投 資 風 險 管 理

✧ 參考書目：

(a) *Don Chance* (AIMR, 2003), *ANALYSIS OF DERIVATIVES FOR THE CFA® PROGRAM*

- *CH. 9 – Risk Management*

(b) *Culp, Miller, and Neves* (1998), *JOURNAL OF APPLIED CORPORATE FINANCE*

- *Value at Risk: uses and abuses*

(c) *Kevin Dowd* (1998), *BEYOND VALUE AT RISK: THE NEW SCIENCE OF RISK MANAG'T*

- *CH. 6 – Stress Testing*
- *CH. 11 – Allocating Capital*
- *CH. 12 – Firm-wide Risk Management*

(d) *Leslie Rahl* (2000), *RISK BUDGETING: A NEW APPROACH TO INVESTING*

- *CH. 6 – Risk Budgeting for Pension Funds and Investment Managers Using VaR*

◆ Topic 1: Risk Management (風險管理簡介)

REFERENCE: *Don Chance* (AIMR, 2003)*, CH. 9*

1. Risk Management:
   (a) 3 important introductory concepts:
      (1) Define risk management.
      (2) Understand the sources of risk.
      (3) Understand why and how risk can be managed.
2. The process:
      (1) Identify the desired level of risk.
      (2) Determine the current level of risk.
      (3) Bring the current level in line with the desired level.
      (4) Monitor the risk exposure to keep it in line with the desired level.
      (5) Alter the process to reflect new information, policies, and preferences.
      (6) Identify and price the appropriate transactions.
3. Risk exposure:
   (a) Nonfinancial risk: often related to unexpected operating problems.
      (1) Accounting risk:
         - Arises from the misrepresentation of the true economic information in the accounting statements.
         - Accounting standards vary from country to country.
         - E.g., FAS 133, IAS 39, 台灣的 34、35 號公報
      (2) Legal risk:
         - A major concern of dealers who write many OTC derivatives contracts.
         - Usually associated with the possibility of a counterparty in an agreement repudiating its obligation based upon some legal technicality.
      (3) Regulatory risk:
         - The risk of a loss that can occur from a change in regulation.
      (4) Settlement risk:
         - Occurs when there are two-way cashflows between parties in an agreement and one party defaults just as the other party is making a payment.
         - How to reduce it? ➔ Netting.
      (5) Model risk:
         - Using the wrong model or improperly using the correct model.
      (6) Operations risk:
         - E.g., employee errors and fraud, computer breakdowns, "acts of God" such as fire and flood, terrorists' acts…etc.

- How to deal with it?
  - Good internal controls.
  - Insurance.

(b) Financial risk: usually associated with transactions with other parties.

(1) Liquidity risk: loss in revenue from selling illiquid assets.

- Asset bid/ask spread

(2) Credit risk.

- Two dimensions:
  - The event of loss → probability of default
  - The amount of loss → recovery rate

(3) Market Risk: Potential change of value in an asset or derivative in response to a change in some basic source of uncertainty.

- Commodity prices.
- Equity prices.
- Exchange rates.
- Interest rates.

4. Why manage risk?

(a) Hedge risks in areas in which it does not have an expertise.

(b) Stabilize earnings and cash flow, which can lead to

- lower taxes
- increased debt capacity so that can borrow at a lower cost of capital, take on more projects with a positive NPV, and increase its value.

5. Measures of Market Risk:

(a) Modern:

(1) **Value-at-Risk**: `Please refer to Topic 2.`

(b) Traditional:

(1) Directional risk:

- **Beta**
  - Mainly for equity prices risk
  - The sensitivity of a stock position to movements in the overall market.
- **Delta**: a per-unit change in value to per-unit change in the underlying
- **Duration** → interest rates

(2) Non-directional risk:

- **Convexity**
  - the duration of a bond changes as the underlying interest rate changes.

- **Gamma**
  - the delta changes with respect to changes in the price of the underlying.
- **Vega** → for options
  - The value of the derivative changes in response to changes in the volatility of the underlying.
- **Correlation coefficient**
  - Important for exotic derivatives with more than one underlying, or firms holding large and varied positions.

6. Credit Risk:
   (a) Current credit risk: whether current obligations will be met.
   (b) Potential credit risk: a counterparty defaulting at a later date.
   (c) Examples:
      (1) Forward Contracts:
         - Both parties may face credit risk.
           - The party that is "in the money" bears the credit risk.
         - The credit risk becomes *current* at each required mark-to-market date. Otherwise, the credit risk is *potential*.
      (2) Swaps: a series of forward contracts
         - There is *current* credit risk at each reset or settlement date.
         - IRS:
           - Only one counterparty faces current credit risk.
           - No potential credit risk at the initiation date.
           - The credit risk of swaps tends to be the highest in the middle of the contract
             - Market conditions have time to change.
             - There are still many more settlement dates in the contract.
         - Currency Swap:
           - Both parties face credit risk unless there is a netting arrangement in the contract.
           - It has the highest credit risk towards to the end of the contract, because the counterparties exchange the notional principals at the beginning and the end of the contract.
      (3) Options:
         - Only buyers have credit risk.
         - European options only have *potential* credit risk prior to expiration, at which time it becomes *current* credit risk.
         - American options have *current* credit risk if they are "in the money."
         - Options traded on an exchange have minimal credit risk because of the role of the clearinghouse.

(d) Ways to lower credit risk:

(1) Limiting the credit exposure.

(2) Marking to market.

(3) Requiring collateral.

(4) Netting: the process of consolidating the exposures between two parties to a single net exposure that one party bears.

(5) Setting minimum credit standards

(6) Establishing enhanced derivative product companies (EDPCs) or special purpose vehicles (SPVs)

- Separated subsidiaries set up by a parent company to engage in certain transactions.

(e) Credit VaR / Credit-at-Risk / Default VaR:

(1) The upper tail of the distributions of gains on positions held.

(2) The task is complicated:

- We must compute the probability of default and the recovery rate.
- Lack of historical data concerning default.

(f) Credit Derivatives:

(1) Specifies a transaction that takes place if and when a specific credit event occurs.

(2) Similar to insurance.

(3) Types:

- **Credit swaps**:
  - The protection buyer holds a reference asset and makes periodic payments to the seller and receives a payment if a credit event occurs.
- **Total return swaps**:
  - The protection buyer passes on the total return on a risky position to the protection seller
- **Credit spread options**:
  - An option with credit spread as the underlying
  - E.g., If the underlying is the AA corporate bond's credit spread and the strike price is 50 bps, then the Payoff
    = Max [0, (AA bond yield – U.S. Treasury yield) – 50 bps]
- **Credit-linked notes**:
  - Loans or bonds that have a clause where the issuer can reduce the payment of interest and/or principal if a credit event occurs.
  - E.g., long a CLN = long a bond + short a CDS

7. Best Practices

(a) Risk Standards Working Group

(1) An informal committee of respected participants in the risk management industry

(2) Their report addresses risk with respect to management, measurement, and oversight.

(3) Most of the recommendations are obvious and very similar to the G-30.

(b) Group of Thirty (G-30)

(1) An international organization of economic experts

(2) 24 recommendations in the *Derivatives: Practices & Principles (1993)*

- Policies regarding the use of derivatives should come from the top, should be clearly defined, and should be managed at all levels.
- Derivatives should be marked to market on at least a daily basis.
- Dealers' portfolios should be valued by mid-market levels less specified costs or adjustments.
- Sources of revenue should be evaluated for risk.
- Market risk should be measured daily using one-day analytical VaR with confidence intervals.
- Dealers should perform periodic stress tests.
- Dealers should periodically forecast funding and investing needs.
- Independent (outside) assessment of risk management function.
- End users should adopt the same market risk management practices as dealers.
- Measure credit risk exposure two ways: current and potential.
- Aggregated credit exposures should be calculated regularly and compared to limits.
- Dealers and end users are encouraged to obtain independent (outside) assessment of the credit risk management function.
- Dealers and end users should use master agreements as widely as possible, which should call for netting of payments.
- Dealers and end users should assess the costs and benefits of credit enhancement and risk reduction agreements and calculate the possible future funding needs.
- Dealers and end users should work together to develop recommendations for continued enforceability as new types of securities are developed.
- Dealers and end users must ensure that their derivatives transactions are performed by specialized professionals.
- Dealers and end users must ensure that systems for data capture, processing, and settlement are in place.
- Dealers and end users should delegate authority to enter into derivatives contracts.

- International standards for accounting for derivatives transactions should be developed.
- Financial statements should disclose adequate information for an understanding of the reasons for derivatives transactions, the risk involved, and the accounting method used to record them.
- Regulators and supervisors should understand the benefits of netting arrangements.
- Legislators, regulators, and supervisors should endeavor to remove any uncertainties regarding:
  - The documentation for legally-enforceable contracts.
  - The extent to which governments, governmental agencies, insurance companies, pension funds, etc. can enter into derivatives transactions.
  - The enforceability of close-out netting.
  - The enforceability of netting arrangements in bankruptcy.
  - The legality and enforceability of derivatives transactions.
- Legislators and tax authorities should remove tax disadvantages of using derivatives in risk management.
- Accounting standards boards should provide guidance on reporting and accounting for derivatives transactions.

8. Application of Risk Management

(a) Risk Governance:

(1) The process of setting policies and standards to manage risk.

(2) It is upper-level management's responsibility.

(3) Begins with Organizational Structure:

- Decentralized risk governance
- Centralized risk governance
  - Firm-wide Risk Management / Enterprise Risk Management (ERM)
  - Please refer to Topic 4.

(4) Important policies:

- Separation of the trading function from the risk management function
- Give the employees in the back office adequate training.

(b) Risk Budgeting

- Setting a maximum amount of risk for a given firm or unit within a firm
- Please refer to Topic 3.

(c) Performance evaluation should have an adjustment for the risk assumed.

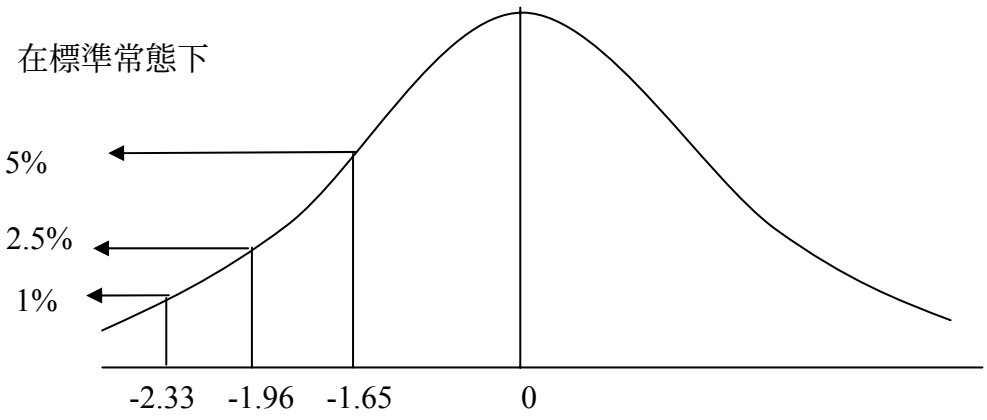
- E.g., imposing a penalty on the return.

◆ Topic 2: Value-at-Risk & Stress Testing (風險值的介紹與壓力測試)

REFERENCE: *Don Chance* (AIMR, 2003)*, CH. 9*; *Culp, Miller, & Neves* (JACF, 1998); *Kevin Dowd* (1998)*, CH. 6*

1. Definition:
   (a) The minimum (maximum) amount of money that one could expect to lose with a given probability over a specific period of time.
   (b) Two parameters:
      (1) Time period: industry specific
         - Banks → 2-week
         - A firm for quarterly report → 3month
      (2) Probability level: 0.01 or 0.05
2. Estimating method:
   (a) Analytical (Variance-Covariance) method:
      (1) Delta-normal method.
      (2) Assume the value or returns of the position are normally distributed.
      (3) For longer periods of time, the expected return should be included:
         - $VaR_\alpha = Z_\alpha \times P \times \sigma_r - P \times \mu$ → absolute VaR
      (4) For short periods of time, we often assume the expected return = 0
         - $VaR_\alpha = Z_\alpha \times PV \times \sigma_P$ → relative VaR

Assume the return： $r \sim N(\mu, \sigma_r^2)$ ➔ $\frac{r-\mu}{\sigma_r} \sim N(0,1)$



$\alpha = 95\%$ Pr(Z＜-1.65) = 5%

$$\frac{r-\mu}{\sigma_r} = Z_{1-\alpha} = -Z_\alpha \quad \Rightarrow \quad r = \mu - Z_\alpha \sigma_r$$

$$P_1 = P_0 \times (1+r)$$

➔ $VaR = -(P_1 - P_0) = -P_0 \times r = P_0 \times (Z_\alpha \sigma_r - \mu) = Z_\alpha \sigma_P - P_0 \times \mu$

(5) For two asset portfolio: $\widetilde{R}_P = w_1\widetilde{R}_1 + w_2\widetilde{R}_2$

➔ $\sigma_P^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{12}\sigma_1^2\sigma_2^2$

➔ $VaR_P^2 = VaR_1^2 + VaR_2^2 + 2\rho_{12}VaR_1VaR_2$

Example 2-1: The historical standard deviation of a stock index has been 0.6% per day. For a $1,000 investment in the index, what is the 1-day VaR with a 5% probability level?

Answer:

*VaR = 1.65 * $1,000 * 0.006 = $9.90*

- The *minimum loss* to be expected for the worst 5% of the days is $9.90.
- We are 95% confident that the *maximum 1-day loss* is $9.90.

Example 2-2: A portfolio consists of two assets, A and B. The expected returns of the assets are 9% and 13%, respectively. The standard deviations are 18% and 21%, respectively. The correlation coefficient of the returns is 0.50. Calculate the VaR of a portfolio consisting of $75,000 of asset A and $25,000 of asset B at a 97.5% probability level.

Answer:

$w_A = 0.75; \quad w_B = 0.25$

$E(R_P) = 0.75 \times 9\% + 0.25 \times 13\% = 10\%$

$\sigma_P^2 = 0.75^2 \times 0.18^2 + 0.25^2 \times 0.21^2 + 2 \times 0.75 \times 0.25 \times 0.5 \times 0.18 \times 0.21 = 0.028$

$\therefore \quad \sigma_P = \sqrt{0.028} = 16.75\%$

➔ $VaR = P_0 \times (Z_\alpha \sigma_r - \mu) = \$100{,}000 \times (1.96 \times 16.75\% - 10\%) = \$22{,}830$

(b) Historical Method: historical simulation method

- Use actual returns to form a frequency distribution and histogram.
- Identify the cutoff below which the lowest 1% or 5% fall.

Example 2-3: Suppose we have 250 daily observations of returns of a given index. After sorting the returns into an array (highest to lowest), we find that 10 percent of the values are –1.2 percent or lower. Define the 90 percent probability 1-day VaR for an investment of $2 million.

Answer:

VaR for a 1-day horizon is equal to $2 million * 1.2% = $24,000

(c) Monte Carlo Simulation Method:

- Create a theoretical distribution based on a number of initial assumptions that preclude the use of an established distribution.
- Generate values with computers. The generated values represent possible returns of the asset or portfolio.
- Form a frequency distribution or histogram of the values.
- Determine the cutoff below which the lowest 1% or 5% fall.

(d) Comparisons of methods

Method	Advantage	Disadvantage
Analytic	✧ Ease of application.	✧ Rely on the assumption of normality. ➔ Fat tail
HS	✧ Do not have to assume any particular distribution.	✧ Assumes past performance is representative of what can occur in the future.
MCS	✧ Do not require that normality assumption. ✧ Can accommodate the required assumptions for complex relationships.	✧ Require many managerial assumptions ✧ A great deal of computer time and calculations

3. Attractions of VaR
   (1) Regulatory requirements.
   (2) Risk budgeting: `Please refer to Topic 3.`
4. Limitations of VaR
   (1) Maybe difficult to estimate, especially for large, complex portfolios.
   (2) The various methods can give different answers.
   (3) Only a single measure that gives limited information.
   (4) The accuracy of the VaR can only be ascertained after the fact.

5. **VaR: uses and abuses ➔** *Culp, Miller, & Neves* (1998)
   (a) Characteristics of VaR:
   (1) VaR is stated in value terms (e.g., $, €, £), so it is a single, easily understood measure and allowed for direct comparison across different products and currencies.
   (2) VaR is a forward-looking risk measure, since it is based on probabilities.
   (3) VaR is dependent on the selected time horizon and probability.
   - The time horizon is dependent on the nature and timing of the cash flows.

(b) For active investment strategy or dynamic portfolios, any VaR metric based on current holdings is transitory:
  (1) The lower the portfolio turnover, the longer the applicable time horizon.
  (2) The higher the turnover, the shorter the applicable time horizon.

(c) VaR is more appropriate for *value risk managers* than *cash flow risk managers*.
  (1) Value Risk Manager: concerned with the risks associated with a large pool of assets or the entire firm.
  (2) Cash Flow Risk Manager
    - Concerned with reducing the variability of cash flows in order to increase the capacity to take on more debt.
    - Primarily deal with the management of the flow of funds.

(d) Total *vs.* Selective Risk Management
  (1) Total Risk Management:
    - Only concerns the overall portfolio risk.
    - Does not distinguish between the different sources of risk.
    - The overall VaR is not the sum the individual VaRs.
  (2) Selective risk management:
    - Hedge the identified risks that are not within the expertise of the firm.
    - Actively pursue the risks that are within the expertise of the firm.

(e) Pitfalls of using VaR
  (1) VaR in isolation is not useful if a firm does not have a proper risk-management infrastructure in place.
    - Sophisticated data retrieval and collection procedures
    - Information flow
    - Stringent policies
    - Clear managerial responsibilities regarding risk exposure
  (2) VaR needs to be presented along with the corresponding expected return. Otherwise, the magnitude of risk cannot be evaluated in the context of the potential returns.
  (3) VaR may be meaningless in situations where cash flow management is critically important, such as the use of interest rate options and some other derivatives.
  (4) The lack of internal controls and an efficient communication system may render a VaR system inoperable.
  (5) VaR is impossible to compute accurately without the existence of an extensive risk-management infrastructure.

(f) Alternatives to VaR:

(1) Cash Flow Management

(2) Probability of Shortfall

(3) Historical VaR

(4) Allocation Techniques: `Please refer to Topic 3.`

6. Stress Testing ➔ *Kevin Dowd* (1998), *CH. 6*

(a) Main uses of Stress Testing:

(1) Scenario Analysis complements VaR.

- VaR only focuses on the probability of the lower tail of a distribution; it cannot provide the severity of a loss in the tail.
- Scenario analysis provides the magnitude of loss in an adverse state of the world, but it cannot provide the likelihood of that outcome.

(2) Highlight weaknesses

(3) Help determining allocation of capital to avoid major losses.

(b) Approaches to stress testing:

(1) Scenario analysis

(2) Mechanical Approaches

(3) The Extreme Value (EV) approach

- A sophisticated statistical approach that estimates values in the tails of the distribution and their associated probabilities.
- The premise of EV:
  - It considers extreme values.
  - It assumes no particular return distribution.
  - It is easy to use.
  - It is flexible, i.e., it is able to incorporate any events.
  - It tends to validate VaR.

(c) Scenario Analysis:

(1) Developing and changing scenarios

- Stylized Scenarios
  - Analyze the effect of changes in one or more factors.
    - Small change → the first order effect (delta / duration)
    - Large change → 2nd order effect (gamma / convexity)
  - Sensitivity analysis:
    - Only appropriate when the number of risk factors is small.

- Extreme Events
  - Measure the potential effect on portfolio values of the possible recurrence of *actual* past extreme events.
- Hypothetical Events
  - Hypothetical one-off events, e.g., earthquake, flooding, tsunami…
- Scenario Changes

(2) During periods of an extreme event:

- Correlations between securities might increase.
  - Underestimates VaR measures.
- Dynamic hedging may fail.
  - Delta will change
  - Liquidity is restricted.
- There may be margin calls of futures contracts. → liquidity burden.

(3) Benefits of Scenario Analysis:

- Hidden Vulnerabilities
  - The risk of making a wrong assumption and its potential consequences.
  - Scenario analysis allows us to avoid this problem by investigating assumptions related to potential outcomes.
- Can take Changing Volatility into consideration.
- Can take Changing Correlations into consideration.
- Management Structure:
  - Scenario analysis allows those who are prepared to face extreme market event to move quickly when the time comes and to minimize losses.
  - Contingency plan.

(4) Problems with scenario analysis

- Dependence on chosen scenarios
  - Analyst's knowledge and experience is important.
- As the number of possible scenarios increases, it's not easy to have a consistent and sensible application of scenario analysis or to interpret the complex situations.
  - Complexity in forecasting secondary effects: Scenario analysis rarely looks at the impact of secondary effects.
  - Deciphering interaction effects: Scenario analysis rarely looks at the correlation between risk factors.
  - Identifying zero-arbitrage conditions: Scenario analysis rarely considers the co-movements of price required to maintain zero-arbitrage conditions.

(d) Mechanical Approaches:

(1) Differences from scenario analysis:

- Mechanical approaches use a range of scenarios to discover the combination of possibilities that will produce the greatest loss, while scenario analysis focuses on a specific number of outcomes.
- Mechanical approaches may be capable of providing estimates of the probability of adverse scenarios. Scenario analysis does not produce estimates of probabilities.

(2) Factor Push Analysis: Push all risk factors in the direction that is most damaging and then computes their combined effect on the value of the portfolio.

(3) Attractions of Factor Push Analysis:

- Relatively easy.
- Identify the worst-case outcome and point out vulnerabilities of the portfolio.
- Not constrained by assumptions.
- Free to choose correlations.

(4) Difficulties of Factor Push Analysis:

- Different assets may have different sensitivities to underlying risk factors. So it's not wise to push all prices by the same amount. You'd better push the underlying risk factors instead.
- Inappropriate assumptions: e.g., the greatest loss does not always occur at the extreme values of the risk variable, for instance, a straddle

◆ Topic 3: Capital Allocation & Risk Budgenting (資本分配&風險預算)

REFERENCE: *Kevin Dowd* (1998), *CH. 11*; *Leslie Rahl* (2000), *CH. 6*

1. Allocating capital ➔ *Kevin Dowd* (1998), *CH. 11*

(a) Setting position limits

(1) Nominal position limits

- Easy to understand.
- Compliance is relatively straightforward.
- Do not control for risk.

(2) VaR position limits

- Account for portfolio size and leverage when computing the overall risk of the position.
- Allow easy comparison across different positions.
- Measure what a position can lose. This allows efficient risk management.
- Are dynamic positions and will adjust to changing market factors, leverage, and portfolio size.
  - But mechanical rules would likely be inappropriate for revising VaR-based position limits
  - Position limit changes should always be gradual, even in situations where the underlying changes seem to be more or less permanent.
- Measure how much each business unit adds to the overall firm VaR.

(b) Using VaR to judge capital strength

(1) VaR-based measure of capital strength:

- $CapitalStrength_{VaR} = \frac{K \times Z_{\alpha}}{VaR}$, where K = capital of the institution
- Uses:
  - To calculate the probability of distress for the firm over a specified period.
  - Since VaR updates with changing conditions, it measures the changing strength of the institution over time.
  - It can be used to compare the strengths across different institutions.

(2) Traditional Measure of capital strength:

- $CapitalRatio = \frac{K}{TotalAssets}$

(3) Criticisms of the traditional Capital Ratio:

- It is not able to consider risk.
  - Risk-weighted capital ration: the ratio of capital to the risk-weighted asset value
    - Assign each asset class to a risk category.
    - Assign each risk category a risk weight.
    - Total risk-weighted asset value = the sum of the products of each risk category and the associated risk weight.
- It could be the same for two institutions even if their risks are completely different.
- The risk-weighted ratio ignores the effects of diversification.

(4) Combining VaR with Stress Tests to determine capital requirement

- This ensures that the capital requirement meets the needs of both every day market factors and extreme events.

2. Key market risks of Pension Funds: ➔ *Leslie Rahl* (2000), *CH. 6*

(a) Defined Benefit Plans

(1) Surplus risk

- The risk that plan assets will underperform plan liabilities, exhausting the plan surplus and necessitating plan contributions.
  - Surplus refers to the excess of assets over liabilities.
- Strategies ➔ strategic asset allocation
  - Select pension assets that are highly correlated with pension liabilities.
  - Use fixed-income securities to immunize the liabilities.
    - Because very long-term securities may not exist to match all the liabilities, equities may be used.

(2) Tracking error risk

- In the DBP, tracking error refers to the difference between asset and liability performance. → the possibility that plan assets will outperform plan liabilities.
- Tracking error is commonly associated with tactical asset allocation.

(3) Comparisons of strategic asset allocation and tactical asset allocation:

- Both assume constant risk tolerance.
- Both are contrarian strategies (always rebalance to original asset allocation within the investment horizon).
- Strategic asset allocation assumes unchanging capital market conditions; while tactical asset allocation assumes changing capital market conditions.
- With tactical asset allocation, the asset allocation fluctuates periodically based on expected changes in capital market conditions.

(b) Defined Contribution Plans / Money Purchase Plans

(1) Participant-controlled asset allocation

- The plan participant might improperly allocate assets. This brings improper risk-taking not only to the participant, but also the sponsor.

(2) Manager control

- The plan sponsor should select managers with a history of consistently low tracking error relative to the banchmark.

3. Key market risks for Asset Management firms

(a) Two market risks:

(1) Variable fees

- Proportion to the assets they manage
- Hard to hedge

(2) Customer satisfaction / product integrity / performance response

- Tracking error-based VaR measures can be used to monitor managers internally to avoid the poor performance due to operational problems, fraud, or violation of investment guidelines.

4. Risk Budgeting

(a) Managers are assigned a certain VaR with the goal of maximizing the return under that constraint.

(b) Process:

(1) Allocating acceptable levels of potential loss to the various parts of the investment process

(2) Monitoring each part relative to the allocated risk.

(3) Taking appropriate action when risk measures are violated.

(4) Using the risk measures for risk-adjusted performance measurement.

(c) 4 sources of risk that warrant monitoring

(1) <u>Surplus at Risk (SaR)</u>

- The amount by which plan assets might underperform plan liabilities over a given time horizon and confidence level.

(2) <u>Tactical allocation</u>

- Implementation risk: the risk that the selected tactical asset allocation will underperform the strategic asset allocation.

(3) <u>Planwide asset selection risk</u>

- Active risk: the potential underperformance between the assets selected in aggregate by all managers in the plan compared to the assets contained in the benchmarks representing the planwide tactical asset allocation.

(4) Individual manager asset selection risk

- Manager active risk: the sum of the tracking errors of each portfolio manager relative to his or her benchmark within the tactical asset allocation.

(d) Risk Tolerance Thresholds

(e) Corrective action guidelines:

(1) Zero exception approach: penalizes managers whenever the budget is violated.

(2) Risk-budget violation: a starting for conversation that may lead to a change in the portfolio.

- SaR Violation
- Planwide asset selection violation
- Planwide risk budget violation
- Individual manager risk budget violation

(f) Risk Budgeting *vs.* Asset Allocation

(1) Downstreaming

(2) Dynamic triggers

(g) Risk Budgeting *vs.* investment guidelines

(1) Principal limits

(2) Sensitivity limits

(3) Leverage

(4) Hedging

(h) Risk Budgeting *vs.* Standard deviation, beta, and duration

(1) Standard deviation

(2) Beta

(3) duration

◆ Topic 4: Firm-wide Risk Management (整合性風險管理)

REFERENCE: *Kevin Dowd* (1998), *CH. 12*

1. Enterprise-wide Risk Management:
   (a) Goal: enables decision makers to have a complete picture of risk analysis and analytics across the entire firm.
      - An attempt to manage all types of risk across all business units of the firm.
   (b) The types of risk include:
      (1) Broad risk (e.g., market risk, credit risk).
      (2) Instrument risk (equity, bond, or commodity risks)
      (3) Risks associated with individual segments of the firm.
      (4) Risk associated with the firm as a whole (e.g., legal risk and regulatory risk)
   (c) The ways of implementing an ERM system is different, depending on:
      (1) The level of sophistication
         - A simple sharing of relevant information *vs.* a sophisticated centralized risk-management system
      (2) Timeliness of information
         - Real time *vs.* far less frequent updating
      (3) The level of integration of risk analysis
         - Little integration *vs.* sophisticated centralized risk-assessment system

2. The benefits of ERM
   (a) Directly proportional to the complexity of the firm.
   (b) Some benefits are:
      (1) Major enhancements to risk-return analysis.
      (2) Improved decision making at all levels.
      (3) Improved allocation of capital.
      (4) Enhanced data collection and analysis.
      (5) Enhanced information available to market participants.

3. Features of an ERM system (steps of establishing an ERM system):
      (1) Centralized data storage
         - The data has to be:
            - Centralized
            - Standardized
            - Cleaned
      (2) Data analysis
      (3) Continual monitoring and updating
      (4) Dissemination of the analysis

4. Benefits of an integrated risk analysis system:
   (a) Efficient use of resources.
   (b) Consistent and comparable results.
   (c) Consistency across different risk measures in their underlying assumptions.
   (d) More easily understood cross-effects of the different risk measures (e.g., the interaction between credit and market risk).
   (e) Better integration of analysis for several types of risks for hybrid securities.