IMPROVING THE MEASUREMENT OF CAPITAL ADEQUACY

THE FUTURE OF ECONOMIC CAPITAL AND STRESS TESTING

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Over the better part of the last 20 years, banks have been developing credit risk economic capital tools to help measure and manage the risk and risk-adjusted returns of credit portfolios. But the recent financial crisis raised some significant questions about the effectiveness of the specific economic capital tools that many institutions used.

In 2008 and 2009, the Federal Reserve, ignoring banks' often poorly performing economic capital models, turned to a universal "stress test" to judge whether banks were adequately capitalized to survive losses in two scenarios: a continued economic downturn and one that significantly worsened. Banks' economic capital models could not answer this question. They could show what a future distribution of losses might look like, but not what losses might be in a specific economic scenario.

Stress testing has now become the primary lens through which banks and regulators assess capital adequacy. Banks have developed a new suite of stress testing models that link credit risk outcomes to macroeconomic variables. At the same time, banks have had to maintain

Most banks are now supporting distinct credit portfolio models. Instead, they should develop a more integrated economic capital and stress testing model.

and enhance existing economic capital models both for regulatory reasons and to support internal pricing and performance measurement tools.

This article examines the implicit choices that banks made in the initial development of credit risk economic capital models and why a different approach was needed for stress testing. We conclude by asking whether a more dramatic rethink of banks' modeling infrastructure is required to continue to enhance and evolve risk management capabilities.

ECONOMIC CAPITAL MODELS AND THE EMERGENCE OF STRESS TESTING

In the late 1990's and early 2000's, there was significant debate over the optimal method of measuring credit risk economic capital, with two main competing approaches: Merton-based and econometric. While both sought to measure the same thing—a future distribution of possible portfolio values – the way in which they did so differed significantly. We summarize the most important differences between these two models in Exhibit 1.

At their simplest, econometric models use historical credit performance data to directly estimate the relationship between credit losses and macroeconomic variables. Merton-based models focus on the correlation of credit performance between obligors, and look to equity markets to help derive these correlations.

By the early 2000's, the industry debate about the modeling approach had subsided. The Merton approach emerged as the winner, largely due to the fact that few institutions had the historical data needed to properly fit an econometric model. The Merton approach and the closed-form derivative that was adopted in Basel 2 became the industry standard and provided further impetus for adoption.

While there are significant advantages to the Merton-based model, it has two important and related weaknesses as implemented by most institutions. First, because the parameters of the model are not consistently derived, economic capital is neither the best estimate for today (conditional) nor for a through-the-cycle estimate

EXHIBIT 1: DIFFERENCES BETWEEN THE MERTON AND ECONOMETRIC MODELS

	MERTON-BASED	ECONOMETRIC
UNDERLYING STRUCTURE	• Relies on the Merton structural model of default where a company defaults when the value of its assets falls below the value of its liabilities • Joint default behavior is determined by relative correlations of each obligor's asset value to a set of underlying factors	• Relies on empirically-derived relationships between the default rate of a loan and a set of macroeconomic factors • Relationships are defined by portfolio type and the loan's rating or risk characteristics • Joint default behavior is determined based upon the strength of observed relationship for each portfolio and the correlation of the macroeconomic variables that impact the different portfolios
UNDERLYING FACTORS	• Asset value indices typically defined by industry and geography	• Macroeconomic variables
DERIVATION OF RISK INPUTS AND FACTORS	• Loan-level risk measures (e.g., probability of default, loss given default, and exposure at default) based upon bank's estimates for each rating • Correlations derived from equity markets for corporate loans and industry default histories for consumer loans	• Loan-level rating or risk characteristics input • Probability of default and dependencies with macroeconomic variables jointly estimated

(unconditional). It is a somewhat unintended hybrid between unconditional and conditional. Second, because the model is not directly driven by macroeconomic factors, it is difficult to draw precise connections between macroeconomic conditions and outcomes. In addition, it cannot directly forecast outcomes for a given macroeconomic environment.

The global financial crisis laid bare these drawbacks. The hybrid nature of the Merton-based model made it difficult to use. Was the model telling us how much capital we need today, or was it producing a long-term view? Perhaps more importantly, this model was inadequate to answer the most salient questions of the day: What will our losses look like over the next few years? And do we have enough capital to survive *this* crisis?

A RETURN TO ECONOMETRIC MODELS

The crisis effectively forced banks down a new path, building models that directly answered the question, "In a specific stress scenario, what will losses be?" Because the focus of bank management, the Federal Reserve, and the market was on a downturn with definable paths, models that could produce macroeconomically-driven, conditional distributions were needed. This prompted the industry to return to the drawing board to develop a set of stress testing models that could accept macroeconomic scenarios and directly produce a set of forecasted losses—a return to the econometric modeling approaches.

While there is a wide range of stress testing models, tailored to specific portfolios and sub-portfolios, at their core these models follow a similar structure. They define credit behaviors (transitions, roll rates, or defaults directly) as a function of both underlying loan characteristics and macroeconomic variables and they can produce a loss estimate for any macroeconomic scenario. The recent focus has been on using these models to produce point estimates of loss to answer stress testing questions, yet these models also allow us to produce a distribution of losses, given a distribution of macroeconomic scenarios. As such, these models could generate estimates of economic capital. In practice, few institutions are doing this today. The current infrastructure could not readily support such an application of the models.

As with any models, these stress testing models also have limitations. First, most banks still have only one cycle of relevant loan-level performance data to fit these models. There is inherent uncertainty around whether the relationships between macro factors and credit behavior will hold up in future downturns and in true tail events. Second, generating accurate point-in-time capital estimates is dependent on the ability to create truly conditional macroeconomic scenarios—a model where the future paths (say, of house prices) are appropriately dependent on the current macroeconomic situation. This type of model would need to produce a more negative distribution of house price scenarios in 2006 than in 2010, a difficult modeling challenge.

HOW THE BANKING INDUSTRY SHOULD MOVE FORWARD

Most banks are now supporting two sets of credit portfolio models: a Merton-based model used for economic capital and econometric models used for stress testing. Because stress test results are the binding constraint for capital management, economic capital has been relegated to secondary applications at most institutions such as high-level limit-setting and some commercial loan pricing, although with somewhat greater caution and overlays than before the crisis.

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Looking to the future, the path of least resistance is to maintain the status quo—continue to run Merton-based models for economic capital and econometric models for stress tests. Most institutions have gotten regulators and management comfortable with existing approaches, and change would be at a cost.

However, we think it is an important time to reconsider that path. The industry has learned a lot about what did not work well and has developed new analytics that could be further leveraged. An alternative to the current situation is an integrated economic capital and stress testing model that uses econometric models. At the most basic level, an integrated platform would have the following elements:

- A macroeconomic scenario and simulation tool that generates or simulates all macroeconomic variables needed by the models
- A suite of econometric models (one for each portfolio) linked to the scenario generator that calculates loss rates for each scenario or simulation and can generate either loss estimates for a single specific scenario for stress testing or a distribution of losses over a wide range of scenarios for the purposes of economic capital

A modeling platform built in this way would have significant advantages over the existing situation. Because the model would be driven by a set of macroeconomic factors, economic capital would be substantially more intuitive and therefore more easily understood by business line management. The key assumptions driving capital levels (relationships of credit behavior and loss to macroeconomic variables) would also be more intuitive, and would allow institutions to more carefully test those assumptions. In addition, the model's ability to simultaneously generate conditional expected loss and economic capital outputs has significant advantages for loan pricing.

Practically speaking, economic capital and stress testing would share a common platform and set of assumptions and would better leverage valuable resources. They would, however, face significant technology and analytical challenges in the current infrastructure.

The path of least resistance is for banks to maintain the status quo and to continue to run Merton models for economic capital and econometric models for stress tests. But we think it is an important time to reconsider that path.

Finally, this type of model would be a more valuable check on Basel 2 regulatory capital. Currently, differences between Basel 2 and economic capital are driven mainly by differences in correlation assumptions, which are the hardest parameters to estimate.

This path does have risks. It is not clear how these models will perform in more benign periods. And it is not known if they will produce reasonable levels of capital consistent with current requirements. As such it may be that we need unconditional or hybrid models in benign periods (when it is difficult to envision a truly stressful scenario) and conditional models in stressful periods (when, as it has been shown, unconditional models are often ineffective).

It is critical that we don't blindly accept the status quo. We need to use what we have learned through the crisis to build better and more useful tools that will allow the industry to better manage capital and price risk.

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CONDITIONAL OR UNCONDITIONAL MODELS?

When building economic capital models banks must decide between conditional and unconditional approaches. A conditional model produces both an expected and tail loss that is based upon current macroeconomic conditions. An unconditional model does not depend on the current macroeconomic environment, and as such produces more stable outputs over time. A well-functioning conditional model is responsive to the credit cycle, meaning that economic capital rises in good periods when risk is building and starts to fall (relatively) in bad periods as losses get realized.

For a model to be fully conditional, all parameters need to be conditional. Merton-based models typically allow users to input their own probabilities of default and loss given defaults and thereby specify the degree of conditionality of these parameters, although banks take a through-the-cycle view. Correlations are typically derived from equity market returns over the recent past, an approach that is neither conditional nor unconditional.