LEVEL III SCHWESER'S QuickSheet

CRITICAL CONCEPTS FOR THE 2020 CFA® EXAM

SS1 & 2: ETHICS

Review the SchweserNotes™ and/or Video Lectures and questions in the SchweserNotes™, CFA® text, and SchweserPro™.

GIPS® at a minimum know:

- The 35 required disclosures
- How to identify and correct errors and omissions in Performance Presentations
- How to calculate a TWRR

SS3: BEHAVIORAL FINANCE

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 consideration given to the initial classification being correct.
  - **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**—Selective memory of past events, remember correct views and forget errors.
- **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 biased 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.

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: CAPITAL MARKET EXPECTATIONS

Long-term economic growth rate:
pop growth + labor force part. + new cap. spending + TFP

Taylor rule:

$$n_{target} = r_{neutral} + i_{target} + [0.5(GDP_{expected} - GDP_{trend}) + 0.5(i_{expected} - i_{target})]$$

n_{target} = target nominal short-term interest rate
$r_{neutral}$ = neutral real short-term interest rate
$GDP_{expected}$ = expected GDP growth rate
GDP_{trend} = long-term trend in the GDP growth rate
$i_{expected}$ = expected inflation rate
i_{target} = target inflation rate

Risk premium approach to expected bond return:
risk-free rate + term premium + credit premium + liquidity premium

Grinold-Kroner model:

$E(R_e) \approx D/P + (\%\Delta E - \%\Delta S) + \%\Delta P/E$

$E(R_e)$ = expected equity return
D/P = dividend yield
$\%\Delta E$ = percentage change in earnings
$\%\Delta S$ = percentage change in shares outstanding
$\%\Delta P/E$ = expected repricing return

Singer-Terhaar model:

Risk premium assuming full integration:
$RP_i = \rho_{i,M}\sigma_i$(market Sharpe ratio)

Risk premium assuming full segmentation:
$RP_i = \sigma_i$(market Sharpe ratio)

Weighted average risk premium:
RP_i = (degree of integration of i) (ERP assuming full integration) + (degree of segmentation of i) (ERP assuming full segmentation)

Commercial real estate:
Cap rate = NOI / (property value)
$E(R_{re})$ = cap rate + NOI growth rate
For a finite time period: $E(R_{re})$ = cap rate + NOI growth rate – $\%\Delta$cap rate

SS5: ASSET ALLOCATION

Asset Allocation Approaches

- **Asset-only:** focuses on asset return and standard deviation.
- **Liability-relative:** focuses on growth of the surplus and standard deviation.
- **Goals-based:** uses subportfolios to meet specified goals.

Asset classes:

- Assets within a class are similar and don't fit in more than one class.
- Classes have low correlation to other classes, cover all investable assets, and are liquid.

Calendar rebalancing is done at a set frequency.

Percentage range rebalancing is when a band is violated. Wider bands for: higher transaction cost and correlations between classes, higher risk tolerance, momentum markets, and less volatile asset classes.

MVO use E(R), σ, and correlations to solve for the efficient frontier (EF) and asset allocation.

Pitfalls of MVO analysis include: estimating the inputs, concentrated allocations, and a single period analysis.

- Reverse optimization solves for the E(R)s based on market weights.
- Black-Litterman view adjusts these returns and then resolves for an EF.
- Monte Carlo simulation models how an allocation may perform over time.

SS6: DERIVATIVES AND CURRENCY MANAGEMENT

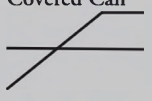
Option Strategies

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 and 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.

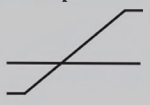
Synthetic long forward = long call and short put

- **Covered Call**



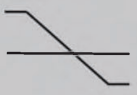
- **Protective Put**

- **Bull Spread**



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

- **Bear Spread**



- **Straddle**

Long call and short put are both short the underlying

- **Calendar spread**—Options have different expirations.
- **Volatility smile**—Further-from-ATM options have higher implied volatilities resulting in a U-shaped (smiling) curve when implied volatility is plotted against strike price.

- **Volatility skew**—Implied volatility increases for more OTM puts, and decreases for more OTM calls. Explained by OTM puts being desirable as insurance against market declines while the demand for OTM calls is low.
- For an expected increase in equity market volatility buy an ATM call on volatility index (VIX) futures and sell an OTM put on VIX futures.

Choosing Options Strategies Based on Direction and Volatility of the Underlying Asset

		Outlook on the Trend of Underlying Asset		
		Bearish	*Neutral*	*Bullish*
Expected move in implied volatility	Decrease	Write calls	Write straddle	Write puts
	Remain unchanged	Write calls and buy puts	Calendar spread	Buy calls and write puts
	Increase	Buy puts	Buy straddle	Buy calls

Interest rate swaps can be used to alter the duration of a fixed-income portfolio by changing a fixed-rate exposure to a floating-rate exposure, or vice versa.

Converting fixed-rate and floating-rate exposures:

Existing Exposure	*Converting*	*Interest Rate Swap Required*	*Beneficial When:*
Floating-rate liability	Floating to fixed	Payer swap	floating rates expected to rise
Fixed-rate liability	Fixed to floating	Receiver swap	floating rates expected to fall
Floating-rate asset	Floating to fixed	Receiver swap	floating rates expected to fall
Fixed-rate asset	Fixed to floating	Payer swap	floating rates expected to rise

The notional principal of the interest rate swap to increase (or reduce) portfolio duration (target duration) can be calculated as:

$$NP_S = \left(\frac{MD_T - MD_P}{MD_S}\right)(MV_P)$$

where:
NP_S = notional swap principal
MD_T = target modified duration
MD_P = current portfolio modified duration
MD_S = modified duration of swap
MV_P = market value of portfolio

Forward rate agreements are typically used to hedge the uncertainty about a future short-term borrowing or lending rate.

Hedging Interest Rate Risk Using Treasury Futures

To hedge the interest rate risk of a long bond portfolio the fund manager will use Treasury bond futures.

A duration-based hedge ratio (BPV HR) is calculated to determine the number of futures contracts required for a hedge.

$$BPVHR = \frac{-BPV_{portfolio}}{BPV_{CTD}} \times CF$$

Basis point value (BPV) is the expected change in value of a security or portfolio given a one basis point (0.01%) change in yield.

BPVHR = number of short futures
$BPV_{Portfolio} = MD_{Portfolio} \times 0.01\% \times MV_{Portfolio}$
MD = modified duration
$BPV_{CTD} = MD_{CTD} \times 0.01\% \times MV_{CTD}$
MV_{CTD} = CTD price / 100 × $100,000

To achieve a target duration, the formula can be amended to:

$$BPVHR = \frac{BPV_{target} - BPV_{portfolio}}{BPV_{CTD}} \times CF$$

$$BPV_{Target} = MD_{Target} \times 0.0001 \times MV_{Portfolio}$$

Currency Swaps

One party agrees to make periodic interest rate payments on a notional amount in one currency, while the other party agrees to make period interest payments on a notional amount in another currency. The notional amounts are equivalent based on the exchange rate at the inception of the swap.

Currency forwards and futures allow users to exchange a specified amount of one currency for a specified amount of another currency on a future date. Forwards are customized while futures are standardized contracts.

The hedge ratio for futures can be calculated as:

$$HR = \frac{\text{amount of currency to be exchanged}}{\text{futures contract size}}$$

Equity swaps can be used to create a synthetic exposure to physical stocks, allowing market participants to increase or decrease their exposure to equity returns.

The three main types of swaps:
1. Pay fixed, receive equity return
2. Pay floating, receive equity return
3. Pay another equity return, receive equity return

Equity Futures and Forwards

Equity futures are exchange-traded, standardized, require margin, have low transaction costs, and are available on indexes and single stocks. They enable market participants to:

- Implement tactical allocation decisions (alter the exposure to equity of a portfolio).
  - Selling futures (short position) reduces equity exposure.
  - Buying futures (long position) increases equity exposure.
- Achieve portfolio diversification.
- Gain exposure to international markets.
- Make directional bets on the direction of the market.

Forwards provide the same advantages but lack liquidity, are not subject to mark-to-market margin adjustments, counterparty credit risk exists, major advantage is they can be customized.

Achieving a target portfolio beta:

$$\text{number of futures required} = \left(\frac{\beta_T - \beta_P}{\beta_F}\right)\left(\frac{MV_P}{F}\right)$$

where:
β_T = target portfolio beta
β_P = current portfolio beta
β_F = futures beta (beta of stock index)
MV_P = market value of portfolio
F = futures contract value = futures price × multiplier

Note that to fully hedge the portfolio from market risk $\beta_T = 0$.

VIX Futures

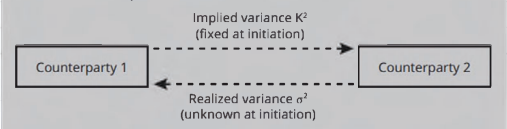
- Negative correlation between the VIX and stock returns which becomes more pronounced during equity market downturns.
- An equity holding can be protected from extreme downturns (tail risk) by buying VIX futures. If volatility increases the equity portfolio will decline in value but VIX futures should increase in value.
- VIX futures will increase in value when the market's expectation of future volatility at contract maturity increases.

Position	*Term structure*	*Roll yield*
Long futures position	Contango	Negative
Short futures position	Contango	Positive
Long futures position	Backwardation	Positive
Short futures position	Backwardation	Negative

VIX Options

- Call options gain in value if expectations of volatility at maturity of the option increase.
- Put options gain in value if expectations of volatility fall.

Variance swaps are based on variance (σ^2) rather than volatility (standard deviation).



There is no initial exchange of notional principal, no interim settlement periods, and a single payment at the expiration of the swap based on the difference between actual and implied variance over the life of the swap.

Settlement $amount_T$ =
(variance notional)(realized variance – variance strike)

Long (purchaser) describes the counterparty who receives the realized variance (actual) and pays the swap's variance strike (implied volatility).

Realized volatility	>	strike	Buyer (long) of swap makes a profit
Realized volatility	<	strike	Buyer (long) of swap makes a loss

Realized variance is calculated by taking the natural log of the daily price relatives, the closing price on day *t* divided by the closing price on day t – 1.

$R_i = \ln(P_t/P_{t-1})$. If we have N days of traded prices, we can compute N – 1 price relatives (R).

$$\text{daily variance} = \left[\sum_{i=1}^{N-1} R_i^2 \Big/ (N-1)\right]$$

annualized variance = daily variance × 252
252 = assumed trading days in a year

The notional amount for a variance swap can be expressed as either variance notional (N_{VAR}) or vega notional (N_{VEGA}).

$$\text{variance notional} = \frac{\text{vega notional}}{2 \times \text{strike price (K)}}, \text{ so}$$

profit or loss = $N_{VAR} \times (\sigma^2 - K^2)$ =

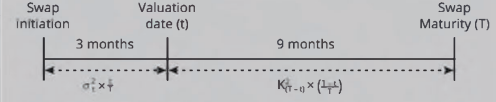
$$N_{vega} \times \left(\frac{\sigma^2 - K^2}{2K}\right)$$

where:
σ = realized volatility
K = strike volatility (implied volatility)

Both the actual (σ) and the implied volatility (K) on the swap are quoted in standard deviations , but remember that this is a variance swap; therefore, we must square the volatility.

The market convention is to quote the notional on a swap as vega notional (N_{VEGA}) rather than variance notional (N_{VAR}). Recall that vega refers to the change in option premium per a 1% change in volatility, $\frac{\Delta\text{premium}}{\Delta\text{volatility}}$, a natural way to think about the return for volatility.

Mark-to-market example of a 1-year variance swap where 3 months have elapsed since inception:



Compute the current value of the swap:

Step 1: Compute the expected variance at maturity.

expected variance to maturity =

$$\left(\sigma_t^2 \times \frac{t}{T}\right) + \left(K_{(T-t)}^2 \times \frac{T-t}{T}\right)$$

where:
σ_t^2 = annualized realized volatility from initiation to valuation date squared
$K_{(T-t)}^2$ = annualized implied volatility from valuation date to swap maturity squared

$$\frac{t}{T} = \frac{3}{12} \quad \frac{T-t}{T} = \frac{9}{12}$$

Step 2: Compute the expected payoff at maturity.

$$\text{variance notional} = \frac{\text{vega notional}}{2 \times \text{strike price (K)}}$$

expected payoff at maturity = $(\sigma^2 - K^2) \times$ variance notional where σ^2 is the expected variance to maturity

Step 3: Discount expected payoff from maturity to valuation date (9 months).

Foreign Currency Equations

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

$R_{DC} \approx R_{FC} + R_{FX}$

R_{FC} = return on the foreign asset and

R_{FX} = return on the foreign currency

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

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).

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.

SS7 & 8: FIXED INCOME

Liability-based mandates:

- Cash flow matching directly funds liabilities with coupon and par amounts.
- Duration matching requires:
  - PVA = PVL; there are exceptions when asset and liability discount rates differ.
  - $D_A = D_L$ or $BPV_A = BPV_L$
  - Minimize portfolio convexity but make it greater than that of the liabilities.
  - Portfolio-based IRR and statistics should be used.
  - Regularly rebalance the portfolio:
    - $BPV_{futures} \approx BPV_{CTD} / CF_{CTD}$
    - $N_f = (BPV_L - \text{current BPV}) / BPV_{futures}$
  - Nonparallel yield curve shifts can be a problem.
  - Horizon match: cash flow match nearer and duration match longer-term liabilities.
  - Contingent immunization: active management if the surplus is positive.

Return can be decomposed as:

1. Yield income: annual coupon amount / current bond price
2. Rolldown yield: (projected ending bond price (BP) – beginning BP) / beginning BP
3. Price change due to investor yield change predictions: $(-MD\Delta Y) + (\frac{1}{2}C\Delta Y^2)$
4. Less credit losses: predicted default adjusted for the recovery rate
5. Currency G/L: projected change in value of foreign currencies weighted for exposure to the currency

$$\text{Leveraged return} = r_I + [(V_B / V_E) \times (r_I - r_B)].$$

Active management for a stable upward sloping yield curve:

- Buy and hold: extend duration to get higher yields.
- Roll down the yield curve: portfolio weighting highest for securities at the long end of the steepest yield curve segments, maximize gains on securities from declines in yield as time passes.
- Sell convexity to increase yield.
- Carry trade: borrow at lower rates to purchase securities with higher rates.

Active management for a changing yield curve:

- Increase (decrease) portfolio duration if rates are expected to decrease (increase).

$$N_f \text{ to change duration} = \frac{(\text{target portfolio PVBP} - \text{current portfolio PVBP})}{\text{PVBP futures contract}}$$

- Increase (decrease) portfolio exposure to key rate durations where relative decreases (increases) in key rates are expected.
- Increase portfolio convexity (decreasing yield) when large changes in rates are expected.
- Bullet portfolios have more yield, but barbells have more convexity and also tend to outperform in curve-flattening environments.
- Long (short) option positions is a more effective way to add (reduce) convexity.

High yield (HY) bonds are more affected by spread change and investment grade (IG) by general market (risk-free) interest rate changes:

- % Δ value = $-MD\Delta y$
- %Δrelative value = $-SD\Delta s$
- spread = $y_{\text{higher yield}} - y_{\text{government}}$

Excess return can be modeled as:

$(s \times t) - (\Delta s \times SD) - (t \times p \times L)$

Liquidity risk is significant for both IG and HY, but more so for HY.

SS9 & 10: EQUITIES

Constructing and maintaining the index involves:

- The weighting method to construct the index: (1) market-cap weighting, (2) price weighting, (3) equal weighting, or (4) fundamental weighting.
- Considering the level of stock concentration. The "effective number of stocks" can be determined as the reciprocal of the Herfindahl-Hirschman index (HHI):

$$HHI = \sum_{i=1}^{n} w_i^2$$

$$\text{effective number of stocks} = \frac{1}{HHI}$$

Common equity risk factors: growth, value, size, yield, momentum, quality, and volatility.

Factor-based strategies: return oriented, risk oriented, and diversification oriented.

Common approaches to passive equity investing use: (1) pooled investments, such as open-end mutual funds and ETFs, (2) derivatives-based strategies, and (3) separately-managed index-based portfolios.

Three methods of constructing passively managed index-based equity portfolios: (1) full replication, (2) stratified sampling, often based on cell matching, (3) technical and quantitative approach (optimization)

Fundamental managers use discretionary judgment vs. **quantitative managers** use rules-based (systematic) data-driven models.

Fundamental law of active management:

$$E(R_A) = IC\sqrt{BR}\,\sigma_{RA}\,TC$$

Active share measures the degree to which the number and sizing of the positions in a manager's portfolio differ to those of a benchmark:

$$\text{Active share} = \frac{1}{2}\sum_{i=1}^{n}\left|W_{p,i} - W_{b,i}\right|$$

Active risk (tracking error), is the standard deviation of active returns (portfolio returns minus benchmark returns).

Active risk has two sources, which are (1) active factor exposure (active beta) and (2) idiosyncratic risk from concentrated positions (variance from both the skill and luck of the manager):

$$\text{Active risk}(\sigma_{RA}) = \sqrt{\frac{\sum_{t=1}^{T}(R_{At})^2}{T-1}}$$

$$= \sqrt{\sigma^2\left(\sum(\beta_{pk} - \beta_{bk}) \times F_k\right) + \sigma_e^2}$$

Risk budgeting is the process by which the contribution to total risk of the portfolio is allocated to constituents of the portfolio in the most efficient manner. Contribution to portfolio variance can be calculated on an *absolute* or *relative* basis.

- The contribution of asset *i* to *absolute* portfolio variance = $CV_i = \sum_{j=1}^{n} w_i w_j C_{ij} = w_i C_{ip}$
- The contribution of factor *i* to *absolute* portfolio variance = $CV_i = \sum_{j=1}^{n} \beta_i \beta_j C_{ij} = \beta_i C_{ip}$

- The contribution of asset *i* to *relative* portfolio variance =

$$CAV_i = \sum_{j=1}^{n}(w_{pi} - w_{bi})(w_{pj} - w_{bj})RC_{ij}$$

$$= (w_{pi} - w_{bi})RC_{ip}$$

Long extension portfolios guarantee investors 100% net exposure with a specified short exposure. A typical 130/30 fund will have 130% long and 30% short positions.

Market-neutral portfolios aim to remove market exposure through offsetting long and short positions. Pairs trading is a common technique in building market-neutral portfolios, with quantitative pair trading referred to as *statistical arbitrage*.

Benefits of long/short strategies include the ability to better express negative views, the ability to gear into high-conviction long positions, the removal of market risk to diversify, and the ability to better control risk factor exposures.

Drawbacks of long/short strategies include potential large losses since share prices are not bounded above, negative exposures to risk premiums, potentially high leverage for market-neutral funds, and the costs of borrowing securities and collateral demands from prime brokers. Being subject to a short squeeze on short positions is also a risk.

SS11: ALTERNATIVE INVESTMENTS

Hedge Funds Strategies:

1. **Equity related** with the primary source of risk being equity risk.
   a. *Long/short equity*—The fund manager takes long positions in stocks that they think will rise in value, and takes short positions in stocks that they believe will fall in value.
   b. *Dedicated short bias funds*—These seek overpriced securities to sell short.
   c. *Equity market neutral*—These seek to attain a near-zero overall exposure to the stock market.
      - Take long positions in undervalued stocks and short positions in overvalued stocks with the betas of the positions summing to zero.
      - Alpha occurs through mean reversion.
2. **Event-driven** relate to corporate actions such as governance activities, mergers, acquisitions, bankruptcies, and other major business events. The main risk is event risk.
   a. *Merger arbitrage* earns a return from the uncertainty that exists in the market from when an acquisition is announced until completed (i.e., the fund manager purchases the stock of the target company and shorts the stock of the acquiring company, anticipating the deal will be completed).
   b. *Distressed securities* take positions in the securities of firms that are in financial distress, including firms that are in bankruptcy or near-bankruptcy.
3. **Relative value** strategies profit from the relative valuation differences between securities.
   a. *Fixed-income arbitrage* takes advantage of temporary mispricing of fixed-income instruments by going long undervalued securities and short overvalued securities.
      - *Yield curve trades* go long and short fixed-income investments in order to profit from the anticipated yield curve steepening or flattening.
      - *Carry trade* the portfolio manager shorts a low-yielding security and goes long a high-yielding security.
   b. *Convertible bond arbitrage* the manager purchases the convertible bond which is often underpriced and short sells the underlying equity.
4. **Opportunistic** strategies employ a top-down approach making macro investments on a global basis across regions, sectors, and asset classes.
   a. *Global macro* profits from making correct assessments and forecasts of various global economic variables.
   b. *Managed futures* strategies take long and short positions in derivatives contracts.
5. **Specialist** strategies require specialized market expertise or knowledge.
   a. *Volatility* strategies trade volatility-related assets globally.
   b. *Insurance/reinsurance* strategies:
      - *Insurance strategy*—An insured person sells their insurance policy (through a broker) to a hedge fund.
      - *Reinsurance* strategies—Insurance companies sell off some of their risk to reinsurance companies who may then sell the risk to hedge funds in exchange for capital.
6. **Multimanager** strategies use other hedge fund strategies as building blocks, combining different strategies together, rebalancing exposures over time.

Conditional linear factor model: to quantify the risk exposures of various hedge fund strategies.

$$(\text{return on HF}_i)_t = \alpha_i + \beta_{i,1}(\text{Factor 1})_t + \beta_{i,2}(\text{Factor 2})_t + \ldots + \beta_{i,K}(\text{Factor K})_t + D_t\beta_{i,1}(\text{Factor 1})_t + D_t\beta_{i,2}(\text{Factor 2})_t + \ldots + D_t\beta_{i,K}(\text{Factor K})_t + (\text{error})_{i,t}$$

where:
α_i is the intercept for hedge fund *i*
$\beta_{i,K}(\text{Factor K})_t$ represents the exposure during *normal* periods to risk factor *K*
D_t is a dummy variable that equals 0 during normal periods, and 1 during a financial crisis
$D_t\beta_{i,K}(\text{Factor K})_t$ represents the *incremental* exposure to risk factor *K* during financial crisis periods
$(\text{error})_{i,t}$ is random error with zero mean

Drawdown:

- Defined as the percentage peak-to-trough decline for a portfolio.
- High-water mark refers to the maximum value the portfolio has ever reached.

Estimating investor cash flows to and from a private investment:

- Capital contribution in period t = percentage to be called in period t × (committed capital – capital previously called)
- Distributions in period t = percentage to be distributed in period t × [NAV in period t – 1 × (1 + growth rate)]
- NAV in period t = [NAV in period t – 1 × (1 + growth rate)] + contributions in period t – distributions in period t

SS12: PRIVATE WEALTH (1)

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:

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

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

Taxable accounts: usually taxed annually, called accrual taxes

Tax drag % > tax rate

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

Tax-deferred accounts: front-end benefits: contributions decrease current taxes, accrue tax free, taxed in future

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

Tax-exempt accounts: back-end benefits: contributions 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:

Prob (joint survival) = Prob (husband survives) + Prob (wife survives) – Prob (husband survives) × Prob (wife survives)

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

r = real risk-free rate

Relative After-Tax Values

Tax-Free Gift:

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

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:

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

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

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

RV of a taxable gift, Tg, paid by receiver:

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

RV of a taxable gift, Tg, paid by giver:

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

where:
T_g = the gift tax rate
$(1 - T_g)$ = the after-tax value of the gift
r_g = pre-tax return on assets held by the gift receiver
t_{ig} = tax rate on returns in gift receiver's portfolio

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 taxpayer; 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 taxpayer; but if the tax rates of S and R were reversed, credit and exemption would produce the same total tax: 40 to S.

SS13: 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 noncore 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 nonrecourse 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 (nonmarket 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.
  - Annuities hedge the risk of the individual outliving their assets.

SS14: INSTITUTIONAL INVESTORS

Stakeholders and key elements of the IPS for defined benefit (DB) pension plans vs. defined contribution (DC) pension plans:

	DB Plan	*DC Plan*
Stakeholders	Employers, plan beneficiaries, investment staff, investment committee/board, governments, shareholders	Employers, plan beneficiaries, investment staff, investment committee/board, governments
Liabilities	Present value of future benefits promised to plan participants. Higher when: • Employees work longer • Salaries are higher • Participants live longer • Lower employee turnover leads to higher vesting • Discount rate is low	No liability to plan sponsor once required contribution to plan has been met
Investment time horizon	Longer if proportion of active lives is higher	Dependent on the age of participant: longer if younger
Liquidity needs	Higher with: • More retired lives • Older workforce • Higher funded status (may reduce contributions) • Flexibility of participants to switch plans	Higher with: • Older workforce • Flexibility of participants to switch plans
External constraints	• Regulations vary by country: IORP II in Europe, ERISA in U.S. • Tax treatment favorable • Accounting rules: ASC 715 requires funded status to be shown on balance sheet (U.S. GAAP); public pension plans follow GASB	• Regulations vary by country: IORP II in Europe, ERISA in U.S. • Sponsor must offer appropriate default option to disengaged participants • Plans are tax deferred
Investment objectives	Achieve a long-term target return over a specified horizon with appropriate risk to meet contractual liabilities.	Prudently grow assets to meet spending needs in retirement.

Stakeholders and key elements of the IPS for the five types of sovereign wealth funds (SWF):

	Budget Stabilization	*Development*	*Savings*	*Reserve*	*Pension Reserve*
Stakeholders	Country's citizens, the government, external and internal investment management				
Liabilities	Uncertain: linked to commodity prices/economic cycle	Linked to socioeconomic investments	Spending on future generations	Yield promised on central bank/government bonds	Future pension Payments
Investment time horizon	Short term	Long/medium term dependent on investment projects	Long term	Long term	Long term
Liquidity needs	Highest	Generally low	Lowest	Intermediate	Varies: low during accumulation stage, higher during decumulation stage
External constraints	Established by national legislation. Best practice set by ISWF's Santiago Principles. Generally tax exempt.				
Investment objectives	Capital preservation	Real growth higher than real GDP growth	Maintain real perpetual spending	Grow faster than yield on central bank/government bonds	Earn returns to meet future unfunded government pension payments

Stakeholders and key elements of the IPS for university endowments and private foundations:

	University Endowments	*Private Foundations*
Stakeholders	Current and future students, alumni, university employees	Founding family, donors, grant recipients and broader community, governments
Liabilities	Set by the future spending promised to the university. Spending policy should consider (1) ongoing donations, (2) reliance of university on spending, (3) ability to issue debt. Spending may use a spending rule which takes a weighted average of last period's spending adjusted for inflation and a fixed spending rate applied to average AUM.	U.S. tax rules require minimum spending of 5% of assets plus investment expenses. Must also spend donations in the same year they are received.
Investment time horizon	Perpetual	Typically perpetual, but shortened for limited-life foundations
Liquidity needs	The spending rate net of donations is very low at 2%–4% of assets.	Higher than endowments—legally required to spend 5% of assets. Reliance on spending by foundation is usually higher than the reliance of a university on endowment spending.
External constraints	Typically tax exempt. Regulation varies by jurisdiction but generally requires a total return approach and prudence in investing (UPMIFA in U.S., The Trustee Act in the U.K.).	
Investment objectives	Generate a total real return after inflation measure by the HEPI of about 5% on a 3–5 year rolling basis, with reasonable annual volatility in the range of 10%–15%	Generate a real return over consumer price inflation of the spending rate (minimum 5%) plus investment expenses on a 3–5 year rolling basis, with reasonable annual volatility in the range of 10%–15%

Stakeholders and key elements of the IPS for banks and insurers:

	Banks	*Insurers*
Stakeholders	External: shareholder, depositors, borrowers, creditors, credit ratings agencies, regulators, and communities Internal: employees, management, and board	External: shareholders, policyholders, derivatives counterparties, creditors, regulators, credit ratings agencies Internal: employees, management, and board
Liabilities	Primarily deposits which are short term	Life insurers: long duration contract payouts P&C insurers: shorter and less certain contract payouts
Investment time horizon	While perpetual organizations, investments are run on a short/medium term LDI basis.	
Liquidity needs	Driven by deposit withdrawals and potential need to raise liquidity in adverse market conditions. Regulators apply liquidity coverage ratios and net stable funding ratios.	Varies by product line—P&C liquidity needs generally higher than life. Liquidity needs will increase in times of high interest rates due to policyholders surrendering in search of high yields elsewhere.
External constraints	Highly regulated due to importance to real economy and systemic risk, particularly SIFIs. Main goal of regulators is to ensure the institution holds sufficient risk-based capital to absorb losses. Three different types of accounting systems apply: 1. Standard financial reporting (GAAP or IFRS) 2. Statutory accounting for regulators (more conservative than financial reporting) 3. True economic accounting (marked-to-market) Banks and insurers are fully taxable.	
Investment objectives	Manage liquidity and risk mismatches between the institution's non-investment assets and liabilities. This needs to be done in the context of the institution's overall profit maximization objective.	

The risk tolerance of a DB pension plan is generally higher when:

- Funded status is higher.
- The sponsor has lower debt levels and is more profitable.
- The plan is small relative to the size of the sponsor's business.
- The correlation between the plan assets and the business of the sponsor is low.

- The plan has no provisions for early retirement/ lump sum options.
- The workforce is young and the plan has a high level of active lives.

SS15: TRADING, PERFORMANCE EVALUATION, AND MANAGER SELECTION

Implementation shortfall (IS) at the highest level the absolute value is:

IS = paper return – actual return

IS can be decomposed into the following parts:

- *Execution cost* occurs due to executing shares at a less favorable price than the original decision price. Execution cost can be further broken down into:
  - *Delay cost* occurs due to adverse price movements in the time between the portfolio manager submits the order to the trader and the time the trader releases the order to the market. For a buy order: delay cost = shares executed × (arrival price – decision price)
    - Decision price = price when manager decides to buy (or sell).
    - Arrival price = price when the order is placed by trader.
  - *Trading cost*: due to the market impact of executing the trade.

  Trading cost = shares executed × (average purchase price – arrival price)
- *Opportunity cost* is the cost of *not* trading any unfilled part of the order. The paper portfolio assumes that all shares are executed immediately at the original decision price. The actual trade may have only filled part of the order and the lost profit on the unfilled portion is the opportunity cost. For a buy order:

  Opportunity cost = portion of order not filled × (closing price – decision price)
- *Fixed fees* are any explicit commissions or fees incurred in executing the trade.

  Fixed fees = shares executed × commission per share

Total IS value ($) = delay cost + trading cost + opportunity cost + fixed fees

All of the components of and total IS can be expressed in terms of basis points (bps) of the original cost of the paper portfolio. A basis point is 1/100th of one percent. A decimal number is multiplied by 10,000 to convert it to basis points.

Trade costs represent costs relative to the benchmark, a positive value represents underperformance:

Absolute cost ($) = side × (execution price – benchmark price) × shares executed

Trade cost (bps) =

$$\text{side} \times \frac{(\text{execution price} - \text{benchmark price})}{\text{benchmark price}} \times 10{,}000$$

where:

side = +1 for a buy order, –1 for a sell order

Market-adjusted cost is used to remove the impact of market movements on trade cost which ensures a trader is not penalized or rewarded for general market movements over the trade horizon.

index cost (bps) =

$$\text{side} \times \frac{(\text{index VWAP} - \text{index arrival price})}{\text{index arrival price}} \times 10{,}000$$

Market-adjusted cost (bps) = arrival cost (bps) – β × index cost (bps)

where:

arrival cost is the arrival cost of the trade based on an arrival price benchmark

β = beta of the security vs. the index used to calculate index cost

Added value is a different method of trade cost analysis comparing the arrival cost of the trade with the estimated pre-trade cost.

Added value (bps) = arrival cost (bps) – estimated pre-trade cost (bps)

A negative cost is a benefit—the trader has added value through their trading decisions.

Micro Attribution vs. Macro Attribution

- *Micro attribution* analyzes the portfolio at the portfolio manager's level.
- *Macro attribution* analyzes investment decisions at the fund sponsor's level.

Returns-Based, Holdings-Based, and Transactions-Based Attribution

- *Returns-based attribution* uses regressions to analyze the portfolio returns over time and isolates the asset class components through indices that would have generated these returns.
- *Holdings-based attribution* uses beginning-of-period portfolio assets.
- *Transactions-based attribution* updates the beginning-of-period holdings-based attribution for any subsequent trades.

Brinson model quantifies the portfolio returns into three attribution effects: allocation effect, security selection effect, and the interaction effect.

- *Allocation effect* refers to the portfolio manager's decision to overweight or underweight specific sector weightings versus the benchmark. The contribution to the ith sector is equal to the portfolio's sector weight minus the benchmark's sector weight, times the benchmark sector return: $A_i = (w_i - W_i)B_i$
- *Security selection* is the portfolio manager's value added by selecting individual securities (stock picking) within the sector and weighting the portfolio differently compared to the benchmark's weightings. The contribution to selection in the ith sector is equal to the benchmark sector weight times the portfolio's sector return minus the benchmark's sector return: $S_i = W_i(R_i - B_i)$
- *Interaction effect* is a residual amount (e.g., plug) that ensures the arithmetic return minus the relative benchmark is fully accounted for in attribution analysis. The contribution to the ith sector is equal to the portfolio sector weight minus the benchmark sector weight, times the portfolio sector return minus the benchmark sector return: $I_i = (w_i - W_i)(R_i - B_i)$

Carhart model is a fundamental factor model calculating the excess return from active management decisions by determining the impact on the portfolio due to the following factors: (1) market index (RMRF), (2) market-capitalization (SMB), (3) book-value-to-price (HML), and (4) momentum (WML):

$$R_p - R_f = a_p + b_{p1}\text{RMRF} + b_{p2}\text{SMB} + b_{p3}\text{HML} + b_{p4}\text{WML} + E_p$$

Common Methods of Fixed-Income Attribution

- *Exposure decomposition* is a top-down approach that utilizes duration to quantify active portfolio manager decisions regarding interest rate decisions relative to its benchmark.
- *Yield curve decomposition* can be either top-down or bottom-up and utilizes both duration and yield to maturity (YTM) in computing price return (as one component in calculating total return).

  % total return = % income return + % price return,

  where % price return ≈ –duration × change in YTM
- *Yield curve decomposition* based on zero-coupon curves or spot rates also known as the full repricing method is the most accurate but more difficult and expensive to use.

Benchmark quality of a portfolio return can be broken up into three components: market, style, and active management.

P = M + S + A

where:

P = investment manager's portfolio return

M = return on the market index

S = B – M = excess return to style; difference between the manager's style index (benchmark) return and the market return (S can be positive or negative)

A = P – B = active return; difference between the manager's overall portfolio return and the style benchmark return

Performance Appraisal

Sharpe ratio

$$S_A = \frac{\bar{R}_A - \bar{r}_f}{\bar{\sigma}_A}$$

Treynor ratio

$$T_A = \frac{\bar{R}_A - \bar{r}_f}{\bar{\beta}_A}$$

Information ratio is used to measure a portfolio's performance against the benchmark accounting for differences in risk.

$$IR = \frac{E(r_p) - E(r_B)}{\sigma(r_p - r_B)}$$

Appraisal ratio is calculated as alpha divided by the standard deviation of the residual/unsystematic risk (the standard error of regression).

$$AR = \frac{\alpha}{\sigma_\varepsilon}$$

Sortino ratio only considers the standard deviation of the downside risk where r_T refers to the minimum acceptable return (MAR) and (σ_D) refers to target semistandard deviation.

$$SR_D = \frac{E(r_p) - r_t}{\sigma_D}$$

Capture ratios determine the manager's relative performance when markets are up or down. Capture is calculated as portfolio return divided by benchmark return. The capture ratio is calculated as upside capture divided by downside capture.

Type I and II errors in hiring managers and continuation decisions

- Null hypothesis (H_0) is that there is no value added.
- Type I error is when the null hypothesis is rejected when in fact there was no value added.
- Type II error is when the null hypothesis is not rejected when in fact there was value added.

SS16: CASES IN PORTFOLIO MANAGEMENT AND RISK MANAGEMENT

- Review the SchweserNotes™ and/or the Video Lectures.

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