Applied Case Studies

Course: Enterprise Risk Management

1 Case Study 1: Market Risk, Value-at-Risk and Risk Appetite

1.1 Context

A mid-sized bank operates a trading desk managing a diversified market-risk portfolio with a total market value of **€100 million**. The bank has implemented an ERM framework centered on quantitative risk limits, with Value-at-Risk (VaR) as the primary risk metric.

The desk is considered compliant as long as its estimated VaR remains below the approved limit.

1.2 Portfolio Composition

The portfolio consists of the following exposures:

- Equity exposure: €60 million invested in a broad equity index.
- Interest rate exposure: €40 million in a 10-year government bond, managed through duration exposure.

1.3 Risk Parameters

The following risk parameters are provided:

- Daily equity volatility: 2%.
- Daily volatility of the 10-year yield: 5 basis points.
- Correlation between equity returns and yield changes: 0.
- Interest rate sensitivity: a **+1 bp** increase in yields results in a **€0.20 million loss**.

Assume normally distributed risk factors and a one-day holding period.

1.4 ERM Constraint

The bank has set the following limit:

- 1-day 99% Value-at-Risk limit: **€3.0 million**.

1.5 Questions

1. Compute the 1-day 99% Value-at-Risk of the portfolio using a variance–covariance approach.
2. Determine whether the trading desk complies with the VaR limit.
3. Consider the following stress scenario:
   - Equity index decline of 8%.
   - Increase of 30 basis points in the 10-year yield.

   Compute the portfolio loss under this scenario.
4. Explain why losses of this magnitude may occur despite compliance with the VaR limit.
5. Identify at least two weaknesses of relying exclusively on VaR from an ERM perspective.

2 Case Study 2: Expected Shortfall, Governance and Escalation

2.1 Context

Following internal reviews, the bank complements VaR with Expected Shortfall (ES) reporting to better capture tail risk. ES is monitored daily and compared against a predefined limit. Breaches are supposed to trigger immediate escalation to senior management.

2.2 Observed Portfolio Performance

The daily profit-and-loss (P&L) of the portfolio over the last 12 trading days (in millions of euros) is reported below:

Day	P&L (€m)
1	+0.6
2	-1.1
3	+0.4
4	-2.3
5	+0.9
6	-0.8
7	-3.5
8	+0.5
9	-1.7
10	-4.2
11	-0.6
12	-6.8

2.3 ERM Rules

The ERM framework specifies:

- 1-day 99% Expected Shortfall limit: **€4.0 million**.
- Mandatory escalation in case of a breach.

2.4 Questions

1. Sort the P&L distribution from worst to best.
2. Compute the empirical 1-day 99% Expected Shortfall.
3. Determine whether the ES limit is breached.
4. The large loss observed on Day 12 occurred without prior escalation. Identify possible failures related to:
    - Risk reporting,
    - Governance architecture,
    - Incentives or risk culture.
5. Explain why replacing VaR with Expected Shortfall does not, by itself, guarantee effective ERM.

3 Case study 3 : signals without escalation

3.1 Context

A mid-sized European bank operates across corporate lending, structured finance, and capital markets activities. The institution is considered well managed and has experienced several years of stable profitability and moderate growth.

The bank is subject to prudential supervision and regularly undergoes internal and external reviews of its risk management practices. No material weaknesses have been identified in recent assessments.

3.2 Risk governance practices

Risk management within the bank is organized around a centralized risk function that operates independently from business units. Risk policies define limits for key risk categories and specify reporting obligations at different levels of management.

Senior management receives periodic risk reports summarizing:

- utilization of risk limits,
- stress-test outcomes,
- qualitative risk assessments prepared by risk functions.

A committee involving senior executives meets regularly to review these reports and discuss emerging risks.

3.3 Strategic development

Over a two-year period, the bank expanded rapidly in structured finance and specialized lending activities. Individual transactions complied with existing risk limits and approval procedures.

However, several features characterized this expansion:

- repeated concentration in similar counterparties and sectors,
- increasing reliance on favorable macroeconomic assumptions,
- frequent use of exceptions and temporary adjustments to internal limits.

While no formal breaches were recorded, internal risk assessments increasingly highlighted rising portfolio sensitivity to adverse scenarios.

3.4 Risk signals

Risk analysts noted that portfolio-level exposures were approaching internally defined thresholds under adverse conditions. These observations were included in written risk reports and discussed during committee meetings.

The language used to describe these risks emphasized uncertainty rather than immediate concern. Follow-up actions were left to business judgment, and no explicit escalation was triggered.

3.5 The event

A sudden downturn affecting several correlated sectors led to a rapid deterioration in asset quality and valuation losses. The combined impact exceeded prior stress-test projections and resulted in a significant reduction in capital buffers.

Although regulatory minimums were not immediately breached, the bank faced heightened supervisory scrutiny, rating downgrades, and a loss of market confidence.

3.6 Questions

1. Based on the information provided, infer the **type of ERM framework** implemented by the bank. What elements support your inference?
2. Reconstruct the bank's **ERM architecture**. Who appears to:
    - take risk,
    - monitor and challenge risk,
    - decide on escalation?
3. Identify the **early warning signals** that preceded the event. Why did they fail to translate into corrective action?
4. Explain how incentives, governance dynamics, or risk culture may have weakened the effectiveness of the ERM system.
5. Propose two concrete changes that would strengthen the bank's ERM architecture and prevent similar failures.

4 Case study 4: hedging effectiveness under ERM (prospective vs retrospective)

4.1 Context

A global industrial firm consumes a key commodity input. To stabilize margins, the firm hedges its input cost exposure using standardized exchange-traded futures linked to a benchmark commodity index.

Let X denote the firm's unhedged monthly profit-and-loss (P&L) exposure (driven mainly by commodity price changes). Let H denote the monthly P&L of the hedging instrument (futures). The firm sets a hedge ratio h and defines the hedged P&L as:

$$Y = X - hH$$

The goal is to reduce risk (variance and tail losses) *without creating unacceptable liquidity stress from margin calls*.

4.2 Data provided

Risk management estimates hedging parameters using a 24-month historical window (*normal period*). A market disruption then occurs (*stress period*), during which correlations and liquidity conditions change.

All statistics below are monthly, expressed in **€ million**.

	Normal period (estimation)	Stress period (realized)
$\mathbb{E}[X]$	0.0	-2.0
$\mathbb{E}[H]$	0.0	0.0
Var(X)	100	225
Var(H)	64	144
Cov(X, H)	48	12

In the stress period, the firm also faces exchange margining:

- Initial margin posted at inception: 10€m (funded from cash).
- Average monthly *variation margin outflow* on the hedge: 18€m.

Assume the firm has a liquidity buffer of 25€m dedicated to hedging operations. If monthly margin outflows exceed this buffer, the firm must raise cash via asset sales or emergency credit.

4.3 Hedging rules used by the firm

- The hedge ratio is set using the minimum-variance benchmark:

  $$h^* = \frac{\text{Cov}(X, H)}{\text{Var}(H)}$$

  computed from the normal-period estimates.

- Hedging effectiveness is assessed via variance reduction:

$$\mathsf{HE} = 1 - \frac{\mathsf{Var}(Y)}{\mathsf{Var}(X)}$$

- Risk management reports prospective (ex ante) effectiveness using normal-period parameters, then evaluates retrospective (ex post) effectiveness using realized stress-period parameters *while keeping the same hedge ratio* h.

4.4 Tasks

1. **Hedge ratio.** Compute the minimum-variance hedge ratio h^* using the normal-period statistics.
2. **Prospective effectiveness (ex ante).** Using $h = h^*$ and the normal-period statistics, compute:

$$\mathsf{Var}(Y) = \mathsf{Var}(X) + h^2\mathsf{Var}(H) - 2h\,\mathsf{Cov}(X, H)$$

   and then compute $\mathsf{HE}_{\mathsf{pros}}$.
3. **Retrospective effectiveness (ex post).** Using the *same* hedge ratio $h = h^*$ but stress-period statistics, compute $\mathsf{Var}(Y)$ and $\mathsf{HE}_{\mathsf{retro}}$.
4. **Interpretation.** Explain why $\mathsf{HE}_{\mathsf{retro}}$ differs from $\mathsf{HE}_{\mathsf{pros}}$ in terms of correlation, basis risk, and regime change.
5. **Liquidity assessment.** Compare the average monthly variation margin outflow (18€m) to the hedging liquidity buffer (25€m). Is the buffer sufficient on average?
6. **ERM stress question.** Suppose variation margin outflows can spike to 40€m in bad months. Under ERM, list two governance or design changes that could reduce the probability of forced asset sales.
7. **ERM integration.** Identify at least three risk categories that interacted in this episode and explain how ERM should have governed the interactions (not the silos).

5 Case study 5: when hedging increased risk

5.1 Context

A large industrial firm operates globally and is highly exposed to commodity price fluctuations. Its core activity relies on a key input whose market price is volatile and subject to geopolitical and macroeconomic shocks.

To stabilize earnings and protect margins, management has historically relied on derivative contracts to hedge price risk. The firm is considered sophisticated and has a dedicated risk management function.

Over recent years, profitability has been stable and volatility of reported earnings has declined.

5.2 Risk governance and hedging strategy

The firm's risk management policy allows the use of derivative instruments to hedge commodity price exposure over a rolling horizon.

- Hedging is conducted primarily using futures and swap contracts linked to benchmark commodity prices.
- Hedge ratios are determined based on historical correlations between input costs and output prices.
- Hedging effectiveness is assessed ex ante using variance reduction metrics and reviewed periodically.

Risk reports show that the hedging program significantly reduces short-term price volatility under normal market conditions.

5.3 Quantitative information

Let X denote the unhedged price exposure of the firm and H the payoff of the hedging instrument.

The hedged position is defined as:

$$Y = X - hH$$

Based on historical data, the estimated minimum-variance hedge ratio is:

$$h^* = \frac{\mathsf{Cov}(X, H)}{\mathsf{Var}(H)} = 0.9$$

Prospective hedging effectiveness is estimated as:

$$\mathsf{HE}_{\mathsf{pros}} = 1 - \frac{\mathsf{Var}(Y)}{\mathsf{Var}(X)} = 75\%$$

As a result, management authorizes a large-scale hedging program aligned with this ratio.

5.4 The shock

Following a sudden market disruption:

- Correlations between the firm's input prices and benchmark contracts weaken significantly.
- Futures markets experience sharp volatility and liquidity deteriorates.
- Margin requirements on derivative positions increase rapidly.

Although the underlying commodity price moves in the expected direction, the firm faces substantial cash outflows due to margin calls.

5.5 Outcomes

Despite being economically hedged in the long term, the firm experiences:

- severe short-term liquidity stress,
- forced asset sales to meet margin calls,
- a deterioration of credit metrics and investor confidence.

Retrospective hedging effectiveness falls sharply:

$$\text{HE}_{\text{retro}} < 0$$

Senior management questions how a risk-reducing strategy could generate such outcomes.

5.6 Questions

1. Identify the main risks faced by the firm. Which risk categories interacted in this episode?
2. From an ERM perspective, explain why the hedging strategy appeared effective ex ante.
3. Interpret the hedge ratio h^*. What assumptions underlie its use?
4. Why did prospective hedging effectiveness fail to predict actual outcomes?
5. Using the ERM framework, identify which secondary risks were insufficiently considered.
6. How should ERM have governed the use of derivatives differently?
7. Propose two changes to the firm's ERM architecture or decision process that would have reduced the severity of the crisis.