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Current Expected Credit Loss: Modeling Credit Risk and Macroeconomic Dynamics

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CURRENT EXPECTED CREDIT LOSS: MODELING CREDIT RISK AND MACROECONOMIC DYNAMICS

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INTRODUCTION

Following the financial crisis in 2007–2008, the Financial Accounting Standards Board (FASB) decided to revisit how banks estimate losses and impairment in the allowance for loan and lease losses (ALLL) calculation. Currently, the ALLL impairment standard is based on incurred losses, and investments are recognized as impaired when there is no longer an assumption that future cash flows will be collected in full under the originally contracted terms.

In June 2016, the FASB issued the final current expected credit loss (CECL) standard that replaces the current impairment model. Under the new CECL framework, financial institutions will be required to use historical information, current conditions and reasonable forecasts to estimate the expected loss over the *life of financial assets within its scope*. The transition to CECL will bring significantly greater data requirements and changes to methodologies to accurately account for expected losses under the new parameters.

Specifically, financial institutions will be expected to demonstrate changes to the expected loss on credit facilities when both the credit quality of the borrower and macroeconomic conditions change. However, the obvious way of modeling these relationships is liable to double-count those macroeconomic effects, and this can lead a bank to be unnecessarily cautious with its capital reserves. In this paper, we show how Alvarez & Marsal (A&M) demonstrates the relationships between the economy and default and loss at aggregate levels that may be replaced by more precise predictors of credit risk for individual borrowers. We explain how the common approach to modeling credit risk for portfolio forecasts may double-count predictive effects when applied to borrower-level forecasts and we offer solutions to this challenge.

HEURISTIC FRAMEWORK

Seasoned credit professionals argue that there should be a close relationship between economic conditions and the outcome of loans and other credit instruments. Specifically, a loan or bond should be paid in full when the borrower has the capacity to repay. If the borrower's capacity to repay comes into doubt, the probability that it will default increases and if that capacity is lost, it will default.

For commercial borrowers, repayment is a function of the borrower's ability to generate cash flow to repay interest and principal. That cash flow typically comes from operating profits generated by the business. For consumers, repayment is also a function of their ability to generate cash flow to cover the repayment of interest and principal. Most often, the cash flow for repayment comes from employment earnings.

In periods of economic expansion, companies should see rising operating profits as they experience increasing sales and individuals should experience rising incomes as employment opportunities increase and they receive raises in their compensation. The probabilities that companies and individuals will default on their debt should drop. Conversely, in recessions, corporate operating profits fall with declining sales and unemployment rises, reducing workers' earnings. Correspondingly, default probabilities should rise as both companies and individuals find it harder to meet their obligations for debt repayment.

Based on this argument, we expect to see strong negative correlations between percent change in real gross domestic product (GDP) (i.e., the definition of economic expansion and recession) and defaults on loans and bonds as well as negative correlations between economic activity and the losses that investors in those instruments incur when the borrowers or issuers default. Conversely, we expect to see strong positive correlations between the unemployment rate and defaults and losses on loans and bonds.

From Stevenson (2010, 2014, 2016a, 2016b), we also hypothesize that defaults are correlated with the flows of capital in the markets and the reaction to those flows by both lenders and borrowers (issuers). Specifically, when excess debt capital exceeds the equilibrium capacity of credit-worthy borrowers to use it productively, lenders continue to lend, driving that debt to ever more risky borrowers as facilitated by the relaxation of credit standards by banks and low perception of risk in the equity markets. When defaults occur, strong tightening of credit standards and elevated risk aversions cause debt capital to leave the markets, taking away some of the borrowers' capacity to repay and precipitating more defaults and losses to lenders.

Prepayment on loans and refinancing of bonds is another outcome that is expected to be linked to macroeconomic conditions. Specifically, when market interest rates fall below the rate of interest paid by a company or an individual, that company or individual can be expected to pay off the existing loan by entering into a new loan agreement that includes a lower rate of interest. Borrowers reduce the cost of the loan as a result. When interest rates rise, we expect prepayments to decline or even go to zero as the incentives to refinance disappear.

We expect to see negative correlations between market interest rates and the rates of refinancings and prepayments of bonds and loans.

In this paper, we focus exclusively on defaults and losses since data on these outcomes is readily available and reliable.

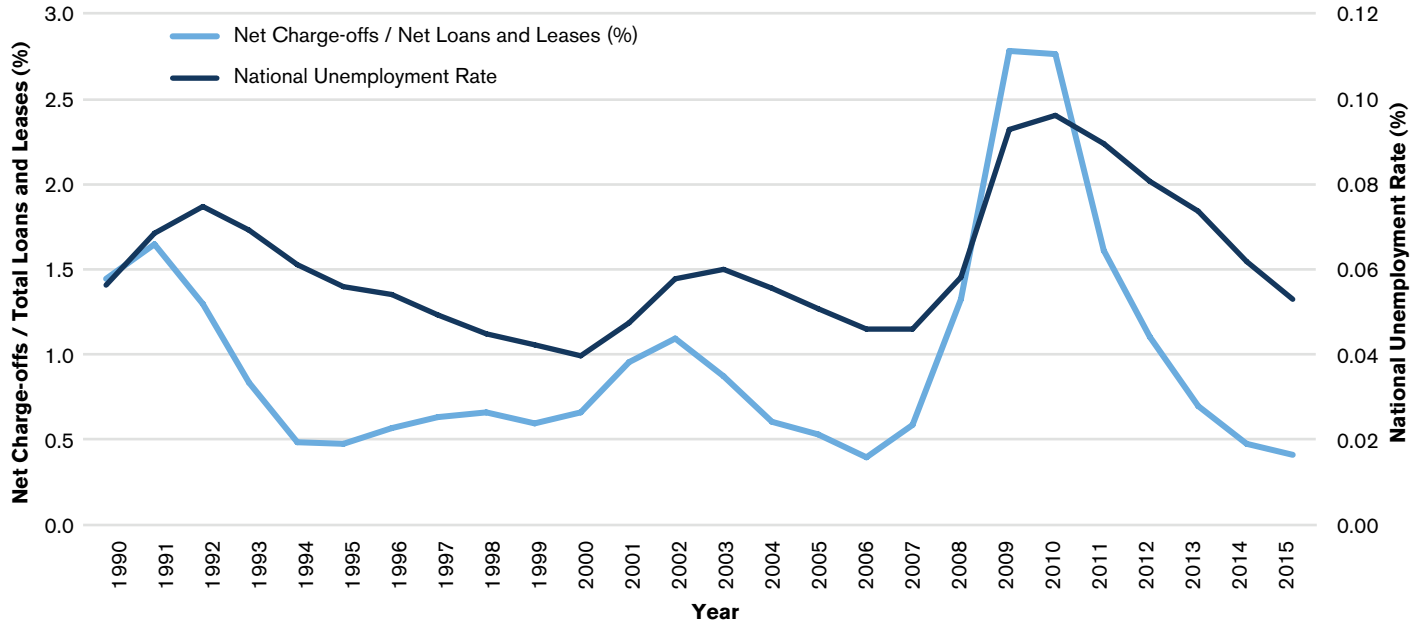
WHAT DO WE OBSERVE?

A&M has tested these hypotheses based on both publicly available data and its own proprietary data sets. We conclude that the correlations that we expect to see between default and loss rates and cyclical macroeconomic variables do exist at an aggregate level. However, when we move away from aggregate data and investigate these relationships at the level of individual borrowers, the picture becomes cloudier and more complex. This difference has important implications for how financial institutions will model expected loss on individual loans and bonds under CECL.

We first investigated the patterns of speculative grade (or non-investment) default rates in the U.S. corporate bond market. The default rate data came from Moody's Investor Service and covers the period of 1920 to 2015, although most of our analysis covers the modern era of 1970 to 2015. We compared and contrasted the pattern of these default rates with variables representing the U.S. macro-economy and the global credit markets.

Second, we investigated the patterns of loan losses in the U.S. commercial banking industry as reported by the Federal Deposit Insurance Corporation. We computed the annual incidence of net charge-offs on loans and leases for the U.S. commercial banking industry as a fraction of the total net loans and leases. We also correlated this "net charge-off incidence" to a series of macroeconomic variables.

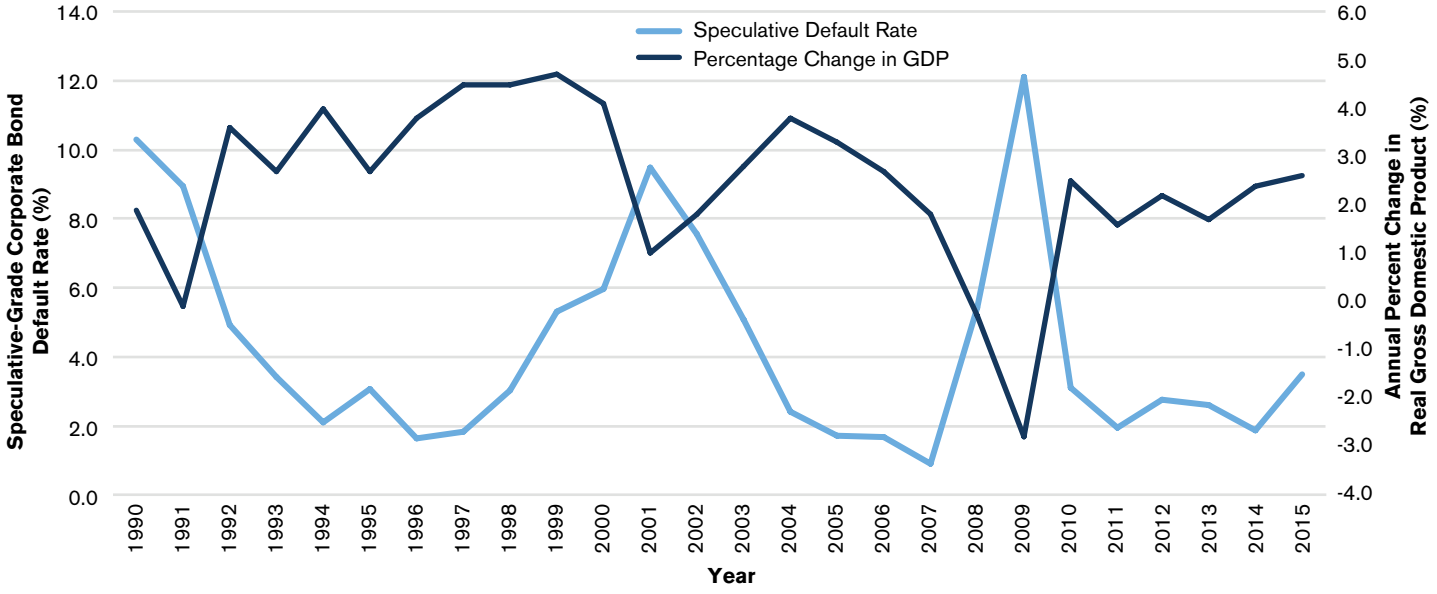
FIGURE 1: U.S. Commercial Banking Industry – Correlation of Net Charge-off Incidence to National Unemployment Rate 1990 - 2015



We found strong correlations that supported our expectations. For example, we show the pattern of net charge-off incidence for the U.S. commercial banking industry compared with the pattern of the U.S. national unemployment rate from 1970 to 2015 in Figure 1. The strong positive correlation that we hypothesized above clearly is borne out, especially from 1990 through 2015.[1]

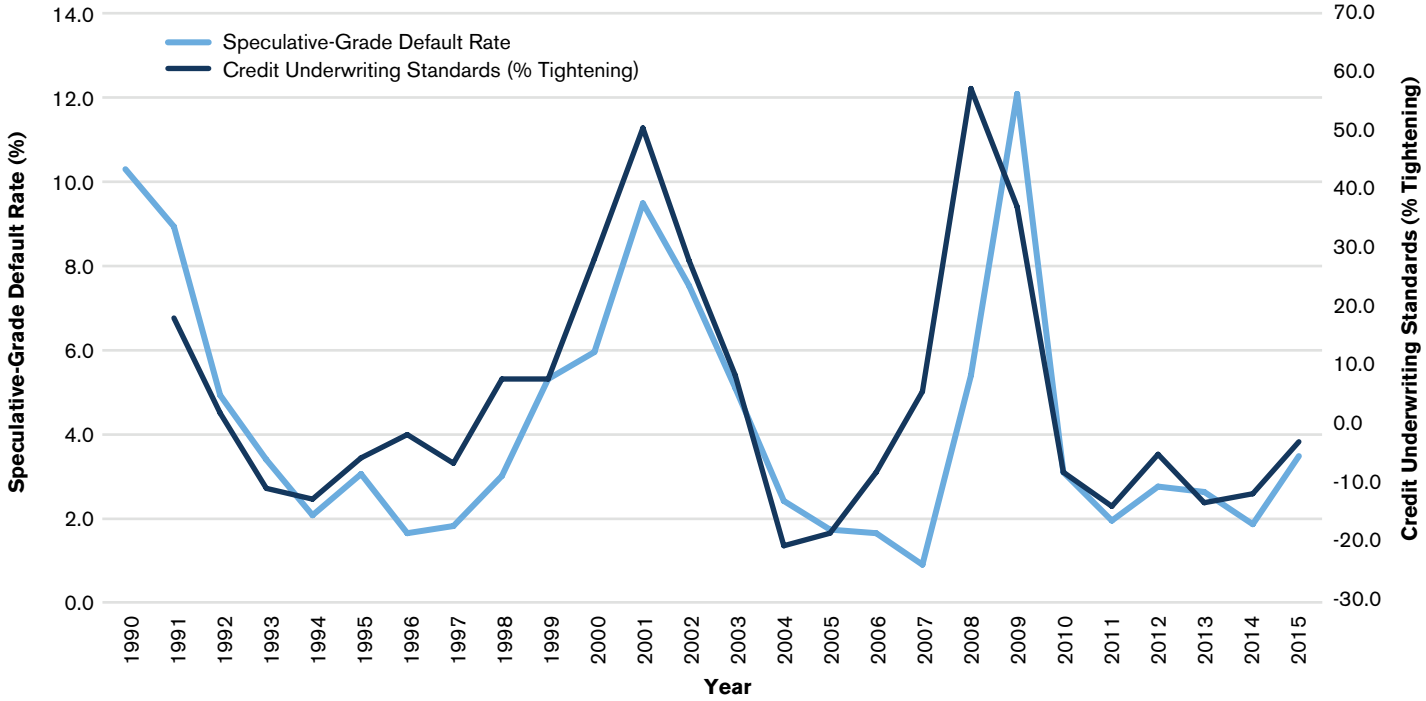
Corporate bond default rates are correlated with the cyclical changes in the U.S. economy, specifically percent change in real gross domestic product (Figure 2).[2] Default rates increase dramatically in economic recessions, such as those in 2001 and 2008–2009, and they decrease in periods of economic expansion.

FIGURE 2: U.S. Corporate Bond Market – Correlation of Speculative-Grade Default Rate to Percent Change in Real GDP 1990 - 2015



[1] Over the period 1990 to 2015, the correlation between the net charge-off incidence and the national unemployment rate is 0.780.
[2] The correlation of speculative-grade default rates and percent change of real GDP over this period is -0.532.

FIGURE 3: U.S. Corporate Bond Market – Correlation of Speculative-Grade Default Rates and Changes in Credit Underwriting 1990 - 2015



We observed other correlations that suggest that additional factors influence the cyclical pattern in loan losses. One of the strongest such relationships is the one with credit underwriting standards (Figure 3). These standards are tabulated in a survey conducted by the Federal Reserve Bank in which senior credit officers are asked about the degree to which they have tightened or loosened credit underwriting standards in the past calendar quarter (negative values indicate that most credit officers have loosened credit standards and positive values indicate tightening).

Figure 3 clearly demonstrates a strong, nearly simultaneous correlation between the waxing and waning of credit standards and speculative-grade default rates in the U.S. corporate bond market.[3] We believe that there is a reciprocal cause and effect relationship in which loose credit standards allow capital in all credit markets to flow to borrowers with marginal creditworthiness and high probabilities of default. Should those borrowers begin to default, then the credit officers will become wary of further losses and will tighten standards further. Credit markets become less liquid as a result and this tightening will drive more borrowers into default.

> CECL POSES REAL CHALLENGES TO BANKS AND ONE OF THE MOST SIGNIFICANT CHALLENGES IS THE ACCURATE PREDICTION OF DEFAULT AND LOSS.

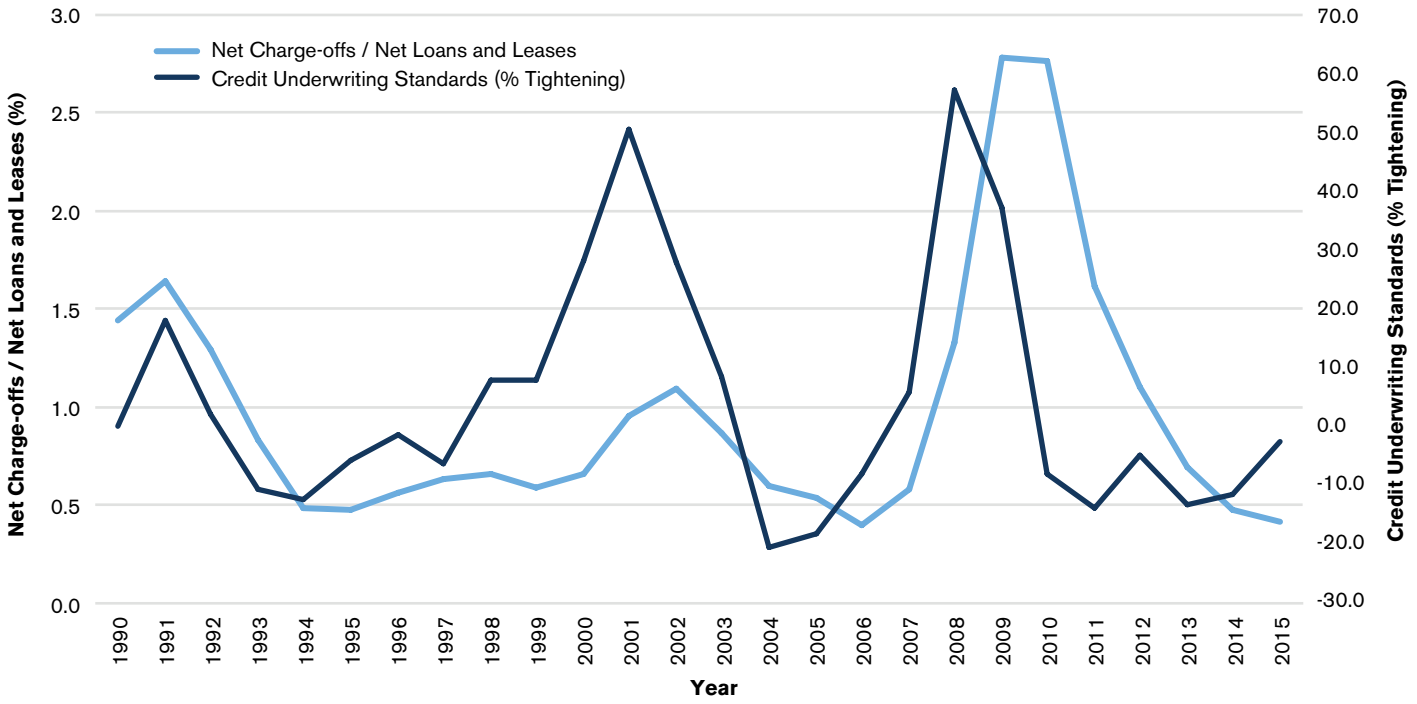
[3] Over the period 1991 to 2015, the correlation between speculative default rates and tightening of credit standards is 0.782. The correlation increases to 0.813 when the tightening of credit standards is lagged by one year.

If there were statistics on loan default rates in the commercial banking industry, we would expect to see the same strong correlation. Importantly, though, there is a similar correlation between changes in underwriting standards and net charge-offs in the U.S. commercial banking industry, though with a time lag (Figure 4). We believe that, in this case, the dynamics are the same: loose credit standards allow debt to be extended to less-than-creditworthy borrowers, defaults of those borrowers cause lenders to tighten credit standards, and tight standards create more defaults as risky borrowers that were dependent on loose credit default when that credit disappears.

The temporal lag between changes in credit standards and net charge-offs is due to the fact that it takes time for banks to recognize non-accruing loans and to determine the level of loss in those defaulted loans. Put differently, the time required for the recognition of non-accrual and accounting of both charge-offs and recoveries is responsible for the lag between changes in credit underwriting standards and net charge-offs.

Other measures of changes in the perception of risk are also correlated with loan losses. For example, we investigated the relationship of the VIX Index,[4] commonly known as the "fear index," to speculative grade default rates and found, again, a strong synchronous correlation (Figure 5).[5] We do not believe that the VIX Index determines or causes changes in bond market default rates. Rather, we hold that investors in equities respond to signals that markets have become more or less risky and respond by bidding the VIX Index up (more risky) or down (less risky). The rate of defaults in the bond market is one important signal to those investors. In short, this relationship is a correlation that does not imply causation.

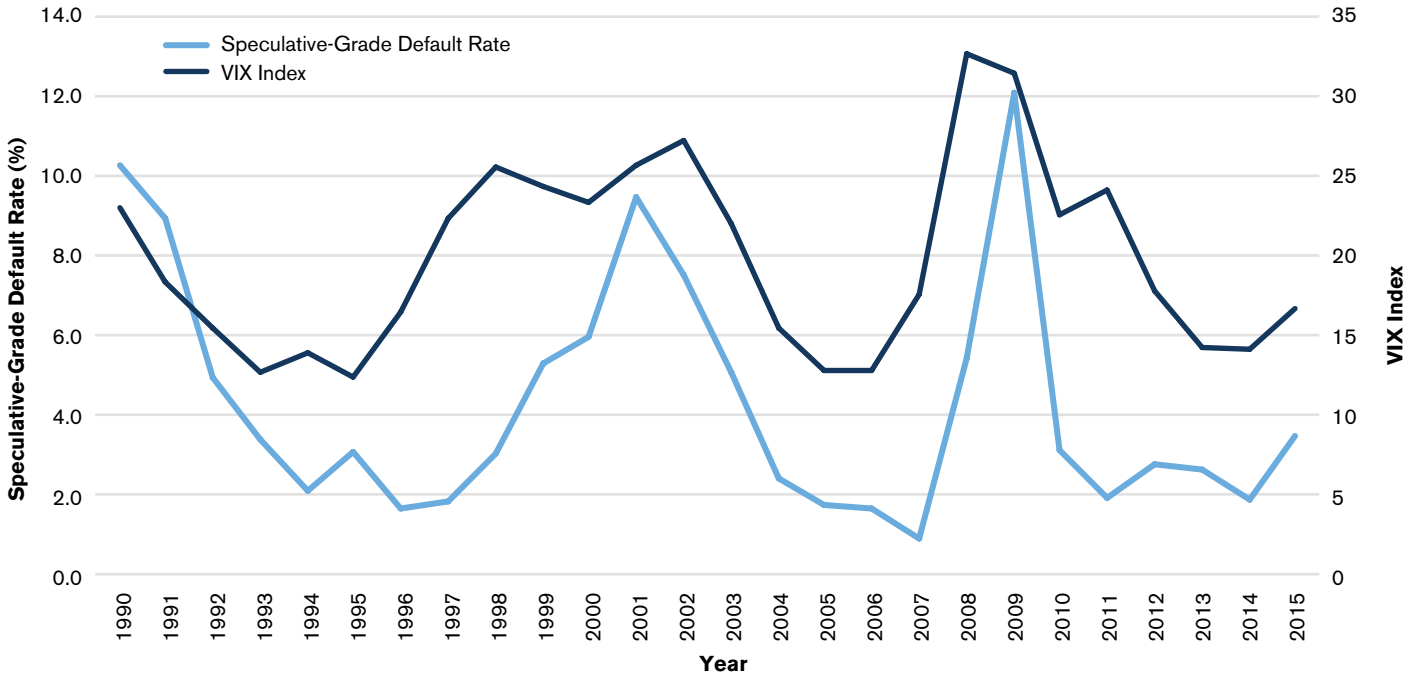
FIGURE 4: U.S. Commercial Banking Industry – Correlation of Change in Credit Underwriting Standards and Net Charge-off Incidence 1970 - 2015



[4] The VIX Index is a measure of the implied volatility of S&P 500 index options and it represents one measure of investors' expectations of the volatility of the stock market over the next 30 days.

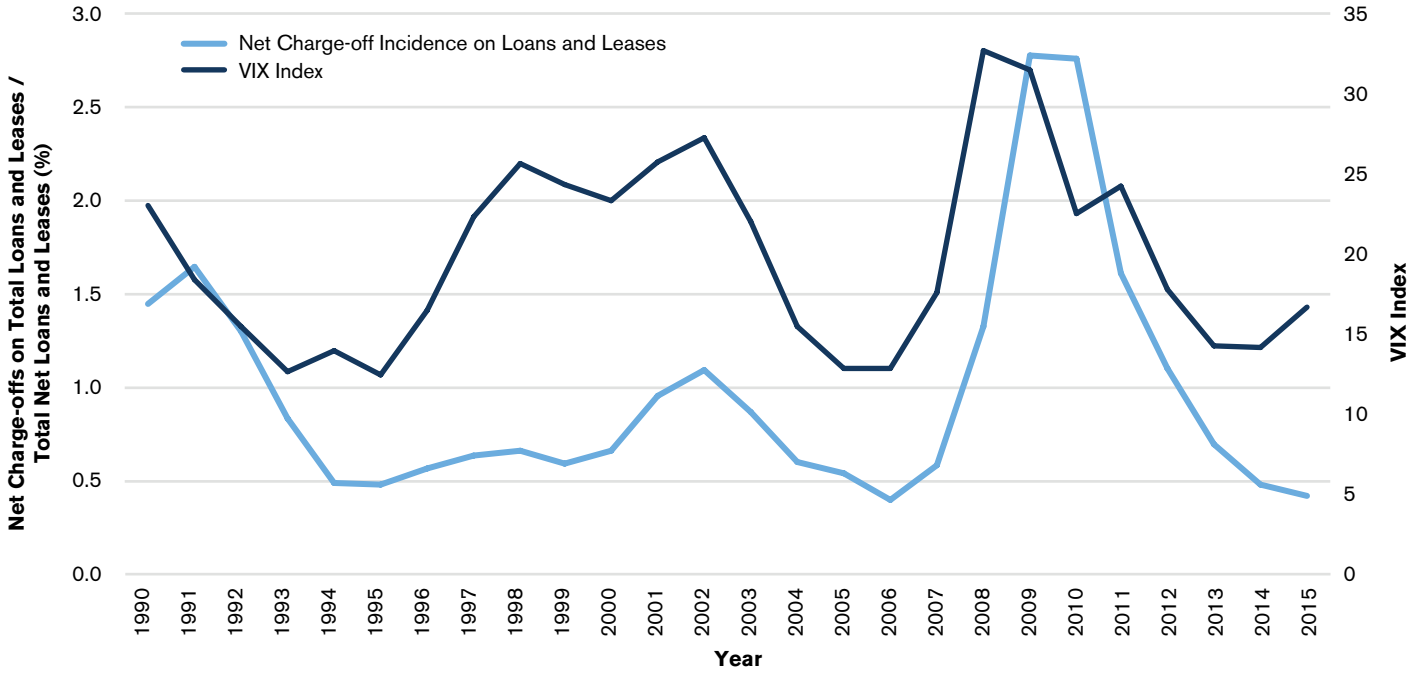
[5] The instantaneous correlation of speculative-grade default rates and the VIX over the period 1990 to 2015 is 0.607. With a one-year lag in the VIX, the correlation increases to 0.644.

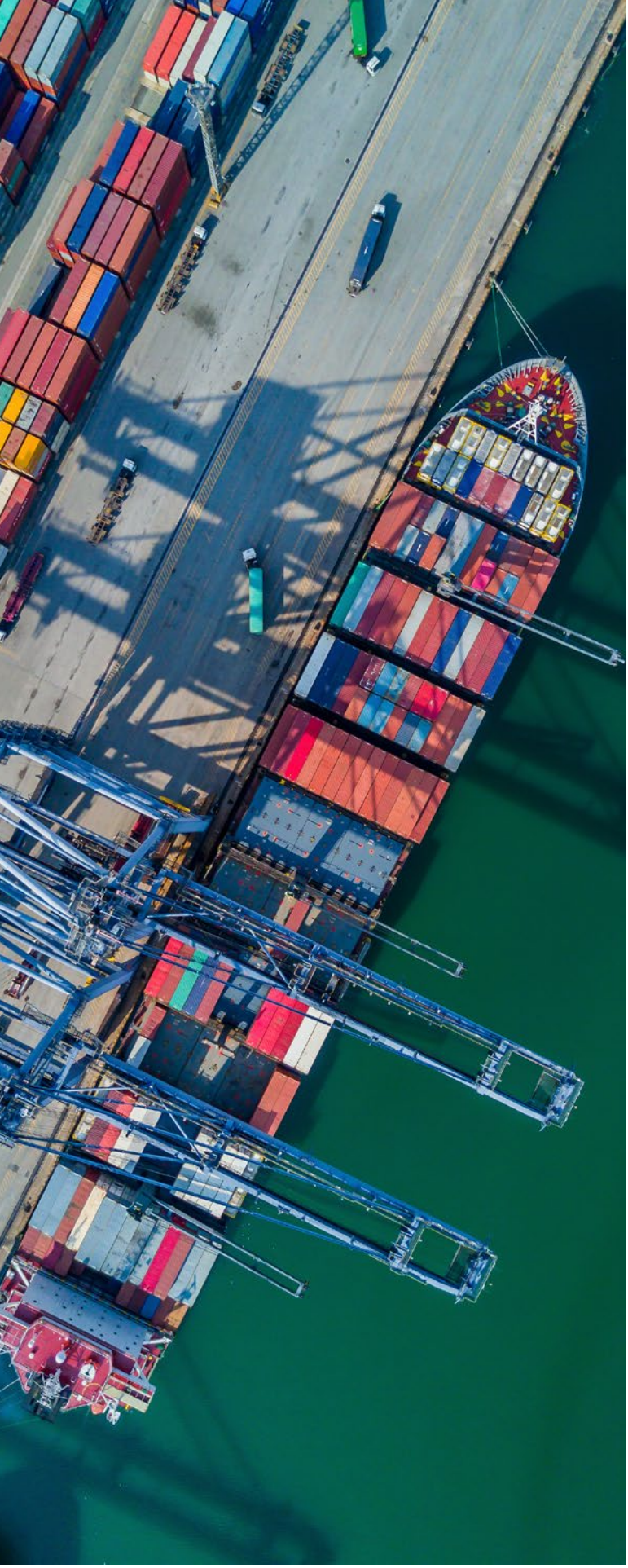
FIGURE 5: U.S. Corporate Bond Market – Correlation of Speculative-Grade Default Rates and the VIX Index 1990 - 2015



The relationship of the VIX Index to net charge-offs in the commercial banking industry is quite similar to that of the VIX Index and speculative-grade default rates, except that we see a time lag again (Figure 6). Changes in the perception of risk in the equity markets lead the emergence of losses in the banking industry by approximately one year. One year is the time generally required for the risk anticipated by the VIX Index to materialize in loan nonaccruals, charge-offs and recoveries.

FIGURE 6: U.S. Commercial Banking Industry – Correlation of VIX Index with Net Charge-off Incidence on Net Loans and Leases 1990 - 2015





Based on these macro-level correlations, the rationale for CECL appears to be sensible: if industry-level defaults and losses are correlated with changes in the macro-economy, shouldn't we expect the same thing for individual borrowers and credit transactions? And if these correlations exist at these most granular levels, accounting rules that require the estimation of macroeconomic influences on the inherent losses in credit instruments also make sense.

We note, however, that some of the strongest correlations of industry- and market-level defaults and loss are not with the traditional metrics of the business cycle (e.g., unemployment rate) but with metrics of the dynamics of human behavior in the markets (e.g., underwriting standards) representing the impact that the ebb and flow of capital has on the capacity of borrowers to repay their debt. So, the modeling of default and loss for CECL should take these other correlations into account.

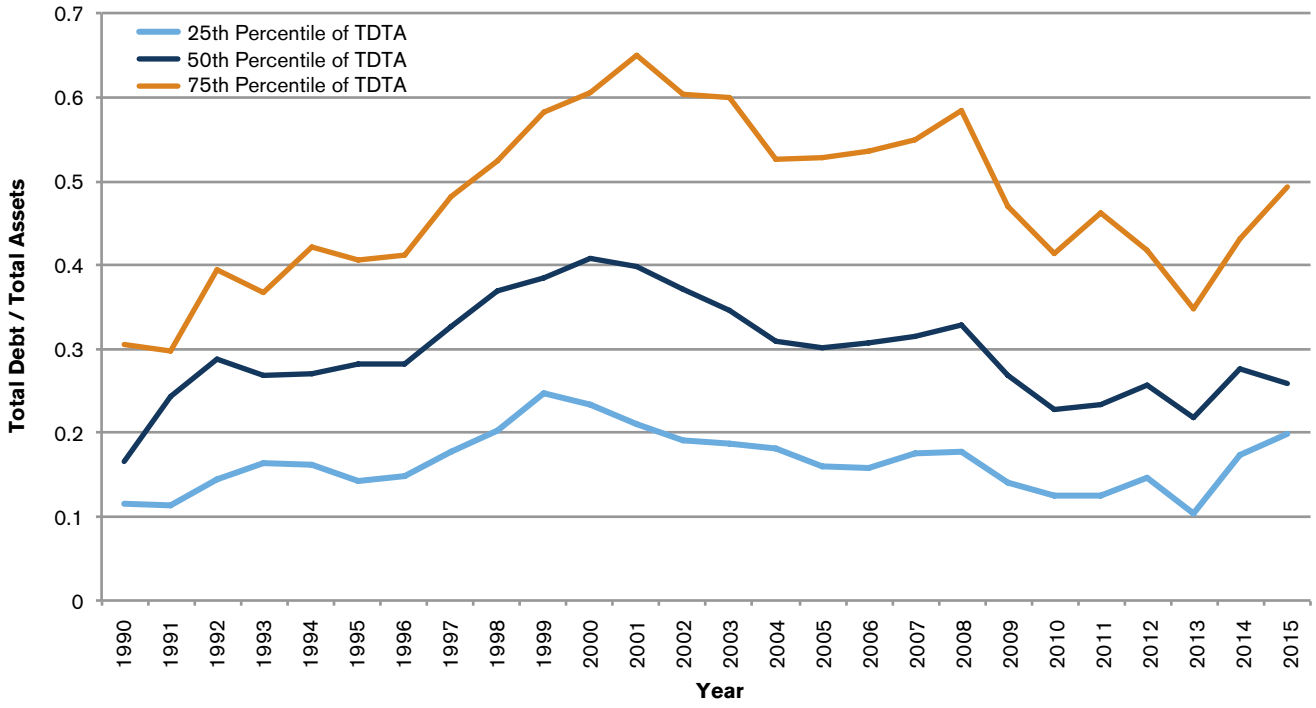
We now turn to our investigation of the company-level determinants of default.

CORRELATION OF COMPANY-LEVEL CREDIT RISK WITH THE MACRO-ECONOMY

In our experience advising clients on the application of mathematics to risk management challenges faced by financial institutions, A&M has had many opportunities to develop, validate and apply models that predict the probability of default for both commercial and individual borrowers. We observe that the best variables for prediction of default are characteristics specific to the borrower, including financial leverage, volatility of income or cash flow, and measures of the income or cash flow relative to the debt repayment obligations of the borrower. A rule of thumb emerging from that experience is that the closer the variable is to the specific circumstances of the borrower, the better it will predict default.

In fact, A&M has recently developed a series of default prediction models for commercial and industrial (C&I) borrowers based on the most advanced database of default and non-defaulted C&I companies in the world. In the research we conducted to build these models, we discovered several things. First, the best models are those that use company-specific variables rather than macroeconomic variables as predictors. Second, once we have built a "best-fit" model using company-specific predictors, macroeconomic variables rarely add additional explanatory power.

FIGURE 7: Manufacturing Companies – Total Debt / Total Assets 1990 - 2015



(Source: proprietary A&M data set)

What's Going on Here?

We believe that the credit characteristics of individual companies are coincident with the dynamics of the macro-economy and, in the language of statisticians, covariant. That is, company-specific variables such as leverage and interest coverage worsen in times of economic contraction and they improve in periods of economic expansion.

In our proprietary dataset on which we have built our default prediction models, we divided companies in specific industries (e.g., manufacturing, retailing or service) into percentiles according to key financial characteristics (e.g., financial leverage or debt service coverage). For this study, we plot the temporal pattern of each financial variable according to the 25 percent of companies with the lowest values of the variable (25th percentile), the middle of the distribution of values for that variable (50th percentile) and the 25 percent of the companies with the highest values for each variable (75th percentile).

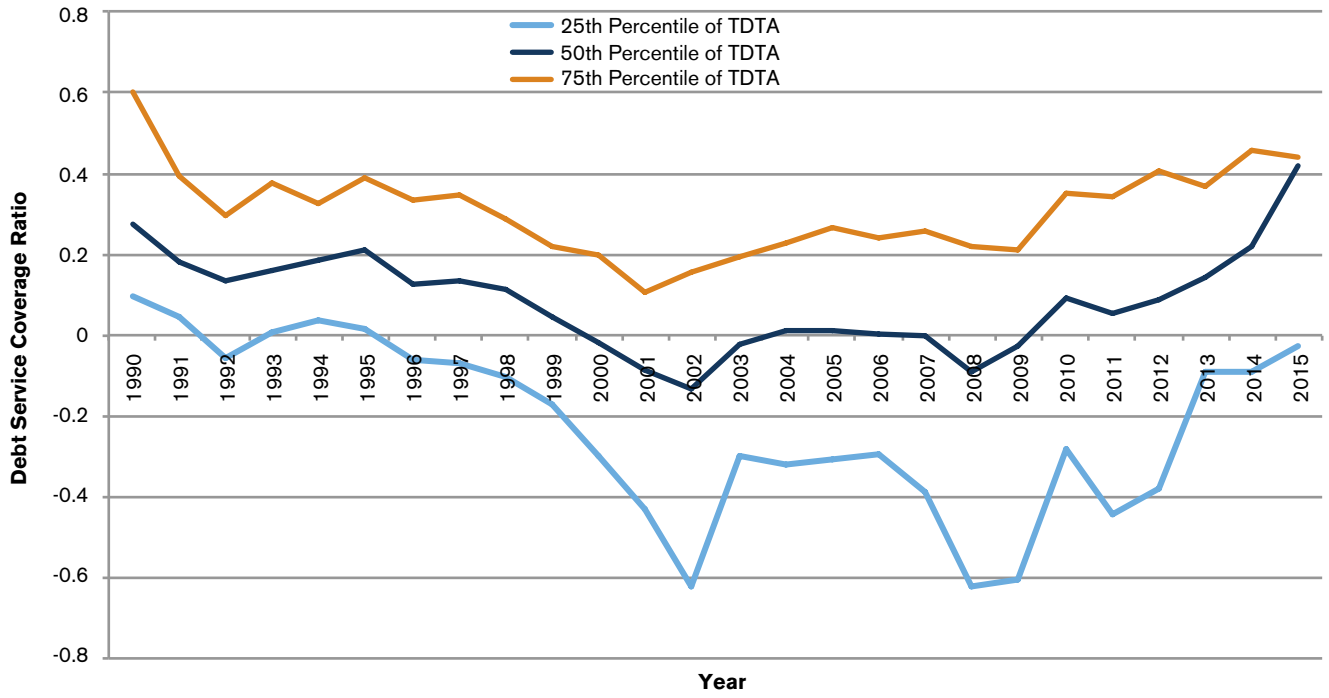
Using manufacturing companies as an example, we observe that credit quality worsens among manufacturing companies in times of economic recession and it improves in periods of economic expansion (Figure 7). Specifically, manufacturing companies have high financial leverage (total debt / total assets) in recessions (e.g., 2001 and 2008) and lower leverage in economic recoveries (e.g., 2013) and this pattern is most dramatic among the companies with the highest overall leverage (75th percentile).

It is notable that manufacturers with the lowest overall leverage (25th percentile) also show the lowest variability over time (Figure 6). While this group of companies did experience a modest increase in leverage leading up to the 2001 recession, it did not show the same increase leading up to the Great Recession.

It appears that financial leverage, a major determinant of default, covaries with the macro-economy, especially for the companies with the highest leverage (75th percentile). That is, the companies with the highest overall leverage experience large increases in leverage in recessions, and during recoveries, leverage decreases somewhat. Consequently, the correlations of total debt / total assets in this quartile to measures of the macro-economy are strong and statistically significant.

Our research further indicates, not unexpectedly, that default rates of companies with the highest financial leverage are much higher than the default rates of companies with lower leverage. We expect, therefore, that companies in the 75th percentile of total debt / total assets will have the highest default rates and the highest correlation of default probability to the macro-economy.

FIGURE 8: Manufacturing Companies – Debt Service Coverage Ratio 1990 - 2015



For manufacturers, the pattern of debt service coverage (DSC) is similar (Figure 8). Companies with the weakest DSCs (25th percentile) show negative values through nearly the entire time series and DSC weakens dramatically in the 2001 recession and the Great Recession. Manufacturers with the highest DSCs (75th percentile) showed weakness in the 2001 recession and the Great Recession but not nearly to the same extent as their weaker brethren.

A&M's research shows that companies with the weakest DSCs are those most likely to default and the highest default rates are found in the 25th percentile of DSC. This group of companies is also the group for which variation in DSC is most strongly correlated with measures of the macro-economy.

The credit migration of U.S. corporate bonds also gives a hint on what is taking place here. Moody's Investor Service rates the bonds issued by U.S. corporations based on a number of characteristics, principally the financial strength of the issuer. They typically use financial ratios, such as the ones discussed in this paper, to differentiate firms based upon financial strength.

A&M has tabulated the patterns of ratings changes by Moody's (upgrades, downgrades and no changes in ratings) in each year from 2004 to 2015 and we display these patterns in Table 1, separated according to whether the rating at the beginning of the year was of investment-grade quality (Baa3 or stronger) or non-investment-grade quality (Ba1 or weaker). In Table 1, we display the percent of ratings that are unchanged at the end of a year, those that are upgraded by one subgrade (notch) or two subgrades within the year, and those that are downgraded by one subgrade or two subgrades. We display these patterns, as well as the percent change in real gross domestic product and the unemployment rate for the United States, for each year of the sample.

In periods of economic growth, ratings of bond issuers tend to be stable, and when not stable, tend more to upgrades in rating quality versus downgrades in rating quality (Table 1). This pattern is especially pronounced among non-investment-grade rating categories (Ba1 or worse). Conversely, in economic recessions or in periods of market crisis, ratings become much more unstable, with strong tendencies toward downgrades. Again, these downgrades are more pronounced among non-investment-grade companies.

TABLE 1:[6] Patterns of Upgrades and Downgrades of Publicly Rated Commercial Bonds – By Year and Macroeconomic Characteristic 2004 - 2015

Year	Percent Change in Real GDP	Percent Unemployment	Investment Grade					Non-Investment Grade				
			Simple Average One-Year					Simple Average One-Year				
				Upgrade		Downgrade			Upgrade		Downgrade	
			Unchanged	One Notch	Two Notch	One Notch	Two Notch	Unchanged	One Notch	Two Notch	One Notch	Two Notch
2004	3.8%	5.5%	79.9%	5.6%	3.5%	5.2%	1.5%	58.7%	12.3%	6.2%	7.1%	4.0%
2005	3.3%	5.1%	79.1%	6.8%	2.0%	2.9%	3.4%	56.2%	15.5%	4.4%	8.8%	2.8%
2006	2.7%	4.6%	81.6%	6.8%	1.4%	3.9%	0.6%	43.6%	15.9%	4.7%	9.3%	2.4%
2007	1.8%	4.6%	69.4%	14.3%	6.3%	3.9%	2.5%	54.4%	9.1%	3.2%	7.2%	3.7%
2008	-0.3%	5.8%	75.4%	2.8%	0.4%	10.0%	3.8%	53.0%	5.4%	0.9%	11.7%	6.5%
2009	-2.8%	9.3%	61.6%	1.7%	0.2%	18.0%	8.2%	44.1%	5.8%	1.3%	13.5%	7.1%
2010	2.5%	9.6%	67.1%	3.4%	0.4%	6.4%	1.7%	57.1%	11.2%	3.6%	6.3%	1.2%
2011	1.6%	8.9%	71.7%	3.1%	0.1%	11.9%	4.5%	55.2%	12.1%	1.9%	6.8%	2.8%
2012	2.2%	8.1%	67.1%	3.4%	0.1%	11.4%	8.8%	53.7%	9.8%	1.8%	10.2%	3.9%
2013	1.7%	7.4%	82.4%	2.7%	0.1%	9.9%	1.0%	53.8%	8.4%	1.3%	9.8%	3.1%
2014	2.4%	6.2%	82.6%	8.5%	0.3%	5.0%	0.8%	58.5%	7.9%	1.9%	9.2%	1.8%
2015	2.6%	5.3%	79.1%	7.5%	1.2%	7.4%	1.8%	60.3%	7.3%	2.5%	8.9%	4.1%

Since Moody's and other rating agencies assign ratings to companies based upon the financial strength of each company, we surmise that the ratings downgrades in economic recessions are due to weakening of those companies' credit fundamentals. It is likely that higher leverage, lower debt service coverage and other weak fundamentals cause these companies, first, to be rated as non-investment grade, and second, to be downgraded in times of economic and financial stress.

Why do A&M's models of default for C&I companies not use macroeconomic variables as predictors? This result is because the most likely macroeconomic variables are correlated with company-specific variables, such as leverage and interest coverage. In statistical models that rely on stepwise regression, it is unlikely that two predictor variables that are strongly correlated to one another will be used in the same equation. The covariance between the two predictors means that they measure essentially the same things and including them in a forecasting model likely means that the model will double-count the predictive effects. Modelers wisely do not use two or more covariant predictors because of the risk of this double-counting.

IMPORTANCE FOR CECL MODELING OF DEFAULT

Under the new CECL standard, financial institutions will be required to use historical information, current conditions and reasonable forecasts to estimate the expected loss over the life of the loan. The proposed rules for CECL call for estimates of current expected credit loss to be sensitive to changes in the macro-economy. For example, the Federal Reserve and other banking regulators state:

> "…the input to a loss rate method would need to represent remaining lifetime losses, rather than the annual loss rates commonly used under today's incurred loss methodology. In addition, institutions would need to consider how to adjust historical loss experience not only for current conditions as is required under the existing incurred loss methodology, but also for reasonable and supportable forecasts that affect the expected collectability of financial assets." (Board of Governors of the Federal Reserve System et al., 2016)

The analysis presented in this paper has significant implications for banks and other financial institutions facing these requirements.

First, estimating default and losses over the life of the loan concept means that any model or analytical method should account for the variability in credit characteristics over time. Weak companies in the bottom percentiles of the distributions of individual financial variables will experience more volatility in their creditworthiness over time and in conjunction with changes in the macro-economy. Developing models that account for lifetime losses is a much more challenging exercise than developing models that account for default over only one period, such as one year.

[6] The data in the table are calculated based on the information provided by Moody's "Annual Default Study: Corporate Default and Recovery Rates."

Second, caution must be applied in using macroeconomic variables as predictors of default of individual companies. We observe that there is covariance between financial variables that describe aspects of an individual company's creditworthiness, such as leverage and debt service coverage, and measures of the macro-economy. Statistical models that incorporate predictor variables too correlated with each other risk over-emphasis of the characteristics. In statistical terms, this is multicollinearity.

These considerations are especially important to banks that attempt to employ their Comprehensive Capital Analysis and Review (CCAR) or Dodd-Frank Act Stress Test (DFAST) models of credit risk. Most CCAR / DFAST models of default or loss are constructed at the level of classes of borrowers or types of loans (e.g., commercial and industrial loans) and these models often use macroeconomic variables as predictors. When applied to forecast lifetime losses for individual loans, CCAR / DFAST models risk two types of errors: (1) masking the important differences among individual companies in terms of their individual financial characteristics, especially differences in company-specific variables that are known predictors of default, and (2) ignoring the important variability in the financial characteristics of companies over time, especially temporal differences in different percentiles of key predictors of default and loss.

Third, credit investors choosing to use macroeconomic variables as predictors of default and loss should include measures of human behavior in the markets. Metrics such as the VIX Index, itself a measure of risk aversion, and changes in underwriting standards are strongly correlated to bond market defaults and loan losses at U.S. commercial banks. The ebb and flow of capital, as determined from the human behavior that underlies these metrics, is a primary correlate and determinate of defaults and loss.

CONCLUSION

CECL poses real challenges to banks and one of the most significant challenges is the accurate prediction of default and loss. At the level of the commercial banking industry or the U.S. commercial bond market, default and losses are correlated with the U.S. macro-economy. However, at the level of individual companies, company-specific variables are the best predictors of default and loss. Banks and other credit investors should take these facts into account when predicting default and loss over the life of a credit instrument. We strongly advise caution in the application of mathematical models calibrated at the level of portfolios, such as types of loans, in CECL.

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