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The Importance of Prepayment Modeling in CECL Estimation

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Since 2019, financial institutions across the spectrum have adopted the Current Expected Credit Loss (CECL) standard for their loan loss reserve process. This standard was introduced to address certain limitations of the previous incurred loss model and aims to provide a more accurate representation of the institution's financial risk.

With the adoption of the CECL standard, financial institutions have explored various methods to estimate expected credit losses, primarily focusing on default rates. Model-building approaches have ranged from the simplest methodologies such as the Weighted-Average Remaining Maturity (WARM) method to vintage analysis and loan-level regression models. These diverse approaches cater to the varying needs and resources of financial institutions.

Despite the attempts to utilize greater model sophistication, financial institutions still face challenges in their CECL processes. Prepayments are a key component of the CECL life-of-loan estimation and can significantly impact the reserve; however, it is an attribute that is least quantitatively derived. Reserve estimates may show unexpected volatility on a period-to-period basis. Fluctuations in reserve estimates may be difficult to attribute to underlying drivers. A model with a reasonable Probability of Default (PD) back testing performance may not perform well when actual loss numbers are considered. Consequently, stress testing may also be limited or unreasonable in assessing overall risk and capital adequacy.

Both financial institutions and regulators recognize that understanding portfolio prepayment behavior is essential to addressing these challenges. While the standard practice has been to use the through-the-cycle prepayment average, it is important to note that prepayments can vary significantly throughout the life cycle of a loan. Accurately modeling prepayments could potentially result in a more precise view of Exposure at Default (EAD), leading to improvements in robustness and reliability of the end-to-end CECL process.

In the Expected Credit Loss (ECL) calculation, the components of EAD and PD may seem to carry equal weight, however their individual effect may vary significantly depending on specific circumstances. While EAD is typically stable and fixed on a contractual basis, prepayments can cause significant EAD shifts. As these changes carry forward to subsequent periods, the results may have a compounding effect on EAD.

Recent macroeconomic conditions, along with anticipated future developments, have underscored the importance of forecasting prepayments and understanding their impact on EAD. Consequently, financial institutions must carefully consider prepayment modeling in the CECL process and evaluate how macroeconomic shifts can alter prepayment assumptions. By incorporating these factors, financial institutions can better anticipate potential changes in EAD, generate more accurate ECL numbers, and ultimately enhance their risk management strategies.

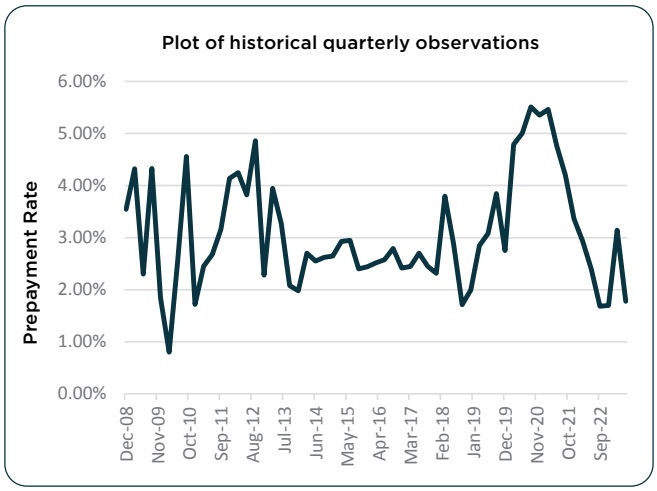
Data Exploration

To understand the impact of prepayment modeling on the CECL process, we introduce our consortium aggregation dataset. This dataset comprises reconciled CECL-quality historical loan level data, which is used to produce broad industry trends and benchmarks in both consumer and commercial credit. The data consortium is categorized into several key product types, with history dating back to 2008. For now, we will focus exclusively on aggregate behavior in the residential mortgage product class. However, future research papers delving into prepayment benchmarking data for both C&I (Commercial & Industrial) and CRE (Commercial Real Estate) sectors are in the pipeline.

Although there is some noise in the early periods, our observations reveal that clear patterns in prepayment behavior emerge subsequently. Beginning in 2011, we see a substantial increase in prepayments tied to the recovering economy and extremely low interest rates. The low rates made refinancing attractive, and consumers benefited from the improved financial security. Through the mid-2010s, prepayments levels remained flat. Despite steady macroeconomic growth, rising interest rates during this period weaken the demand for refinances, keeping prepayment activity low.

However, during the Covid pandemic, prepayments surge dramatically. This increase was driven by extremely low interest rates and government-sponsored cash inflows to consumers. As a significant portion of existing loans were refinanced and interest rates began to rise, we observed prepayment levels returning to their pre-pandemic norms.

Figure 1



Prepayments and CECL numbers

Given the substantial variations in prepayment activity over time, it's worth considering whether financial institutions could meaningfully improve their CECL reserves by incorporating prepayment modeling. We will explore three approaches in calculating the CECL estimate:

- **Base Case:** In this approach, the institution does not use a model for defaults or prepayments. Instead, historical averages are used to drive both forecasts.
- **Current Practice Model:** In this approach, we replicate the most used practice at financial institutions for CECL calculations. Defaults are forecasted for each period in the reasonable and supportable ("R&S") forecast period, however prepayments are forecasted using historical averages.
- **Comprehensive Forecasting Model:** In this approach, both prepayments and defaults are forecasted for every period in the forecast.

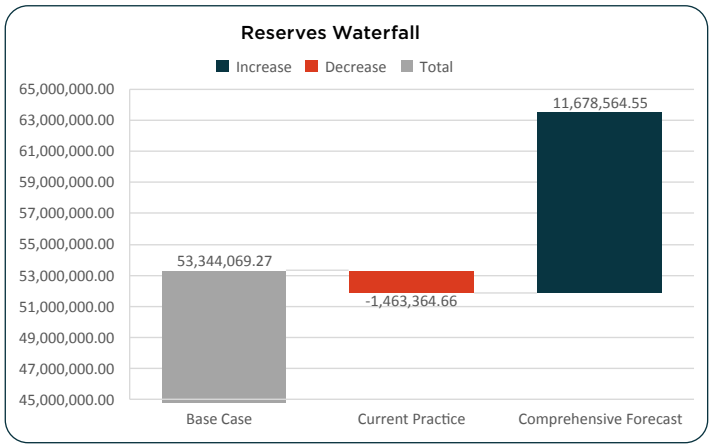
To ensure that quality of the models does not affect this thought experiment, we assume both prepayments and defaults are perfectly forecasted in the cases where they are being modeled. We will investigate the assumption that prepayments can be modelled adequately later in this discussion. All forecasts use the second quarter of 2021 (2021Q2) as a starting point for forecasting.

The results are shown in Table 1 below.

Table 1

Model Approach	Loss Rate	Reserves	Shift from Previous	% of total Shift
Base Case	0.87%	53,344,069.27	0.00	0.00%
Current Practice	0.85%	51,880,704.60	-1,463,364.66	-14.33%
Comprehensive Forecast	1.01%	63,559,269.16	11,678,564.55	114.33%

Figure 2



In the example shown, replacing a historic average as forecast with a perfect default forecast leads to a $1.5 million reduction in reserves. However, when we replace the prepayment historic average forecast with a perfect prepayment forecast, this change yields an $11.6 million increase in reserves. As a result, when we look back at the historic example, we see that prepayment forecasting can dramatically alter reserve results, even to the point of outweighing defaults considerably. However, this result depends on our ability to properly forecast prepayments, which we explore in the next section.

Modeling Prepayments: Feasible or Not?

While the previous exercise demonstrates that financial institutions could benefit from applying perfect foresight to prepayments, they do not have that capability in practice. Instead, financial institutions must operate in a real world characterized by messy and sometimes inaccurate statistical forecasts. Given these conditions, it is essential to evaluate the potential accuracy and benefits of a prepayment model. If a prepayment model demonstrates a good fit with historical data, then financial institutions may consider enhancing their prepayment modeling capabilities.

We take our usual approach for model choice via regression analysis, where point-in-time ("PiT") quarterly prepayment rates are the dependent variable and macroeconomic variables are the independent variables. Here is the selected model:

Table 2

Variable	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.026522	0.001254	21.152	< 2e-16 ***
House Price Index (Difference)	0.00122	0.000229	5.339	1.83e-06 ***
30 Year Mortgage (Difference)	-0.01307	0.002869	-4.554	2.96e-05 ***
3 Month Treasury (Diff Lag 3)	-0.01205	0.00256	-4.706	1.75e-05 ***

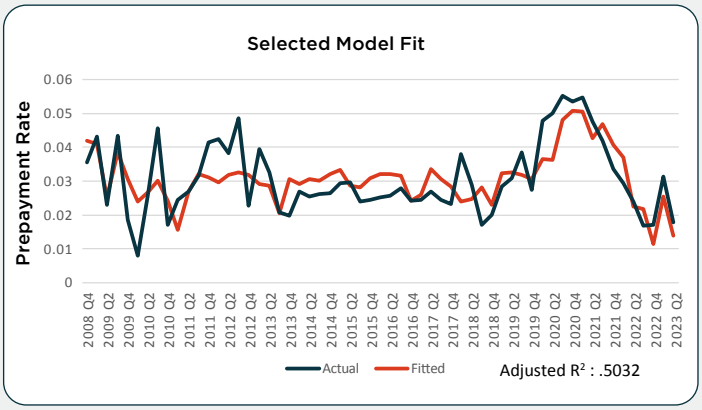
We can see three variables that all make sense from a business perspective. Higher housing prices lead to more prepayments. This result is logical because the loan-to-value (LTV) component is critical in the origination decision, making it easier for borrowers to refinance when housing prices are rising. Mortgage rates are another significant factor. Lower rates encourage borrowers to refinance and lock in favorable rates, whereas higher rates discourage refinancing. The 3-month treasury also makes sense as it provides more information about the broader interest rate environment, influencing the decisions of all parties involved.

From Figure 3, we observe that the model fits the historical data well. It accurately captures the low prepayment levels in the mid-2010s. Furthermore, it successfully predicts the sharp increases and subsequent decreases in the recent post-Covid data.

Although the model is less precise with the earlier noisier data, it still captures some of the underlying behavior from that period.

Here is the model fit:

Figure 3



Forecasting: does it matter?

In this exercise, we analyze the relative impacts of prepayments versus defaults on CECL reserves. We applied a similar methodology to our historical data analysis but adapted it for forecasting purposes.

Methodology:

1. **Baseline Scenario:** We start with a baseline macroeconomic scenario.
2. **Economic Shock:** We apply a one standard deviation (1sd) positive shock to all macroeconomic variables, consistent with an optimistic scenario (e.g., an increase in GDP and a decrease in unemployment).
3. **Prepayment Forecast:** We input this optimistic economic scenario into our prepayment forecast model while keeping defaults at baseline levels.
4. **Combined Forecast:** Next, we input the optimistic scenario into both the prepayment and default forecast models.
5. **Pessimistic Scenario:** We repeat steps 2 through 4 using a pessimistic scenario forecast consistent with a deep recession.

Table 3 – Upside Scenario Results

	Loss Rate	Reserve	Shift from Previous	% of Total Shift
Baseline	1.32%	151,990,701.66	0	0
1sd Upside - Only Prepay	1.25%	144,993,032.31	-6,997,669.35	33.62%
1sd Upside - Default & Prepay	1.14%	131,174,702.03	-13,818,330.28	66.38%

Table 4 – Downside Scenario Results

	Loss Rate	Reserve	Shift From Previous	% of Total Shift
Baseline	1.32%	151,990,701.66	0	0.00%
Downside - Only Prepay	1.36%	156,677,435.38	4,686,733.72	6.09%
Downside - Default & Prepay	1.98%	228,960,867.61	72,283,432.22	93.91%

Findings:

1. **Impact of Prepayments:** The positive economic shock led to a $7 million reduction in required reserves. The downside economic scenario led to a $5 million increase in reserves.
2. **Impact of Defaults:** Adding in prepays alongside defaults in the upside scenario leads to an additional $14 million shift in reserves. Doing the same for the downside leads to a $72 million increase in reserves.
3. **Relative Contribution:** In the upside scenario, prepayments accounted for nearly 33% of the total reserve reduction ($21 million total reduction, with $7 million attributed to prepayments), whereas in the downside scenario, prepayments only accounted for 6% of the total reserve increase ($77 million total increase, with $5 million attributed to prepayments).

Discussion:

The analysis shows that prepayments matter under both scenarios, but that the direction of the shock is important. Under stress scenarios, expected defaults change, but prepayments do not change nearly as much. The countervailing effects of large interest rate drops under stress and a worsening economy create a dampened impact of prepayments on reserves. However, under an upside scenario, we see the impact of reserves on prepayments become more substantial.

In the current macroeconomic context— marked by steady economic growth and historically high interest rates— the primary concern for financial institutions is the direction of inflation, federal rate cuts, and the future trajectory of economic growth.

As demonstrated above, these scenarios are more sensitive to fluctuations in prepayment rates. Consequently, defaults may be less influential under such circumstances in comparison to severe stress scenarios.

As shown in table 3, scenarios related to these questions show strong sensitivity to prepayments. In these cases, defaults will vary less than they would under severe stress scenarios. As such, it is crucial for institutions to carefully consider their prepayment models, as they are likely to have a more substantial impact on reserves within the current macroeconomic environment.

Conclusion

Yes, prepayment modeling is essential in CECL Estimation

In this paper, we have established the importance of prepayments as a vital factor in the credit loss estimation process. Our analysis demonstrates several key points:

1. **Historical Significance:** Prepayments have historically played a crucial role in the accuracy of credit loss predictions. By examining past data, we have shown that prepayments significantly affect credit loss outcomes.
2. **Predictive Accuracy:** Prepayments can be forecasted with a high degree of accuracy. Our models indicate that incorporating prepayments into credit loss estimations yields more reliable and precise results.
3. **Impact on Future Forecasts:** The tangible impacts of prepayments on future forecasts are evident. By including prepayments in our models, we can better anticipate changes in credit loss, thereby improving the quality of our forecasts.

Given these findings, financial institutions aiming to produce the highest quality ECL figures should strongly consider incorporating prepayment modeling into their methodology.

By doing so, financial institutions can enhance their predictive accuracy and achieve more robust and reliable credit loss estimations.

Leveraging our aggregated consortium dataset, we will continue to examine the impacts of prepayments to other asset classes.

Our upcoming research paper will focus on prepayment benchmarking data for both C&I and CRE sectors.