LEVEL III SCHWESER'S QuickSheet

CRITICAL CONCEPTS FOR THE 2017 CFA® EXAM

SS1&2: ETHICS

Review the SchweserNotes™ and work the questions.

SS3: BEHAVIORAL FINANCE

- **Bounded rationality** – Individuals act as rationally as possible, but are constrained by lack of knowledge and cognitive ability.
- **Satisfice** – Making a reasonable but not necessarily optimal decision.

The Traditional Finance Perspective

- **The price is right** – Asset prices reflect and instantly adjust to all available information.
- **No free lunch** – No manager should be able to generate excess returns (alphas) consistently.

Market Efficiency

- **Weak-form efficient** – Prices incorporate all past price and volume data.
- **Semi-strong form efficient** – Prices reflect all public information.
- **Strong-form efficient** – All information reflected in prices. No one can consistently earn excess returns.

THE BEHAVIORAL FINANCE PERSPECTIVE

1. Consumption and savings:
   - **Framing** – The way income is framed affects whether it is saved or consumed.
   - **Self-control bias** – Favor current consumption rather than saving income for future goals.
   - **Mental accounting** – Assigning different portions of wealth to meet different goals.
2. Behavioral asset pricing:
   - **Sentiment premium** – Added to discount rate; causes price deviation from fundamental values.
3. Behavioral portfolio theory (BPT):
   - Investors structure their portfolios in layers according to their goals.
4. Adaptive markets hypothesis (AMH):
   - Apply heuristics until they no longer work, then adjust them. Must adapt to survive.

COGNITIVE ERRORS AND EMOTIONAL BIASES

- **Cognitive errors** – Result from incomplete information or inability to analyze.
- **Emotional biases** – Spontaneous reactions that affect how individuals see information.

Cognitive Errors

- **Conservatism bias** – Emphasizing information used in original forecast over new data.
- **Confirmation bias** – Seeking data to support beliefs; discounting contradictory facts.
- **Representativeness bias** – If-then stereotype heuristic used to classify new information.
  - **Base rate neglect** – Too little weight on the base rate (e.g., probability of A given B).
  - **Sample size neglect** – Inferring too much from a small new sample of information.
- **Control bias** – Individuals feel they have more control over outcomes than they actually have.
- **Hindsight bias** – Perceiving actual outcomes as reasonable and expected.
- **Anchoring and adjustment** – Fixating on a target number once investor has it in mind.
- **Mental accounting bias** – Each goal, and corresponding wealth, is considered separately.
- **Framing bias** – Viewing information differently depending on how it is received.
- **Availability bias** – Future probabilities are impacted by memorable past events.

Emotional Biases

- **Loss aversion bias** – Placing more "value" on losses than on a gain of the same magnitude.
  - **Myopic loss aversion** – If individuals systematically avoid equity to avoid potential short run declines in value (loss aversion), equity prices will be biased downward (and future returns upward).
- **Overconfidence bias** – Illusion of having superior information or ability to interpret.
  - **Prediction overconfidence** – Leads to setting confidence intervals too narrow.
  - **Certainty overconfidence** – Overstated probabilities of success.
- **Self-attribution bias** – Self-enhancing bias plus self-protecting bias causes overconfidence.
  - **Self-enhancing bias** – Individuals take all the credit for their successes.
  - **Self-protecting bias** – Placing the blame for failure on someone or something else.
- **Self-control bias** – Suboptimal savings due to focus on short-term over long-term goals.
- **Status quo bias** – Individuals' tendency to stay in their current investments.
- **Endowment bias** – Valuing an asset already held higher (than if it were not already held).
- **Regret-aversion bias** – Regret can arise from taking or not taking action.
  - **Error of commission** – From action taken.
  - **Error of omission** – From not taking action.

INVESTMENT POLICY AND ASSET ALLOCATION

- **Goals-based investing** – Building a portfolio in layers, pyramiding up from key base goals.
- **Behaviorally modified asset allocation** – Constructing a portfolio according to investor's behavioral preferences.
  - **Standard of living risk** – If low, greater ability to accommodate behavioral biases.

Behavioral biases in DC plan participants:

- **Status quo bias** – Investors make no changes to their initial asset allocation.
- **Naïve diversification** – 1/n allocation.
- **Disposition effect** – Sell winners; hold losers.
- **Home bias** – Placing a high proportion of assets in stocks of firms in their own country.
- **Mental accounting** – See mental accounting bias.
- **Gambler's Fallacy** – Wrongly predicting reversal to the mean.
- **Social proof bias** – Following the beliefs of a group (i.e., "groupthink").

Market anomalies:

- **Momentum effect** – Return pattern caused by investors following others' lead ("herding").
- **Financial bubbles and crashes** – Unusual returns caused by irrational buying or selling.
- **Value vs. growth stocks** – Value tends to outperform growth and the market in general.

SS4: PRIVATE WEALTH (1)

IPS Objectives and Constraints: Individuals

The **individual IPS** has been heavily tested on the exam. **Questions are typically case fact specific. You must apply taught concepts to the unique case facts to answer the specific questions asked.** The solution process involves working through the constraints [taxes, time horizon, legal/regulatory, liquidity, and unique circumstances (other relevant issues presented in the case)] to determine and quantify the objectives (return and risk). This does not mean every step will be asked every time; answer what is asked. **It is very important you review the class slides (or SchweserNotes if you do not have the slides) to understand how to solve these questions.** Answers are highly consistent once you understand how to reach a solution.

Taxes and Private Wealth Management

Future Accumulation Formulas (selected)

annual accrual taxation: $FVIF_{AT} = [1 + r(1 - t_i)]^n$

deferred capital gains taxation:

$FVIF_{AT} = (1 + r)^n(1 - t_{cg}) + t_{cg}B$

B = cost basis / asset value at start of period n

annual wealth taxation: $FVIF_{AT} = [(1 + r)(1 - t_w)]^n$

Annual return after taxes on interest, dividends, and realized capital gains:

$r^* = r[1 - (p_i t_i + p_d t_d + p_{cg} t_{cg})] = r(1 - \text{wartr})$

effective capital gains tax rate:

$T^* = t_{cg}[p_{\text{deferred cg}} / (1 - \text{wartr})]$

$FVIF_{AT} = (1 + r^*)^n(1 - T^*) + T^* - (1 - B)t_{cg}$

Accrual Equivalent After-Tax Return (Return that produces the same terminal value as the taxable portfolio)

$R_{AE} = (FV_{AT} / \text{initial investment})^{1/n} - 1 = r(1 - T_{AE})$

Accrual Equivalent Tax Rate

$T_{AE} = 1 - {}^{R_{AE}}\!/_{r}$ (An overall effective tax)

Taxable Accounts: usually taxed annually called accrual taxes

- As the holding period ↑, T_{AE} ↓.

Tax drag % > tax rate

- Investment horizon ↑, tax drag ↑
- Investment return ↑, tax drag ↑

Tax-deferred Accounts: Front-end benefits: contrib. decr. current taxes, accrue tax free, taxed in future.

(TDA): $FVIF_{AT} = (1 + r)^n(1 - t_n)$

Tax-exempt Accounts: Back-end benefits. Contrib. made after-tax, accrue tax free, tax-free in future.

$FVIF_{AT} = (1 + r)^n$

If $T_0 > T_N \Rightarrow FV_{TDA} > FV_{TEA}$

Investor's After-tax Std. Dev of Returns: $\sigma(1 - t_I)$.

Estate Planning

Calculating core capital

$$\text{Prob(joint survival)} = \text{Prob(husband survives)} + \text{Prob(wife survives)} - \text{Prob(husband survives)} \times \text{Prob(wife survives)}$$

$$\text{CoreCapital}_{\text{Nyears}} = \sum_{t=1}^{N} \frac{P(\text{surv}_t)(\text{spending})}{(1+r)^t}$$

r = real risk-free rate

Relative After-Tax Values

Tax-Free Gift:

$$FV_{\text{tax-free gift}} = PV\left[1 + r_g\left(1 - t_{ig}\right)\right]^n$$

where:

PV = value of the gift (stock) today

r_g = pre-tax return if held by recipient

t_{ig} = tax rate if gifted (recipient's tax rate)

Bequest:

$$FV_{bequest} = PV\left[1 + r_e\left(1 - t_{ie}\right)\right]^n\left(1 - T_e\right)$$

where:
r_e = pre-tax return if held in the estate
t_{ie} = tax rate on returns in testator's portfolio
T_e = estate tax rate

$$RV_{tax\text{-}free\ gift} = \frac{FV_{tax\text{-}free\ gift}}{FV_{bequest}} = \frac{\left[1 + r_g\left(1 - t_{ig}\right)\right]^n}{\left[1 + r_e\left(1 - t_{ie}\right)\right]^n\left(1 - T_e\right)}$$

$$RV_{taxable\ gift} = \frac{FV_{taxable\ gift}}{FV_{bequest}} = \frac{\left(1 - T_g\right)\left[1 + r_g\left(1 - t_{ig}\right)\right]^n}{\left[1 + r_e\left(1 - t_{ie}\right)\right]^n\left(1 - T_e\right)}$$

where:
T_g = the gift tax rate
$\left(1 - T_g\right)$ = the after-tax value of the gift

Relief from Double Taxation

Without tax relief, pay tax to two countries. There are three methods of relief. Consider 100 of source income with t in source (S) and residence (R) countries of 30% and 40% respectively.

- Deduction: Tax paid to S reduces taxable income to R. Pay 30 to S and (100 – 30)(0.4) to R, the least favorable method to the tax payer; total tax 58.
- Credit: Tax to S directly offsets the tax that would have been owed to R. Pay 30 to S and another 10 to R; total tax 40.
- Exemption: Income taxed in S is not taxed in R. Pay 30 to S; total tax 30.
  - Exemption is always best for the tax payer; but if the tax rates of S and R were reversed, credit and exemption would produce the same total tax; 40 to S.

SS5: PRIVATE WEALTH (2)

Three Techniques Used to Manage Concentrated Positions

- Sell the asset, which triggers a tax liability and loss of control.
- Monetize the asset: borrow against its value and use the loan proceeds for client objectives.
- Hedge the asset value using derivatives to limit downside risk.

Hedging the Asset Value

- **Short sale against the box:** borrow and short the stock. Uses the short sale proceeds to meet portfolio objectives.
- **Equity forward sale contract:** sell the stock forward. The investor has a known sale price.
- **Forward conversion with options:** selling calls and buying puts with the same strike price used to establish a hedged ending value of the concentrated position.
- **Total return equity swap:** the investor enters a swap to pay the total return on a stock and receives LIBOR.

Modified Hedging Minimizes Downside Risk While Retaining Upside Potential

- Buy **protective puts** (portfolio insurance).
- **Prepaid variable forwards** (PVF): The dealer pays the owner now—equivalent to borrowing. The loan will be repaid by delivering shares at a future date. Delivery of all shares on the repayment date if the price per share drops but delivery of a smaller number of shares if the price rises.

Tax-Optimization Strategies

1. **Combining tax planning with investment strategy.**
   - **Index tracking with active tax management:** cash from a monetized position invested to track a broad market index.
   - **Completeness portfolio:** select other portfolio assets such that total portfolio better approximates desired risk and return characteristics.
2. **Cross hedge:** use an imperfect hedge if perfect does not exist or may trigger the tax liability.
3. **Exchange funds:** multiple investors contribute a different position and then each holds a pro rata portion of the resulting portfolio with no taxes paid at initial contribution.

Strategies in Managing A Private Business Position

- **Strategic buyers:** take a buy and hold perspective.
- **Financial buyer** or **financial sponsor:** restructures the business, add value, and resell the business.
- **Recapitalization:** owner restructures the company balance sheet and directs the company to take actions beneficial to the owner, such as paying a large dividend or buying some of owner's shares.
- **Sale to (other) management or key employees:** called a management buyout (MBO).
- **Divestiture, sale, or disposition of non-core business assets.**
- **Sale or gift to family members.**
- **Personal line of credit secured by company shares:** the owner borrows from the company.
- **Initial public offering (IPO).**
- **Employee stock ownership plan (ESOP):** the owner sells stock to the ESOP.

Strategies in Managing A Single Investment in Real Estate

- **Mortgage financing:** a non-recourse loan would allow the owner to default without risk to other assets.
- **Donor-advised fund** or **charitable trust:** providing a tax deduction for and with conditions that meet other objectives of the owner.
- **Sale and leaseback.**

Risk Management for Individuals

- The economic balance sheet (EBS) is superior to the traditional balance sheet for planning resource consumption. Total assets are expanded to include human capital (the PV of future earnings) and liabilities to include the PV of future expenses and bequests.
- Market risk can be managed with traditional portfolio tools.
- Idiosyncratic (non-market risks) can be managed with portfolio diversification and insurance products when appropriate.
  - Life insurance can provide funds to meet expenses that would have been covered in the absence of premature death. Temporary insurance is generally less costly but permanent insurance continues for the lifetime of the insured.
  - Annuities hedge the risk of the individual outliving their assets. Immediate annuities provide an immediate income stream while deferred annuities cost less. Fixed annuities provide an initially higher income stream while variable annuities may potentially provide higher total return over time and are more likely to keep up with inflation.

SS6: INSTITUTIONAL INVESTORS

Factors Affecting Investment Policies of Institutional Investors

The **institutional IPS** follows the same general construction process used for individuals but with specific issues by institution type. **Be sure and review the class slides for institutional IPS as well as for individuals.** Questions are usually very case specific. Generally legal/regulatory can be important and willingness to bear risk is not relevant for institutions. As an overview by type:

- **Foundations and endowments** are asset only and can take higher risk if otherwise appropriate. Return is the compounded distribution, relevant inflation, and expense rate. Usually tax exempt and perpetual. Higher beneficiary dependency on the portfolio reduces risk tolerance.

  Geometric spending rule

  $$\text{spending}_t = (R)\left(\text{spending}_{t-1}\right)\left(1 + I_{t-1}\right) + (1 - R)(S)\left(\text{market value}_{t-1}\right)$$

- **DB portfolios** are ALM and liability duration determines time horizon. Discount rate or a bit higher is the usual return objective. They are more conservative than most foundations and endowments. DB are managed solely for the participants' benefit and are generally untaxed. Risk tolerance is reduced by: underfunding (A < L for –S), a financially weak sponsor, high + correlation of sponsor and portfolio results, and plan/workforce issues that increase liquidity needs or decrease time horizon.
  - The **liability relative approach** and **liability mimicking portfolio** are refinements on basic ALM and duration matching. If the liabilities can be broken down into categories use: traditional nominal bonds for fixed future benefits, real rate (inflation indexed) bonds for inflation indexed future benefits, and equity for future benefits linked to future real (above inflation) wage growth. Risk due to liability noise cannot be eliminated (e.g., benefits for future new employees, deviations from actuarial assumptions, etc.).
- **Insurance portfolios** are ALM and usually taxable to some degree. Conservative and fixed income oriented (with perhaps some equity in the surplus). The minimum return is set by the crediting (analogous to discount) rate needed to meet liabilities to policyholders.
  - **Life insurers** may face disintermediation risk.
  - **Non-life** is more varied, less regulated, and often has higher and more complex liquidity needs. Non-life can be exposed to inflation risk, and an underwriting/profitability/tax cycle.
- **Banks** are ALM, the most regulated, and conservative. The securities portfolio is a **residual use** of funds; managed in order to control total balance sheet interest rate (duration) risk and provide liquidity while contributing to interest earnings and credit diversification.

SS7: ECONOMIC ANALYSIS

Problems in Forecasting

- Limitations to using economic data
- Data measurement errors and biases
- Limitations of historical estimates
- Ex post data to determine ex ante risk and return
- Patterns
- Failing to account for conditioning information
- Misinterpretation of correlations
- Psychological traps
- Model and input uncertainty

Forecasting Tools

Statistical tools:

$$R_i = \alpha_i + \beta_{i,1}F_1 + \beta_{i,2}F_2 + \varepsilon_i$$

Discounted cash flow models:

$$P_0 = \frac{Div_1}{\hat{R}_i - g} \Rightarrow \hat{R}_i = \frac{Div_1}{P_0} + g$$

Grinold Kroner model:

$$\hat{R}_i = \frac{Div_1}{P_0} + i + g - \Delta S + \Delta\left(\frac{P}{E}\right)$$

Risk Premium Approach to expected bond return:

$\hat{R}_{Bond}$ = Real risk-free rate + Inflation risk premium + Default risk premium + Illiquidity risk premium + Maturity risk premium + Tax premium

ICAPM:

$$\hat{R}_i = R_F + \beta_i\left(\hat{R}_M - R_F\right)$$

Singer and Terhaar Analysis

ERP_i = Equity Risk Premium of a partially integrated market:

$$= \begin{pmatrix}\text{degree of}\\ \text{integration}\end{pmatrix} \times \sigma_i \times \rho_{i,m} \times \left(\frac{ERP_m}{\sigma_m}\right) + \begin{pmatrix}\text{degree of}\\ \text{segmentation}\end{pmatrix} \times \sigma_i \times \left(\frac{ERP_m}{\sigma_m}\right)$$

$\rho_{i,m}$ = correlation of market with global portfolio

The Taylor Rule

$$r_{target} = r_{neutral} + \left[\begin{array}{l} 0.5\left(GDP_{expected} - GDP_{trend}\right) \\ + 0.5\left(i_{expected} - i_{target}\right) \end{array}\right]$$

Cobb-Douglas Production Function, $Y = AK^{\alpha} L^{\beta}$, uses the country's labor input (L) and capital stock (K) to estimate the total real economic output where:

Y = total real economic output
A = total factor productivity (TFP)
α = output elasticity of K ($0 < \alpha < 1$)
β = output elasticity of L ($\alpha + \beta = 1$)

The form of the CD that is used to estimate *expected changes* in real economic output:

$$\frac{\Delta Y}{Y} \cong \frac{\Delta A}{A} + \alpha\frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L}$$

H-model:

$$P_0 = \frac{D_0}{r - g_L}\left[(1+g_L) + \frac{N}{2}(g_S - g_L)\right]$$

Relative value models:

$$\textbf{Fed model ratio} = \frac{\text{S\&P earnings yield}}{\text{Treasury yield}}$$

A value >1 indicates that equities are undervalued and should increase in value.

Yardeni Model:

$$\text{if } \frac{E_1}{P_0} - \left[Y_B - d(LTEG)\right] > 0 \Rightarrow \text{market is under-valued}$$

$$\text{if } \frac{E_1}{P_0} - \left[Y_B - d(LTEG)\right] < 0 \Rightarrow \text{market is over-valued}$$

10-Year Moving Average Price/Earnings Ratio, P/10-year MA(E)

$$\text{P/10-year MA(E)} = \frac{\text{current level of S\&P 500 price index}}{\text{avg of previous 10 years' reported S\&P earnings (adjusted for inflation)}}$$

Compares its current value to its historical average to determine whether the market is over- or under-priced.

Tobin's q and Equity q

Both ratios are considered *mean-reverting*: if >1 the stock should decline, <1 the stock should increase.

$$\text{Tobin's q} = \frac{\text{market value of debt + equity}}{\text{asset replacement cost}}$$

$$\text{equity q} = \frac{\text{market value of equity}}{\text{replacement value of assets} - \text{liabilities}}$$

SS8: ASSET ALLOCATION (1)

Utility-Adjusted Return

$$U_p = \hat{R}_P - 0.005(A)(\sigma_P^2)$$

Downside Risk

Roy's Safety-First Measure: $RSF = \dfrac{\hat{R}_P - R_{MAR}}{\sigma_P}$

Add investment if:

$S_i > S_p \times \rho_{i,p}$

where:

S_i = Sharpe ratio of proposed investment
S_p = current portfolio Sharpe ratio
$\rho_{i,p}$ = correlation of the returns on the proposed investment with the portfolio returns

Specifying Asset Classes

- Assets in a class have similar traits and stats.
- Classes are not highly correlated (= diversification).
- Individual assets cannot fit more than one class.
- Classes cover the majority of investable assets.
- Classes contain sufficient liquid assets.

SS9: ASSET ALLOCATION (2)

Foreign Currency Equations

$R_{DC} = (1 + R_{FC})(1 + R_{FX}) - 1 = R_{FC} + R_{FX} + (R_{FC})(R_{FX})$

R_{FC} = return on the foreign asset and R_{FX} = return on the foreign currency

$\sigma^2(R_{DC}) \approx \sigma^2(R_{FC}) + \sigma^2(R_{FX}) + 2\sigma(R_{FC})\sigma(R_{FX})\rho(R_{FC},R_{FX})$

If R_{FC} is a risk-free asset:

$\sigma(R_{DC}) = \sigma(R_{FX})(1 + R_{FC})$

Currency Management Strategies

- **Passive hedging:** eliminates currency risk relative to the benchmark.
- **Discretionary hedging** allows the manager to deviate modestly from passive hedging. The goal is risk reduction.
- **Active currency management** allows a manager to have greater deviations from passive hedging. The goal is adding value.
- **Currency overlay** is the outsourcing of currency management to another manager.

Factors That Shift the Strategic Decision Toward a Benchmark Neutral or Fully Hedged Strategy

- A short time horizon for portfolio objectives.
- High risk aversion.
- Little weight given to the opportunity costs of missing positive currency returns.
- High short-term income and liquidity needs.
- Significant foreign currency bond exposure.
- Low hedging costs.
- Clients who doubt the benefits of discretionary management.

Tactical Currency Management

- **Economic Fundamentals:** in the long term, relative currency values will converge to their fair values. Increases in currency values are associated with currencies:
  - That are undervalued relative to their fundamental value.
  - That have the greatest rate of increase in fundamental value.
  - With higher real or nominal interest rates.
  - With lower inflation relative to other countries.
  - Of countries with decreasing risk premiums.
- **Carry Trade:** borrow in a lower interest rate currency and invest in a higher interest rate currency.
- **Volatility Trading:** profit from predicting changes in currency volatility. If volatility is expected to increase, purchase an at-the-money call and put (long straddle). Sell volatility by selling both options (a short straddle).

Note clearly that the evidence rejects using F_0 as a valid way to predict the future movement of a currency. Based on IRP a currency with a higher interest rate will trade at a forward discount ($F_0 < S_0$) but more often than not the currency will appreciate, S_T will end up above S_0.

Forward Premiums or Discounts and Currency Hedging Costs

If the hedge requires:	$F_{P/B} > S_{P/B}$, $i_B < i_P$ The forward price curve is upward sloping.	$F_{P/B} < S_{P/B}$, $i_B > i_P$ The forward price curve is downward sloping.
A long forward position in currency B the hedge earns:	Negative roll yield, which increases hedging cost and discourages hedging.	Positive roll yield, which decreases hedging cost and encourages hedging.
A short forward position in currency B the hedge earns:	Positive roll yield, which decreases hedging cost and encourages hedging.	Negative roll yield, which increases hedging cost and discourages.

The **minimum-variance hedge ratio** (MVHR): a regression of past changes in value of the portfolio to past changes in value of the foreign currency. The hedge ratio is the beta (slope coefficient) of that regression.

- Strong positive correlation between R_{FX} and R_{FC} increases the volatility of R_{DC} resulting in a hedge ratio > 1.0.
- Strong negative correlation between R_{FX} and R_{FC} decreases the volatility of R_{DC} resulting in a hedge ratio < 1.0.

Capitalization weighted index: Weight of each security based on its price multiplied by shares outstanding, performance influenced by securities with largest market cap.

- Advantages: based on market price, float adjusted reflects what is available for investors to own, does not require rebalancing for stock splits and dividends.
- Disadvantages: can lead to overconcentration in a few securities.

Price-weighted index: reflects owning one share of each stock. Performance heavily influenced by the securities with the highest price.

- Advantages: easy to construct.
- Disadvantages: stocks that appreciate are more likely to split in price reducing the impact of that security on the index.

Equal-weighted index: reflects the same initial investment in each security.

- Advantages: places more emphasis on smaller cap securities that may offer a return advantage.
- Disadvantages: biased to the performance of smaller issuers, requires constant rebalancing to maintain equal weight.

SS10: FIXED-INCOME INVESTMENTS (1)

Dollar duration of a bond or portfolio, also the contribution to **dollar duration.**

$$DD = (\$\Delta\text{value}) = (\text{effective duration})(0.01)(\text{value})$$

Adjusting Portfolio Dollar Duration

DD changes as interest rates change or as time passes. To re-adjust portfolio DD:

$$\text{rebalancing ratio} = \frac{\text{target DD}}{\text{new DD}}$$

Spread Duration

Sensitivity of a non-Treasury to change in *spread* over Treasuries.

- **Nominal Spread** – Spread between a non-Treasury and a Treasury security of same maturity.
- **Zero-Volatility Spread** – Spread over the Treasury spot rate curve.
- **Option-Adjusted Spread** – Determined using a binomial interest rate tree.

Immunization: A low risk (ALM) strategy designed to achieve a target terminal value (FVL) at a specified date.

- Matching the duration of assets and liabilities should produce offsetting effects between higher/lower reinvestment earnings versus loss/gain in price as interest rates increase/decrease.
- Set initial PVA = PVL and continually rebalance assets to maintain the duration match.
  - A cash flow match will meet the conditions of immunization, is more conservative, and will not require rebalancing; but it is more restrictive in asset selection and likely to be more expensive.
- Multiple liabilities can be immunized by matching average duration of assets and liabilities.
  - To minimize yield curve risk, set the asset duration distribution (and time to cash flow receipt) somewhat wider than that of the liabilities' distribution.

Contingent immunization: An active management strategy that starts with a positive surplus (S = PVA – PVL).

- +S means the client will accept a minimum return less than the immunization rate.
- Continually compare the PVA to the recomputed PVL:
  - Successful CI will grow S.
  - If S reaches zero, the portfolio must be immunized.
- **Combination matching** – Creates a duration matched portfolio that is also cash flow matched during first few years.

SS11: FIXED INCOME INVESTMENTS (2)

Effect of Leverage on Return

$$R_p = R_i + [(B/E) \times (R_i - c)]$$

Effect of Leverage on Duration

$$D_p = \frac{D_i I - D_B B}{E}$$

Hedging formula using duration:

number of contracts =

$$= \frac{(D_T - D_P)P_P}{D_{CTD}P_{CTD}}(\text{CTD conversion factor})$$

$$= \frac{DD_T - DD_P}{DD_f}$$

Remember, if a yield beta is given, include it as a multiplication.

Types of Credit Risk

- Default risk
- Credit spread risk
- Downgrade risk

Credit Derivatives

- Credit options.
  - Binary credit option: payoff based on a credit event occurring and the underlying asset's price. OV = max[(strike – value), 0]
  - Credit spread call: OV = max[(actual spread – strike spread) × notional × risk factor, 0]
  - Credit spread option: payoff based on the underlying asset's yield spread.
- Credit forwards. Payment at settlement is a function of the credit spread over the benchmark at the time the contract matures. FV = (spread at maturity – contract spread) × notional × risk factor
- Credit swaps. Provide credit risk transfer.
  - Credit default swaps provide protection against default on an underlying credit instrument.

Covered Interest Rate Parity (IRP)

$$F = S_0\left(\frac{1+c_d}{1+c_f}\right), \text{ F and } S_0 \text{ in DC/FC}$$

Forward premium, $f_{d,f}$, for a foreign currency is roughly equal to the interest rate differential:

$$f_{d,f} = \frac{(F - S_0)}{S_0} \approx c_d - c_f$$

Hedging Currency Risk

- **Forward Hedge** – Sell the foreign currency at the current forward rate.
- **Proxy Hedge** – Short second foreign currency that is correlated with the long foreign currency.
- **Cross Hedge** – Contract to deliver the original foreign currency for a third currency.

Breakeven Yield Change:

$$\frac{\%\Delta\text{price}}{-\text{duration}} \times 100 = \Delta y \text{ in basis points}$$

return on a bond denominated in a foreign currency:

$$R_b = R_l + R_c \approx R_l + (i_d - i_f) \Rightarrow i_d + (R_l - i_f)$$

$$\textbf{duration of an option} = \text{option delta} \times \text{duration of the underlying} \times \frac{\text{price of the underlying}}{\text{price of the option}}$$

SS12: EQUITIES

Approaches to Creating An Indexed Portfolio

- Full replication
- Stratified sampling
- Optimization (Factor Model)

Identifying Style

- **Return-Based Style Analysis:**

$$R_{i,t} = \left(b_1 R_{1,t} + b_2 R_{2,t} + ... + b_{k,t} R_{k,t}\right) + \left(\varepsilon_t\right)$$

- **Holdings-Based Style Analysis** – Evaluate the individual securities in the manager's portfolio.

Information ratio:

$$IR_P = \frac{\text{active return}}{\text{active risk}} = \frac{R_P - R_B}{\sigma_{(R_P - R_B)}} \approx IC\sqrt{IB}$$

Utility of Active Return:

$$U_A = R_A - \lambda_A \sigma_A^2$$

Components of Total Active Return

manager's true active return = manager's total return – manager's normal portfolio return

manager's misfit active return = manager's normal portfolio return – investor's benchmark return

$$\text{total active risk} = \sqrt{(\text{true active risk})^2 + (\text{misfit active risk})^2}$$

$$\text{true information ratio} = \frac{\text{true active return}}{\text{true active risk}}$$

SS13: ALTERNATIVE INVESTMENTS

Alternative investments often:

- Have low correlation to traditional investments, providing a diversification benefit.
- Lack information transparency and have higher due diligence costs.
- Are less liquid.
- Lack investable benchmarks.
- Lack inherent asset class characteristics and instead reflect manager skill.
- Are infrequently traded and/or use appraisal pricing; leading an artificially low, reported standard deviation (and correlation closer to zero).

Specific issues by AI type include:

- **Real estate** has inherent asset class characteristics with low correlation and good diversification. Diversified, direct investment in properties requires larger amounts of funds. REITS are liquid, with investable benchmarks but REITS are more equity like (not true RE). CREFS are classified as indirect investment but provide true RE exposure. Unsmoothed CREF data provides true measures of RE characteristics.
- **Private equity** offers higher return and risk. **Venture capital** is typically high risk with long time horizons. **Buyout investments** are somewhat less risky with somewhat shorter time horizons, but are generally leveraged. PE has some similarity to equity but is more manager skill than asset class based.
- **Commodities** have inherent asset class characteristics with lower return (and risk) but with good diversification. There are liquid, investable benchmarks. A fully collateralized long position in commodity futures earns the risk-free rate, roll return, and change in the spot price. Storable commodities linked to economic activity have provided desirable, positive correlation to inflation.
- **Hedge funds** (HF) appear to offer positive value added and good diversification but there are significant challenges in interpreting the data (self-reporting, survivorship bias, skewed returns) and with significant due diligence issues. Return is based largely on manager skill. Benchmarks are more akin to manager universes and are not investable.
- **Managed futures** have many similarities to HFs. Systematic (rule following) strategies may be replicable and investable.
- **Distressed securities** are also similar to or a subset of HFs.

SS14: RISK MANAGEMENT

A **centralized Risk Management System** (an enterprise risk management system or ERM) provides a better view of how business units are correlated than a decentralized system.

Some of the most common risks include:

- Market risk. (Financial)
- Liquidity risk. (Financial)
- Credit risk. (Financial)
- Settlement risk. (Non-Financial)
- Operations risk. (Non-financial)
- Model risk. (Non-financial)
- Regulatory risk. (Non-financial)
- Sovereign risk. (Financial and non-financial)

VaR is used as an estimate of the minimum expected loss (alternatively, the maximum loss) over a set time period at a desired level of significance (alternatively, at a desired level of confidence).

Computing VaR:

- Analytical VaR:

$$\text{VaR} = \left[\hat{R}_p - (z)(\sigma)\right] V_p$$

- Historical VaR ranks actual past returns.
- Monte Carlo is computer intensive but allows assumptions of any distributions and correlations.

Extensions to VaR:

- Incremental VaR (IVaR) is the effect of an individual asset on the overall VaR.
- Cash flow at risk (CFAR) is VaR applied to the company's cash flows.
- Earnings at risk (EAR) is analogous to CFAR only from an accounting earnings standpoint.
- Tail value at risk (TVaR) is VaR plus the expected value in the lower tail of the distribution.

Credit VaR (a.k.a. Credit at Risk or Default VaR) is like VaR, but focuses on the upper tail of returns.

Methods for Managing Market Risk: Position limits, liquidity limits, performance stopouts, and risk factor limits.

Risk Budgeting – The process of determining which risks are acceptable and how total enterprise risk should be allocated across business units or portfolio managers.

Measures to help control credit risk are limiting exposure to any single debtor, marking to market, assigning collateral to loans, payment netting agreements, setting credit standards, and using credit derivatives.

Risk-Adjusted Performance Measures:

$$\text{RoMAD} = \frac{\bar{R}_p}{\text{max. drawdown}}$$

$$\text{Sortino} = \frac{\bar{R}_p - \text{MAR}}{\text{downside deviation}}$$

SS15: RISK AND DERIVATIVES

Changing Portfolio Duration with Bond Futures

$$\begin{pmatrix}\#\\ \text{contracts}\end{pmatrix} = \begin{pmatrix}\text{yield}\\ \text{beta}\end{pmatrix}\left(\frac{MD_T - MD_P}{MD_F}\right)\left(\frac{V_P}{P_f\,(\text{multiplier})}\right)$$

Changing Portfolio Beta with Equity Futures

$$\#\ \text{contracts} = \left(\frac{\beta_T - \beta_P}{\beta_F}\right)\left(\frac{V_P}{P_F\,(\text{multiplier})}\right)$$

Altering Debt and Equity Allocations

From equity to bonds: sell equity futures and buy bond futures.

From bonds to equity: sell bond futures and buy equity futures.

Synthetic positions are also based on the same equity hedging formula:

- V_p is replaced with the FV of V_p: $V_p\,(1 + r_f\ \text{periodic})$
- If betas are not given, it is presumed the desired change in beta is the same as contract's beta.

For **synthetic equity**, buy contracts and hold the PV (discounted at r_f periodic) of the full contract price x number of contracts in cash equivalents.

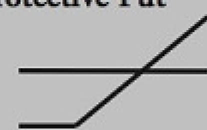
For **synthetic cash**, sell contracts and hold sufficient shares that with dividends reinvested, shares can be delivered to close the contract position (i.e., hold the multiplier × number of contracts "discounted by" the dividend yield periodic).

Option Strategies

Know the inherent payoff patterns of the option combinations, then:

- Calculate profit/loss at any ending price for the underlying as sum of initial investment versus ending value of the positions held.
- Max gain: examine the payoff pattern and, from that underlying's price, sum the initial investment versus ending value of the positions held.
- Max loss: examine the payoff pattern and, from that underlying's price, sum the initial investment versus ending value of the positions held.
- Breakeven(s): examine the payoff pattern and, from either max gain or loss, determine how much the underlying must increase or decrease.
- **Covered Call**

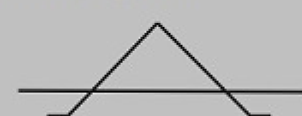
Protective Put



- **Bull Spread**

- **Collar:** Payoff pattern is identical to a bull spread but includes owning the underlying.
- **Bear Spread**

Butterfly Spread



- **Straddle**

Box Spread

Interest Rate Options

- **Call:** Used to limit the cost of borrowing. If rates rise, call pays off, reducing effective loan rate. interest rate call payoff = (NP)[max(0, LIBOR – strike rate)](D / 360)
- **Put:** Used to maintain the return on an asset (e.g., floating rate loan). If rates fall, the option pays off. interest rate put payoff = (NP)[max(0, strike rate – LIBOR)(D / 360)]
- **Cap:** Series of calls (caplets).
- **Floor:** Series of puts (floorlets).
- **Interest Rate Collar:** Combination of cap and floor.

Change Portfolio Duration with Swaps

$$MD_{\text{Pay Floating}} = MD_{\text{Fixed}} - MD_{\text{Floating}} > 0$$

$$MD_{\text{Pay Fixed}} = MD_{\text{Floating}} - MD_{\text{Fixed}} < 0$$

$$NP = V\left(\frac{MD_T - MD_V}{MD_{\text{Swap}}}\right)$$

$$MD_{\text{Floating}} \approx 0$$

- ◆ To lower asset duration, pay fixed.
- ◆ To raise asset duration, receive fixed.

- **Currency Swap** – The standard currency swap has two notional principals. The counterparties usually exchange the principals on the effective date and return them at maturity. Periodic interest payments are not usually netted.
- **Equity Swap** – One counterparty makes payments based on an equity position. Counterparty makes payments based on another equity, a bond, or fixed payments.
- **Swaptions** – An option on a swap.

Interest Rate Swaptions

- **Payer Swaption** – gives the buyer the right to be the fixed-rate payer.
- **Receiver Swaption** – gives the buyer the right to be the fixed-rate receiver.

SS16: TRADING, MONITORING, & REBALANCING

effective spread = 2 × |(execution price) – (midquote)|

Market Structures

- **Quote-driven markets:** traders transact with dealers who post buy and sell prices.
- **Order-driven:** traders transact with traders.
- **Auction market:** traders post their orders to compete against other orders for execution.
- **Automated auctions:** also known as electronic limit-order markets.
- **Brokered markets:** brokers act as traders' agents to find counterparties.
- **Hybrid markets:** combine quote-driven, order-driven, and broker markets.

Market Quality

- A **liquid** market has (1) small bid-ask spreads, (2) market depth, and (3) resilience.
- **Transparent market:** investors can obtain pre-trade and post-trade information.
- **Assurity of completion.**

Execution Costs

- **Explicit costs** in a trade include commissions, taxes, stamp duties, and fees.
- **Implicit costs** include the bid-ask spread, market or price impact costs, opportunity costs, and delay costs (a.k.a. slippage costs).
- **Volume weighted average price** (VWAP) is a weighted average of execution prices during a day.

  Advantages of VWAP:
  - ◆ Easily understood.
  - ◆ Simple to compute.
  - ◆ Can be applied quickly to enhance decisions.
  - ◆ Most appropriate for comparing small trades in nontrending markets.

  Disadvantages of VWAP:
  - ◆ Not informative for trades that dominate trading volume.
  - ◆ Can be gamed by traders.
  - ◆ Does not evaluate delayed or unfilled orders.
  - ◆ Does not account for market movements or trade volume.

Implementation shortfall (IS) measures transaction cost as the difference in performance of a hypothetical portfolio (trade is fully executed with no cost) and actual portfolio results. Total IS can be calculated as an amount.

- For per share: divide by the number of shares in the initial order.
- For percentage or basis point (bp): divide by the market value of the initial order.

Data required:

- *Decision price (DP)*: The market price of the security when the order is initiated. If the market is closed, use the previous closing price.
- *Execution price (EP)*: The price or prices at which the order is executed.
- *Revised benchmark price (BP*)*: This is the market price of the security if the order is not completed in a timely manner as defined by the user. If not otherwise stated, timely is within the trading day.
- *Cancelation price (CP)*: The market price of the security if the order is not fully executed and the remaining portion of the order is canceled.

IS component costs:

- Explicit costs: Cost per share × # of shares executed.
- Missed trade: |CP – DP| × # of shares canceled.
- Delay: |BP* – DP| × # of shares later executed.
- Market impact: |EP – DP or BP*| × # of shares executed at that EP.

Note that trading cost can be negative, an account benefit:

- An increase in price while selling.
- A decrease in price while buying.

Advantages of implementation shortfall:

- Portfolio managers can see the cost of implementing their ideas.
- Demonstrates the tradeoff between quick execution and market impact.
- Decomposes and identifies costs.
- Can be used to minimize trading costs and maximize performance.
- Not subject to gaming.

Disadvantages of implementation shortfall:

- May be unfamiliar to traders.
- Requires considerable data and analysis.

Major Trader Types

Trader Types	*Motivation*	*Time or Price Preference*	*Preferred Order Types*
Information-motivated	Time-sensitive information	Time	Market
Value-motivated	Security misvaluations	Price	Limit
Liquidity-motivated	Reallocation & liquidity	Time	Market
Passive	Reallocation & liquidity	Price	Limit

Trading Tactics

Trading Tactic	*Strengths*	*Weaknesses*	*Usual Trade Motivation*
Liquidity-at-any-cost	Quick, certain execution	High costs & leakage of information	Information
Costs-are-not-important	Quick, certain execution at market price	Loss of control of trade costs	Variety of motivations
Need-trustworthy-agent	Broker uses skill & time to obtain lower price	Higher commission & potential leakage of trade intention	Not information
Advertise-to-draw-liquidity	Market-determined price	Higher administrative costs and possible front running	Not information
Low-cost-whatever-the-liquidity	Low trading costs	Uncertain timing of trade & possibly trading into weakness	Passive and value

Algorithmic trading is a form of automated trading. The **motivation for algorithmic trading** is to execute orders with minimal risk and costs. Algorithmic trading strategies are classified into *logical participation, opportunistic, and specialized strategies*. There are two subtypes of logical participation strategies: simple logical participation strategies and implementation shortfall strategies.

- **Simple logical participation strategies** (SLP) trade with market flow to minimize market impact.
  - SLP strategies break the trade into small pieces that are each a small part of trading volume, minimizing market impact costs.
  - VWAP SLP: Order is broken up over the course of a day to match the day's VWAP.
  - In a time-weighted average price strategy (TWAP), trading is spread out evenly over the whole day to equal a TWAP benchmark.
- **Implementation shortfall** (arrival price) **strategies**:
  - Focus on trading early to minimize opportunity costs. Typically execute the order quickly.

Rebalancing

- **Calendar rebalancing.** Benefit: provides discipline without constant monitoring. Drawback: portfolio could stray considerably between rebalancing dates.
- **Percentage-of-portfolio rebalancing:** PPR (a.k.a. *interval rebalancing*). Benefit: Minimizes degree of corridor violations. Drawback: Must constantly monitor portfolio.

Optimal Corridor Width

Minimizes transactions costs and the probability of the allocation changing significantly.

- **Transactions costs.** The more expensive it is to trade, the less frequently you should trade, and the wider the corridor should be.
- **Correlations.** The more highly correlated the assets, the less frequently the portfolio will require balancing, and the wider the corridors.
- **Volatility.** The greater the volatility of the asset class, the narrower the corridor should be.

Impact of Strategies on Risk and Return

	Buy-and-Hold	*Constant-Mix*	*CPPI*
Return	Outperforms a constant-mix strategy in a trending market; outperforms CPPI in a *flat* but *oscillating* market.	Outperforms a comparable buy-and-hold strategy; outperforms a CPPI strategy in a *flat* but *oscillating* market.	Outperforms a comparable buy-and-hold strategy; outperforms a constant-mix strategy in trending markets.
Risk	Passively assumes risk tolerance is directly related to wealth.	Absolute risk tolerance increases/decreases with wealth. Relative risk tolerance is constant.	Actively assumes risk tolerance is directly related to wealth.

SS17: PERFORMANCE EVALUATION

Measures of Risk-Adjusted Return:

Treynor Measure shows the excess return (over the risk-free rate) earned per unit of systematic risk.

$$T_A = \frac{\bar{R}_A - \bar{R}_F}{\beta_A}$$

Sharpe Ratio excess return per unit of total risk.

$$S_A = \frac{\bar{R}_A - \bar{R}_F}{\sigma_A}$$

Ex Post Alpha:

$$\alpha_A = R_{At} - \hat{R}_A$$

where:

α_A = ex post alpha on the account

R_{At} = actual return on the account in period t

$\hat{R}_A = R_F + \beta_A\left(\hat{R}_M - R_F\right)$ = predicted account return

M² compares the risk-adjusted portfolio return to the market return:

$$M_P^2 = \bar{R}_F + \left(\frac{\bar{R}_p - \bar{R}_F}{\sigma_p}\right)\sigma_M$$

Information Ratio is excess return per standard deviation of excess return.

$$IR_P = \frac{\text{active return}}{\text{active risk}} = \frac{R_P - R_B}{\sigma_{(R_P - R_B)}}$$

A portfolio return has 3 components:

Market, Style, and Active Management.

$$R_p = M + S + A$$

Benchmarks

- A valid benchmark should meet the following:
  1. Specified in advance
  2. Appropriate
  3. Measurable
  4. Unambiguous
  5. Reflect current investment opinions
  6. Accountable
  7. Investable
- Common benchmarks:
  1. Absolute return
  2. Manager universes
  3. Broad market indexes
  4. Style indexes
  5. Factor-model-based
  6. Returns-based
  7. Custom security-based
- A custom security-based benchmark is the most appropriate as it meets all the benchmark criteria.
- Good benchmarks should exhibit:
  1. Minor systematic bias between the account and the benchmark returns.
  2. Minimal tracking error.
  3. Strong correlation with the manager's universe.
  4. Low turnover.

Macro and Micro Performance Attribution

- *Macro attribution* is performed at the fund sponsor level. Levels of analysis include:
  - Net contributions.
  - Risk free asset.
  - Asset categories.
  - Benchmarks.
  - Investment managers.
  - Allocation effects.
- *Micro attribution* analyzes individual portfolios rather than the whole fund. The manager's value-added return is the difference between the portfolio and benchmark returns.

Micro Performance Attribution

$$R_V = \underbrace{\sum_{j=1}^{S}\left(w_{P,j} - w_{B,j}\right)\left(R_{B,j} - R_B\right)}_{\text{pure sector allocation}} + \underbrace{\sum_{j=1}^{S}\left(w_{P,j} - w_{B,j}\right)\left(R_{P,j} - R_{B,j}\right)}_{\text{allocation/selection interaction}} + \underbrace{\sum_{j=1}^{S} w_{B,j}\left(R_{P,j} - R_{B,j}\right)}_{\text{within-sector selection}}$$

SS18: GIPS®

Know:

- The required disclosures that must appear versus those that must appear but only if relevant.
- How to identify and correct errors and omissions in Performance Presentations.

Review the class slides (or SchweserNotes™).

ISBN: 978-1-4754-4121-5

9 781475 441215