P1.T4. Valuation & Risk Models

Chapter 6. Credit Risk and Capital Modeling

Bionic Turtle FRM Study Notes

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- **Evaluate a bank's economic capital relative to its level of credit risk**
- **Explain the distinctions between economic capital and regulatory capital and describe how economic capital is derived.**
- **Identify and describe important factors used to calculate economic capital for credit risk: probability of default, exposure, and loss rate.**
- **Define and calculate expected loss (EL).**
- **Define and calculate unexpected loss (UL).**
- **Estimate the mean and standard deviation of credit losses assuming a binomial distribution.**
- **Describe the Gaussian copula model and its application.**
- **Describe and apply the Vasicek model to estimate default rate and credit risk capital for a bank.**
- **Describe the CreditMetrics model and explain how it is applied in estimating economic capital.**
- **Describe and use the Euler's theorem to determine the contribution of a loan to the overall risk of a portfolio.**
- **Explain why it is more difficult to calculate credit risk capital for derivatives than for loans.**
- **Describe challenges to quantifying credit risk.**

Retaining some capital to safeguard a bank against failure due to unfavorable conditions is a necessary alternative to transferring (or hedging) away the bank's risks. The choice of capital structure is directly associated with the risks undertaken by a bank such as market risks, credit risks, operational risks, etc.

First, it is important to distinguish between cash capital and risk capital:

- *Cash capital* is the cash required for the day-to-day transactions of a bank and it constitutes its working capital.
- *Risk capital* is a measure of the capital required by banks to absorb all the losses caused by the overall risks undertaken by them.

Schroeck defines **risk capital** as "the minimum capital amount that has to be invested to buy insurance that fully protects the value of a bank's net assets against a decline in value, so that completely default-free financing of these net assets can be obtained."[1]

- The bank runs its business with the help of cash capital supplied by its stakeholders. Thus, it can be said that the stakeholders sell insurance in the form of assets to the bank. Debt holders and shareholders sell the majority of this insurance, while depositors sell little to no insurance. The risk capital may be viewed as the cash (premium) required by the banks to purchase this insurance from the bank's shareholders.

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[1] Gerhard Schroeck, Risk Management and Value Creation in Financial Institutions, (New York: Wiley, 2002)

- **Equity capital** and insurance are subordinate to debt capital which is, in turn, subordinate to deposits implying that when losses occur, equity capital and insurance are used up first followed by debt capital before depositors are affected. The equity capital is considered as the "going concern capital" (used while the bank is still solvent) whereas the debt capital is the "gone concern capital" (used up after the bank becomes insolvent).

Risk Capital (Schroeck Figure 5.2)[2]
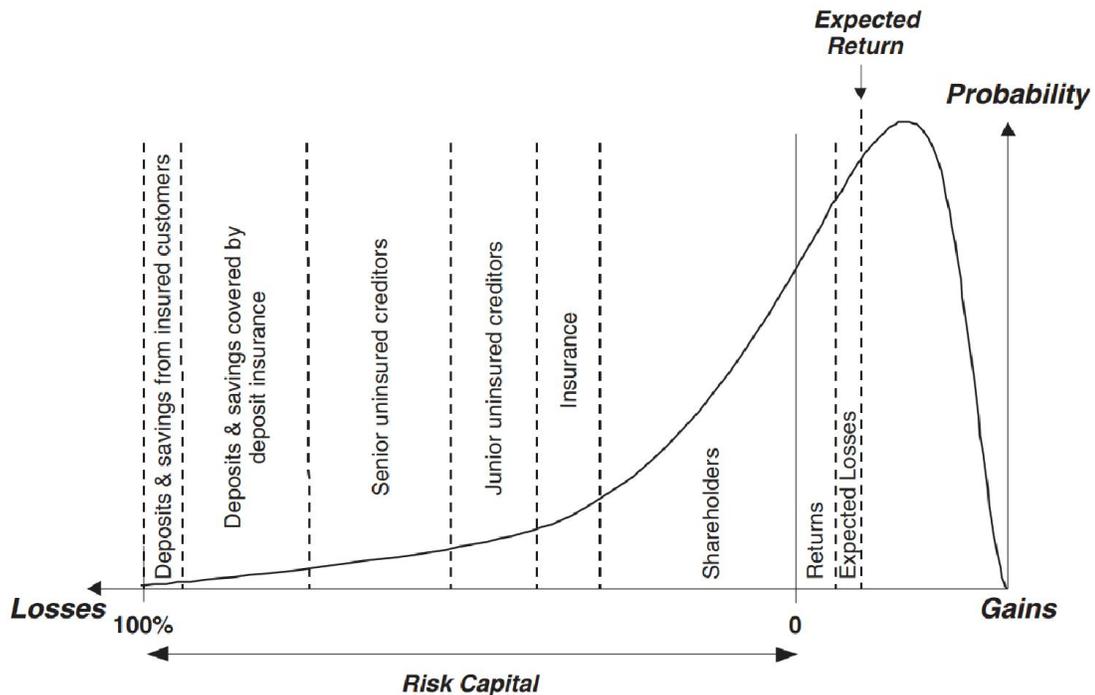
In short, risk capital must be able to absorb all the losses caused due to risky activities taken by a bank. In the real world, however, it is too costly to hold capital fully for all of the potential losses caused by the risks taken. So, **economic capital is used as a possible substitute for risk capital.**

Economic capital is a specific type of risk capital which is derived economically (internally) as well as by regulation (externally):

- **Economic capital** is the bank's internal estimate of the minimum capital required for its risky operations so that it can continue to perform as a going concern despite conditions of financial distress.

- **Regulatory capital** is the minimum capital required to be kept by a bank as mandated externally by regulators.

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[2] Gerhard Schroeck, Risk Management and Value Creation in Financial Institutions, (New York: Wiley, 2002)

To understand the economic capital in terms of credit risk (risk held in the bank's loan portfolio), let's first define credit risk. **Credit risk** emerges due to:

- Uncertainty related to (i) repayment of loan amount[3] by the obligor within the agreed time frame and/or (ii) fulfillment of the payment obligation by a counterparty and thereby not honoring the pre-agreed contract – e.g., Over the Counter (OTC) derivative.

- Deterioration in the credit quality of the borrower/counterparty, which is called credit migration, also leads to credit risk – e.g., macroeconomic factors such as country risk[4], forbidding the borrowers from meeting their obligations.

In the event of a default, as a result of nonpayment or due to diminished credit quality, banks stand to lose their capital in the form of economic losses. Furthermore, for banks, credit losses are inevitable. It is, therefore, essential for banks to differentiate between Expected Losses (losses that can be predicted) and Unexpected Losses (losses that cannot be predicted) when measuring credit losses and the capital required to manage them.

If a bank's expected loss is always equal to its actual loss for the same time period, then there is no credit risk for the bank because risk arises exclusively due to uncertainty (unexpected losses). Moreover, in such a case, the bank need not compute and keep economic capital aside for unforeseen losses as the expected losses can be combated by the bank simply by increasing its lending cost.

Economic capital for credit risk

Expected Losses (EL) by itself cannot capture all aspects of credit risk owing to the uncertainty associated with the lending business. Hence, banks capture this uncertainty (variation or standard deviation of expected losses) by estimating Unexpected Losses (UL) for their credit portfolio and deriving Economic Capital (EC) to anticipate these UL. Since credit risk results in economic loss to a bank, economic capital is the amount of funds required to safeguard against such losses.

Put more specifically, **Economic Capital (EC) is the amount of risk capital a bank estimates in order to remain solvent at a given confidence level and time horizon.**

According to Schroeck, "**Economic capital is an estimate of the overall level of capital necessary to guarantee the solvency of the bank at some predetermined confidence level that is consistent with the target credit rating of its senior debt. It is therefore, risk capital that is estimated up to a critical threshold level and provided by shareholders and junior debt holders**."[5]

- Banks continue to be solvent even after their equity value falls below their liabilities when they default on junior or subordinated debt. But the critical threshold is reached once it crosses the level of junior debt and starts defaulting on its senior debt too.

- This leads to a downgrade of its credit rating on senior debt, which could trigger a bank run and make it difficult to continue its operations.

- So, the minimum capital required to be held by a bank to safeguard its credit rating of senior debt so that it could continue as a going concern is the bank's economic capital.

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[3] Loan Amount = Outstanding principal plus accrued interest from the last date of payment. This includes all credit exposures of the bank, such as bonds, customer credits credit cards, derivatives, etc.

[4] Inability of solvent borrowers to freely convert currency due to transaction restrictions, also called transfer risk.

[5] Gerhard Schroeck, Risk Management and Value Creation in Financial Institutions, (New York: Wiley, 2002)

Economic capital (Schroeck Figure 5.3)[6]
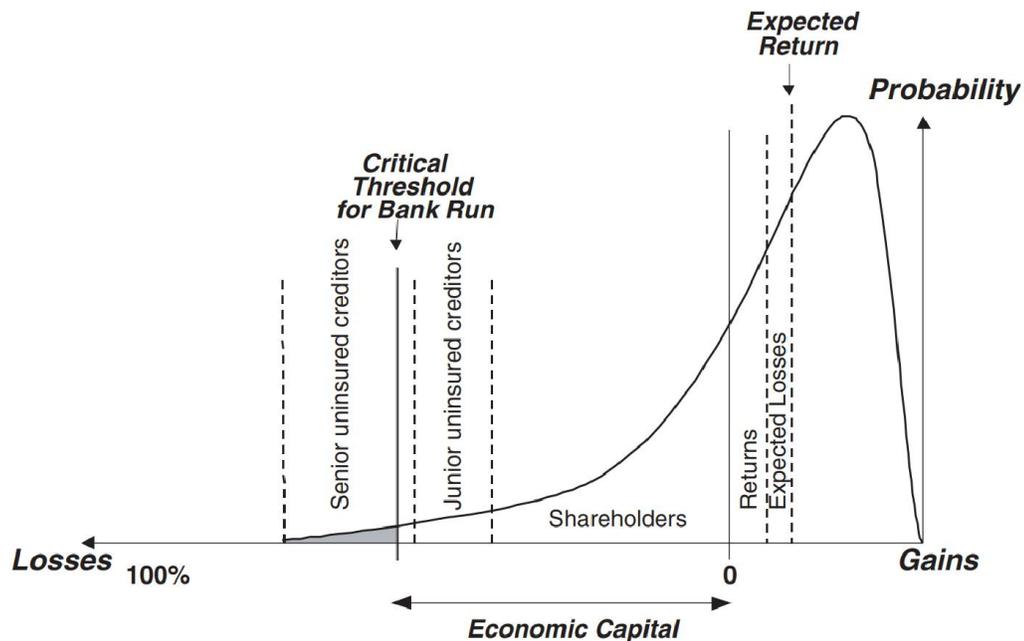
Note: Compared to the Risk Capital (see Figure 5.2), for Economic Capital (see Figure 5.3), the tranche with external insurance and deposit insurance are ignored on the assumption that they are already paid for and are insured. Thus, for these tranches, capital need not be kept aside as a buffer against losses.

Explain the distinctions between economic capital and regulatory capital and describe how economic capital is derived.

Distinction between economic and regulatory capital

Economic capital is a **bank-specific or internal measure of capital requirement** defined according to the bank's own solvency standard. It is separate from regulatory capital and aims to support various business decisions or evaluate different business units of a bank.

For example, a bank's management can use economic capital estimates to allocate capital across business streams, promoting those units that provide desirable profit per unit of risk. This capital depends on the bank risk appetite and its desired ability to absorb shocks such as an abnormal default rate on loans. Therefore, economic capital is different for any given bank. In the past, banks decided freely on their own level of capital (based on the concept of economic capital) that they wanted to keep aside according to their strategy.

When considering the level of capital, one has to note that the lower the bank capital, the higher the leverage. A bank can be enticed to decrease its capital because leverage magnifies return, and therefore, improves the returns on equity for the shareholders. Thus, more risk-taking banks would target very low economic capital to improve profitability in good times at the expense of solvency in bad times.

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[6] Gerhard Schroeck, Risk Management and Value Creation in Financial Institutions, (New York: Wiley, 2002)