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Application of Expected Loss (EL) for Loan Loss Estimation Based on Loan Term Using Simulation Data

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Abstract

This study aims to evaluate the effect of loan tenor on loan loss estimation using the Expected Loss (EL) model. Through this simulation data calculation, various scenarios with varying loan tenors show that loan tenors have a significant influence on the calculation of Expected Loss (EL). Longer tenors tend to increase the Expected Loss (EL) due to an increase in credit risk over time. The calculation results provide important implications for financial institutions in setting lending policies and managing credit risk.

Keywords: Expected Loss (EL), Loss Estimation, Loan Tenor

1. Introduction

Credit risk management plays a vital role in maintaining the stability and sustainability of financial institutions, as stipulated in the global regulatory framework (Basel Committee on Banking Supervision, 2006).One important aspect of managing this risk is an in-depth understanding of loan tenor, which affects various dimensions of risk management, such as liquidity, borrower repayment ability, the impact of economic changes, and portfolio diversification strategies.Short tenors, for example, provide the advantage of quick turnaround and reduced liquidity risk (Hull, 2012), while long tenors require more complex liquidity strategies due to the longer duration of locking up funds (Schuermann, 2004).In addition, the ability of borrowers to meet their repayment obligations is also influenced by the tenor of the loan, where short tenors may lead to a larger installment burden (Brown & Moles, 2014), while long tenors increase the risk associated with future economic uncertainty (Altman & Saunders, 1997). Furthermore, long tenors are also more susceptible to fluctuations in interest rates, inflation, and global economic dynamics (Merton, 1974), which are less significant for short tenors (Jorion, 2007). Therefore, adjusting the tenor to the risk profile of the borrower is an essential strategy in mitigating default risk and ensuring the stability of the loan portfolio (Ross et al., 2002).

In terms of interest rate setting, short tenors usually have lower interest rates due to less risk, while long tenors require higher interest rates to compensate for long-term uncertainty (Fabozzi, 2009; Hull, 2012). The strategy of diversifying loan portfolios through tenor management also enables the creation of a balanced portfolio of risk and return, as advocated in modern portfolio theory (Markowitz, 1952). More importantly, compliance with banking regulations, as stipulated by the Basel Committee on Banking Supervision (2011), requires financial institutions to mitigate systemic risk through effective tenor risk management.

Proactive monitoring of loan tenors assists financial institutions in identifying potential problems early, so that accumulated credit risk can be prevented (Schuermann, 2004). In this context, an Expected Loss (EL)-based approach is a relevant analytical tool to estimate loan losses by considering various risk factors inherent in the loan tenor (Basel Committee on Banking Supervision, 2006). This study aims to apply the EL method to simulated data, with the hope of providing deep and strategic insights to support more effective credit risk management in financial institutions.

2. Literature Review

Credit loss is one of the fundamental risks faced by financial institutions in their financing operations. This accounting standard underscores the importance of a proactive approach in measuring credit risk, one of which is through the Expected Loss (EL) method. This approach includes three key elements: Probability of Default (PD), Loss Given Default (LGD), and Exposure at Default (EAD), which collectively provide a quantitative estimate of the potential losses a financial institution could incur (Basel Committee on Banking Supervision, 2017). The complexity of EL estimation increases when temporal factors, such as loan term or tenor, are taken into account. Previous literature reveals that credit risk is not only affected by borrower characteristics, but also by loan duration. As shown by Duffie & Singleton (2003), default risk tends to increase exponentially as tenor increases, due to higher uncertainty regarding future economic and market conditions.

Each component of EL is directly affected by the term of the loan. In the study of Altman et al. (2005), longer tenors correlate with higher Probability of Default (PD), as the level of economic uncertainty continues to increase over a longer period. In addition, Loss Given Default (LGD) also changes significantly, with recovery rates tending to be lower for longer-term loans due to greater asset liquidation challenges and declining collateral values. Exposure at Default (EAD) is not immune to the influence of tenor, as loan exposure may increase when loan repayments are made later than the planned amortization.

Other studies have also highlighted the relationship between tenor and the sensitivity of credit risk to macroeconomic variables. For example, an increase in interest rate volatility or commodity price fluctuations tends to affect long-duration loans more, thus magnifying the overall risk (Merton, 1974). Therefore, it is important for financial institutions to integrate tenor analysis into the EL framework to effectively mitigate risk. In the context of EL, simulation data allows exploration of the relationship between tenor and credit losses under various assumptions and parameters. This study utilizes simulation to validate that Expected Loss increases with the length of loan duration. The findings are in line with existing literature, but make an additional contribution by providing a more flexible quantitative framework for further exploration.

The application of the EL method in loan loss estimation not only provides guidance for financial institutions in managing risk, but also opens up opportunities to refine more precise risk mitigation strategies. By integrating loan term analysis into the EL framework, financial institutions can identify potential losses more accurately. In the future, further research could explore the influence of external variables, such as macroeconomic indicators or geopolitical risks, to improve the accuracy of EL estimation. The integration between data simulation and more complex risk models could be an important step in developing a more adaptive and data-driven credit risk management approach.

3. Materials and Methods

This study aims to apply the Expected Loss (EL) method in credit loss estimation based on loan tenure, using self-designed simulation data. This method integrates three main components, namely Probability of Default (PD), Loss Given Default (LGD), and Exposure at Default (EAD), which are analyzed through a quantitative approach based on bond attributes.

3.2. Materials

The data used in this study is simulated data designed to reflect the characteristics of corporate and risk-free bonds. This data includes key variables, such as coupon rate, face value/principal, price/present value, yield to maturity, recovery rate, and credit spread. Corporate Bonds represent debt instruments with credit risk that reflect the probability of default by the debtor, used to calculate PD and LGD. Risk-Free Bonds are used as a comparison to determine credit spread, describing debt instruments without default risk, such as government bonds. This study considers various tenors to analyze the effect of loan duration on EL. The simulation data assumes varying loan tenors with respect to the relationship between duration and credit risk. Components of Expected Loss (EL) In this study, EL is calculated based on the following three components:

- Probability of Default (PD): Estimates the probability of default of the borrower over the loan tenor.
- Loss Given Default (LGD): Measures the loss relative to the value of the exposure that cannot be recovered in the case of default.
- Exposure at Default (EAD): Indicates the value of the exposure at the time of default, often represented by the face value of the loan or bond.

Some basic assumptions used in this simulation are, Coupon rate and YTM are different over the tenor, Recovery rate is considered constant and assumed to reflect the average recovery based on historical data and Credit spread is used as an indicator of corporate bond credit risk.

3.1. Methods

Bond attributes are designed to reflect characteristics relevant to credit risk analysis. For corporate bonds, attributes such as coupon rate, face value, YTM, and credit spread are combined to determine PD. Meanwhile, the attributes of risk-free bonds are used as a comparison in calculating the credit spread.

3.2.1 Probability of Default (PD)

$$PD = \frac{Credit\ Spread}{1-Recovery\ Rate} \quad (1)$$

This formula assumes that the *credit spread* reflects the additional risk of default. The PD value is adjusted based on the tenor of the loan, where default risk tends to increase at longer tenors.

3.2.2 Loss Given Default (LGD) Calculation

$$LGD = EAD\ \times\ (1 - Recovery\ Rate) \quad (2)$$

LGD is determined by multiplying the exposure at the time of default by the unrecoverable loss rate calculated for each tenor, assuming that the recovery rate remains constant throughout the study period.

3.2.3 Exposure at Default (EAD) determination and Expected Loss (EL) calculation

The EAD is deemed to be equal to the face value of the bond at the beginning of the loan period. For certain cases, the EAD value may be adjusted based on different exposure scenarios. The PD, LGD and EAD components are then combined to calculate EL using the formula:

$$EL = EAD\ \times\ PD\ \times\ LGD \quad (3)$$

3.2.4 Tenor Time Effect Analysis and Model Validation

EL is calculated for various tenors, the data is analyzed to determine how changes in loan duration affect each component of EL. This approach utilizes linear regression to understand the relationship between tenor and the cumulative EL value. Although simulated data was used, the designed model was validated against proven credit risk principles, as described in the relevant literature (Basel Committee on Banking Supervision, 2017). This approach ensures that the results are consistent with best practices in credit risk management.

4. Results and Discussion

The analysis is based on simulated data that reflects the characteristics of corporate bonds and risk-free bonds, so the findings are relevant for credit risk assessment. The calculation results show:

Table 1. Corporate Bond Attributes

Corporate Bond Attributes:			
Year	9	7	5
Coupon (%)	13%	9%	8%
Principal (FV)	$1.300,00	$1.200,00	$1.100,00
Yield to Maturity	8%	6%	6%
Recovery Rate	60%	60%	60%

Corporate Bond Attributes covers the characteristics of corporate bonds, which are debt instruments with inherent credit risk. The components listed provide an overview of the credit risk from the perspective of both the issuer and the investor. Coupon Rate, decreasing from 13% (9 years) to 8% (5 years), reflects that the credit risk and compensation required by investors is greater for long tenors while for Principal (FV), decreasing with tenor, indicates less risk exposure at short tenors.

Table 2. Risk Free Bond Attributes

Risk Free Bond Attributes:			
Year	9	7	5
Coupon (%)	13%	9%	7%
Principal (FV)	$1.300,00	$1.200,00	$1.100,00
Yield to Maturity	10%	8%	8%
Price (PV)	$1.490,87	$1.249,82	$1.077,42

Risk Free Bond Attributes describe the characteristics of bonds without credit risk, such as government bonds, which are used as benchmarks to determine credit spreads. Coupon Rate, reduced from 13% to 7% with shorter tenors, even though there is no credit risk. For price, the price of risk-free bonds is always higher than corporate bonds, indicating that investors are willing to pay a premium for security.

Table 3. Probability of Default (PD) Analysis

Probability of Deafault (PD) = Credit Spread/(1-Recovery Rate)			
Term	9 year	7 year	5 year
Credit Spread	2%	2%	2%
PD	6%	5%	4%

The Probability of Default (PD) analysis shows an increasing trend in default risk as the loan duration increases. This trend is in line with theoretical expectations, as longer durations usually involve higher uncertainty and a greater likelihood of negative financial events for the debtor.

Table 4. Lost Given Default (GD)

Lost Given Default (LGD) = Exposure at Risk*(1-Recovery Rate)			
Term	9 year	7 year	5 year
LGD ($)	$682,42	$560,39	$477,07
LGD%	40%	40%	40%

The LGD value is relatively stable across tenors due to the assumption of a constant recovery rate in the simulation model. Despite this stability, LGD directly affects the magnitude of EL.

Table 5. Cumulative Expected Loss (EL)

Exposure at Default (EAD)			
Term	9 year	7 year	5 year
Exposure at Default (EAD)	$1.706,05	$1.400,97	$1.192,67
Expected Loss (EL) = EAD*PD*LGD			
EL	$41,10	$30,78	$17,98

Analysis of cumulative EL shows a strong positive correlation between loan duration and credit losses. Results show that EL increases exponentially with increasing loan duration, emphasizing the combined effect of increasing PD over time.

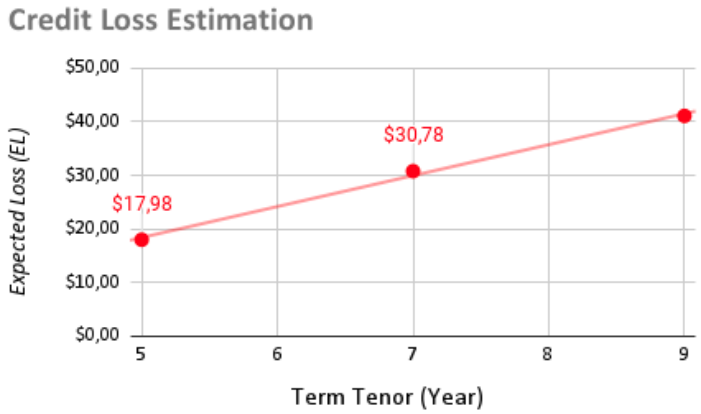

Figure 1. Credit Loss Estimation Analysis

The results of this study are in line with the credit risk principles established by the Basel Committee on Banking Supervision (2017). The patterns observed in PD and EL are consistent with previous studies, such as those by Altman and Sabato (2007), which emphasize the increased risk associated with longer loan duration. Moreover, the use of simulated data allows for a controlled analysis, although future research should include empirical datasets to improve generalizability. Practical implications, the calculations have some practical implications:

1. Loan Pricing: Lenders should consider higher risk premiums for long-term loans to offset the increase in ELs.
2. Risk Management: Accurate PD and LGD estimates are essential for effective credit risk management, especially for long-duration loans.
3. Policy Formulation: The regulatory framework should promote transparency in reporting recovery rates and credit spreads to improve the accuracy of EL estimates.

5. Conclusion

Expected Loss (EL) estimation results show an important relationship between loan tenure and credit risk components. Credit risk management based on loan tenor is very important to maintain the financial health of financial institutions and ensure smooth payments by debtors. Credit risk management is strongly influenced by the choice of loan tenor. Short tenors, with generally lower credit risk, allow financial institutions to manage portfolios more stably. However, concentration on short tenors may limit loan growth and reduce profitability. On the other hand, long tenors offer higher credit growth potential, but increase vulnerability to credit risk and liquidity risk.

Therefore, tenor diversification in the loan portfolio is an important strategy to optimize returns and minimize risk. By monitoring tenor, financial institutions can identify loans that are nearing maturity and anticipate potential defaults. With good tenor-based risk management, financial institutions can ensure operational sustainability, maintain profitability, and protect debtors from excessive burden.

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