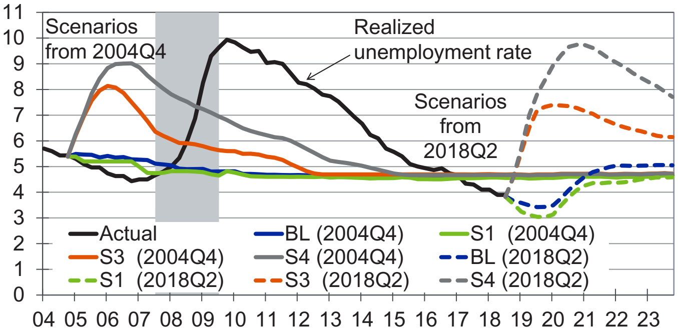
The standard scenarios that Moody's Analytics produces are based on fixed probabilities of occurrence. For example, the upside scenario "Scenario 1," or S1, is consistent with the 10th percentile in a distribution of possible economic outcomes. This does not imply that the forecast path defined by S1 has a 10% chance of occurrence. Rather, there is a 10% chance that the realized economy will be better than the defined path and a 90% chance that the realized economy will be worse than the defined path. Similarly, S0 through S4 are each associated with a point in the distribution, as illustrated in Chart 1.

Holding the percentiles constant has the advantage of easy interpretability of the scenarios from month to month. Defining calculations and processes around these percentiles allows users to translate general economic indicators to the specific measures that affect their businesses, such as revenue, loss or profit. If a building materials supplier finds that its revenue is directly correlated with the growth of house prices along with the level of interest rates, it could specify an equation incorporating these factors. Based on the Moody's Analytics-provided scenarios, the supplier could then forecast its expected revenues for the baseline, 10th percentile (S1), and 90th percentile (S3) scenarios to assess the fluctuations in risk from month to month or year to year. Although useful, the disadvantage of keeping the percentiles fixed in this exercise is that the scenarios themselves will fluctuate over the business cycle. The level and shape of a 10th percentile scenario during an expansion looks very different than during a contraction, as illustrated in Chart 2. As a result,

1 See "A Practical Guide for Using Scenarios in CECL" for additional information.

Chart 2: Standard Scenarios Evolve

Alternative scenario forecast for unemployment rate, %

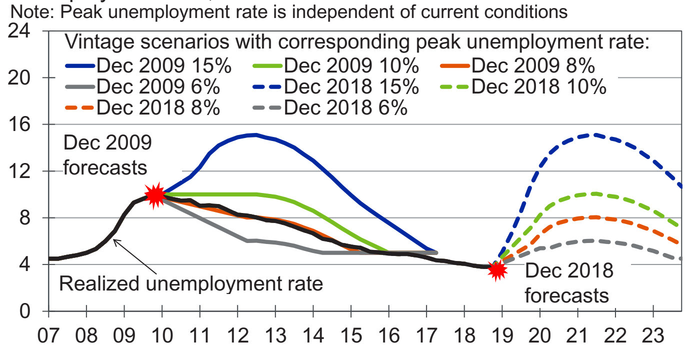


Sources: BLS, Moody's Analytics

Chart 3: Constant Severity Scenarios

Unemployment rate, %

Note: Peak unemployment rate is independent of current conditions



Sources: BLS, Moody's Analytics

scenario users will need to keep this in mind when evaluating the results of any forecasting exercise. Understanding the reason for changes in forecast results from one month to the next will require a deeper examination of the specific drivers—in this case, house prices and interest rates.

Moody's Analytics recently introduced a set of constant severity scenarios in which the scenarios stay constant over time but the associated probabilities change as the economy moves through the business cycle. For example, Moody's Analytics has a scenario with a peak unemployment rate of 8%. Every month, this scenario gets updated with the latest historical data and moves to a new starting point, but the contours of the economic projections remain the same, with the unemployment rate always peaking at 8% within a two-year period. What changes instead is the probability of this scenario occurring. The probability will go up or down, depending on what the economic conditions are at the start of the forecast. If the unemployment rate is close to 3% and falling, the likelihood that it rises to 8% within eight quarters may be very low, whereas the probability may be quite high if the unemployment rate is already at 7% and has been rising rapidly.

Constructing constant severity scenarios

The construction of constant severity scenarios is relatively straightforward. The severity of each individual scenario is defined by an assumed peak level of unemployment over an eight-quarter forecast horizon (see Chart 3). For example, the 6% constant severity scenario assumes the unemployment rate increases at a constant rate until it peaks at 6%. After that point, the Moody's Analytics macroeconomic model takes over to return the economy back to its long-run equilibrium based on demographic and productivity trends. A similar process is followed for the 8%, 10% and 15% constant severity scenarios that Moody's Analytics has produced. Based on user demand, additional scenarios may be produced.

The key assumptions underpinning the constant severity scenarios are that severity is defined by the peak in the unemployment rate, and the timing from current conditions to peak is similar across all scenarios, namely eight to 12 quarters. The first assumption is consistent with the Moody's Analytics standard constant probability scenarios. The unemployment rate is used to rank-order the simulated scenarios generated by the Moody's Analytics global model. For most applications, this is a reasonable approach given that unemployment is a primary driver of consumer behavior and is highly correlated with other key economic indicators such as house prices or GDP. However, there may be instances where other factors are more important for specific portfolios and do not track the behavior of unemployment. In these cases, users may wish to generate more customized scenarios in consultation with Moody's Analytics economists.

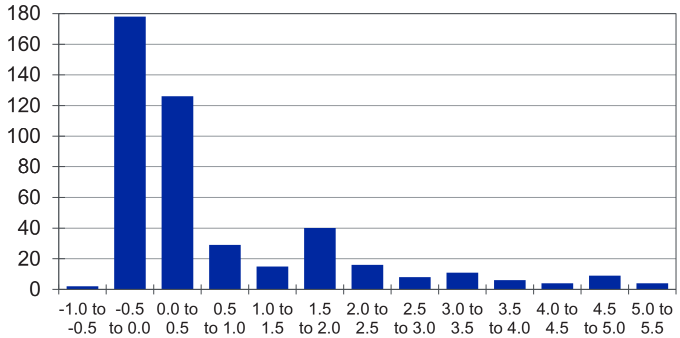
The timing or shape of the scenarios is also an important consideration. As a standard practice, Moody's Analytics focuses on next-recession scenarios in the short to medium term. The alternative scenarios are intended to capture the range of possible outcomes within a two- to three-year timeframe with a reversion to trend after that period. This is consistent with the guidance outlined in IFRS 9 and CECL as well as regulatory stress-testing programs such as the Comprehensive Capital Analysis and Review/Dodd-Frank Act in the U.S. or the Prudential Regulation Authority in the U.K. Users wishing to consider a different pattern of timing can do so through the construction of custom scenarios.

Estimating probabilities conditional on the current economy

To complement the use of the constant severity scenarios, Moody's Analytics has also developed a model to estimate the probabilities of changes in the unemployment rate over the next two years conditional on current economic and financial indicators. The structure of the model is similar to that of the probability of recession models that Moody's Analytics runs to gauge recession risk. The main difference is that recession is a binary (0/1) event, whereas changes in the unemployment rate (ΔUR) are continuous, though bounded. To address this particular structure, Moody's Analytics computed the maximum change in unemployment within 24 months for every point in history

Chart 4: Small Changes in Unemployment

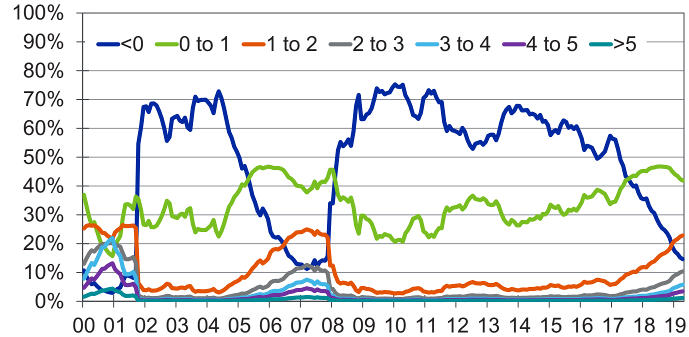
Frequency of max ppt change in unemployment rate over 24 mo



Sources: BLS, Moody's Analytics

Chart 5: Unemployment Increase Rises

Probability of max ppt change in unemployment rate, next 24 mo



Source: Moody's Analytics

and then discretized this value into five ΔUR categories:

- More than 0-percentage point decline
- 0- to 1-percentage point increase
- 1- to 2-percentage point increase
- 2- to 3-percentage point increase
- More than 4-percentage point increase

The historical distribution of these categories reveals that sharp unemployment increases far exceed sharp declines (see Chart 4). This is consistent with the theory that shocks to the economy tend to occur suddenly while recoveries take time. Moody's Analytics defines an ordered logit model that seeks to estimate the probability that the economy will be in one of these categories within a 24-month time horizon, consistent with the constant severity scenarios. For example, this specification might consider:

Pr(ΔUR in 24 months category) =
f (Yield curve,

Chicago leading activity index,

Federal funds rate,

Current unemployment rate,

Initial unemployment insurance claims,

Time since crossing natural unemployment rate
)

The ordered logit specification is employed primarily to ensure that the probabilities across all of the categories sum to one and that the impact of explanatory variables flows naturally from one category to the next. That is, a larger increase in initial unemployment insurance claims should raise the probability of a larger increase in the unemployment rate.

Various specifications were tested to identify the most predictive set of regressors with the fewest false positives. The Moody's Analytics analysis found that the yield curve is highly predictive of future increases in the unemployment rate, as is expected given its track record for preceding—if not actually predicting—recessions. Other variables such as the fed funds rate and various leading indicator indexes increased predictive power as well, though they tend to be correlated with each other. For the sake of parsimony, Moody's Analytics selected a model that relies on a handful of key indicators as the best candidate model (see Table 1). Reliance on just a few factors makes it transparent and easy to understand for nontechnical audiences, a key consideration in the development of the constant severity scenarios.

The beauty of this modeling approach is that it automatically adjusts with the business cycle. As the unemployment rate rises, the probability that it will rise further eventually declines under the presumption of reversion to the mean. The reduction in the marginal increases acts as a natural stabilizer within the model structure, thereby reducing possible procyclicality. Chart 5 provides both historical and probability estimates for each category change in the unemployment rate. Given movements in interest rates and the yield curve as of the writing of this report, the probability of an increase in the unemployment rate over the next 24 months has been rising, though it remains low from a historical perspective.

Table 1: Ordered Logit Model Parameter Estimates

Variable	Coefficient	Std Error	t-value
Yield curve			
10-yr Treasury - 3-mo Treasury	-0.4414	0.0930	-4.7450
Fed funds rate	0.1551	0.0254	6.1190
Number of mo from NAIRU	0.0372	0.0074	5.0530
Intercepts:			
(0%,1%]	-0.4909	0.2884	-1.7020
(1%,2%]	1.5372	0.3064	5.0171
(2%,3%]	2.6201	0.3270	8.0125
(3%,4%]	3.4384	0.3473	9.9015

Source: Moody's Analytics

Table 2: Probabilities Associated With Different Peak Unemployment Rates

24-mo max UR change, ppt	24-mo UR level	Probability
(-4,0]	(0%,4%]	15%
(0,1]	(4%,5%]	42%
(1,2]	(5%,6%]	23%
(2,3]	(6%,7%]	10.1%
(3,4]	(7%,8%]	5.5%
(4,5]	(8%,9%]	3.3%
(5,6]	(9%,10%]	1.1%

Note: The model provides probability estimates for five categories. Estimates for the remaining categories are extrapolated.

Assuming a starting unemployment rate of 4%, the model estimates the probabilities in Table 2.

The estimated 4.4% probability of a greater than 8% unemployment rate almost matches the 4% probability attached to the Moody's Analytics Scenario 4, which, as of the April release, defines a path where the unemployment rate peaks at 8.5%.

Benefits, limitations and uses of constant severity scenarios in CECL

One attractive feature of the constant severity scenarios is that users do not need to keep track of the month-to-month changes in the scenarios. This can create significant efficiencies during turning points in the economy when these changes are nontrivial. As a result, these scenarios might be easier to communicate to senior stakeholders, auditors and regulators, especially when used in a CECL application. Under a probability-weighted multiple scenario approach, the scenario probabilities could be tweaked to reflect various qualitative assumptions.

For example, if an institution is slightly more pessimistic than Moody's Analytics, it could simply increase the Moody's Analytics estimated probability of a constant severity scenario, rather than adjust all of the individual components of the scenario such as the outlook for unemployment, house prices and interest rates. Using these scenarios in CECL could also potentially mitigate some of the procyclicality in loss reserves that many institutions are concerned with, since the peak unemployment rates do not climb higher as economic conditions deteriorate.

However, users should also be cognizant of the limitations of this approach. First, the scenarios do not have associated narratives to explain what causes the unemployment rate to peak at a certain level. Because CECL requires that institutions' selected scenarios reflect a "reasonable and supportable" view of future economic conditions, users will need to frame their own narratives every month or quarter to support the use of the constant severity scenarios in CECL. Narratives may shift from focusing on a description of the forecast paths to a discussion and justification of the selected probability weights. Second, like every model, the model used to estimate the scenario probabilities is not perfect. Since there have been relatively few business cycles in postwar history where data are available, the probabilities estimated from the model could potentially be biased. And third, in the event that the U.S. economy experiences a deep recession where the unemployment rate reaches 15%, another scenario with an even higher peak unemployment rate would need to be considered.

A new set of scenarios

Some users of the Moody's Analytics standard alternative scenarios have argued that it is more intuitive to think of the likelihood of a scenario, rather than the scenario itself, as being conditional on the current economy. With this in mind, Moody's Analytics has introduced a set of constant severity scenarios that target fixed levels of economic stress defined by the peak unemployment rate within the next 24 months. While the scenarios are fixed, their associated probabilities are fluid and depend on the current state of the economy. Moody's Analytics constructed an econometric model to estimate these probabilities to provide a useful starting point for organizations to make any adjustments based on the understanding of clientele and/or local market conditions. While CECL was the motivation for constructing these scenarios, the hope is that this new set of scenarios will provide users with another set of tools to address their risk management and day-to-day business needs.

While no econometric model or forecast is perfect, most are useful if used in the proper context and with a clear understanding of their strengths and weaknesses. Lack of perfect foresight should not stop us from making predictions—quite the opposite. We need to make predictions—lots of them, and under a wide range of scenarios. Only then can we understand and manage the risk we are facing and make optimal decisions given the expected outcome and the variation around it.

About the Authors

Cristian deRitis is a senior director at Moody's Analytics, where he leads a team of economic analysts and develops econometric models for a wide variety of clients. His regular analysis and commentary on consumer credit, policy and the broader economy appear on the firm's Economy.com web site and in other publications. He is regularly quoted in publications such as The Wall Street Journal for his views on the economy and consumer credit markets. Currently he is spearheading efforts to develop alternative sources of data to measure economic activity more accurately than traditional sources of data.

Before joining Moody's Analytics, Cristian worked for Fannie Mae and taught at Johns Hopkins University. He received his PhD in economics from Johns Hopkins University and is named on two U.S. patents for credit modeling techniques.

Sohini Chowdhury is a director and senior economist with Moody's Analytics, specializing in macroeconomic modeling and forecasting, scenario design, and market risk research, with a special focus on stress-testing and CECL applications. Previously, she led the global team responsible for the Moody's Analytics market risk forecasts and modeling services while managing custom scenarios projects for major financial institutions worldwide. An experienced speaker, Sohini often presents at client meetings and industry conferences on macroeconomic models, scenarios and CECL solutions. Sohini holds a PhD and a master's degree in economics from Purdue University, and a master's degree in applied statistics from West Chester University in Pennsylvania. Before joining Moody's Analytics in 2011, she taught economics at the University of Cincinnati.

About Moody's Analytics

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Concise and timely economic research by Moody's Analytics supports firms and policymakers in strategic planning, product and sales forecasting, credit risk and sensitivity management, and investment research. Our economic research publications provide in-depth analysis of the global economy, including the U.S. and all of its state and metropolitan areas, all European countries and their subnational areas, Asia, and the Americas. We track and forecast economic growth and cover specialized topics such as labor markets, housing, consumer spending and credit, output and income, mortgage activity, demographics, central bank behavior, and prices. We also provide real-time monitoring of macroeconomic indicators and analysis on timely topics such as monetary policy and sovereign risk. Our clients include multinational corporations, governments at all levels, central banks, financial regulators, retailers, mutual funds, financial institutions, utilities, residential and commercial real estate firms, insurance companies, and professional investors.

Moody's Analytics added the economic forecasting firm Economy.com to its portfolio in 2005. This unit is based in West Chester PA, a suburb of Philadelphia, with offices in London, Prague and Sydney. More information is available at www.economy.com.

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