



## Whitepaper

DECEMBER 2017

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# How Much Will CECL Impact Reserves for First Mortgage Portfolios?

Ever since the Financial Accounting Standards Board announced that accounting standards for loss reserves will move from an incurred-loss method to a forward-looking approach there has been much speculation on how lending institutions will be impacted.

To the best of our knowledge, there has been no study that quantifies this impact in a rigorous manner for the industry as a whole, although a few individual lending institutions have conducted their own analysis.

According to some industry surveys, reserves are expected to increase by up to 50% under the current expected credit loss guideline.<sup>1</sup> In this article, we estimate the impact on first mortgage portfolios, which constituted 68% of all outstanding balances of consumer credit in the U.S. as of July 2017.<sup>2</sup> Using industry data from CreditForecast.com,<sup>3</sup> we estimate lifetime losses under a Moody's Analytics consensus scenario, a stress scenario, and a probability-weighted scenario as if CECL had gone into effect in July 2017, and then we compare results with the incurred-loss method used in accordance with current U.S. generally accepted accounting principles. Our results show that reserves may increase by as much as 100% under a consensus scenario. We further analyze the results to identify the source of these losses. We focus on different states, score bands, term buckets, and vintages of loans for this segment analysis. Finally, we discuss the reasonability and sensitivity of the results to some of our assumptions, including our estimate of loss given default.

## Introduction

Since the FASB's changes to accounting standards became official, lenders and regulators alike have been worried about what the impact of changing into a forward-looking approach would be and whether the possible increase in reserves would disrupt future loan originations. Based on empirical analysis performed by Moody's Analytics,<sup>4</sup> CECL would in general raise the level of reserves at most banks compared with the incurred-loss methodology. In a previous article,<sup>5</sup> we reviewed the new accounting standard and estimated the potential increase in reserve allowances across all FDIC-insured institutions at different points in the business cycle under a variety of assumptions.

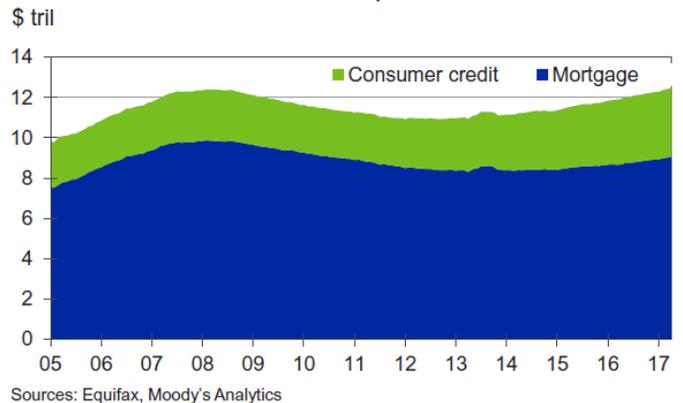
In reality, the actual quantification of the impact on reserves is an arduous task using both actual industry data encompassing all lines of business and institution-level data. Indeed, the impact on reserves from adopting CECL depends on many variables, including:

- » Age and expected remaining life of the loans in a portfolio. For example, the younger the portfolio, the larger the impact.

- » Portfolio quality, defined by credit score, loan-to-value ratio, debt-to-income ratio, etc. There will be less impact on higher-quality portfolios.
- » Types of loans in the portfolio. Installment versus revolving, as future draws could impact losses.
- » Contractual maturity. Longer-term loans will see a bigger impact.
- » Geographic location of loans. Weaker geographies may experience a larger impact.
- » Current delinquency status of loans.

In this article, we narrow the task of quantifying the overall impact of adopting CECL to the impact on first mortgage portfolios, as this line of business constitutes the biggest portion of consumer credit, as shown in Chart 1.

Chart 1: Balances on Open Accounts



One of the biggest motivations of this article is to get lending institutions to think seriously about what the impact of CECL could be on their reserves. Institutions should start doing their own impact analysis sooner rather than later so that they can understand the implications that CECL could have on their lending businesses. Although institutions cannot build up reserves in anticipation of CECL under GAAP accounting, they may adjust their allocation, underwriting, and pricing practices as well as their general business strategies to avoid an unexpected increase in their reserves.

The following sections describe the data we use in this industry-level CECL impact analysis as well as assumptions we make to quantify reserves under CECL. We lay out the methodology behind the expected credit loss calculation and present results using both the CECL and incurred-loss methodologies. We identify the segments with the greatest losses and CECL results under other scenarios.

#### Data description

The historical and forecast data used in this article are based on the CreditForecast.com data service. The credit data are sourced from the full Equifax consumer credit report database and include consumers with at least one active trade. This results in approximately 220 million consumer records in a given month. Selection always occurs at month's end so that the results are not affected by in-month reporting fluctuations.

Moody's Analytics partners with Equifax to get these data monthly and forecasts them quarterly under various Moody's Analytics and regulatory scenarios that allow this article to be possible, as CECL is a forward-looking approach. CreditForecast.com data have the following dimensions: loan origination vintage, origination credit risk score, geography, and term/maturity for installment loans. This unique combination of dimensions and granularity, especially the vintage dimension, allows for a forecast methodology consistent with the CECL guidelines such as the probability of default/loss given default, or loss-rate methodology.

To clarify, in our calculations below, PD rates are coming from CreditForecast.com (default plus bankruptcy fields). We use other databases and services for LGD rates such as the Moody's Analytics Bank Call Reports Forecasts, the Fannie Mae/Freddie Mac loan-level performance database, and Mortgage Portfolio Analyzer, which is based on loan-level securitized data. This combined PD and LGD database makes a unique CECL-specific product that we call Moody's Analytics Expected Consumer Credit Losses, or ECCL.

In terms of origination vintages, the CreditForecast.com database provides quarterly vintages starting from 2005 until now. The annual vintages start in 1996 and go through 2004, with older vintages aggregated into the pre-1990 and 1990 to 1995 cohorts.

Origination risk score-level classification is done at

the consumer level, based on the VantageScore 3.0. CreditForecast.com has 11 score bands, allowing the user flexibility in identifying consumer risk profiles of interest.<sup>6</sup>

CreditForecast.com also has installment loans (auto, consumer finance, first mortgage, HELOANs, and student) further classified into loan-term bands. Loan term is reported by lenders and financial institutions and represents the number of months over which an installment loan is to be paid. CreditForecast.com provides loan terms on installment loans in fixed ranges or bands at the time of originations. For first mortgages, these bands are fewer than 180 months, 180 to 359 months, and 360 or more months.

The geographic information in CreditForecast.com include 53 states/territories as well as 457 metropolitan statistical areas/rest-of-state areas (complete coverage of the entire country). For the purposes of this study we focused on state-level data for which forecasts are available readily through CreditForecast.com.

One of the biggest differences between the CreditForecast.com database and the ECCL service is the fact that ECCL forecasts performance beyond five years. This is necessary for expected lifetime calculations under CECL, especially for longer-term products such as first mortgages.

#### CECL assumptions

This section explains the assumptions for our CECL calculations. In a later section we show justifications for these assumptions.

It is important to note that the analysis will change based on several factors that can affect expected credit losses, for instance:

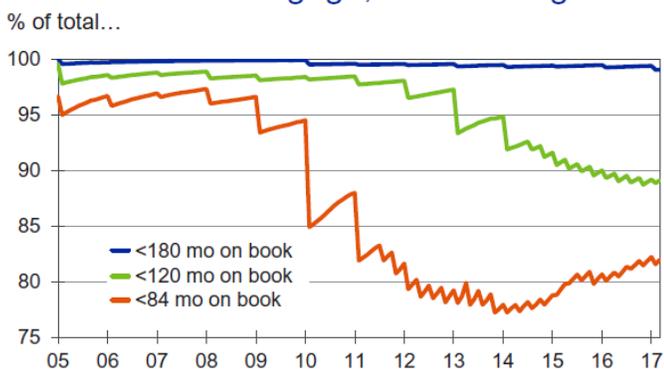
- » The line of business in question, because of its inherent riskiness; for example, unsecured loans would be riskier than secured loans.
- » Where in the business cycle the line of business is;<sup>7</sup> for instance, first mortgage loan portfolios currently have strong loan profiles compared with auto loans, hence we should expect a higher impact for auto loans than for first mortgage loans.

- » Whether the portfolio is made up of installment or revolving accounts, which can change the life of loan and exposure at default calculations; bankcards, for example, would have to be treated separately because of being “unconditionally cancelable.”
- » The assumptions behind the expected lifetime of the loan; for instance, here we use a lifetime based on aggregate industry data, but this might change because of institutional characteristics.
- » How we incorporate LGD; for example, which database we use for LGD numbers and at what granularity.
- » The effective interest rate used for discounting in net present value calculations.
- » The scenario used; for instance, we use a consensus and a stress scenario as well as a probability-weighted scenario to give some comparisons, but results can change under different scenarios.<sup>8</sup>

Expected lifetime of first mortgage loans. Based on CreditForecast.com data, we assume that the expected life of first mortgage loans does not exceed 15 years. This helps us cover, according to our calculations, 99% of the first mortgage industry loans.

Chart 2 shows how much the total outstanding balance of the industry is affected by censoring cohorts that are older than specific cut points (seven years, 10 years, 15 years). Fifteen years seems to be a valid cutoff point for the life of a first mortgage, as less than 1% of the aggregate first mortgage industry balance has ever been observed to be 15+ years at any given time from July 2005 to June 2017.

**Chart 2: First Mortgage, Outstanding Bal.**



Sources: Equifax, Moody's Analytics

Loss given default. One of the simplifying assumptions we are making is with the LGD value. We assume the LGD for first mortgages to be 40%, based on a variety of Moody's Analytics aggregate and loan-level databases. We assume a fixed segment/cohort and scenario independent scalar for the LGD value, although we realize that LGD might be scenario-dependent and it might also change from cohort to cohort.

Discount rate.<sup>9</sup> We assume the discount rate to be the 30-year mortgage rate<sup>10</sup> as of the start of our forecast: 4.3%. Although in theory it makes more sense to use the time series of this 30-year mortgage rate and under different scenarios, CECL guidelines clearly advise to use a scalar as the effective interest rate.

Scenario. Our first set of results is based on the Moody's Analytics consensus scenario. This scenario is designed to incorporate the central tendency of a range of baseline forecasts produced by various institutions<sup>11</sup> and professional economists. Since the result is itself a baseline, by definition the probability that the economy will perform better than this consensus is equal to the probability that it will perform worse. Later on we also give results under a stress scenario as well as a probability-weighted scenario.

### Methodology

As noted previously, quantification of the impact of CECL involves several assumptions and complex calculations. Using our newly developed ECCL framework, we are now able to do this impact analysis in a rigorous manner for consumer credit portfolios. In this section we present the methodology behind the CreditForecast.com industry models as well as the ECCL methodology to calculate CECL-compliant, forward-looking lifetime expected loss rates.

CreditForecast.com industry models are based on cohort-level industry data with these following dimensions: loan origination vintage, geography (states for this analysis), credit-score bands, and term/maturity category. The dimensions allow for a lot of granularity, approaching that of loan-level data. In addition, models built at the cohort level are often better able to capture the impact of the current and future economy on loan performance than other methodologies. The CreditForecast.com model methodology is consistent with the CECL guidelines, since it includes a vintage dimension that allows for life-of-loan calculations.

Moody's Analytics produces CreditForecast.com forecasts using a detailed econometric model system. The forecasts are produced with models developed using a pooled time series and cross-sectional specification. Estimations are done at the state level with macroeconomic variables and fixed effects utilized when appropriate. Explanatory variables for forecasting loan performance may be defined by four broad categories: vintage-specific effects such as credit quality; age maturation or life cycle; economic environment at the time of origination; and the ongoing or time-varying economic environment. Forecasting accuracy is the main criteria used to specify and accept models, though attention is also paid to econometric stability and theoretical consistency.<sup>12</sup>

Within the ECCL framework, CreditForecast.com provides the PD component of the expected credit loss calculation. The other component of ECL required by CECL is LGD. In preparation for this analysis, we reviewed various sources of LGD data and forecasts. These data ranged from loan-level information (such as that available from Fannie Mae, Freddie Mac, and in the Moody's Analytics Mortgage Portfolio Analyzer) to aggregate portfolio-level data (such as that underlying Moody's Analytics Bank Call Report Forecasts). In the end, we used a single value of LGD in between what these various models produced.<sup>13</sup>

Finally, the ECCL framework we developed allows analysts to put together the different components of the ECL calculation and makes the results easily consumable by calculating the expected lifetime loss rate as:

$$\text{Expected lifetime loss rate} = \frac{\sum_{\text{Start of forecast horizon}}^{\text{Expected Lifetime horizon}} \text{Discounted Industry Gross Default} \$ * \text{LGD}}{\text{EAD of industry at start of forecast horizon}}$$

## Results using the ECCL methodology

Using our ECCL methodology, we calculate expected lifetime credit losses for outstanding first mortgages as of July 2017 at the industry level to be \$80.6 billion (see Table 1). This net loss projection takes into account LGD (at 40%) as given in the formula in the previous section and is based on a single consensus scenario.

**Table 1: First Mortgage Industry ECCL Results for CECL Under Consensus Scenario**

Aggregate portfolio	
Asset class	First mortgage
Exposure	\$8,287,257,314,739
ECL	\$80,628,573,836.65
ECL rate	0.97%
Start of forecast horizon	2017M7
LGD assumption method	Fixed scalar
Mean LGD assumption (%)	40
Discount rate method	Fixed scalar
Discount rate % per annum	4.3
Scenario utilized	Consensus

Source: Moody's Analytics

Decomposing the estimates by portfolio segment (see Table 2), we find that most of the losses come from the near-prime buckets of 620-659 and 660-699, given their relative size and risk. However, we note that the ECL rates are highest for the subprime buckets of 530-579 and 580-619, as would be expected.

**Table 2: First Mortgage ECCL Results Under Consensus Scenario for Different Score Bands**

Risk score	Exposure	ECL	ECL rate
810-850	\$838,611,063,783	\$1,679,197,307	0.20%
780-809	\$1,731,285,255,853	\$5,572,239,103	0.32%
740-779	\$1,904,720,846,983	\$11,038,449,432	0.58%
720-739	\$815,252,158,634	\$7,194,454,262	0.88%
700-719	\$649,229,712,173	\$7,601,373,278	1.17%
660-699	\$1,061,738,948,496	\$17,504,984,133	1.65%
620-659	\$778,621,127,534	\$17,202,323,897	2.21%
580-619	\$309,396,123,906	\$8,235,102,422	2.66%
530-579	\$124,681,844,010	\$3,400,088,592	2.73%
300-529	\$38,491,894,788	\$902,233,366	2.34%
Missing	\$35,228,338,579	\$298,128,046	0.85%

Source: Moody's Analytics

In terms of the state distribution (see Table 3), most of the losses come from California and Texas, closely followed by Florida, again because of industry-wide exposure in those states. However, the ECL rate is highest for Maryland among the 10 largest states (as measured by exposure).<sup>14</sup>

**Table 3: First Mortgage ECCL Results Under Consensus Scenario for Different States**

Geography	Exposure	ECL	ECL rate
CA	\$1,610,824,367,705	\$9,897,291,603	0.61%
FL	\$456,041,235,199	\$5,220,582,420	1.14%
IL	\$305,393,717,283	\$3,541,358,878	1.16%
MD	\$244,486,158,680	\$2,996,477,933	1.23%
NJ	\$286,840,235,122	\$3,310,108,190	1.15%
NY	\$479,508,391,125	\$3,809,458,775	0.79%
Other	\$3,564,506,533,250	\$38,340,525,264	1.08%
PA	\$248,773,752,190	\$2,413,006,393	0.97%
TX	\$499,698,720,384	\$5,255,511,431	1.05%
VA	\$317,260,660,740	\$3,682,799,091	1.16%
WA	\$273,923,543,061	\$2,161,453,859	0.79%

Source: Moody's Analytics

**Table 4: First Mortgage Industry ECCL Results for CECL Under Stress Scenario**

Aggregate portfolio	
Asset class	First mortgage
Exposure	\$8,287,257,314,739
ECL	\$154,727,086,349
ECL rate	1.87%
Start of forecast horizon	2017M7
LGD assumption method	Fixed scalar
Mean LGD assumption (%)	40
Discount rate method	Fixed scalar
Discount rate % per annum	4.3
Scenario utilized	S4: Protracted Slump

Source: Moody's Analytics

### Comparison to incurred-loss method

For comparison, we calculated allowance numbers using CreditForecast.com data<sup>15</sup> for a consistent analysis<sup>16</sup> and calculated the reserves with the incurred-loss method to be approximately \$41.5 billion for about \$8 trillion loans assuming a 40% LGD rate. According to the 10Qs in the second quarter of 2017, Fannie had \$20 billion in reserves for its \$3 trillion credit guaranty portfolio, while Freddie had \$8.8 billion in reserves on its \$1.8 trillion portfolio.

Compared with our CECL estimate of about \$80 billion, loss reserves will need to increase by about 100%, much higher than previous estimates of the impact.

A major driver of this dramatic increase is the extension of the loss estimate over the expected lifetime of each loan. Other important factors in the CECL estimate include the LGD assumption as well as the choice of scenario.

Results under Moody's Analytics stress and probability-weighted scenarios

In this section, we present results under a stress scenario as well as a probability-weighted scenario. Results in the previous section assumed a consensus scenario that is similar to a baseline scenario. It would be important to know how the impact would change if we were to observe a stress scenario in the upcoming years as laid out by the Moody's Analytics severe stress scenario, S4.

Using the same methodology outlined in the previous section, Table 4 gives the results under a stress scenario.

Compared with the \$80.6 billion that would be expected under a consensus scenario, results under a stress scenario would be much higher, at \$154.7 billion, if CECL had gone into effect as of July 2017. This is more than a 200% increase over the incurred-loss methodology.

Table 5 gives the results under a probability-weighted scenario. First we estimated losses using three scenarios: the Moody's Analytics baseline, S1, and S3. We then computed a weighted average of the losses based on the simulated likelihood of each of the three scenarios.<sup>17</sup> Probability-weighted scenarios can provide more stability to the loss estimates over time and are increasingly being adopted as the preferred method for CECL implementation, particularly for large lending institutions.<sup>18</sup>

**Table 5: First Mortgage Industry ECCL Results for CECL Under a Probability-Weighted Scenario**

Aggregate portfolio	
Asset class	First mortgage
Exposure	\$8,287,257,314,739
ECL	\$91,987,536,062
ECL rate	1.11%
Start of forecast horizon	2017M7
LGD assumption method	Fixed scalar
Mean LGD assumption (%)	40
Discount rate method	Fixed scalar
Discount rate % per annum	4.3
Scenario 1	Baseline
Scenario 1 weight	0.4
Scenario 2	S1: Stronger Near-Term Rebound
Scenario 2 weight	0.3
Scenario 3	S3: Moderate Recession
Scenario 3 weight	0.3

Source: Moody's Analytics

Compared with the \$80.6 billion that would have been expected under a consensus scenario, results under a probability-weighted scenario would have been higher, at \$92 billion, if CECL had gone into effect in July 2017. This is more than a 100% increase in reserves from the incurred-loss methodology.

### Reasonability of assumptions

This section provides evidence on the reasonability of the assumptions made in this study.

Expected lifetime of first mortgage loans. We assumed that the expected lifetime of first mortgage loans at the industry level is 15 years. This covers 99% of the first mortgage industry loans. We chose this number to err on the conservative side.

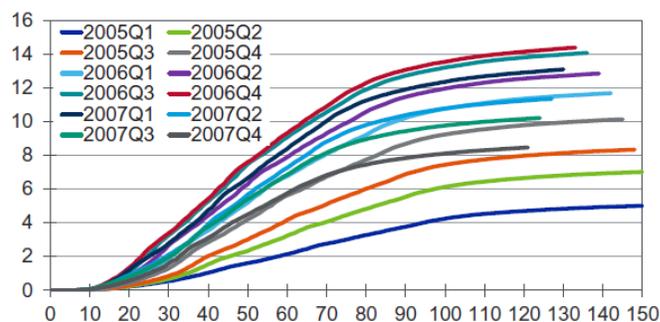
There are many ways to calculate the effective life of loans. Often, although this could change from one line of business

to another, the effective lives of loans are much shorter than contractual maturities of loans.<sup>19</sup> We give two different ways to calculate the effective life of loans based on cumulative defaults and remaining active balances. The following figures represent both these analyses.

Chart 3 presents cumulative default rates as a percentage of origination balance by age and includes several vintage cohorts. Cumulative default rates are appropriate to capture lifetime losses, and the concavity at a certain number of years reflects the fact that most of a vintage's defaults occur before that age. The chart supports the conservative 15-year lifetime assumption we made, as concavity appears long before that, at about eight to 10 years.

**Chart 3: First Mortgage, Cum. Default Rate**

% of origination balance, mo on book

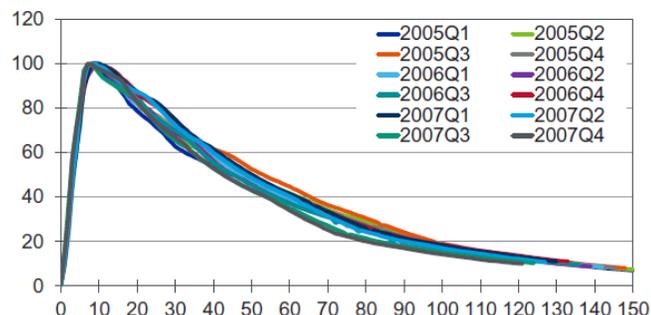


Sources: Equifax, Moody's Analytics

Chart 4 presents remaining outstanding balances as a percentage of origination balance by age. The chart, similar to Chart 3, includes several vintage cohorts.<sup>20</sup> Remaining outstanding balances are appropriate to capture lifetime losses (especially for installment loans where there will be no new draws), and the low percentages remaining reflect the fact that most of a vintage's payments occur before that age. The chart supports the 15-year lifetime assumption we made, as remaining outstanding balances fall below 20% long before that, at about eight to 10 years.

## Chart 4: First Mortgage, Outstanding Bal.

% of origination balance, mo on book



Sources: Equifax, Moody's Analytics

Loss given default. To check the validity of our 40% LGD rate assumption, we compared the results from several different historical databases.

Table 6 gives historical averages for LGD using different databases.

Table 6: First Mortgage LGD Numbers With Different Databases

Sample period*	Source	Segment	Method	LGD
2002Q1-2016Q3	Call Reports Forecasts	All U.S. banks	Portfolio level**	45%
2002Q1-2016Q3	Call Reports Forecasts	CCAR banks	Portfolio level**	44%
2002Q1-2016Q3	Call Reports Forecasts	DFAST banks	Portfolio level**	40%
2000M1-2015M12	Fannie Mae/Freddie Mac	All U.S. conforming	Loan level***	44%

\*All values in this table are based on historical avg

\*\*Sum of six mo of recoveries/charge-offs

\*\*\*Weighted by default balance

Source: Moody's Analytics

Historical averages for LGD using the Moody's Call Report Forecast or the CRF database<sup>21</sup> are calculated using the sum of six months of recoveries and dividing them by charge-offs available within the same database.<sup>22</sup> As a comparison with the U.S. aggregate, we also give LGD numbers for different segments using the CRF database.<sup>23</sup> As can be seen, LGD numbers for CCAR banks<sup>24</sup> are slightly higher than DFAST banks,<sup>25</sup> yet our assumed 40% LGD remains within the values presented in the table.

We can also derive LGD numbers from publicly available loan-level data provided by Fannie Mae and Freddie Mac.<sup>26</sup>

The LGD numbers, weighted by default balance, for Fannie and Freddie's mortgage data are close to our 40% LGD assumption.

We estimated forecast models for LGD using the Fannie Mae/Freddie Mac dataset and can provide forward-looking projections for LGD.<sup>27</sup> These forecast numbers, although slightly on the lower end, support our 40% LGD rate assumption.

One final LGD datapoint we can share comes from the Moody's Analytics Mortgage Portfolio Analyzer product and is based on historical residential mortgage-backed securities data. The forecast average LGD rate from MPA is 46% under a baseline scenario, once again confirming that our 40% LGD assumption is not too far off from industry experience. LGD numbers using securitized data are slightly higher because of the inherent riskiness of these loans as compared with, for instance, conforming loans.

## Conclusion

As the results of this paper show, adopting the CECL accounting standard in July 2017 would have increased reserves by about 100% under a consensus scenario over the existing incurred loss methodology. The results would have been even higher under a probability-weighted or stress scenario. Though these results should be alarming and entice institutions to start preparing for CECL, they also should be taken with a grain of salt, as they were based on broad set of industry-level assumptions. The impact for each institution will depend on various factors, including the age of the portfolio, servicing capabilities, and the quality and mix of the portfolio. In summary, it is better to prepare early for CECL than to scramble later, when the options for managing the transition are more limited.

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## FOOTNOTES

<sup>1</sup> The Office of the Comptroller of the Currency and the Federal Reserve predicted in mid-2011 that the industry allowance will go up by 30% to 50%. Keefe, Bruyette and Woods predicted in September 2015 that small and midsize banks would see median increases of 3%. A June 2015 Sageworks survey found that 57% of bankers expect 10% to 50% increase in allowances. In 2015, a MainStreet Technologies survey found expectations of a 20% to 50% increase in allowances. In an August 2016 Risk Article, Fitch warned that U.S. banks could see allowances surge by \$50 billion to \$100 billion if implemented today. Citi released an estimate of a 10% to 20% increase. There is also a recent KPMG survey that gives impact numbers around 51% across the board for the banking, insurance and specialty finance sectors.

<sup>2</sup> Based on CreditForecast.com data.

<sup>3</sup> [www.creditforecast.com](http://www.creditforecast.com).

<sup>4</sup> "What Do Half a Million Loans Say About the Impact of CECL on Loan Loss Allowances?" Moody's Analytics (July 2017). <http://www.moody-analytics.com/risk-perspectives-magazine/managing-disruption/regulatory-review/what-do-half-a-million-loans-say-about-the-impact-of-cecl-on-loan-loss-allowance>

<sup>5</sup> "CECL's Implications for Bank Profitability, System Stability, and Economic Growth," Risk Perspectives (November 2016).

<sup>6</sup> <https://www.creditforecast.com/solution/basepackage>.

<sup>7</sup> "From Bust to Bubble: Tracking the Consumer Credit Cycle," Regional Financial Review (2017).

<sup>8</sup> Moody's Analytics has more than 10 alternative scenarios that can be tested and utilized for further analysis.

<sup>9</sup> Although the CECL guidelines are vague in whether the losses with the PD and LGD methodology should be discounted, we believe that the industry standard will be, in fact, to discount them to take into account the time value of money.

<sup>10</sup> Mortgage Bankers Association, Weekly Mortgage Applications Survey: 50%/75% sample.

<sup>11</sup> The consensus scenario is based on a review of publicly available baseline forecasts of the U.S. economy. These sources include the Congressional Budget Office, Social Security Administration, Federal Open Market Committee members' range of forecasts, Federal Reserve Comprehensive Capital Analysis and Review baseline, the European Commission U.S. baseline, the U.K. Prudential Regulation Authority U.S. baseline, and the Philadelphia Federal Reserve Survey of Professional Forecasters.

<sup>12</sup> For more on CreditForecast.com methodology, please visit [www.creditforecast.com](http://www.creditforecast.com).

<sup>13</sup> For more on Moody's Analytics LGD methodologies, please contact authors.

<sup>14</sup> There might be smaller states that could have higher ECL rates, but they are all lumped together in the "Other" category in the table for presentation purposes.

<sup>15</sup> Allowances under the incurred-loss method were calculated by multiplying the average PD rate from the previous year with 40% LGD and

outstanding balances as of the date of the CECL forecasts.

<sup>16</sup> We also checked the aggregate balance sheet for all FDIC-insured commercial banks and savings institutions for comparison, but the FDIC balance sheet does not break down reserves for different asset classes, nor does it cover reserves of all types of lenders.

<sup>17</sup> More precisely, we assigned a weight to each of the three scenarios used that was consistent with the probability mass between each of the selected economic scenarios. Please contact Moody's Analytics for additional information on the derivation of these probability weights.

<sup>18</sup> For more research on scenarios under CECL, please refer to "Economic Scenarios: What's Reasonable and Supportable?" Moody's Analytics (October 2017).

<sup>19</sup> Expected lifetime calculation can get more complicated for revolving accounts. We will analyze this in a separate paper.

<sup>20</sup> Unfortunately, because of the data limitations on the performance time frame (July 2005 being the first monthly time point we have available in CreditForecast.com), we can reasonably estimate origination balance only for vintages after the first quarter of 2005. As a result, we do not see much of the rest of the tail behavior.

<sup>21</sup> The Moody's Analytics CRF database provides bank income and balance sheet statements at the industry level, based on call report data from the FDIC. For more information, please refer to <https://www.economy.com/products/data/forecast-bank-call-reports>.

<sup>22</sup> With the CRF database, there is the issue of matching the recovery dates with the charge-off dates, as recoveries do not happen right away and can take quite a while. Also, it is hard with this database to figure out which recoveries correspond to which charge-offs.

<sup>23</sup> We stick to using a numerator with a sum of just six months of recoveries, as this seems to give results closer to other industry knowledge.

<sup>24</sup> CCAR banks are those that are more than \$50 billion in asset size.

<sup>25</sup> DFAST banks are those that are more than \$10 billion but less than \$50 billion in asset size.

<sup>26</sup> LGD numbers from Fannie Mae/Freddie Mac might make more sense for those institutions interested only in conforming loans statistics.

<sup>27</sup> Please note that the historical data are based on loans that already defaulted. The forecasts are based on active loans conditional on default events.

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