



# CAIA<sup>®</sup> Level II Workbook

## September 2019

Chartered Alternative Investment  
Analyst Association<sup>®</sup>

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## Preface

Congratulations on your successful completion of Level I and welcome to Level II of the Chartered Alternative Investment Analyst (CAIA) program. The CAIA program, organized by the CAIA Association and co-founded by the Alternative Investment Management Association (AIMA) and the Center for International Securities and Derivatives Markets (CISDM), is the only globally recognized professional designation in the area of alternative investments, the fastest growing segment of the investment industry. The following is a set of materials designed to help you prepare for the CAIA Level II exam.

## Workbook

The exercises are provided to help candidates enhance their understanding of the reading materials. The questions that will appear on the actual Level II exam will not be of the same format as these exercises. In addition, the exercises presented here have various levels of difficulty, and, therefore, candidates should not use them to assess their level of preparedness for the actual examination.

## September 2019 Level II Study Guide

It is critical that each candidate should carefully review the study guide. It contains information about topics to be studied as well as a list of equations that the candidate MAY see on the exam. The study guide can be found on the CAIA website, on the Curriculum page.

## Errata Sheet

Correction notes appear in the study guide to address known errors existing in the assigned readings that are viewed as being substantive. Occasionally, additional errors in the readings and learning objectives are brought to our attention after publication. At those points, we will then post the errata directly to a **separate errata sheet on the Curriculum and Study Materials section of the CAIA website.**

It is the responsibility of the candidate to review these errata prior to taking the examination. Please report suspected errata to [curriculum@caia.org](mailto:curriculum@caia.org).

## The Level II Examination and Completion of the Program

All CAIA candidates must pass the Level I examination before sitting for the Level II examination. Separate Study Guides are available for each level. As with the Level I examination, the CAIA Association administers the Level II examination twice annually. Upon successful completion of the Level II examination, and assuming that the candidate has met all the Association's membership requirements, the CAIA Association will confer the CAIA Charter upon the candidate. Candidates should refer to the CAIA website, [www.caia.org](http://www.caia.org), for information about examination dates and membership requirements.

**Reading:** *Alternative Investments: CAIA Level II*, 3rd edition, Wiley, 2016.

## Chapter 1: Asset Allocation Processes and the Mean-Variance Model

### Exercises

1. Mike Jennings is an assistant at XYZ, an investing consulting firm based in London. He is trying to measure the actual performance of a group of pension funds and the performance that would have been attained had the funds invested their capital in passively managed market indices, and according to the weights set forth in their investment policy statements. To this end, Mr. Jennings regressed the quarterly rates of return reported by a group of U.K. pension funds against passively managed benchmarks that were created using the weights proposed by the investment policy statements of the funds. The average r-squared of these regressions exceeded 85%, and this led Mr. Jennings to conclude that more than 85% of the average returns of these pension funds can be explained by the asset allocation decision described in their investment policy statements. Is the conclusion by Mike Jennings correct?

2. Suppose that an investor's utility is the following function of wealth ( $W$ ):

$$U(W) = \sqrt{W}$$

An investor currently has \$150 and is considering whether to speculate on an investment with a 70% chance of earning 20%, and a 30% chance of losing 30%. Find the current and expected utility of the investor. Should the investor take the speculation rather than hold the cash?

3. Continuing with the previous exercise (#2), suppose instead that the investor's utility is the following function of wealth ( $W$ ):

$$U(W) = W - 0.005W^2$$

Should the investor take the speculation rather than hold the cash? (Suppose once again that the investor currently has \$150 and is considering whether to speculate on an investment with a 70% chance of earning 20%, and a 30% chance of losing 30%).

4. Suppose that an investor's expected utility,  $E[U(W)]$ , from an investment can be expressed as:

$$E[U(W)] = \mu - \frac{\lambda}{2} \times \sigma^2$$

where  $W$  is wealth,  $\mu$  is the expected rate of return on the investment,  $\sigma^2$  is the variance of the rate of return, and  $\lambda$  is a constant that represents the asset owner's degree of risk aversion.

Use the expected utility of an investor with  $\lambda = 0.7$  to determine which of the following investments is more attractive:

Investment X:  $\mu = 0.05$  and  $\sigma^2 = 0.03$

Investment Y:  $\mu = 0.07$  and  $\sigma^2 = 0.10$

5. In the previous exercise, suppose now that the investor is risk neutral. Would the answer change?
6. Briefly explain the major internal and external investment policy constraints.
7. An investor's optimal portfolio has an expected return of 9%, which is 6% higher than the riskless rate. If the variance of the portfolio is 0.02, what is the investor's degree of risk aversion,  $\lambda$ ?
8. Suppose that an investor is using mean-variance optimization with one risky asset and a riskless asset. Suppose that the riskless rate is 2%, and that the expected rate of return on the risky asset is 7% per year. The standard deviation of the index is estimated to be 10% per year. What is the optimal investment in the risky asset for an investor with a risk aversion degree of 8?
9. Consider the case of mean-variance optimization and suppose that the expected annual rate of return of an optimal portfolio is 12%, and the riskless rate is 3% per year. What is the hurdle rate for a new asset that has a beta of 1.2 with respect to the optimal portfolio? What if the new asset has a beta of  $-0.5$ ?
10. What are the three components of the expected return on all asset classes?

## Solutions

1. The conclusion by Mike Jennings is incorrect because the average r-squared of these regressions can be interpreted as implying that more than 85% of the return volatility (and not the average return, as Mr. Jennings claimed) of the portfolio through time can be explained by the asset allocation decision described in the investment policy.

(Section 1.1)

2. The current utility of holding the cash is 12.25, which can be found as (rounded):

$$U(W) = \sqrt{150} = 12.25$$

The expected utility of taking the speculation is found as (rounded):

$$E[U(W)] = (0.70 \times \sqrt{180} + 0.30 \times \sqrt{105}) = 12.47$$

Where:  $180 = 150 \times 1.20$ ; and  $105 = 150 \times 0.7$ . Because the investor has an expected utility of taking the speculation of 12.47, the investor would prefer to take the speculation as opposed to holding the cash, which has a utility of only 12.25.

(Section 1.5.2)

3. With this utility function, the current utility of holding the cash is 37.50:

$$U(W) = W - 0.005W^2 = 150 - 0.005 \times 150^2 = 37.50$$

In this case, the investor has an expected utility of taking the speculation of 27.56, found as (rounded):

$$\begin{aligned} E[U(W)] &= 0.70 \times (180 - 0.005 \times 180^2) + 0.30 \times (105 - 0.005 \times 105^2) \\ &= 27.56 \end{aligned}$$

In this case, the investor would prefer to hold the cash.

(Section 1.5.2)

4. The expected utility of the investments are found as:

$$\text{Investment X: } E[U(W)] = 0.05 - \frac{0.7}{2} \times 0.03 = 0.0395$$

$$\text{Investment Y: } E[U(W)] = 0.07 - \frac{0.7}{2} \times 0.10 = 0.0350$$

Investment X is more attractive because the investor's expected utility of holding X is higher.

(Section 1.5.4)

5. In the case of a risk neutral investor,  $\lambda=0$ . This means that:  $E[U(W)] = \mu$ . Therefore, Investment Y is more attractive than Investment X for a risk neutral investor, because:

$$E[U(W_Y)] = 0.07 > E[U(W_X)] = 0.05$$

(Section 1.5.4)

6. Internal investment policy constraints are those that are imposed by the asset owner. The three main internal constraints are:
- Liquidity- the asset owner may have specific liquidity requirements that must be clearly acknowledged
  - Time horizon- the investment horizon of the asset owner can affect its liquidity needs. Also, investors with a short time investment horizon should take less risk, as there is not enough time to recover from a potential large drawdown
  - Sector and country limits- an asset owner may wish to impose constraints on allocations to specific countries or sectors.

External investment policy constraints are driven by factors that are not directly under the control of the asset owner. The two main external constraints are:

- Tax status- most institutional investors are tax exempt, and for that reason allocations to tax-exempt investment vehicles are not as attractive to institutional investors as they are for taxable investors
- Regulations- some institutional investors are subject to rules and regulations regarding their investment strategies.

(Section 1.6)

7. Using Equation 1.9, the degree of risk aversion ( $\lambda$ ) can be obtained as follows:

$$\lambda = \frac{E[R_p] - R_f}{\sigma^2} \quad (1.9)$$

$$\lambda = \frac{E[R_p] - R_f}{\sigma^2} = \frac{0.06}{0.02} = 3$$

(Section 1.5.8)

8. The solution is found using Equation 1.19:

$$w = \frac{1}{\lambda} \times \frac{E[R - R_0]}{\sigma^2} \quad (1.19)$$

$$w = \frac{1}{8} \times \frac{0.07 - 0.02}{0.10^2} = 62.5\%$$

$$w_0 = 1 - 62.5\% = 37.5\%$$

That is, the optimal investment in the risky asset for this investor is 62.5%. The remaining 37.5% will be invested in the riskless asset.

(Section 1.8.2)

9. According to Equation 1.21, the hurdle rate for a new asset that has a beta of 1.2 with respect to the optimal portfolio would be:

$$E[R_{New}] - R_f > (E[R_p] - R_f) \times \beta_{New} \quad (1.21)$$

$$E[R_{New}] - 3\% > (12\% - 3\%) \times 1.2, \quad E[R_{New}] > 13.8\%$$

If the new asset has a beta of -0.5:

$$E[R_{New}] - 3\% > (12\% - 3\%) \times (-0.5), \quad E[R_{New}] > -1.5\%$$

In this case, the negative beta of the new asset implies that it can hedge some of the portfolio's risk, even if the new asset is expected to lose some money (i.e., less than 1.5%). Therefore, its addition to the optimal portfolio could still improve its risk return properties.

(Section 1.8.5)

10. The expected return on all asset classes can be expressed as the sum of three components (Equation 1.11):

Asset class return = Short-term real riskless rate + Expected inflation + Risk premium

(Section 1.7.2)

## Chapter 2: Tactical Asset Allocation, Mean-Variance Extensions, Risk Budgeting, Risk Parity, and Factor Investing

### Exercises

1. Suppose active manager A has the skill to select stocks from a universe of 150 securities and generate an information ratio ( $IR$ ) of 1.4. Active manager B can generate the same information ratio (1.4) using 20 asset classes. What are the managers' information coefficients?
2. Consider two similarly skilled active managers, each with an information coefficient ( $IC$ ) of 0.40. Active manager X can apply his skills to only 15 asset classes, whereas active manager Y can apply her skills to 150 securities. What level of transfer coefficient ( $TC$ ) does each manager need to have in order to generate an information ratio ( $IR$ ) of 1.1?
3. Suppose that in the previous exercise there is a third active manager, Z, having the same information coefficient as managers X and Y. Manager Z can apply his skills to only 8 asset classes. What level of transfer coefficient does he need to have in order to generate the same information ratio as managers X and Y? Interpret the result obtained.
4. Suppose that a manager experienced a drawdown of 30%, and has been replaced by a new manager. Assuming a 15% performance fee, how much will the new manager have to earn for the investor to break even?
5. Suppose the beta of a diversified portfolio against the S&P 500 Index is 1.1. The portfolio manager wants to lower the beta to 0.8 because of perceived worsening economic conditions. If the market value of the portfolio is \$200 million, what notional position does the portfolio manager need to take in the S&P 500 futures market with a beta of 1 in order to achieve a beta of 0.8? What position would have increased the beta to 1.3?
6. A portfolio manager has assigned a liquidity level ( $L$ ) of 0.6 to the hedge fund asset class. The expected annual mean return on this asset class is estimated to be 14%. The asset owner is an endowment and the portfolio manager has set the investor's preference for liquidity ( $\phi$ ) equal to 0.12. What is the adjustment to the mean return of the hedge fund asset class?
7. Continuing with the previous exercise, suppose that the manager of a family office portfolio is considering the same asset class and assigns a liquidity level of 0.6 as well. However, the manager has set  $\phi = 0.15$ . What is the adjustment to the mean return of the hedge fund asset class?
8. Consider the following information regarding a portfolio consisting of three assets (mean expected returns, standard deviations, portfolio weights, and correlation coefficients

between each asset and a portfolio that is invested as follows: 40% in Asset 1, 40% in Asset 2, and 20% in Asset 3):

	Mean	Standard Deviation	Weights	Correlation with Portfolio
<b>Asset 1</b>	5.21%	6.93%	40%	0.8623
<b>Asset 2</b>	4.00%	3.87%	40%	0.7511
<b>Asset 3</b>	4.86%	11.09%	20%	0.2938

Calculate the contribution of each asset to the standard deviation of the portfolio.

- Suppose that the correlation between changes in the credit spread and the return on a certain portfolio is 0.25. The standard deviation of changes in the credit spread is estimated to be 23%, and the factor loading of the portfolio on the credit spread is 0.587. If the total risk of the portfolio is 9.94%, what is the risk contribution of the credit spread to the total risk of the portfolio?
- What is the difference between a risk parity portfolio and a minimum volatility portfolio?
- Consider the following two hypothetical risk parity and minimum volatility portfolios:

Two Hypothetical Portfolios	Expected Return	Standard Deviation	Sharpe Ratio
Risk Parity Portfolio	6%	8%	0.63
Minimum Volatility Portfolio	10%	15%	0.60
Riskless Rate	1%		

Suppose that an investor thinks that the expected return of the risk parity portfolio is too low and is considering enhancing the risk-adjusted return of this portfolio using 50% leverage. What would be the expected return and volatility of the levered risk parity portfolio?

## Solutions

- Using Equation 2.1:

$$IR = IC \times \sqrt{BR} \quad (2.1)$$

where  $IR$  is the information ratio,  $IC$  is the information coefficient of the manager, and  $BR$  is the strategy's breadth.

First, notice that an information ratio ( $IR$ ) of 1.4 means that the expected alpha of each manager's portfolio is 40% higher than the volatility of the alpha.

Active manager A has an information coefficient of 0.114 (rounded):

$$1.4 = IC \times \sqrt{150}, \quad IC = 0.114$$

Active manager B has an information coefficient of 0.313 (rounded):

$$1.4 = IC \times \sqrt{20}, \quad IC = 0.313$$

Active manager B has to be about 2.75 times more skillful using active management among asset classes than active manager A, who is using security selection to achieve the same *IR*.

(Section 2.1.1)

2. Using Equation 2.2:

$$IR = IC \times \sqrt{BR} \times TC \quad (2.2)$$

Active Manager X (rounded):

$$1.1 = 0.40 \times \sqrt{15} \times TC, \quad TC = 0.710$$

Active Manager Y (rounded):

$$1.1 = 0.40 \times \sqrt{150} \times TC, \quad TC = 0.225$$

The transfer coefficient measures the ability of the manager to implement her recommendations. In this exercise, by having greater breadth, active manager Y can achieve an *IR* of 1.1 with a *TC* of only 0.225.

(Section 2.1.2)

3. From the previous exercise, we know that the information coefficient (*IC*) of managers X and Y is 0.4, and the information ratio (*IR*) of both managers is 1.1.

Once again, using Equation 2.2:

$$IR = IC \times \sqrt{BR} \times TC \quad (2.2)$$

We find that the transfer coefficient (*TC*) of active manager Z is (rounded):

$$1.1 = 0.40 \times \sqrt{8} \times TC, \quad TC = 0.972$$

The transfer coefficient of active manager Z is close to the upper limit for *TC*, which is one. Therefore, manager Z must be able to implement almost all of his recommendations in

a very efficient manner. In order to do so, manager Z must not subject to either hard constraints (such as no short selling of funds), or soft constraints (such as the high transaction costs usually associated with the rebalancing of alternative assets). As more constraints are applied and inefficiencies come in to the manager's process, the value of  $TC$  declines to levels well below one.

(Section 2.1.2)

4. First, the next 42.86% return [i.e.,  $(1/0.7)-1$ ] generated by the new manager will be passed on to investors gross of performance fees. Assuming a 15% performance fee, the new manager will have to thus earn 50.42% [i.e.,  $0.4286/(1-0.15) = 0.5042$ ] for the investor just to break even.

(Section 2.1.3)

5. Inserting the known values into Equation 2.3:

$$\beta_{New} = \beta_{Port} + \frac{F}{P} \beta_{Futures} \quad (2.3)$$

$$0.8 = 1.1 + \frac{F}{200} \times 1, \quad F = -60$$

The manager has to establish a \$60 million short position in S&P 500 futures contracts to lower the beta to 0.8 from 1.1.

If the manager had decided to increase the equity exposure to 1.3, the futures position would have been:

$$1.3 = 1.1 + \frac{F}{200} \times 1, \quad F = 40$$

That is, the manager has to take long positions in \$40 million worth of S&P 500 futures contracts to increase the beta to 1.3 from 1.1.

(Section 2.1.4)

6. From Equations 2.4 and 2.5 we know that the adjustment to the mean return of the hedge fund asset class by the endowment is:

$$\bar{R} - \phi L_i = 0.14 - 0.12 \times 0.6 = 6.8\%$$

(Section 2.2.1)

7. First, notice that liquidity is more important to this family office compared to the endowment. The adjustment to the mean return of the hedge fund asset class by the family office is:

$$\bar{R} - \phi L_i = 0.14 - 0.15 \times 0.6 = 5.0\%$$

(Section 2.2.1)

8. Using Equation 2.12 (results were rounded):

$$\frac{\partial \sigma_P}{\partial w_i} \times w_i = \frac{\sigma_{iP}}{\sigma_P} \times w_i = \rho_i \times \sigma_i \times w_i \quad (2.12)$$

$$\text{Contribution of Asset 1} = 0.8623 \times 0.0693 \times 40\% = 2.39\%$$

$$\text{Contribution of Asset 2} = 0.7511 \times 0.0387 \times 40\% = 1.16\%$$

$$\text{Contribution of Asset 3} = 0.2938 \times 0.1109 \times 20\% = 0.65\%$$

(Section 2.3.3)

9. First, recall that the factor loading of the portfolio on credit spreads is the coefficient of credit spread in Equation 2.13:

$$R_{Pt} = a + b_1 F_{1t} + b_2 F_{2t} + \varepsilon_t$$

The risk contribution of credit spread to the total risk of the portfolio is calculated as follows:

$$\text{Contribution of credit spread (rounded)} = 0.25 \times 0.23 \times 0.587 = 3.38\%$$

Therefore, 3.38% of the total risk of 9.94% (i.e., around a third) of the portfolio can be explained by the volatility in the credit spread.

(Section 2.3.4)

10. The risk-parity approach proposes that the portfolio allocation to each asset class should be set so that each asset class has the same marginal contribution to the total risk of the portfolio. By doing so, the risk parity portfolio recommends an equalization of the risk contributions of each asset class in the portfolio.

In turn, the minimum volatility portfolio is constructed using mean-variance optimization, with the goal of assigning positive weights to create a portfolio with minimum standard deviation (when used as a measure of total risk), regardless of mean returns.

(Section 2.4)

11. The expected return of the levered risk parity portfolio is:

8.5% (i.e.,  $1.5 \times 6\% - 0.5 \times 1\%$ ),

and the volatility of the levered risk parity portfolio is:

12% (i.e.,  $1.5 \times 8$ ).

(Section 2.4.3)

## Chapter 3: The Endowment Model

### Exercises

1. List the six advantages that may explain the excellent returns earned by large endowments in recent years.

#### Problems 2 to 4

XYZ is a hypothetical Foundation that ended 2013 with assets that amounted to \$124 million. In 2014, the foundation received gifts for a total of \$6 million, and spent \$7 million. For simplicity, assume that gifts and expenditures occurred at the end of the year. The U.S. inflation rate was 0.76% in 2014 (based on the CPI, from December to December). The foundation's assets grew to \$131 million at the end of 2014.

2. What was the nominal rate of return on the foundation's assets?
3. What was the real rate of return on the foundation's assets?
4. Suppose that in 2015 the foundation received gifts for \$3 million and had a spending rate of 5% of the prior year's closing level of the foundation's assets. For simplicity, assume that gifts and expenditures occurred at the end of the year. The foundation's assets close at \$118 million at the end of 2015. The U.S. inflation rate in 2015 was 0.73% (based on the CPI, from December to December). What was the real rate of return on the foundation's assets in 2015?

#### Problems 5 to 9

123 is a relatively large U.S. endowment that is considering allocating funds to alternative investments. To this end, 123 hired a consultant who has just made a preliminary presentation in which she discusses whether each of the following five factors can explain the returns earned by large endowments in recent years: the degree of aggressiveness of asset allocation, the effectiveness or ineffectiveness of investment manager research, whether there exists a first mover advantage, the potential impact of having access to a network of talented alumni, and the effects of a specific type of risk.

5. At the beginning of the presentation, the consultant comments that “...*In the case of traditional investments, security selection and market timing of pension plans explained a very large percentage of the variance in pension fund returns. The remaining portion of fund returns can be explained by strategic asset allocation.*” Is this comment by the consultant correct? Explain.
6. Later, the consultant asserts that “...*The value added by active managers in alternative investments can be quite substantial.*” Is this assertion by the consultant empirically sound? Explain.

7. An analyst working at 123 is concerned about the returns that 123 might obtain if they decide to invest in top managers in alternative assets and asks the consultant about the empirical evidence on this issue, considering that 123 is new to the world of alternative investments. The consultant replies that “...*Empirical evidence shows that newer investors pursuing access to top managers (in alternative investments), especially in venture capital, are expected to underperform when the top managers allow commitments only from those investors who participated in their earlier funds.*” Is the consultant’s reply correct?
8. The consultant explains that “...*Empirical evidence suggests that hedge fund managers who attended undergraduate colleges with higher average SAT scores recorded higher performance.*” Is this statement correct? Explain.
9. Towards the end of the presentation, the consultant asserts that “...*As the longest-term investors charged with protecting the real value of endowment principal for future generations of students, universities are seeking to earn a premium by investing in privately held vehicles with the idea that their perpetual nature allows them to easily handle this specific type of risk.*” What type of risk is the consultant most likely to be referring to?
10. Consider the following two put options contracts: the first is 15% out-of-the-money and the second is 25% out-of-the-money. How could a bear put spread be created?

Problems 11 to 14

ABC is a U.S. endowment that previously has invested only a marginal portion of its portfolio in alternative investments. ABC is considering allocating more funds to alternative investments, including hedge funds, but is afraid of the negative effects that the illiquidity of some of these alternative assets may have on the riskiness of its portfolio. To this end, ABC hires a consultant to determine, among other issues, the effects of lockup periods on returns, the costs of liquidity risk during periods of market stress, how to manage liquidity risks, the potential effects of gates on investors, as well as the effects that the smoothing of data reported by a number of alternative assets may have on allocations to these investments. The consultant has just submitted a report to ABC addressing these questions.

11. The consultant comments that “...*Everything else being the same, evidence suggests that funds with long lockup periods normally provide a higher rate of return to investors.*” Is this comment by the consultant correct? Explain.
12. The consultant states that “...*When a small fraction of a fund's investors redeem their shares during periods of market turmoil, the cost of liquidity risk remains essentially the same for all investors, even in the case in which the underlying assets of the fund are less liquid than the liquidity provisions it offers to its investors.*” Is this statement by the consultant empirically sound? Explain.

13. Towards the end of the report, the consultant cautions that, during times of market turmoil “...*Endowments that invest in leveraged hedge funds must be prepared for the potentially large drawdowns in these strategies, as well as the potential for the erection of gates.*” Is this advice by the consultant correct?
14. At the end of the report, the consultant expresses that “... *To the extent that certain alternative investments have smoothed returns or net asset values that are reported with a time lag, liquid alternatives and traditional assets will decline in allocation rapidly during times of crisis.*” What is the underlying principle of this analysis?
15. Endowment ABC was founded in December 31<sup>st</sup>, 2011. At that time, assets totaled €100 million. Between 2012 and 2015 the endowment received annual gifts and made annual expenditures in the amounts depicted in the following table (amounts in millions):

Endowment ABC	2012	2013	2014	2015
<b>Beginning assets</b>	€ 100	€ 112	€ 115	€ 122
<b>Income from gifts</b>	€ 6	€ 5	€ 7	€ 6
<b>Expenditures</b>	-€ 8	-€ 9	-€ 10	-€ 9
<b>Ending assets</b>	€ 112	€ 115	€ 122	€ 108

To simplify, assume that gifts and expenditures occurred at the beginning of each year. What were the annual rates of return earned by the endowment in each year?

## Solutions

1. The six advantages that may explain the exceptional returns earned by large endowments in recent years are:
  1. Aggressive asset allocation
  2. Effective research by the investment manager
  3. First-mover advantage
  4. Access to a network of talented alumni
  5. Acceptance of liquidity risk
  6. Sophisticated investment staff and board oversight

(Section 3.4)

2. From Section 3.2 we know that:

Change in foundation value = Income from gifts – Spending + Net investment returns

Therefore, we have (amounts in U.S. \$ millions):

$$(\$131 - \$124) = \$6 - \$7 + \text{Net Investment Returns (\$ Nominal)}$$

⇒ Net Investment Returns (\$ Nominal) = \$8 million

⇒ Net Investment Returns (% Nominal) = \$8 million / \$124 = 6.45% (rounded)

(Section 3.2)

3. Real Net Investment Returns are:

$$(1 + R_{real}) = \frac{(1 + R_{Nominal})}{(1 + Inflation\ rate)}, \quad R_{real} = \frac{(1 + 0.0645)}{(1 + 0.0076)} - 1 = 5.65\% \text{ (rounded)}$$

(Section 3.2)

4. A spending rate of 5% implies that \$6.55 million (i.e., 5% of \$131 million) were spent in 2015.

As explained in exercise 2:

Change in foundation value = Income from gifts – Spending + Net investment returns

Therefore, we have that (amounts in U.S.\$ millions):

$$(\$118 - \$131) = \$3 - \$6.55 + \text{Net Investment Returns (\$ Nominal)}$$

⇒ Net Investment Returns (\$ Nominal) = -\$9.45 million

⇒ Net Investment Returns (% Nominal) = -\$9.45 million / \$131 = -7.21% (rounded)

$$\begin{aligned} \Rightarrow \text{Net Investment Returns (\% Real)} &= (1 + R_{real}) = \frac{(1 + R_{Nominal})}{(1 + Inflation\ rate)} = R_{real} = \\ &= \frac{(1 - 0.0721)}{(1 + 0.0073)} - 1 = -7.88\% \text{ (rounded)} \end{aligned}$$

It can be seen that the foundation experienced heavy asset losses in 2015, mainly because of the negative investment returns received, but also because expenditures were above income from gifts.

(Section 3.2)

5. This comment by the consultant is incorrect. In the case of traditional investments, studies indicate that the strategic asset allocation of pension plans accounted for more than 90% of the variance in fund returns. The remaining portion of fund returns, which is below 10%, is explained by security selection and market timing.

(Section 3.4.1)

6. This assessment is consistent with empirical evidence. Managers working in inefficient markets have a greater opportunity to profit from information, skill, and access to deal flow. Inefficient markets are inherent to many alternative asset classes.

(Section 3.4.2)

7. The consultant's reply is correct.

(Section 3.4.3)

8. This statement is correct. Research shows that hedge fund managers who attended universities with higher average SAT scores earned higher returns with lower risk than the median fund managers.

(Section 3.4.4)

9. Liquidity risk.

(Section 3.4.5)

10. The investor could create a put bear spread by selling the put option that is 25% out-of-the-money (i.e., the contract that is farther out-of-the-money), and buying the put option that is 15% out-of-the-money.

(Section 3.5.4)

11. The consultant's comment is correct. A long lockup period helps managers to decrease the cost of liquidity risk. For instance, during the recent financial crisis, funds with long lockup periods had the advantage of not being under pressure to sell their assets at fire sale prices.

(Section 3.5.2)

12. This statement is not empirically sound. According to evidence presented in the book, when the underlying assets of a fund are less liquid than the liquidity provisions it offers to its investors, then the cost of liquidity risk increases for all investors, even if only a small fraction of the fund's investors decide to redeem their shares during periods of market turmoil.

(Section 3.5.2)

13. This advice by the consultant is correct and consistent with events that occurred during the recent financial crisis.

(Section 3.5.2)

14. In the case of relatively illiquid investments (e.g., certain alternative investments such as private equity and hedge funds), the net asset value adjusts slowly to changes in public market valuation. As a result, in periods of crisis, prices of liquid assets decline rapidly and investors may react by only rebalancing within the liquid assets, while slowly changing allocations to relatively illiquid alternative investments (by modifying the size of future commitments).

(Section 3.5.3)

15. The annual rates of return earned by the endowment in each year are calculated at the end of the following table (some rounding):

<b>Beginning assets</b>	€ 100	€ 112	€ 115	€ 122
<b>Income from gifts</b>	€ 6	€ 5	€ 7	€ 6
<b>Expenditures</b>	-€ 8	-€ 9	-€ 10	-€ 9
<b>Amount invested</b>	€ 98	€ 108	€ 112	€ 119
<b>Ending assets</b>	€ 112	€ 115	€ 122	€ 108
<b>Rate of return per year</b>	14.29%	6.48%	8.93%	-9.24%

First, we need to compute the amount of assets invested each year, which is equal to beginning assets plus annual gifts minus annual expenditures. Gifts and expenditures were assumed to occur at the beginning of the year. For example, in 2012 the amount of assets invested was  $€100 + €6 - €8 = €98$ . Given that the ending assets for that year totaled €112, the rate of return earned by the manager of the endowment in 2012 was 14.29% [i.e.,  $(€112 - €98) / €98 \times 100$ ]. The same procedure was used to calculate the rates of return for the other three years.

(Section 3.2)

## Chapter 4: Pension Fund Portfolio Management

### Exercises

#### Problems 1 to 4

Julia Sullivan, John Ng, and Paola Ruggeri retired in 2016 after each having worked for 40 years. Each one of them started with an income of \$20,000 in 1976 and received average annual salary increases of 3.5% until they had retired.

Julia worked 40 years at the same firm, which provided a benefit of 1.5% of the average of the final five years of salary multiplied by the number of years of service. John worked for two employers, each for 20 years. Each employer provided a benefit of 1.5% of the average of the final five years of salary multiplied by the number of years of service. Finally, Paola worked for 40 years at the same firm, but was under a defined contribution plan where she invested 5% of her salary and earned employer contributions in a similar amount. The plan provided average investment returns of 7% per year during the 40-year period.

1. Calculate the annual benefit to be received by Julia.
2. Calculate the annual benefit to be received by John.
3. Compare and comment on the annual benefits to be received by Julia and John.
4. Calculate the total amount accumulated by Paola.
5. As discussed in the book, The Citigroup Pension Liability Index tracks corporate bond yields that can be used to discount future values of the projected benefit obligation (PBO). At December 31<sup>st</sup>, 2009, the discount rate was 5.98%, while the duration of PBO benefits was estimated at 16.2 years. By June 30<sup>th</sup>, 2016, the discount rate had fallen to 3.61%. Calculate the percentage increase in the PBO, assuming that duration and future benefits assumptions remain unchanged.
6. Consider a retiree earning a pension of \$3,000 per month and having an 80% cost of living adjustment (COLA). Calculate the retiree's pension after six years if inflation rates averaged 3.5% per year during the first three years, and 2.5% during the last three years.
7. Suppose that the market value of the retirement fund of an individual is £1,200,000. The annual net of fees nominal rate of return on the fund is estimated to be 6%, the inflation rate is projected to be 2% per year, and the retiree wants to withdraw £100,000 in the first year, and an amount each year thereafter that will grow at the rate of inflation. What is the expected economic life of the fund?

8. A pension plan offers a choice of a fixed €150,000 initial annual benefit or a €50,000 initial annual benefit that will grow by 2% per year. Using a market interest rate of 4%, calculate the present value of both choices based on a life expectancy of 15 years (based on annual compounding).
9. Suppose the case of an employer that offers a retirement benefit of 2% of salary for each year the employee worked before retirement. If the final salary to which the benefits apply is \$75,000, and the employee has worked for 35 years, calculate the retirement income-replacement ratio.
10. Suppose the case of a retiree earning a pension of \$2,500 per month. Calculate the retiree's pension in seven years if inflation rates are 5% per year and the cost of living adjustment (COLA) is 80%.

Problems 11 to 15

Lisa Larsson and Karl Lehman worked for 40 years at XYZ. Mike Mancini worked for 20 years at ABC and for the following twenty years at XYZ. Both XYZ and ABC provide their employees with a benefit of 1.5% of the average of the final four years of salary multiplied by the number of years of service.

Lisa started with an income of \$18,000 in 1972 and retired in 2011 with an income of \$65,000. Her final four years of salary were \$65,000 (2011), \$63,050 (2010), \$61,789 (2009), and \$59,940 (2008).

Mike also started with an income of \$18,000 in 1972 and also retired in 2011 with the same income as Lisa (\$65,000). Mike worked for ABC from 1972 to 1991, with an average annual salary in the final four years of \$32,041. His final four years of salary at XYZ, his second employer (1992-2011), were the same as those of Lisa.

Finally, and paralleling the case of Lisa, Karl Lehman also worked at XYZ for forty years, also started with a salary of \$18,000 in 1972 and also retired when he was earning a salary of \$65,000 in 2011, enjoying the same average annual salary increases as Lisa. However, Karl had a Defined Contribution (DC) plan in which 5% of his salary was invested and earned employer contributions in a similar amount (i.e., annual contributions were for 10% of his salary). Investment returns in the DC plan averaged 7% per year.

11. Calculate the average annual salary increase received by Lisa and Mike.
12. Calculate the annual benefit received by Lisa.
13. Calculate the annual benefit received by Mike and compare it to the annual benefit received by Lisa.
14. Calculate the amount that Karl would have accumulated on his DC plan at retirement.

15. Determine the amount accumulated by Karl in his DC plan that corresponds to contributions by Karl and XYZ, and the amount that corresponds to investment earnings.

### Solutions

Assuming that the each employee receives his/her salary at the end of 1<sup>st</sup> year, the future values will be as follows. Please note that since the first salary is earned at the end of 1<sup>st</sup> year, the salary earned at the end of year 40 will be  $76507 = 20000 \times (1 + 0.035)^{39}$ . That is, the salary will have 39 growth periods.

1. Julia worked her entire career with one employer. Her final five-year salaries should have been (rounded):

$$2016 : 76507 = 20000 \times (1 + 0.035)^{39}$$

$$2015 : 73920 = 20000 \times (1 + 0.035)^{38}$$

$$2014 : 71421 = 20000 \times (1 + 0.035)^{37}$$

$$2013 : 69005 = 20000 \times (1 + 0.035)^{36}$$

$$2012 : 66672 = 20000 \times (1 + 0.035)^{35}$$

This results in a final five-year salary average of \$71,505 (rounded). Therefore, Julia's annual benefit would be \$42,903 ( $1.5\% \times 40 \text{ years} \times \text{the final five-year salary average of } \$71,505$ ).

(Section 4.3.1)

2. John worked at the first employer from 1976 to 1996, with an average annual salary in the final five years of:

$$1996: 38450 = 20000 \times (1 + 0.035)^{19}$$

$$1995: 37150 = 20000 \times (1 + 0.035)^{18}$$

$$1994: 35894 = 20000 \times (1 + 0.035)^{17}$$

$$1993: 34680 = 20000 \times (1 + 0.035)^{16}$$

$$1992: 33507 = 20000 \times (1 + 0.035)^{15}$$

This results in a final five-year salary average of \$35,936. The annual benefits of \$10,781 ( $1.5\% \times 20 \text{ years} \times \$35,936$ ) are determined in 1996, but not paid until retirement in 2016. The second employer pays annual benefits in the amount of \$21,452 ( $1.5\% \times 20 \text{ years} \times \$71,505$ ). The final five-year salary average of \$71,505 was calculated in the previous exercise. Therefore, John earns an annual pension of \$32,232 (\$10,781 plus \$21,452).

(Section 4.3.1)

3. It can be seen that the benefits are quite different between Julia and John. This is because defined benefit plans reward workers who spend their entire career with a single employer and punish workers who experience job mobility. Compared to the annual benefit of \$42,903 received by Julia after working the entire career for a single employer, John earns an annual pension of only \$32,232 (\$10,781 plus \$21,452), which is \$10,671 per year less than if he had worked for a single firm.

(Section 4.3.1)

4. Paola would have accumulated \$629,439.89 at retirement. This is calculated as the future value of a growing annuity (the future value of the amount calculated using equation 4.5), in which the first payment is equal to \$2,000 [i.e., her initial annual salary of \$20,000 multiplied by the defined contribution of 10%, 5% from her and 5% from her employer]. The growing annuity has a return ( $r$ ) of 7% (which represents the average investment returns earned by the plan during the 40 year period,  $t = 40$ ), and grows ( $g$ ) at a 3.5% rate per year, which are the average annual salary increases.

$$PV_{\text{Growing Annuity}} = \frac{\text{Initial Payment}}{r - g} \times \left[ 1 - \left( \frac{1 + g}{1 + r} \right)^t \right] \quad (4.5)$$

$$PV_{\text{Growing Annuity}} = \frac{\$2,000}{0.07 - 0.035} \times \left[ 1 - \left( \frac{1.035}{1.07} \right)^{40} \right] = \$42,034.24$$

$$FV_{\text{Growing annuity}} = PV_{\text{Growing Annuity}} \times (1 + r)^t$$

$$FV_{\text{Growing annuity}} = \$42,034.24 \times (1.07)^{40} = \$629,439.89$$

Note that we could have also used the formula for the future value of a growing annuity (as we will do in exercise 14):

$$FVGA = C \left[ \frac{(1 + r)^t - (1 + g)^t}{r - g} \right] = \$2,000 \left[ \frac{(1.07)^{40} - (1.035)^{40}}{0.07 - 0.035} \right] = \$629,439.89$$

(Section 4.5.3)

5. The pension plan's PBO, which is the present value of the amount of benefits assumed to be paid to all future retirees of the firm, can be compared to a short position in corporate bonds, which will change in value as described in equation 4.2 (approximate amounts):

$$\% \text{Change in Liabilities} = -\text{Modified Duration} \times \text{Change in Yield} \quad (4.2)$$

Over the six and a half year period between December 2009 and June 2016, the 2.37% decline in corporate bond yields (i.e., from 5.98% to 3.61%) has led to an increase of 38.89% in the PBO, assuming that duration and future benefits assumptions remain unchanged.

$$38.39\% = -16.2 \times (-2.37)$$

(Section 4.3.3)

6. The retiree's pension will have risen by 2.8% per year (i.e., 80% x 3.5%) during the first three years, and by 2% per year (i.e., 80% x 2.5%) during the last three years. Therefore, the retiree's pension will have risen to \$3,458.61 [i.e., \$3,000 x (1.028)<sup>3</sup> x (1.02)<sup>3</sup>] per month after six years.

(Section 4.3.5)

7. First, the annual net of fees *real* rate of return on the fund is estimated to be 4% (i.e., 6% - 2%).

Using Equation 4.3, the expected economic life of the fund is:

$$EL = -\frac{1}{\ln(1 + R)} \times \ln \left( \frac{\text{Payment} - R \times \text{Assets}}{\text{Payment}} \right) \quad (4.3)$$

$$EL = -\frac{1}{\ln(1 + 0.04)} \times \ln \left( \frac{\text{£}100,000 - 0.04 \times \text{£}1,200,000}{\text{£}100,000} \right) = 16.67 \text{ Years}$$

The fund is expected to last 16.67 years (rounded).

(Section 4.6.3)

8. Both choices can be valued using Equation 4.5 by using a zero growth rate for the fixed payment choice and 2% for the growth choice (as well as the different initial payments).

The fixed annuity has a higher present value.

$$PV_{\text{Growing Annuity}} = \frac{\text{Initial Payment}}{r - g} \times \left[ 1 - \left( \frac{1+g}{1+r} \right)^t \right]$$

$$PV_{\text{Fixed Annuity}} = \frac{\text{€150,000}}{0.04} \times \left[ 1 - \left( \frac{1}{1+0.04} \right)^{15} \right] = \text{€1,667,758}$$

$$PV_{\text{Growing Annuity}} = \frac{\text{€50,000}}{0.04 - 0.02} \times \left[ 1 - \left( \frac{1+0.02}{1+0.04} \right)^{15} \right] = \text{€631,717}$$

(Section 4.6.5)

9. In this problem, the retiree will be paid retirement benefits in the amount of \$52,500 per year (i.e., 2% × 35 years × \$75,000) for the rest of his life. This provides the worker with a retirement income-replacement ratio of 70% (i.e., \$52,500/\$75,000). This is the pension benefit as a portion of the final salary.

(Section 4.1)

10. The retiree will have a cost of living adjustment of 4% (i.e., 80% × 5%) per year. Therefore, the retiree's pension in seven years will be: \$2,500 × (1.04)<sup>7</sup> = \$3,289.83 per month.

(Section 4.3.5)

11. In both cases, the average annual salary increase was 3.26% (i.e., in a financial calculator:  $n = 40$ ,  $PV = -18,000$ ,  $PMT = 0$ ,  $FV = 65,000$ , and solve for  $i$  or  $r$ ).

(Section 4.3.1)

12. For Lisa, the average annual salary for the final four years was \$62,444.75 [i.e., (\$65,000 + \$63,050 + \$61,789 + \$59,940)/4].

The annual benefit received by Lisa would be \$37,466.85 (i.e., 1.5% × 40 years × \$62,444.75).

(Section 4.3.1)

13. The annual benefit received by Mike at ABC would be of \$9,612.30 (i.e.,  $1.5\% \times 20$  years  $\times$  \$32,041). This annual benefit is determined in 1991, but not paid until retirement in 2011. The second employer, XYZ, pays annual benefits in the amount of \$18,733.43 (i.e.,  $1.5\% \times 20$  years  $\times$  \$62,444.75). The final four-year average salary of \$62,444.75 was calculated in the previous exercise.

Compared to the annual benefit of \$37,466.85 received by Lisa after working her entire career for XYZ, Mike only earns an annual pension of \$28,345.73 (i.e., \$9,612.30 + \$18,733.43), which is \$9,121.12 per year less than Lisa (who worked her entire career for a single firm, XYZ).

(Section 4.3.1)

14. We already calculated in Problem 11 that the average annual salary increase enjoyed by Lisa was 3.26%. This is the same percentage salary increase received by Karl.

Karl would have accumulated \$547,041.46 at retirement. This value is found using the formula for the future value of a growing annuity (*FVGA*), which is:

$$FVGA = C \left[ \frac{(1+r)^t - (1+g)^t}{r-g} \right]$$

Where:

*C* is Karl's first annual contribution (i.e., 1971), which is equal to  $\$18,000 \times 10\% = \$1,800$

*r* is the average annual returns in the DC plan, which in this case is 7%

*g* is the average annual salary increase, which in the case of Karl is 3.26%

*t* is the total number of years that Karl and XYZ contributed to the DC plan, which in this case is 40 years.

Therefore,

$$FVGA = \$1,800 \left[ \frac{(1+0.07)^{40} - (1+0.0326)^{40}}{0.07 - 0.0326} \right] = \$547,041.46$$

(Section 4.5.3)

15. The contributions by Karl and XYZ totaled \$144,008.39 (i.e., in a financial calculator:  $n = 40$ ,  $r = 3.26$ ,  $PV = 0$ ,  $PMT = \$1,800$ , and solve for *FV*). Half of this (\$72,004.19) was contributed by Karl and the other half by XYZ. The amount that corresponds to investment earning is \$403,033.07 (i.e.,  $\$547,041.46 - \$144,008.39$ ).

(Section 4.5.3)

## Chapter 5: Sovereign Wealth Funds

### Exercises

1. Country XYZ experienced a \$20 billion drop in its reserve account and recorded a \$30 billion deficit in its current account. What was the capital account surplus or deficit of country XYZ?
2. Briefly, explain under which scenarios a country's currency is likely to depreciate as it pertains to:
  1. Inflation rate compared to its trading partners
  2. Real interest rates compared to its trading partners
  3. Policies that attract or discourage capital inflows
  4. Income growth versus trading partners

### Problems 3 to 6

ABC is a small country that derives 70% of its income from oil exports.

3. Explain the three concerns that this country should have regarding tax revenues.
4. Explain the four common motivations which may lead to the establishment of a sovereign wealth fund (SWF) by country ABC.
5. Suppose that oil companies working in country ABC have recently discovered vast amounts of new oil reserves. The government of country ABC is worried that this discovery will cause country ABC to suffer from a case of the "Dutch disease." Explain the meaning of the concept "Dutch disease" applied to the case of country ABC.
6. Country ABC is considering engaging in sterilization policies to counter the effects of the recent discovery of oil reserves. Explain the two types of sterilization policies that country ABC may implement.

### Solutions

1. Inserting the known values into Equation 5.1 and solving for the capital account surplus generates a value of \$10 billion, which indicates a capital account surplus of \$10 billion.

$$\Delta \text{ Reserve Account} = \Delta \text{ Current Account} + \Delta \text{ Capital Account} \quad (5.1)$$

(Section 5.1.1)

2. Like any other asset, currency prices are typically set by supply and demand. A country's currency is likely to depreciate when the country has:
  1. A higher inflation rate compared to its trading partners
  2. Lower real interest rates compared to its trading partners
  3. Policies that discourage capital inflows
  4. Higher income growth versus trading partners that increases the demand for imports

(Section 5.1.2)

3. First, the volatility of oil prices can create a volatile income stream for country ABC. This is a concern for the country because government spending is likely more stable than oil prices. Second, it is unclear how long these oil revenues will continue, as the oil reserves of the country will not last forever (i.e., there is a concern regarding depletion). Third, the government of country ABC would like to have a diversified economy, ideally earning tax revenues from other industries, rather than depending almost exclusively on oil revenues.

(Section 5.1.3)

4. The following are four common motivations which may lead to the establishment of a sovereign wealth fund (SWF) by country ABC:
  1. Protect the economy and fiscal budget of country ABC from a possible decline or volatility in income from oil;
  2. Assist the central bank to offset redundant liquidity;
  3. Build up the level of savings for future generations, especially considering that country ABC is mainly an oil exporting country, and thus the situation that caused the surplus is at a reasonable risk for depletion or reversal; and/or
  4. Invest the money saved in infrastructure or projects that promote economic growth today to strengthen a sector of the economy or grow a specific industry, and thus help diversify away from oil revenues.

(Section 5.3.1)

5. Dutch disease occurs when large currency inflows from oil exports harm the long-run strength of country ABC's other sources of economic growth (e.g., manufacturing sector). In particular, the discovery of vast amounts of new oil reserves will have two major impacts. First, it will increase local wages and cause a shift in workers from other sectors of the economy to the oil sector. Second, the value of the local currency will increase due to large inflows of cash, even if they have not yet occurred but are expected to take place. These two results reduce the competitiveness of country's ABC manufacturing sector, leading to its de-industrialization.

(Section 5.3.3)

6. There are two types of sterilization policies that country ABC may implement.

First, the central bank of country ABC may sell local currency and buy foreign currency to satisfy the higher demand for local currency by foreign importers of its products. This would lead to inflation as the money supply would be increasing. To sterilize the local economy from the impact of the intervention in the foreign currency markets, the central bank will need to sell bonds denominated in local currency to keep the money supply unchanged and inflation under control.

Second, the central bank of country ABC may accumulate a significant amount of foreign reserves if the oil revenues are earned by companies that are completely or partially controlled by the government. If the government were to spend the revenues in the local economy, this could cause major disruptions in the local economy, especially in the case of a small country such as ABC, which most likely has a small economy compared to the size of the inflows. In this case, the government may choose to invest much of the oil revenues outside of the country, for example, investing much of its sovereign assets in dollar or euro denominated securities of other countries in order to not disrupt the local economy and to prevent the appreciation of the local currency.

(Section 5.3.3)

## Chapter 6: The Family Office Model

### Exercises

1. In the U.S., are family offices allowed to operate under a “safe harbor” with the Securities and Exchange Commission (SEC)?
2. Aiko Yamaguchi is an entrepreneur who owns a substantial stake in a Japanese-based construction company. Explain the concepts of a completion portfolio and a concentrated portfolio applied to her case.
3. To a family office, what is the difference in taxation between cash dividends and capital distributions from a private equity fund?
4. Suppose that the portfolio of a family office generates \$200,000 of profit from short-term trading and is in an ordinary income tax bracket of 40%. Assume that the long-term capital gains tax rate is half the ordinary tax rate. Compare the after-tax profits if the gains were and were not from Section 1256 contracts.
5. Compare the liquidity profile of an ultra-high-net-worth individual (UHNWI) to that of a well-known university endowment.
6. Can a family office eliminate the potential conflicts of interest to which a wealthy family is subject to when it allocates capital to different financial advisers and managers? Explain

### Solutions

1. In the U.S., family offices were allowed to operate under a “safe harbor” with the SEC in the past. This safe harbor allowed family offices to accept up to 15 outside clients. However, with the 2010 passage of the Dodd-Frank Act by the U.S. government, this safe harbor was abolished from the U.S. securities laws. Therefore, if a family office accepts \$1 from a non-family member, it may be required to register with the SEC.

(Section 6.2.3)

2. A completion portfolio is a group of assets that is managed with the objective of diversifying and managing the aggregated risks of the concentrated portfolio (i.e., construction company stock in the case of Aiko), and the completion portfolio. The

assets purchased by Aiko for the completion portfolio should have a low correlation to the assets she holds in the construction company stock.

For example, she could invest in sovereign debt, or foreign stocks from sectors other than the construction sector. This should gradually lead to a more diversified portfolio, even when counting the construction company stock she holds.

(Section 6.3.2)

- Income taxes are a significant constraint for family offices. To a family office, there is a significant difference between cash dividends and capital distributions from a private equity fund. This is because, in most jurisdictions, cash dividends are considered ordinary income, and thus taxed at a higher tax rate than distributions from a private equity fund.

(Section 6.5)

- In non-Section 1256 securities, the lower tax rate on long-term capital gains is levied only on investment gains in which assets are held for longer than one year. The after-tax profits for non-Section 1256 contracts are:

$$\$200,000 \times (1 - \text{Tax Rate}) = \$200,000 \times (1 - 40\%) = \$120,000$$

Trading in securities in the U.S. that qualify for Section 1256 contracts can be used as a major advantage for high-net-worth investors because 60% of the gains are taxed favorably at the long-term capital gain tax rate.

For Section 1256 contracts, the after-tax profit can be derived by first computing the tax rate using Equation 6.1:

$$T_{1256 \text{ Contracts}} = (0.40 \times T_{\text{Ordinary}}) + (0.60 \times T_{\text{LTCG}}) \quad (6.1)$$

$$T_{1256 \text{ Contracts}} = (0.40 \times 0.40) + (0.60 \times 0.40/2) = 0.28$$

The after-tax gain using the blended rate (28%) raises the after-tax profits from \$120,000 to \$144,000 [i.e.,  $\$200,000 \times (1 - 28\%) = \$144,000$ ]

(Section 6.5.2)

- The liquidity profile of a UHNWI can be more aggressive than a well-known university endowment. This allows UHNWIs to gain the liquidity premium inherent to illiquid assets. University endowments are constrained by the sum of the university budget that they must backfill. On the other hand, UHNWIs are in an advantageous situation because they don't have a university budget to which they must commit resources each year. Therefore, family offices can assign more of their wealth to long-dated assets (compared to a university endowment).

(Section 6.9)

6. When a wealthy family allocates capital to different financial advisers and managers, it usually encourages competition among outside money managers and creates incentives that can be detrimental to the family. A family office removes these possible conflicts by producing structures where the interests of the total family, external money managers, and the family office, are aligned toward common objectives. For example, by combining the money of the family members, the family office can negotiate fee breaks and other beneficial conditions that a single family member may not be able to achieve. Finally, by taking more asset management in-house family offices mitigate external conflicts of interest and have a greater power to negotiate fees.

(Section 6.9)

## Chapter 7: Private Equity Market Structure

### Exercises

1. What is mezzanine financing?
2. How do buyout and venture capital compare in terms of sector focus and business model (i.e., anticipated proportion of winners versus losers)?
3. What are the main functions served by private equity funds?

### Problems 4 to 5

Consider the following two statements on private equity funds-of-funds:

4. *“Private equity funds-of-funds are often perceived as less efficient than direct fund investment because of the double layer of management fees.”* Is this a perception often held by market participants? Explain.
5. *“Studies have shown that because of their diversification, funds-of-funds perform similarly to individual funds, but with more pronounced extremes.”* Is this assertion correct? Explain.
6. *Alpha Partners*, a private equity buyout fund, was founded in 2005 by three co-workers who left a major private equity firm. Until a few years ago, *Alpha Partners* had earned stellar returns, sometimes 40% to 50% a year, and has become recognized as one of the top experts in the field. In spite of this, Mary Reinhart, a recently hired manager of the fund, is worried about the recent performance of *Alpha Partners* and argues that the fund should aim for a more diversified portfolio by also including venture capital investments. Ms. Reinhart contends that *“...Investors seeking long-term stable returns would be prone to increase their exposure to venture capital, while those looking for higher returns would do so overweighting buyout.”* Is Ms. Reinhart’s statement correct?

### Problems 7 to 9

Consider the following simple example in which limited partners contribute \$200 million in the first year to fund investments A and B, at \$100 million each, with an 80/20 carry split (see the following exhibit). There is no hurdle rate.

#### Year 1: Deal-by-deal

	Limited partners		General partner	Total
	Investment A	Investment B		
Original contributions	(\$100 million)	(\$100 million)		(\$200 million)
Acquisition of investments A and B				

Closing balance	(\$100 million)	(\$100 million)	(\$200 million)
-----------------	-----------------	-----------------	-----------------

- Investment A is sold at the end of the second year for \$160 million. Calculate the 80/20 carry split between limited partners and the general partner. Calculate the closing balance of limited partners and the general partner under the deal-by-deal approach.
- Investment B is sold at the end of the third year for \$70 million. Calculate the 80/20 carry split between limited partners and the general partner. Calculate the closing balance of limited partners and the general partner under the deal-by-deal approach. Calculate the total gain or loss for the fund.
- How much would the limited partners and the general partner receive under the fund as a whole approach?
- Suppose that one of a named key persons departs a team. What does the key-person provision allow limited partners to do?
- What is the rationale for the existence of the good-leaver termination clause?
- Assume a \$200 million contribution by the limited partners in the first year to fund an investment, a 6% hurdle rate, a 100% catch-up, an 80/20 carry split, and the sale of the investment by the fund in the second year for \$300 million. Fill in the following waterfall table.

Original contributions	Limited partners (\$200 million)	General partner	Total (\$200 million)
<i>Sale of investment for \$300 million one year later</i>			
Profit to be distributed			
Return of capital			
Preferred return for limited partners			
Catch-up for general partner			
80/20 split of residual amount			
Closing balance			

- In which situations is a clawback provision relevant?

## Solutions

- Mezzanine financing is capital offered through the issuance of subordinated debt. This form of financing is halfway between common equity and secured debt. Mezzanine financing typically include warrants or conversion rights to back the expansion or transition capital for established companies.

(Section 7.1)

2. Buyouts typically focus on established industry sectors, while venture capital concentrates on cutting-edge technology or rapidly growing sectors.

In terms of business model, buyouts are characterized by a high percentage of success with limited number of write-offs, while venture capital is differentiated by a few winners with many write-offs.

(Section 7.2)

3. Private equity funds primarily serve the following functions:

- Collecting investors' capital to be invested in private companies
- Screening, evaluating, and selecting potential companies possessing expected high-return opportunities
- Controlling, coaching, and monitoring portfolio companies
- Financing companies to develop new products and technologies, to make acquisitions, to promote their growth and development, or to allow for a buyout or a buy-in by experienced managers
- Sourcing exit opportunities for portfolio companies

(Section 7.3.2)

4. The answer is yes, this is often the perception of market participants. This additional layer of fees is supposed to be one of the main disadvantages of investing in private equity through funds-of-funds. This is because funds-of-funds would have to outperform direct fund investment to overcome this double layer of fees. However, investing through fund-of-funds might be more cost-efficient when one takes into consideration the resources needed to run a portfolio of private equity funds internally.

(Section 7.4.1)

5. The first part of the statement is correct, while the second part is not correct. The correct statement would be as follows: While it is true that studies have shown that funds-of-funds perform similarly to individual funds, it has also been documented that funds-of-funds performance exhibits *less* pronounced extremes (presumably due to their diversification).

(Section 7.4.2.1)

6. No, the statement is incorrect, because investors seeking long-term stable returns would be inclined to overweight *buyout*, while those seeking higher returns would do so through increased exposure to *venture capital*.

(Section 7.2)

## CAIA Level II Workbook, September 2019

7. The profits of \$60 million for Investment A are distributed to limited and general partners in line with the agreed-upon 80/20 split after the limited partners receive their return of capital.

### Year 2: Deal-by-deal

	Limited partners		General partner	Total
	Investment A	Investment B		
Opening balance	(\$100 million)	(\$100 million)	\$0 million	(\$200 million)
<i>Sale of investment A for \$160 million</i>				
Return of capital	\$100 million			\$100 million
80/20 split of residual amount	\$48 million		\$12 million	\$60 million
Closing balance	\$48 million	(\$100 million)	\$12 million	(\$40 million)

(Section 7.6.5)

8. In the third year, the split of Investment B is as shown in the top half of the following exhibit with all \$70 million going to the limited partners as return of capital. Under the deal-by-deal approach the limited partners would earn \$18 million (\$48 million - \$30 million) and the general partners would earn \$12 million for both projects combined.

### Year 3

	Limited partners		General partner	Total
	Investment A	Investment B		
Opening balance	\$48 million	(\$100 million)	\$12 million	(\$40 million)
<i>Sale of Investment B for \$70 million</i>				
Return of capital		\$70 million		\$70 million
80/20 split of residual amount				
Closing balance	\$48 million	(\$30 million)	\$12 million	\$30 million
Subtotal	\$18 million		\$12 million	\$30 million

(Section 7.6.5)

9. The fund as a whole had a gain of \$30 million (\$60 million - \$30 million). Under the fund-as-a whole approach, the general partner would receive \$6 million of carried interest (20%) and the limited partners would receive \$24 million (80%).

(Section 7.6.5)

10. In this case, the key-person provision allows limited partners to suspend investment/divestment activities until a replacement is found. If allowed by the terms of the limited partnership agreement, the limited partners may even terminate the fund if they decide to do so.

(Section 7.6.8)

11. The good-leaver termination clause offers a clear framework for closing a partnership that is not functioning well, or when the confidence of the limited partners is lost. This

without-cause clause allows limited partners to stop funding the partnership with a vote requiring a qualified majority (generally more than 75% of the limited partners).

(Section 7.6.9)

12. Answer:

	Limited partners	General partner	Total
Original contributions	(\$200 million)		(\$200 million)
<i>Sale of investment for \$300 million one year later</i>			
Return of capital	\$200 million		\$200 million
Profit to be distributed			\$100 million
6% Preferred return for limited partners	\$12 million		\$12 million
Catch-up for general partner		\$3 million	\$3 million
80/20 split of residual amount	\$68 million	\$17 million	\$85 million
Closing balance	\$80 million	\$20 million	\$100 million

Thus, limited partners receive \$280 million and general partners receive \$20 million.

(Section 7.6.10)

13. A clawback provision is relevant when early investments are successful and repay more than the invested capital plus the preferred return, but later investments fail. A clawback is a provision activated when, at the end of a fund's life, the limited partners have recovered less than the sum of capital provided and a certain amount of the fund's profits. A clawback is designed to ensure that the general partners will not collect a greater portion of the fund's total distributions by collecting a share of early profits without adjustments being made for subsequent losses. Clawback liabilities can also exist for limited partners.

(Section 7.6.10)

## Chapter 8: Private Equity Benchmarking

### Exercises

#### Problems 1 to 2

Suppose the following values for distributions, contributions, and net asset values (NAVs) for two German private equity funds (named PE Fund 1 and PE Fund 2) that belong to the vintage year 2002-stage focus buyout (amounts in Euro millions):

	2002	2003	2004	2005	2006	2007 (NAV)
PE Fund 1	(100)	(300)	(200)	(700)	400	1,400
PE Fund 2	(1,300)	(1,200)	(600)	900	1,400	1,800

*Where: Positive numbers correspond to years in which investors received net distributions, negative numbers correspond to years in which investors made net contributions, and the figures for 2007 correspond to the NAVs of each of the two funds at the end of that year.*

1. Calculate the IIRR (interim internal rate of return), the TVPI (total value to paid-in ratio), the DPI (distribution to paid-in ratio or realized return), and the RVPI (residual value to paid-in or unrealized return) for the two funds. Interpret the results obtained.
2. Perform a classical benchmark analysis based on the following hypothetical information collected for a sample of European private equity funds categorized as vintage year 2002-stage focus buyout, from inception to December 31, 2007:
  - The maximum return (measured using the IIRR) registered by a private equity fund was 34.70%
  - The highest quartile of PE funds had a return of 11.70% or more
  - The median return was 8.60%
  - The lowest quartile funds had returns of 0% or less
  - The minimum return was -8.40%

#### Problems 3 to 5

Mohamed Alasaaf is a research analyst working at *Krug Capital Group*, a mid-size U.S. endowment. Mr. Alasaaf has been evaluating the performance of a number of U.S. private equity funds to be considered to be added to *Krug's* portfolio of private equity funds. In this regard, he is in the process of evaluating the performance of *Parker Partners*, a hypothetical U.S. private equity fund that belongs to the vintage year 2001-stage focus buyout. The following numbers correspond to distributions, contributions, and the net asset value (NAV) for *Parker* (amounts in US\$ millions):

	2001	2002	2003	2004	2005	2006	2007
PE Fund Parker	(900)	(100)	200	(1,500)	(600)	2,300	?

Where: Positive numbers correspond to years in which investors received distributions, negative numbers correspond to years in which investors made net contributions, and the figure for 2007 corresponds to the NAV of the fund at the end of that year.

Mr. Alasaaf has already calculated that the total value to paid-in ratio (TVPI) for Parker is 1.77.

- Calculate the distribution to paid-in ratio (DPI) of *Parker*.
- Calculate the residual value to paid-in ratio (RVPI) of *Parker*.
- Calculate the net asset value of *Parker* at the end of 2007.
- What are the cash flow J-curve and the net asset value (NAV) J-curve?
- Suppose that the four-year cash flows of a PE investment generate a future value of distributions  $[FV(D)]$  of \$523.07, and that the future value of contributions  $[FV(C)]$  is \$131.82. The NAV of the fund is \$100 in year 4. Calculate the public market equivalent (PME) ratio over the four years.
- The following numbers correspond to distributions, contributions, and the net asset values (NAVs) for Fund XYZ (amounts in € millions):

	2008	2009	2010	2011	2012	2013	2014	2015
Fund XYZ	-161	-67	12	-20	56	51	48	185

Where: Positive numbers correspond to years in which investors received distributions (D), negative numbers correspond to years in which investors made net contributions (C), and the figure for 2015 corresponds to the NAV of the fund at the end of that year.

Calculate the interim IRR.

#### Problems 9 to 11

The following numbers correspond to distributions, contributions, and the net asset values (NAVs) for Funds A and B (amounts in US\$ millions):

	2010	2011	2012	2013	2014	2015
Fund A	-100	-55	23	36	48	120
Fund B	-210	-153	-52	65	162	321

Where: Positive numbers correspond to years in which investors received distributions, negative numbers correspond to years in which investors made net contributions, and the figures for 2015 correspond to the NAVs of the funds at the end of that year.

9. What is the simple average of the IRRs for a PE portfolio composed of these two funds?
10. What is the commitment-weighted average of the IRRs for a PE portfolio composed of these two funds?
11. What is the pooled IRR for a PE portfolio composed of these two funds?
12. Consider Fund X with an investment (and commitment) of \$50 in year 0 and a NAV in year 1 of \$60, and Fund Y with an investment (and commitment) of \$90 in year 0 and a NAV of \$102 in year 2. What is the commitment-weighted average of the IRRs for a PE portfolio composed of these two funds?

## Solutions

1. The interim IRR (IIRR) is defined as the discount rate that makes the net present value of the distributions, the contributions, and the NAV equal to zero. Therefore, in the case of PE Fund 1, the IIRR is found by solving the following equation (See Equation 8.11):

$$\frac{(100)}{(1 + IRR)} + \frac{(300)}{(1 + IRR)^2} + \frac{(200)}{(1 + IRR)^3} + \frac{(700)}{(1 + IRR)^4} + \frac{400}{(1 + IRR)^5} + \frac{1,400}{(1 + IRR)^6} = 0$$

Solving this equation using a financial calculator or Excel (function IRR), we obtain that the IIRR is equal to 12.92% (rounded). Following the same procedure for PE Fund 2, we find that its IIRR is lower: 8.46% (rounded).

Thus, subject to the limitations of internal rate of return analysis, PE Fund 1 has a 4.46% higher annual performance than PE Fund 2. Notice that we would need to compare these IIRRs to the discount rates or required rates of return applicable to each private equity fund to determine whether these returns were greater than the required minimum returns.

TVPI: In the case of PE Fund 1, the TVPI is (rounded, see Equation 8.7):

$$TVPI_T = \frac{400 + 1,400}{100 + 300 + 200 + 700} = 1.38$$

In the case of PE Fund 2, the TVPI is 1.32 (rounded). Thus, PE Fund 1 has a slightly higher ratio of total distributions and NAV to total contributions between 2002 and 2007 than does PE Fund 2. This measure does not take into account the time value of money. Also, note that even though the drawdowns or paid-in had a negative sign in the table (given that they represent a use of cash to private equity funds), we used their values expressed in positive numbers in the denominator of the equation. This convention is followed, because it generates a more meaningful sign (i.e., a positive value) for the TVPI index, which is more easily interpreted in a manner similar to how benefit-to-cost ratios are usually expressed and interpreted. We followed the same procedure when calculating the total value of drawdowns in the case of the next two indices (DPI and RVPI).

DPI: In the case of PE Fund 1, the DPI is (rounded, see Equation 8.5):

$$DPI_T = \frac{400}{100 + 300 + 200 + 700} = 0.31$$

In the case of PE Fund 2, the DPI is 0.74 (rounded). Therefore, PE Fund 1 has a lower ratio of total distributions to total commitments between 2002 and 2007 than does PE Fund 2. This measure does not take into account the time value of money.

RVPI: For PE Fund 1, the RVPI is (rounded, see Equation 8.6):

$$RVPI_T = \frac{1,400}{100 + 300 + 200 + 700} = 1.08$$

In the case of PE Fund 2, the RVPI is 0.58 (rounded). It can be seen that PE Fund 2 has a lower ratio of NAV to total contributions than does PE Fund 1. Again, note that this measure does not consider the time value of money.

(Sections 8.2.1, 8.2.2, and 8.2.4)

2. It can be seen that PE Fund 1 had an excellent return, 12.92%, when compared to its peers, as its IIRR was located between the upper and the maximum return corresponding to hypothetical information collected for a sample of European private equity funds categorized as vintage year 2002-stage focus buyout, from inception to December 31, 2007. In the case of PE Fund 2, the observed return, 8.46%, was less impressive. Its IIRR was approximately equal to the median private equity fund return of the sample.

(Sections 8.4.2, 8.4.2.1, and 8.7.4)

3. DPI = 0.81(rounded) found as sum of distributions (25) over sum of capital drawn (31).

(Sections 8.2.4 and 8.7.2)

4. RVPI = 0.97 found as TVPI (1.77) minus DPI (0.81) with rounding.

(Sections 8.2.4 and 8.7.2)

5. NAV = \$3 million, rounded, found as RVPI (0.97) times sum of contributions (3.1 million).

(Sections 8.2.4 and 8.7.2)

6. The cash flow J-curve illustrates the evolution of the net accumulated cash flows to and from the investors (limited partners) to a private equity fund. These accumulated cash flows are first increasingly negative during the early years of the fund's life before

typically making an upward turn and becoming positive in the later years of the fund's existence.

The net asset value (NAV) of a fund is computed by adding the value of all of the investments held in the fund and dividing by the number of outstanding shares of the fund. The NAV J-curve illustrates the evolution of the NAV versus the net paid-in (NPI), which first decreases during the early years of the fund's life and then typically improves in the later years of its existence.

(Section 8.2.5)

7. The future values of distributions  $FV(D)$  and contributions  $FV(C)$  are:

$$FV(D) = FV(\text{Distributions}) = \sum_{t=0}^T \frac{D_t \times I_T}{I_T} = \$523.07 \quad (8.8)$$

$$FV(C) = FV(\text{Contributions}) = \sum_{t=0}^T \frac{C_t \times I_T}{I_T} = \$131.82 \quad (8.9)$$

The PME ratio is calculated using equation 8.10:

$$\text{PME Ratio} = \frac{FV(D) + NAV}{FV(C)} \quad (8.10)$$

The PME ratio is therefore  $(523.07 + 100)/131.82 = 4.73$  (rounded).

Since the ratio is higher than 1.0, it is concluded that this private equity investment has outperformed the public market index by a substantial amount.

(Section 8.4.2.1)

8. In theory, we should solve Equation 8.11 to find the interim IRR:

$$\sum_{t=0}^T \frac{D_t}{(1 + IRR_T)^t} - \sum_{t=0}^T \frac{C_t}{(1 + IRR_T)^t} + \frac{NAV_T}{(1 + IRR_T)^T} = 0 \quad (8.11)$$

However, one must take into account that the cash flows of PE Fund XYZ from left to right have three sign changes. Therefore, there can be up to three different IRRs that solve Equation 8.11. In these cases, none of the solutions can be trusted.

(Section 8.7.1)

9. Using Equations 8.11 and 8.15:

$$\sum_{t=0}^T \frac{D_t}{(1 + IRR_T)^t} - \sum_{t=0}^T \frac{C_t}{(1 + IRR_T)^t} = 0 \quad (8.11)$$

$$IIRR_{P,T} = \frac{1}{N} \sum_{i=1}^N IIRR_{i,T} \quad (8.15)$$

The IIRR of Fund A is 10.65% (rounded), and the IIRR of Fund B is 7.49% (rounded). Therefore, the simple average of the IIRRs is 9.07%. The IIRRs can be found using Excel (function IRR or XIRR) or a financial calculator.

(Sections 8.7.1 and 8.8.1)

10. The commitment-weighted average of the funds' performance measures is (Equation 8.16):

$$IIRR_{P,T} = \frac{1}{\sum_{i=1}^N CC_i} \sum_{i=1}^N CC_i \times IIRR_{i,T} \quad (8.16)$$

Where  $CC_i$  is the commitment made to fund  $i$ .

The IIRR of Fund A is 10.65%, and the IIRR of Fund B is 7.49%. They were reported in the previous exercise, where they were calculated using Excel (function IRR or XIRR) or a financial calculator. The commitment-weighted average of the IIRRs is 8.35% (rounded), found as  $[(155/570) \times 10.65\%] + [(415/570) \times 7.49\%]$ , where (amounts in US\$ millions): 155 are the commitments made to Fund A (100 + 55), 415 are the commitments made to Fund B (210 + 153 + 52), and 570 are the total commitments made by the funds (155 + 415).

(Section 8.8.1)

11. The formula for the pooled IIRR is:

$$\sum_{t=0}^T \sum_{i=1}^N \frac{CF_{i,t}}{(1 + IIRR_{P,T})^t} + \sum_{i=1}^N \frac{NAV_{i,T}}{(1 + IIRR_{P,T})^T} = 0 \quad (8.17)$$

The following table shows the calculation of the pooled cash flows of these two funds. The pooled IIRR is 8.37% (rounded). The pooled IRR can be found using Excel (function IRR or XIRR) or a financial calculator.

	2010	2011	2012	2013	2014	2015	IRR
Fund A	-100	-55	23	36	48	120	10.65%
Fund B	-210	-153	-52	65	162	321	7.49%
Pooled	-310	-208	-29	101	210	441	8.37%

(Section 8.8.1)

12. The commitment-weighted average of the funds' performance measures is (Equation 8.16):

$$IIRR_{P,T} = \frac{1}{\sum_{i=1}^N CC_i} \sum_{i=1}^N CC_i \times IIRR_{i,T} \quad (8.16)$$

Where  $CC_i$  is the commitment made to fund  $i$ .

The IIRR of Fund A is 20% [i.e.,  $(60-50)/50 \times 100$ ], and the IIRR of Fund B is 13.33% (rounded) [i.e.,  $(102-90)/90 \times 100$ ]. The commitment-weighted average of the IIRRs is 15.71% (rounded), found as  $[(50/140) \times 20\%] + [(90/140) \times 13.33\%]$ .

(Section 8.8.1)

## Chapter 9: Fund Manager Selection and Monitoring

### Exercises

1. Briefly describe the following four types of teams: Blue chip, established, emerging, and re-emerging.
2. Comment on the following statement: “*Empirical evidence suggests that most top teams tend to give priority allocation to new investors.*”
3. What role might the design of the limited partnership agreement play in alleviating the risk of style drift?

### Problems 4 to 6

Discuss whether the following three statements are accurate regarding the potential value created through monitoring activities at the portfolio of funds level.

4. “*Intensive contact with the fund managers is important when deciding whether to invest in a follow-on fund (i.e., re-ups).*”
5. “*Empirical evidence suggests that superior reinvestment skills are not important for investors in private equity.*”
6. “*Networking and liaising with other limited partners is an important instrument for gathering information on the aggregate market and learning about other funds, and may help an investor gain access to deals that might otherwise not appear on the institution’s radar screen.*”
7. Have private equity fund managers in the U.S. historically relied on the exemption from registration under the Investment Advisers Act?
8. Why might limited partners prefer to limit the degree of transparency of a private equity fund?

### Problems 9 to 10

Isabel Yale works at *Yellow Global*, an insurance company that is considering investing in *Lamont Private*, a private equity fund, as a limited partner. *Yellow Global* monitors its investments in private equity routinely and systematically, collecting information in an organized and planned way. *Yellow Global’s* philosophy considers the monitoring process -where problems are identified and a plan to address them is worked out- as an integral part of the control system within the investment process. In the past five years, *Yellow Global* has been very successful, with several investments made in private equity funds. In spite of this success, Xabier Berria, a consultant to *Yellow Global*, is worried

that the private equity portfolio of this insurance company is already too large to be managed efficiently and is considering proposing to Ms. Yale to engage in secondary transactions to adjust the portfolio structure.

*Lamont Private*, incorporated in 2003, has been a leader in the U.S. buyout market, their declared investment strategy. However, the projected sluggishness in the U.S. market in the coming years has forced *Lamont* to look for investments in other more promising areas. In fact, *Lamont* is now considering becoming a leader in the buyout markets of South-East Asian emerging markets such as Vietnam, Malaysia, and the Philippines. These markets are considered to be riskier than the U.S.

9. Ms. Yale is concerned about the risk of “style drift” arising from the investments that *Lamont Private* is about to make in South-East Asian emerging countries. Ms. Yale states that “...*Style drift arises because adherence to a stated investment style may not always hold true in the world of private equity funds.*” Is Ms. Yale’s statement correct?
10. How does the secondary transactions “exit route” that Mr. Berria suggests to Ms. Yale work?

## Solutions

1. A blue-chip team is a team that has been able to produce top-quartile performance for all of its funds through at least two business cycles (i.e., a sequence of more than three funds).

An established team is a team that has been able to generate a top-quartile performance for most of its funds (more than three funds) through at least two business cycles.

An emerging team is a team with a thin joint history, but with all the features to become an established team.

A re-emerging team is a previously blue-chip or established team that has been through a restructuring (after experiencing recent poor performance or some significant operational issues), and has the potential to re-emerge as an established or blue-chip team.

(Section 9.1)

2. The statement is incorrect. General partners typically reward their previous investors with access to future funds. However, while top teams give priority allocations to loyal limited partners, they may also decide to allocate a share of the new fund to newcomers who could add value, such as exit opportunities, deal flow, and industry expertise. Nonetheless, it must be said that access is far less a problem for limited partners who are financially strong and have shown that they are long-term players. For new investors, however, this is an important barrier to entry.

(Section 9.2)

3. The upfront design of the limited partnership agreement is an important step to lessen the risk of style drift. The covenants of the limited partnership agreement guide the behavior of the fund manager and may be used to set the risk profile of the investment at the time of commitment. However, there are risks associated with holding on too strictly to a declared investment strategy, particularly when market conditions change significantly, creating new investment opportunities.

(Section 9.5.2)

4. This statement is correct. Intensive contact with fund managers improves the due diligence process and can lead to a faster finalization of contracts after incorporating enhancements based on the previous experience with the fund manager. Furthermore, a strong relationship can extend to junior team members ready to spin out and set up their own fund.

(Section 9.5.3)

5. The opposite is true. Empirical evidence actually suggests that investors in private equity owe their success to superior reinvestment skills. For instance, Lerner, Schoar, and Wong (2007) refer to the case of endowment funds, where they found that these funds were rather unlikely to reinvest in a partnership. However, in the cases in which endowments did reinvest, the subsequent performance of the follow-on fund was significantly better than those of funds they let pass.

(Section 9.5.3)

6. This statement is correct. Networking and liaising with other limited partners can also improve access to secondary opportunities in advance of the less favorable auction process.

(Section 9.5.3)

7. The answer is yes. In the U.S., both hedge fund managers and private equity fund managers have historically relied on the same exemption from registration under the Investment Advisers Act.

(Section 9.6.1)

8. Limited partners may prefer to limit the degree of transparency of a private equity fund because making public knowledge information regarding star funds (very successful funds) may draw the attention of competing investors. As private equity funds are not scalable, limited partners may be concerned about being locked out of follow-on funds because general partners have a preference for deep pocket investors. Limited partners need to protect their privileged access to follow-on funds or to new teams that set up their own vehicles outside the old fund.

(Section 9.6.2)

9. Yes, Ms. Yale's statement is correct.

(Section 9.5.2)

10. Secondary transactions for limited partnership shares represent one of the main exit routes available to adjust the structure of a portfolio. However, this market offers limited liquidity and is expected to remain quite inefficient. Often shares in a private equity fund cannot be sold off without the consent of the general partners (and possibly that of other limited partners). Secondary transactions occur at a negotiated price, often at a considerable discount to net asset value.

(Section 9.8)

## Chapter 10: Private Equity Operational Due Diligence

### Exercises

1. Distinguish operational due diligence from investment due diligence.
2. What are the five key benefits to performing operational due diligence on private equity funds?
3. What are the eight core elements of the operational due diligence process?
4. What is the purpose of the valuation committee in the context of private equity?
5. What are desk reviews? Why aren't they considered best practice?
6. In an operational risk context, what are meta risks?
7. In the context of private equity firms, what is the purpose of fund administrators?

### Solutions

1. In general, investor due diligence can be divided into two broad parts. The first, investment due diligence (IDD), centers on obtaining a thorough understanding of the strategy followed by a fund manager in order to establish whether or not the strategy is suitable for the investor. The second part, operational due diligence (ODD), focuses on all aspects of a fund manager other than those that are solely investment related. However, it is important to bear in mind that having a comprehensive understanding of a fund's investment strategy can be crucial to the ODD process.

(Section 10.1.2)

2. The five key benefits of ODD for private equity funds are:
  1. Superior understanding of a fund's back office operational procedures and processes.
  2. Identification of how scalable the operations of a PE fund are (from a personnel and systems point of view to assist growth).
  3. Study of the ability of a company to become accustomed to future external operational issues (this includes regulatory changes and new accounting rules).
  4. Gathering of practical information about risk modeling and management.

5. Diagnostic benefits to LPs, including further comprehension of a fund's operational details across many operational risk areas (from information technology to cash management).

(Section 10.1.4)

3. The following are the eight core elements of the operational due diligence process:

1. Document collection
2. Document analysis
3. On-site visit
4. Service provider review and confirmation
5. Investigative due diligence
6. Process documentation
7. Operational decision
8. Ongoing monitoring (if investment made)

(Section 10.2)

4. The valuation committee reviews fund valuations and any proposed valuation changes. Two general causes for changing the valuations of positions held are the occurrence of a material event related to the security and changes in general markets that necessitate a revaluation of the security. The committee, which typically consists of representatives of various departments, both operational and investment, assists internal GP and usually meets on a predefined basis.

(Section 10.5.1)

5. A desk review is an ODD review based exclusively on documents collected, and possibly conference or video calls. LPs may argue in favor of desk reviews because of their lower costs (compared to on-site visits), shortened overall review time, and a belief that the quality of information collection is the same for desk reviews as it is for on-site visits.

Desk reviews are not regarded to be best practice because they generally produce a less comprehensive review, thus exposing investors to higher levels of operational risk. Even though LPs can still collect compromise documentation when they conduct a desk review, they nonetheless miss the opportunity to review documentation on-site with the manager. Finally, the problem is compounded by the inherent illiquidity of private equity investing (the long lockup period of PE funds prevents redemption for many of the problems that may come up after the capital has been committed).

(Section 10.6.2)

6. Meta risks are all non-investment-related risks not covered by a particular category. An example would be the case of fund manager's expenditures of company funds on

luxurious office decorations rather than on hiring additional employees. Another example would be a fund manager who is confrontational during an on-site meeting. Some investors may feel that such examples should be regarded as part of the overall evaluation of the fund manager. These types of risks are categorized as meta risks because they cannot be grouped precisely into any one specific operational risk category. Assigning values to meta risks is intrinsically subjective and can differ from one investor to another.

(Section 10.7)

7. Fund administrators offer fund accounting and shareholder services to those private equity firms that desire to work with this third-party service provider. Fund accounting usually includes reconciling cash and positions of the fund, independently reviewing portfolio pricing, and maintaining the official books and records of the fund. Shareholder services center on supervising the investor's capital commitment and withdrawal process and preparing investor statements.

(Section 10.8)

## Chapter 11: Private Equity Investment Process and Portfolio Management

### Exercises

1. Why is it difficult to quantify the risks intrinsic to investing in private equity?
2. The endowment of XYZ University is considering allocating funds to private equity investments. Roger Gallagher, a research analyst working for the endowment's investment committee, has been assigned the task of determining the viability of using the Modern Portfolio Theory (MPT) framework to estimate the potential benefits of adding private equity to traditional investments. Mr. Gallagher has just handed in a report addressing these concerns. The following statement appears in the report.

*“The MPT usually assumes a normal return distribution, which clearly does not hold for private equity. In fact, the distribution of private equity returns departs significantly from the normal distribution.”* Is this statement correct? Explain.

3. Which factors should be taken into consideration to determine the balance between core and satellite portfolios?
4. What are the cost-averaging and market-timing approaches to achieve vintage-year diversification?
5. Using the information presented in the following table, calculate the expected return and standard deviation of returns of a portfolio that is 75% invested in international stocks excluding the U.S. (MSCI EAFE) and 25% invested in U.S. private equity, with returns as represented by the PE index. Interpret the results obtained.

1991-2008	Annualized Return	Standard Deviation	Correlation with PE
Non-U.S. Stocks (MSCI EAFE)	4.50%	15.90%	0.71
U.S. Bonds (BarCap U.S. Government)	7.20%	4.30%	-0.19
Private Equity (PE) Index	7.60%	25.10%	1

Source: Edited from Schneeweis, Crowder, and Kazemi, *The New Science of Asset Allocation*, Wiley Finance, 2010

6. Why do investors generally follow the bottom-up approach when designing a private equity portfolio?

7. According to evidence presented in the book, how many funds are needed to diversify away most (e.g., 80%) of a portfolio's risk (standard deviation)? What is the strongest argument against a high level of diversification?
8. What are the advantages of the core-satellite approach?
9. State the reasons that explain why a diversification strategy that does not take into account the specificities of the private equity asset class can be quite inefficient.

Problems 10 to 12

*Catai Partners*, a private equity fund of funds, was incorporated in 1996. Originally established as the 'in-house' private equity fund of a large endowment, *Catai* is a leader in the South-East Asian buyout market. The fund has established well-resourced local offices in Shanghai and Seoul, positioning the fund at the center of South-East Asian emerging large buyout deal flow. The portfolio construction methodology followed by *Catai Partners* starts by identifying suitable investments, followed by an intensive examination and due diligence in order to rank the fund managers by their attractiveness. Subsequently, the best funds are selected in order to invest the capital allocated to private equity. *Catai Partners* is concerned whether the fund managers are top-quartile. These concerns are addressed through the due diligence process and the structuring of the limited partnership agreements, with the addition of covenants and the post-commitment monitoring.

Francois Lefebvre, CAIA, is a consultant working for *Catai Partners*. Mr. Lefebvre has suggested to *Catai Partners* a strategy that will allow them to diversify most of their portfolio, but to manage a smaller portion of their holdings with the objective of generating especially high returns using highly selective active management strategies. In response, Angelica Ng, a research analyst at *Catai Partners*, comments to Mr. Lefebvre that naïve diversification allows private equity investors to avoid extreme concentrations by managing a number of dimensions.

10. What private equity portfolio construction approach is employed by *Catai Partners* to identify their fund managers?
11. What private equity portfolio construction approach does Mr. Lefebvre suggest?
12. What are the dimensions suggested by Ms. Ng?

## Solutions

1. It is difficult to quantify the risks inherent to investing in private equity because of the idiosyncrasies of this asset class. The opaque nature of the private equity industry implies that:

- Not all outcomes are known,
- Information is difficult to collect, and
- The quality of data is usually very poor.

These difficulties are particularly prominent in the case of technology-focused venture capital funds.

(Section 11.1)

2. This statement is correct, although MPT can be developed using assumptions other than a normal distribution. Empirical evidence on private equity returns suggests the existence of significant skewness and excess kurtosis.

(Section 11.4.2)

3. The following factors need to be taken into consideration:
  - The time horizon of the PE fund's investment program. For example, the value of the option of more long-term oriented programs is higher and, therefore, the degree of exploration that should be undertaken should be higher.
  - The resources available. A higher degree of exploration is possible when a large reserve buffer is available.
  - The changes in the PE market environment (expected or unexpected). For instance, the more innovatively disruptive a market environment is, the more one needs to spread out one's options.

(Section 11.4.1)

4. The cost-averaging approach sets an annual investment target for each PE fund type (or a relatively constant target throughout funding cycles). This approach avoids any attempt to try to time the cycles.

The market-timing approach entails varying levels of investment across vintage years trying to invest more in years with better projections and less in years with inferior prospects.

(Section 11.4.4)

5. The expected return of the portfolio  $E(R_p)$  is equal to the weight of each asset in the portfolio multiplied by its expected return:

$$E(R_p) = (0.75 \times 4.5\%) + (0.25 \times 7.6\%) = 5.28\%$$

The formula for the standard deviation of returns of the portfolio ( $\sigma_p$ ) is:

$$\begin{aligned}\sigma_p &= \left[ w_S^2 \times \sigma_S^2 + w_{PE}^2 \times \sigma_{PE}^2 + 2 \times w_S \times w_{PE} \times \sigma_S \times \sigma_{PE} \times \rho_{S,PE} \right]^{1/2} \\ &= \left[ (0.75^2 \times 0.159^2) + (0.25^2 \times 0.251^2) + (2 \times 0.75 \times 0.25 \times 0.159 \times 0.251 \times 0.71) \right]^{1/2} \\ &= 16.97\%\end{aligned}$$

Where:  $w$  are the weights of each asset class in the portfolio and  $\rho$  is the correlation coefficient between the returns of non-U.S. stocks and private equity.

In this case, the expected return of the portfolio increases from 4.50% to 5.28% when private equity ( $PE$ ) is added to an all equity (non-U.S.) portfolio ( $S$ ). However, the portfolio volatility increases slightly when private equity is added to an all equity (non-U.S.) portfolio (from 15.90% to 16.97%).

The high risk experienced by private equity during the period of analysis combined with the relatively high correlation between non-U.S. stocks and private equity cannot render private equity as a particularly good diversifier to add to an all equity (non-U.S.) portfolio. Notice, however, that private equity could be a good addition to a multiple asset portfolio that includes other traditional and alternative assets, given the lower correlation that private equity exhibits in general with respect to those other assets.

(Section 11.2)

6. Investors generally follow the bottom-up approach when designing a private equity portfolio because it is usually thought that the quality of the fund management team is the most important factor when investing in private equity, an asset class that is characterized by a high differential between top-quartile and lower-quartile fund performance. Other factors such as sector or geographical diversification are commonly regarded as less important.

The bottom-up approach also has the following advantages: It is simple, it depends solely on ranking, it is easy to understand, robust, and it can enhance the expected performance by focusing the portfolio in the highest alpha funds, while controlling for risk by diversifying across multiple funds. Unfortunately, the bottom-up approach has the following two problems. First, it can lead to an unbalanced portfolio and thus it might carry substantially more risk than planned. Second, the proposed portfolio may ignore some important macroeconomic changes or opportunities.

(Section 11.3.2)

7. Empirical evidence in private equity suggests that 80% of the standard deviation is diversified away with a portfolio of 20 to 30 funds. The strongest argument against a high level of diversification is that fund quality may deteriorate rapidly as one continues to add funds to a portfolio. This is because there are too few excellent fund management teams within a vintage-year peer group, and thus over-diversification not only causes a reduction in positive skewness and kurtosis, but also diminishes the portfolio's expected return (this is more of an issue for venture capital funds than for buyouts). It is important

to note that these notions only hold for the plain-vanilla limited partnership stakes in funds.

(Section 11.4.2)

8. The core-satellite approach structures a portfolio in various sub-portfolios, which can then be assembled using one of the three construction techniques available (e.g., bottom-up, top-down, or mixed). The following are some of the advantages of the core-satellite approach:
  - This approach aims to increase risk control, reduce costs, and add value. This may be an effective strategy, particularly for institutions desiring to diversify their portfolios without giving up the potential for higher returns generated by selected active management strategies.
  - The flexibility it offers to customize a portfolio to meet specific investment objectives and preferences.
  - This approach also offers the structure for targeting and controlling those areas in which an investor considers that she is better able to control risks, or is simply willing to take more risks. What constitutes core versus satellite depends on the investor's focus and expertise. Some see venture capital as satellite, while others view a balanced buyout and a venture capital funds portfolio as core.
  - It facilitates dedicating more time to the satellite portfolio, which is expected to generate excess performance, and less time on the lower-risk core portfolio.

(Section 11.4.1)

9. The following are some of the reasons that a diversification strategy that does not take into account the specificities of the private equity asset class can be inefficient:
  - Over-diversification may lead to capping the upside
  - Investing in many teams without managing the diversification of each risk dimension (e.g., geography and industry sectors), can harm portfolio performance
  - The benefits of diversification set in more slowly when funds are highly correlated
  - There exist diseconomies of scale
  - The number of investments sets the cost base (e.g., legal expenses, due diligence, and monitoring efforts) of a portfolio of funds
  - It becomes increasingly difficult to identify and gain access to suitable funds, as the number of quality opportunities is limited.

(Section 11.4.3)

10. A bottom-up approach

(Section 11.3.2)

11. A core-satellite approach

(Section 11.4.1)

12. Number of fund managers, vintage years and calendar years, and industry sectors

(Section 11.4.3)

## Chapter 12: Measuring Private Equity Risk

### Exercises

1. In private equity, what is commitment risk or funding risk?
2. In private equity, what is cash flow at risk?

### Problems 3 to 7

Consider the following example. Let us assume that we need to determine the year-end VaR for one fund. For this fund, four cash flow scenarios are run (with a given discount rate), obtaining the following four expected lifetimes and present values (PVs):

- Scenario 1: Fund's remaining expected lifetime is 9.25 years, PV = -\$10.
- Scenario 2: Fund's remaining expected lifetime is 10.50 years, PV = \$18.
- Scenario 3: Fund's remaining expected lifetime is 10.70 years, PV = \$62.
- Scenario 4: Fund's remaining expected lifetime is 11.25 years, PV = \$138.

Assume that each of these four scenarios may occur with equal probability.

3. What is the fair value of the fund at time 0?
4. What would be the gain in value of the fund per annum over its projected lifetime under each scenario?
5. How much should the fund be worth after one year under each scenario?
6. What is the expected value of the fund after one year?
7. Comment on how the risk of losing any capital until the next year could be assessed.

### Solutions

1. The unpredictability of the timing of cash flows over the life of a fund creates risks to limited partners (LP). Commitment risk or funding risk is the risk that arises when a LP has to meet his commitments, which are contractually binding, within a fixed short-notice period, and the limited partner cannot meet his obligations. This forces the LP to default on payments and lose a substantial portion of his share in the partnership.

(Section 12.1)

2. Cash flow at risk (CFaR) measures, for a given confidence level, the maximum deviation (due to changes in the underlying risk factors) between actual cash flows and a set level (e.g., a budget figure) over a specific time period. In the case of the CFaR for a portfolio of funds, the focus is on variations in cash flow within a given time interval.

(Section 12.5)

3. Using Equation 12.1:

$$Avg (PV) = \frac{1}{m} \sum_{i=1}^m PV_i \quad (12.1)$$

The fair value of the fund at time 0 is the simple average of these four scenarios:

$$(-\$10 + \$18 + \$62 + \$138) / 4 = \$52$$

(Section 12.5.2)

4. We proceed to calculate the risk of this fund based on these four scenarios and the gain/loss over a given time period. Using Equation 12.2, the fund would gain the following values per annum (p.a.) over its projected lifetime under each scenario:

$$GAIN/LOSS = \frac{Avg (PV) - PV_i}{n} \quad (12.2)$$

Scenario 1:  $(-\$10 - \$52) / 9.25 \text{ years} = -\$6.70 \text{ p.a.}$

Scenario 2:  $(\$18 - \$52) / 10.50 \text{ years} = -\$3.24 \text{ p.a.}$

Scenario 3:  $(\$62 - \$52) / 10.70 \text{ years} = \$0.94 \text{ p.a.}$

Scenario 4:  $(\$138 - \$52) / 11.25 \text{ years} = \$7.64 \text{ p.a.}$

(Section 12.5.2)

5. The density function for the fund's valuation after one year is (with rounding):

1. Should scenario 1 materialize, after one year the fund would be worth  $\$52 - \$6.70 = \$45.30$ .

2. Should scenario 2 materialize, after one year the fund would be worth  $\$52 - \$3.24 = \$48.76$ .

3. Should scenario 3 materialize, after one year the fund would be worth  $\$52 + \$0.94 = \$52.94$ .

4. Should scenario 4 materialize, after one year the fund would be worth  $\$52 + \$7.64 = \$59.64$ .

(Section 12.5.2)

6. We simply need to apply the formula for the expected value of the fund. Remember that it was assumed that each of the four scenarios may occur with equal probability. The expected value of the fund under each scenario was calculated in the previous question.

$$\begin{aligned} E(\text{Fund Value}_{t=1}) &= \$45.30 \times 0.25 + \$48.76 \times 0.25 + \$52.94 \times 0.25 \\ &+ \$59.64 \times 0.25 = \$51.66 \end{aligned}$$

(Section 12.5.2)

7. With these valuations, one can determine the histogram and density function for many scenarios of fund valuations at a future point in time. This analysis forms the basis for determining the VaR over a required projection period (e.g., annually, quarterly, etc.).

(Section 12.5.2)

## Chapter 13: The Management of Liquidity

### Exercises

1. What are funding risks and exit risks?
2. What is the meaning of the term “harvesting period”?
3. May a limited partner default when he cannot meet a drawdown request? If so, is there any penalty involved?
4. An investor signs commitments for private equity investments in the size of 6% of her fund, while having resources available to allocate an additional investment of 8% to private equity. What is the over-commitment ratio? Are resources being used efficiently or inefficiently?

### Problems 5 to 8

*Amazonian Private Equity Fund* (APEF) invests in late-stage Brazilian companies seeking to either enter the growing Brazilian market, or improve their current business operations in Brazil. The fund plans to generate medium-term capital appreciation and to offer investors a unique access to transactions in the largest emerging market of Latin America.

APEF is currently conducting a study on how to improve the management of its liquidity, a task that involves balancing between the benefits of putting money to work efficiently and the potential costs of having insufficient available resources to fund commitments and attractive opportunities. In this regard, the fund is reconsidering its over-commitment strategy, while it is also looking at possibilities of tapping into well-diversified and stable sources of financing. At the same time, APEF is also analyzing the pros and cons of using various approaches to cash flow projections.

5. Briefly explain the concept of the over-commitment strategy.
6. In an over-commitment strategy, is it typically appropriate for commitments to exceed the available resources in order to optimize the level of liquidity? Explain
7. Could the sale of limited partnership shares in the secondary market be regarded as a well-diversified and stable source of financing for APEF? Explain
8. Mention the three cash flow projection approaches available for a portfolio of private equity funds that APEF may be considering.

## Solutions

1. Funding risk (also known as default risk within the PE industry), is the risk that an investor will not be able to honor his capital commitments to a PE fund in agreement with the terms of the obligation to do so.

Exit risk is the risk that an investor cannot redeem or liquidate his investment at the time of his choosing or that he would exit at depressed valuations.

(Sections 13.1, 13.1.3 and 13.1.4)

2. The harvesting period of a private equity fund consists of the later years of the fund, after the investments have matured and gained in value, when the fund seeks to exit its investments. The value of these investments is related to the growth of the company, the market environment at the time of the exit period, and the value added by the fund manager.

(Section 13.3.2)

3. If a drawdown request cannot be met, a limited partner may default as a measure of last resort. However, in addition to the reputation damage suffered by the defaulting limited partner, there are onerous penalties associated with not meeting capital calls. These penalties may include:

- The partial or total forfeiture of the partnership interest
- The loss of entitlement to income or distributions
- The termination of the limited partner's right to participate in future investments by the fund
- The mandatory transfer or sale of its partnership interests
- The continuing liability for interest in respect of the defaulted amount
- The liability for any other rights and legal remedies the fund managers may have against the defaulting investor.

Furthermore, defaulting limited partners may continue to be liable for losses or expenses incurred by the fund.

(Section 13.3)

4. The over-commitment ratio is defined as (see Equation 13.2):

$$\text{Over-commitment ratio} = \frac{\text{Total commitments}}{\text{resources available for commitments}}$$

Therefore, in this example, the over-commitment ratio is 75% (6%/8%). An over-commitment ratio of less than 100% suggests an inefficient use of resources.

(Section 13.7)

5. The over-commitment strategy is followed by a private equity fund when more commitments to invest capital in the future are signed than can be met with existing capital resources. The goal is to be able to meet future capital calls with cash that becomes available such as through distributions from other investments. The objective of the over-commitment strategy is to keep a program permanently and fully invested in portfolio companies, so as to minimize the amount of capital that may remain uninvested at any point in time (i.e., in cash) with the resulting drag on total return.

(Section 13.7)

6. The answer is yes. Typically, a portion of the commitments can be met with distributions received from existing investments during the period prior to the capital being called.

(Section 13.7)

7. The answer is no. Exiting private equity investments through the secondary market may take considerable time and may occur at discounts to NAV. The following may be three well-diversified and stable sources of financing for APEF: The possibility of having a mandatory stepping in as a provider of follow-on funding, the existence of short- and medium-term borrowing facilities, and the establishment of a reinvestment plan.

(Section 13.3)

8. The projections may be based on three approaches: estimates, forecasts, or scenarios.

(Section 13.6)

## Chapter 14: Real Estate as an Investment

### Exercises

1. Does real estate offer the potential to hedge against unexpected inflation?
2. Real estate assets cannot be easily and inexpensively bought and sold in sizes or quantities that meet the preferences of buyers and sellers. What is the term used in real estate to describe this characteristic of real estate?

### Problems 3 to 4

Consider an all-equity investment in an office building that has a 15-year, non-cancelable fixed-rate lease with a large and well-capitalized corporation.

3. Would the income from this property be similar to that of a corporate bond (issued by the tenant) or to that of a stock (also issued by the tenant)? Explain
4. Would rising and unanticipated inflation during the life of the lease positively or negatively affect the value of this investment? Explain.
5. Explain whether most commercial real estate investments are held publicly or privately and who typically owns the equity.
6. Why is it difficult to correctly and empirically measure the effect of unanticipated inflation on real estate prices?
7. Suppose that an unexpected reduction in long-term interest rates (i.e., capitalization rates) takes place. Use the Four-Quadrant Model to explain the effect of this decline in long-term rates on property rents, real estate prices, new construction, and the stock of real estate. Assume that rents remain stable in the short-run.

### Solutions

1. Yes, real estate has the potential to hedge against unexpected inflation.  
(Section 14.1.1)
2. This characteristic of real estate is known as lumpiness.  
(Section 14.1.2)

3. The rental revenues provided by the property will be comparable to those offered by a corporate bond, because the lease locks in the income provided by the property for the next fifteen years. Furthermore, the value of the property to the investor will fluctuate in reaction to factors such as changes in riskless interest rate and changes in the credit spread on the debt of the tenant. These same factors would affect the value of a corporate bond issued by the tenant.

(Section 14.2.1)

4. In principle, rising and unanticipated inflation during the life of the lease may harm the investor in this all-equity office building investment because this is a long-term, fixed-rate, lease. In theory, the investor would have been at least partially hedged against the risk of rising and unanticipated inflation if the lease were an adjustable-rate lease, and assuming that adjustable-rates would reflect inflation rates.

(Section 14.4)

5. Most commercial real estate is privately held and the occupier holds most of the equity of residential real estate.

(Section 14.3.7)

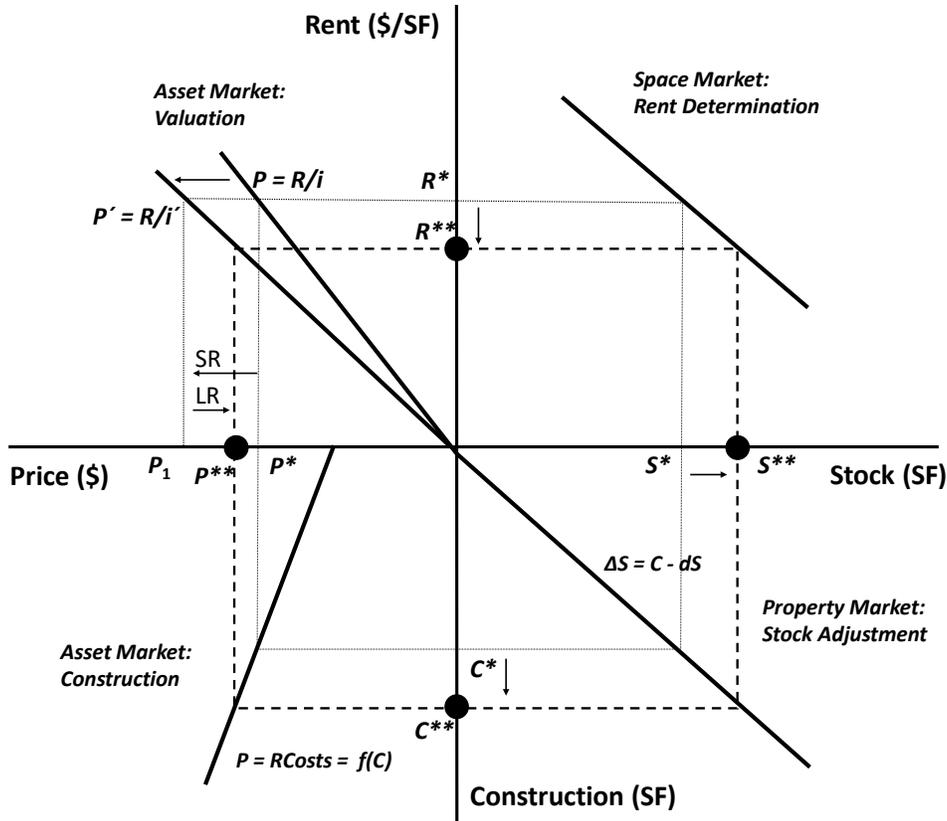
6. Unanticipated inflation is defined as the realized or observed rate of inflation minus the anticipated inflation. The difficulty to correctly measuring the effect of unanticipated inflation on real estate prices resides in developing an objective and accurate estimate of a variable that is unobservable: the market consensus-expected rate of inflation. The problem is further complicated because there are usually different time horizons over which market participants form their anticipated inflation rates.

(Section 14.4)

7. While the Four Quadrant model can help in understanding the dynamics of the real estate market, this particular question can be answered without a particular reference to the model. A reduction in the cap rate will increase real estate prices. Higher prices attract more capital to the real estate market, slowly increasing the supply of real estate space. Once the additional space becomes available, rents begin to decline, reducing the real estate prices to a level that will be above the initial price but below the price level that was reached in response to a decline in the cap rate.

We can present the same results using the Four Quadrant model. In the following exhibit, the unexpected reduction in long-term interest rates or capitalization rate for real estate causes a counter-clockwise rotation in the capitalization rate line that starts out of the origin (NW quadrant). In the short-run, real estate prices increase from  $P^*$  to  $P_I$  in the asset market (NW quadrant). However, this is not a long-run equilibrium. Given a level of property rents, the higher real estate prices caused by the unexpected reduction in long-term interest rates stimulate new constructions (SW quadrant). After a year or two, new space would have been developed ( $C^{**} > C^*$ ), thus increasing the stock of space

( $S^{**} > S^*$ , SE quadrant). This would have caused a decline in rents in the market for space ( $R^{**} < R^*$ ), and a decline in real estate prices ( $P^{**} < P_1$ , although notice that  $P^{**} > P^*$ ) in the NE quadrant. In the Four-Quadrant Model, the new long-run equilibrium is found by the new rectangle connecting the four quadrants based on the new and lower long-term interest rates (dotted line). New equilibrium quantities and prices are represented by double asterisks, and indicate a significant increase in construction, the stock of new space, higher real estate prices, and lower rents (notice once again that that  $C^{**} > C^*$ ,  $S^{**} > S^*$ ,  $P^{**} > P^*$ , and that  $R^{**} < R^*$ ).



(Section 14.5)

## Chapter 15: Real Estate Indices and Unsmoothing Techniques

### Exercises

- Suppose that overall equity market returns were 0%, 10%, 0%, and 0% in the first, second, third, and fourth quarter of a certain year, respectively. Two other return series having betas of 0.60 also need to be calculated. The first return series is an unsmoothed return series that experiences its entire price response to the overall market in the same quarter as the market. The second return series is a strongly smoothed return series that experiences half of its price response in the same quarter as the market, and the other half in the subsequent quarter. Calculate the returns of each of the series in each quarter, and the arithmetic average and standard deviations of returns of each of the series during the year. Ignore compounding for simplicity. Comment on the results obtained.
- Suppose that the value of the parameter alpha for the following equation (Equation 15.2 from the book) is 0.40.

$$P_{t,\text{reported}} = \alpha P_{t,\text{true}} + \alpha(1-\alpha)P_{t-1,\text{true}} + \alpha(1-\alpha)^2 P_{t-2,\text{true}} + \dots \quad (15.2)$$

How much of the current reported price depends on the current true price, how much depends on the true price of the previous observation date, and how much depends on the true price of the observation date from two periods before?

- Suppose that alpha has been estimated to be 0.50 for the following equation (Equation 15.3, Equation 15.4 may also be used):

$$P_{t,\text{true}} = (1/\alpha) \times P_{t,\text{reported}} - [(1-\alpha)/\alpha] \times P_{t-1,\text{reported}} \quad (15.3)$$

According to this, how much larger than the most recent reported price change should true price changes be?

### Problems 4 to 9

The following Exhibit contains quarterly return data for two real estate series between the third quarter of 2007 and the second quarter of 2012. The first series (column 3) corresponds to the returns of a hypothetical U.S. real estate index (XYZ RE Index) that is unlevered and that is based on appraised prices of private real estate properties. The second series (column 4) corresponds to the returns of the all-equity FTSE NAREIT, which is based on closing market prices of publicly traded equity real estate investment

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trusts (REITs) in the U.S. The fifth and sixth columns contain the lagged returns of the XYZ RE Index and the all-equity FTSE NAREIT, respectively.

Year	Quarter	XYZ RE Index returns	NAREIT All Eq returns	XYZ RE Index lagged values	NAREIT All Eq lagged values
2007	3	2.87%	2.59%		
2007	4	4.01%	-12.67%	2.87%	2.59%
2008	1	2.12%	1.40%	4.01%	-12.67%
2008	2	0.21%	-4.93%	2.12%	1.40%
2008	3	0.02%	5.55%	0.21%	-4.93%
2008	4	-7.28%	-38.80%	0.02%	5.55%
2009	1	-8.87%	-31.87%	-7.28%	-38.80%
2009	2	-6.61%	28.85%	-8.87%	-31.87%
2009	3	-4.21%	33.28%	-6.61%	28.85%
2009	4	-3.04%	9.39%	-4.21%	33.28%
2010	1	-0.36%	10.02%	-3.04%	9.39%
2010	2	2.98%	-4.06%	-0.36%	10.02%
2010	3	3.71%	12.83%	2.98%	-4.06%
2010	4	5.01%	7.43%	3.71%	12.83%
2011	1	4.97%	7.50%	5.01%	7.43%
2011	2	4.66%	2.90%	4.97%	7.50%
2011	3	4.17%	-15.07%	4.66%	2.90%
2011	4	3.45%	15.26%	4.17%	-15.07%
2012	1	3.43%	10.49%	3.45%	15.26%
2012	2	3.59%	3.97%	3.43%	10.49%
	Mean	0.74%	2.20%		
	Std. Dev.	4.40%	17.27%		
	Autocorrelation XYZ RE Index		86.45%		
	Autocorrelation NAREIT AllEq		23.04%		

4. Comment on the mean and standard deviations of XYZ RE Index and FTSE NAREIT returns. Furthermore, offer potential explanations for the finding that the standard deviation of returns for the XYZ RE Index is substantially lower to that of FTSE NAREIT.
5. Offer potential explanations for the finding that the autocorrelation of the all-equity FTSE NAREIT returns is substantially lower to that of XYZ RE Index returns.
6. Calculate the first unsmoothed return (i.e., fourth quarter of 2007) for XYZ RE Index.
7. Calculate the unsmoothed return in the fourth quarter of 2008 for XYZ RE Index. Comment on the result obtained.
8. In terms of asset allocation, what is the consequence of using the XYZ RE Index (original smoothed data) versus the unsmoothed version of this index?

9. In terms of correlations between real estate and other asset classes, what is the effect of using the XYZ RE Index returns (original smoothed data) versus the unsmoothed version of this index returns?
10. Why can't arbitrageurs prevent smoothed returns series from being unsmoothed?
11. What is the effect of data smoothing on estimated Sharpe ratios?
12. The smoothed returns of a return series with an autocorrelation of 0.45 have a true beta of 1.15 after adjusting for smoothing. What is the estimated reported beta (i.e., the beta of the smoothed returns)?

Problems 13 to 15

The Fullertown City Employees' Pension Fund is considering allocating funds to real estate investments. As a first step, the fund's investment committee has asked researchers John Troconis, Virginia Peterman, and Jay Ahn, to write a report on alternative investment vehicles available to institutional investors for gaining access to real estate investments. The three researchers are examining the characteristics of real estate indices as a first step to understand the idiosyncrasies of reported real estate returns and return standard deviations.

Mr. Troconis finds that properties that are transacted during a particular period and that are used to calculate these indices may not be representative of the underlying real estate market. Ms. Peterman finds that a technique used when designing real estate indices uses observed transactions of some properties to estimate the prices of all properties, including those that did not transact, by directly modeling the heterogeneity of real estate properties. Finally, Mr. Ahn finds that a technique used when constructing real estate indices has been criticized because only a few data points can be found to create an index when following this methodology.

13. Which bias does Mr. Troconis discover?
14. To which technique is Ms. Peterman referring?
15. What is the technique that Mr. Ahn finds to be problematic?
16. Is the NCREIF NPI (National Council of Real Estate Investment Fiduciaries Property Index) calculated on a leveraged or on an unleveraged basis? Is it calculated on a before or on an after-tax basis?
17. Is the NCREIF NPI (National Council of Real Estate Investment Fiduciaries Property Index) based on appraised values or on market transactions?
18. What are the three main disadvantages of repeat-sales indices?

19. Suppose that a hedonic pricing model has been estimated for land prices during a hypothetical period of time and for a hypothetical county in England using the following equation:

$$P = B_0 + B_1B + B_2S + B_3L + B_4U$$

Where:

$P$  = Price of an acre of land (in British Pounds or GBP)

$B$  = Depreciated cost of buildings on the land (in British Pounds)

$S$  = Soil productivity index

$L$  = Land productivity index

$U$  = Distance (in miles) to the city center

Using Ordinary Least Squares, suppose that we get the following estimated equation:

$$P = 43.72 + 1.120B + 0.183S + 0.802L - 2.321U; R^2 = 0.63$$

Interpret the values of the coefficients obtained in the regression.

20. Which method is used to construct the Case-Shiller Home Price Indices, an index group that tracks the value of U.S. residential real estate properties?

## Solutions

- The unsmoothed and strongly smoothed series have the same mean returns of 1.5% per quarter, which is lower than the mean equity market return of 2.5%. This is not surprising, as the unsmoothed and strongly smoothed return series have a low systematic risk (beta of only 0.6). Furthermore, the strongly smoothed series has almost half the standard deviation of returns of the unsmoothed series (and both volatilities are lower to that of the overall equity market). One of the main problems resulting from price smoothing is that it causes a substantial understatement of volatility.

The following table shows the answers:

(1) Quarter	(2) Equity Market Returns	(3) Unsmoothed Returns	(4) Strongly Smoothed Returns
1	0%	0%	0%
2	10%	6%	3%
3	0%	0%	3%
4	0%	0%	0%
Mean Returns	2.5%	1.5%	1.5%
Standard dev.	5.0%	3.0%	1.7%

(Section 15.1)

- 40% (i.e.,  $\alpha = 0.40$ ) of the current reported price depends on the current true price, 24% (i.e.,  $0.40 \times 0.60$ ) depends on the true price of the previous observation date, and 14.4% (i.e.,  $0.40 \times 0.60 \times 0.60$ ) depends on the true price of the observation date from two periods before.

(Section 15.2.1)

- $(1/0.50) = 2 \rightarrow$  True price changes should be estimated based on a price change that is 2 times larger than the most recent reported price change.

(Section 15.2.1)

- The mean quarterly return of the all-equity FTSE NAREIT is slightly higher than the corresponding mean quarterly returns of the XYZ RE Index (2.20% vs. 0.74%). The difference in standard deviations is striking (17.27% for the all-equity FTSE NAREIT versus only 4.40% for the XYZ RE Index).

The difference in the standard deviations of returns can be partially explained by the fact that, as mentioned in the exercise, the XYZ RE Index has no leverage, whereas the all-equity FTSE NAREIT reflects the returns of the levered real estate positions that are generally included in REITs. The other explanation arises from the fact that the XYZ RE Index is based on appraisals, and thus is subject to price smoothing.

(Section 15.4)

- The autocorrelation of the all-equity FTSE NAREIT returns is low, and its positive (although) small value may even have a spurious component arising from the extraordinary events that affected the real estate market in the years following 2007. This low value suggests that the market for REITs is informationally efficient. This REIT index can be considered a proxy of a true return series. On the other hand, the high value for the autocorrelation of XYZ RE Index returns is consistent with XYZ RE Index being based on appraisals, and thus subject to price smoothing.

(Section 15.4)

- Using Equation 15.9:

$$R_{t,true} = (R_{t,reported} - \rho R_{t-1,reported}) / (1 - \rho)$$

$$R_{t,true} = [4.01\% - 0.8645 \times 2.87\%] / (1 - 0.8645) = 11.28\%$$

(Section 15.4)

- Using Equation 15.9:

$$R_{t,true} = (R_{t,reported} - \rho R_{t-1,reported}) / (1 - \rho)$$

$$R_{t,true} = [-7.28\% - 0.8645 \times 0.02\%] / (1 - 0.8645) = -53.85\%$$

The -7.28% (smoothed) XYZ RE Index return in the fourth quarter of 2008 produces a striking -53.85% return in the unsmoothed return, which is closer to the true return during that quarter (proxy by the all-equity FTSE NAREIT), which fell by -38.80% during that quarter.

(Section 15.4)

- The XYZ RE Index (original smoothed data) wrongly and dangerously suggests a very low standard deviation of returns for real estate and thus, asset allocations based on these falsely low volatilities would substantially overweight real estate in a mean-variance optimization framework.

(Section 15.4.6)

- The use of XYZ RE Index returns (original smoothed data) understates the correlation of the (smoothed) returns to the returns of other asset classes. In a mean-variance framework, the combination of low volatility (already discussed in the previous exercise) with the low correlation of smoothed returns would assign weights to real estate that can be substantially higher than those corresponding to unsmoothed data.

(Section 15.4.6)

10. There are two main reasons that prevent smoothed return series from being unsmoothed by arbitrageurs. First, the return series may suggest arbitrage opportunities. For example, in the case of appraisals, they represent estimated values (and not market prices) that do not correspond to either bids to buy or offers to sell. Second, significant transaction costs or other barriers to arbitrage may prevent smoothed returns series from being unsmoothed by arbitrageurs.

(Section 15.1.2)

11. Smoothed prices understate true volatility and, therefore, the denominator of the Sharpe ratio is artificially low when using smoothed data. Given that mean returns (which go in the numerator of the Sharpe ratio) are usually only slightly affected by smoothing, the final effect will be an artificial increase in the estimated Sharpe ratio.

(Section 15.1.3)

12. Inserting the true beta and autocorrelation coefficient into Equation 15.15 generates the following equation:

$$\beta_{true} = \frac{\beta_{reported}}{1-\rho} \quad (\text{Eq. 15.15})$$

$$1.15 = \frac{\beta_{reported}}{1 - 0.45}$$

$$\beta_{reported} = 1.15 \times 0.55 = 0.6325$$

The smoothed series exhibits a much lower beta than the true return series.

(Section 15.4.5)

13. Sample selection bias.

(Section 15.7.4)

14. Hedonic-price indices.

(Section 15.7.2)

15. Repeat-sales method.

(Section 15.7.1)

16. The NCREIF NPI is calculated on an unleveraged basis. This means that the properties being included in the index are assumed to have been purchased with 100% equity. The returns to the NPI are calculated on a before-tax basis.

(Section 15.6.2)

17. The NCREIF NPI is based primarily on appraised values reported every quarter, rather than market transactions.

(Section 15.6.2)

18. The three main disadvantages of repeat-sales indices are: First, a bias may be present in the indices because the properties that are most highly represented in the construction of the index are those properties that are transacted most frequently. The problem is that these properties may be unrepresentative of all of the properties that compose the index. Second, the properties that turned over at a certain point in time may have had major improvements (and, thus, are of a different quality) that were made to smooth the progress of the transaction. Third, when the repeat-sales method is updated, it creates backward adjustments in the series of returns, with the consequence that previously estimated returns for specific years in the past might change.

(Section 15.7.1.2)

19. Every GBP increase in the depreciated cost of building in the land increases the price of one acre by GBP 1.120, every unit increase in the soil productivity index increases the price of one acre by GBP 0.183, every unit increase in the land productivity index increases the price of one acre by GBP 0.802, and every mile further distant from the city center that a lot of land is located lowers the price of one acre by GBP 2.321.

(Section 15.7.2.1)

20. Repeat-sales pricing.

(Section 15.8.1)

## Chapter 16: Investment Styles, Portfolio Allocation, and Real Estate Derivatives

### Exercises

#### Problems 1 to 4

Suppose that a U.S. real estate fund is considering incorporating the following four properties in its portfolio:

- A. An unleveraged purchase of a well-recognized and fully operating office complex located in downtown Atlanta, Georgia. The complex is currently experiencing a high occupancy rate. The fund plans to hold this property for the long-term.
  - B. A highly leveraged purchase of an unoccupied and undeveloped land located in a rural area in Alberta, Canada. The fund predicts that the lot will appreciate in the near-term as the economy in the area improves, and plans to hold it for only one to two years.
  - C. Leasing of a hotel located in Panama City, Panama. This hotel will be held for an intermediate-term sale and roll over into new properties.
  - D. A limited partnership investment in a highly leveraged development for sale of housing units for low-income families in Atlanta, Georgia.
1. According to NCREIF's (National Council of Real Estate Investment Fiduciaries) style category, how would the office complex depicted as investment A be categorized?
  2. According to NCREIF's (National Council of Real Estate Investment Fiduciaries) style category, how would the lot (investment B) be categorized?
  3. According to NCREIF's (National Council of Real Estate Investment Fiduciaries) style category, how would the hotel (investment C) be categorized?
  4. According to NCREIF's (National Council of Real Estate Investment Fiduciaries) style category, how would the development (investment D) be categorized?
  5. In terms of investment structure/control, and using NCREIF's style category, how would core attributes, value-added attributes, and opportunistic attributes properties be categorized?
  6. Compare expected returns and risks of core, value-added, and opportunistic real estate portfolios.
  7. A real estate project has a current market value of \$180 million and expected annual cash flows from rent, net of operating expenses, of \$12 million. Calculate the cap rate.

8. Suppose that in the previous problem the \$12 million annual net operating income is expected to grow at a constant rate of 3% per year forever and that the discount rate for this real estate project is 9%. Calculate the market value of the real estate project.

Problems 9 to 10

Suppose that Real Estate Fund ABC is considering purchasing a well-recognized and fully operating office building located in downtown Philadelphia, Pennsylvania. It is the first of January. Last year, the net operating income (NOI) provided by this property was \$10 million. NOI is expected to grow 10% this year, 9% during the second year, and 5% per year from the third year and until eternity. The risk-free rate, measured using the U.S. Treasury Bond yield to maturity, is 3%.

9. Analysts at Real Estate Fund ABC have estimated that the added risk of this property suggests the inclusion of a 5% risk premium above the risk-free rate. Calculate the market value of this property.
10. The current owner of the office building agrees with the estimates of future NOI growth used by analysts at Real Estate Fund ABC for this property, but considers that the risk premium used by ABC is too high and cannot be warranted by the relative stability of the rents that she argues this building provides and will continue to offer. The current owner argues that it would be more reasonable to consider adding a risk premium of 4% to this property. Calculate the market value of this office building from the point of view of the current owner.
11. What is rollover risk in real estate?
12. Suppose that the real estate quarterly return autocorrelation of a series has been calculated to be 0.70. Estimate the true annualized volatility of a return series with a smoothed volatility (quarterly) of 3.3%.
13. Assume that a smoothed return series has  $\beta$  equal to 0.30, and that the autocorrelation of the smoothed series is 0.65. What would the true but unobservable  $\beta$  of the return series be?
14. Suppose that a three-year floating-rate swap with a notional contract value of \$50 million is to be negotiated. Let us suppose that a buyer of a real estate index forecasts that real estate returns (as reflected by “XYZRE Index,” a hypothetical real estate index that includes both income and capital appreciation) will be 7.2%, 5.7%, and 4.9% during the next three years. Floating interest rates are forecasted to be 5.04%, 4.86%, and 4.69% during the next three years. Assume that no margin above the floating rate was paid for this swap. The required return for investing in real estate is 7% per year for the next three years. What is the present value of the expected payments to be paid/received by the buyer of the XYZRE Index in this swap?

15. The present value of a three-year floating rate swap on a real estate index is £3.45 million. The discount rate used to obtain this present value is 4.5%. Calculate the forecast for real estate returns by the swap buyer if LIBOR during the next three years is expected to be 5%, and the notional contract value is £40 million.

## Solutions

1. The office complex would typically be classified as a “core” investment.  
(Section 16.2)
2. The undeveloped land would typically be considered an “opportunistic” investment.  
(Section 16.2)
3. The hotel would typically be categorized as a “value-added” investment.  
(Section 16.2)
4. The development would typically be considered an “opportunistic” investment.  
(Section 16.2)
5. Properties with core attributes tend to have substantial direct control. Value-added attributes often have moderate control and offer security or a preferred liquidation position. Opportunistic properties are characterized by insignificant control, as these investment structures generally come in the form of limited partnerships and with unsecured positions.  
(Section 16.2)
6. Core portfolios should achieve relatively high income returns and display relatively low volatility. Value-added portfolios should derive a considerable part of their return from real estate property appreciation and should exhibit moderate volatility. Opportunistic portfolios are expected to achieve most of their return from the appreciation of real estate property values and may exhibit substantial total return volatility.  
(Section 16.2)
7. Isolating the cap rate from Equation 16.2:

$$\text{Value} = \text{NOI} / \text{Cap Rate} \quad (16.2)$$

The cap rate is simply \$12 million/\$180 million = 6.67%

(Section 16.5)

8. Using the formula for the present value of a perpetuity that grows at a constant rate [which in this case would be:  $\text{NOI} / (\text{Cap rate} - g)$ ], we have:

$$\text{Market value} = \$12 \text{ million} / (0.09 - 0.03) = \$200 \text{ million}$$

(Section 16.5)

9. In this case, the cap rate is equal to (equation 16.5):  $3\% + 5\% = 8\%$

To calculate the market value of the property, we need to compute the present value of the expected net operating income. NOI is expected to grow 10% this year and 9% during the second year. Therefore, we can calculate the present value of NOI for these two years.

Thereafter, NOI is expected to grow 5% per year from the third year and until eternity, and thus we can use the formula for the present value of a growing perpetuity to compute the present value of NOI from the third year and until eternity, (this formula is  $\text{NOI}/r-g$ , where  $g$  is the annual constant growth rate for NOI). In this exercise, the value  $\text{NOI}_{t=3}/r-g$  is a present value obtained two years from now. Therefore, we need to bring that value to the present.

The market value of the property is thus calculated as follows (\$ amounts in millions):

$$MV_0 = \frac{\$10(1.10)}{(1.08)} + \frac{\$10(1.10)(1.09)}{(1.08)^2} + \frac{\$10(1.10)(1.09)(1.05)}{(0.08 - .05)} \frac{1}{(1.08)^2} = \$380.25$$

According to these estimates, the market value of the property is \$380.25 million.

*Note: Review the book, Investments, by Bodie, Kane, and Marcus if you need to refresh concepts related to valuation calculations.*

(Sections 16.5 and 16.6.3)

10. In this case, the cap rate to be used is equal to (equation 16.5):  $3\% + 4\% = 7\%$

The market value is calculated as follows (\$ amounts in millions):

$$MV_0 = \frac{\$10(1.10)}{(1.07)} + \frac{\$10(1.10)(1.09)}{(1.07)^2} + \frac{\$10(1.10)(1.09)(1.05)}{(0.07 - .05)} \frac{1}{(1.07)^2} = \$570.56$$

According to these estimates, the market value of the property is \$570.56 million. Notice how using a cap rate that is just 1% lower increases the market value of the property by around 50%. Remember that these discount rates are used for cash flows that are projected until infinity and, therefore, the present value of these cash flows can be very sensitive to changes in the discount rate.

*Note: Review the book, Investments, by Bodie, Kane, and Marcus if you need to refresh concepts related to valuation calculations.*

(Sections 16.5 and 16.6.3)

11. Rollover risk in real estate generally refers to the risk that arises from:

- Changes in financing (e.g., converting a construction loan to a permanent mortgage loan),
- Changes in the nature of a real estate project (e.g., completion and full leasing of a certain project),
- Changes in ownership (e.g., this risk is particularly high for opportunistic investments, given the importance of capital appreciation for this style of real estate).

(Section 16.1)

12. Using Equation 16.3:

$$\text{True Volatility} = \text{Smoothed volatility} \times \sqrt{\frac{1+p}{1-p}}$$

$$\text{True Volatility (quarterly)} = 3.3\% \times \sqrt{\frac{1+0.70}{1-0.70}} = 7.86\%$$

Notice that the relatively high return autocorrelation of the smoothed return series causes the unsmoothed volatility to be more than double the smoothed volatility.

The annualized return volatility is:

$$\text{True Volatility (annualized)} = 7.86\% \times \sqrt{4} \text{ (quarters per year)} = 15.72\%$$

(Section 16.6.2)

13. Using Equation 16.4:

$$\beta_{\text{true series}} = \beta_{\text{smoothed series}} / (1 - \rho) \quad (16.4)$$

$$\beta_{\text{true series}} = 0.30 / (1 - 0.65) = 0.86 \text{ (rounded)}$$

(Section 16.6.2)

14. The present value of the expected payments to be received by the buyer of the XYZRE Index in this swap during the next three years is equal to the difference in each of the

three years between the expected returns on the real estate index and the expected floating rate, multiplied by the notional value of the contract and brought to the present at the discount rate:

$$PV_{\text{Swap Buyer}} = \frac{(7.2\% - 5.04\%) \times \$50 \text{ million}}{(1.07)} + \frac{(5.7\% - 4.86\%) \times \$50 \text{ million}}{(1.07)^2} + \frac{(4.9\% - 4.69\%) \times \$50 \text{ million}}{(1.07)^3} = \$1,461,901$$

The total present value of the expected payments for the three years is \$1,461,901.

(Section 16.8.1)

15. First, we need to calculate the annual constant expected cash flows that the swap buyer is expecting to receive:

$$\frac{\text{Expected cash flow}}{(1.045)} + \frac{\text{Expected cash flow}}{(1.045)^2} + \frac{\text{Expected cash flow}}{(1.045)^3} = £3.45 \text{ million}$$

Solving for expected cash flows = £1,255,018. Notice that the present value of the three-year floating rate swap is positive, and thus the swap buyer is expecting to receive positive annual payments from the swap.

Second, using the estimated constant expected annual cash flows, we can infer the annual real estate returns that the swap buyer is expecting to earn as follows:

$$[E(R_{RE}) - 5\%] \times £40,000,000 = £1,255,018$$

Solving for  $E(R_{RE}) = 8.14\%$  (rounded)

(Section 16.8.1)

## Chapter 17: Listed versus Unlisted Real Estate Investments

### Exercises

1. In the U.K., what are property unit trusts (PUTs)?
2. List the six advantages of real estate funds.
3. What are the three main criticisms that non-traded REITs have received?
4. Why do unlisted real estate funds suffer from cash drag?
5. The book documents a much wider dispersion of real estate market-based returns relative to appraisal-based returns. Is the lower accuracy of market prices relative to smoothed appraisals a reason for this?
6. State the steps that an arbitrageur would follow when an exchange-traded fund (ETF) becomes overpriced relative to its net asset value (NAV).
7. Pension Fund ABC is a U.S. pension fund that has previously only invested in traditional investments. ABC is considering allocating funds to real estate, given the perceived low volatility of this asset class. To this end, ABC hires a consultant to determine the potential diversification benefits of being exposed to real estate by investing in real estate investment trusts (REITs). ABC is concerned about the high volatility levels experienced by REITs during the recent financial crisis. More specifically, ABC's analysts are perplexed when they learn that the NAREIT index shot up almost 100% in 2009 after having plummeted in 2008, and wonder whether these numbers reflect the true evolution of real estate prices. They ask the consultant for an explanation. The consultant replies that *"this price increase represents the true changes in the values of real estate properties adjusted for the effects of leverage."* Is the consultant's assessment on the behavior of real estate prices during the financial crisis correct?

### Problems 8 to 11

ETF XYZ is a hypothetical ETF comprised of five stocks. Each stock trades at \$2 and the ETF trades at \$10. ETF XYZ tracks an index (Index XYZ) consisting of the same five stocks, but ten shares of each stock are in the index. The index is currently at 100. For simplicity, ignore interest rates, margin requirements, commissions and transaction costs. Consider the three hypothetical scenarios for the next trading day ( $t=1$ ) depicted in problems 8 to 10.

8. Suppose that on the next trading day ( $t=1$ ), Index XYZ declines 10%, each of the stocks that make up ETF XYZ decline to \$1.80, and ETF XYZ declines to \$8. Is there an arbitrage opportunity? If so, what steps would an arbitrageur follow? What would be the arbitrage profit?

9. Suppose that on the next trading day ( $t=1$ ), Index XYZ declines 10% (i.e., from 100 to 90), each of the stocks that make up ETF XYZ decline to \$1.80, and ETF XYZ declines to \$9. Is there an arbitrage opportunity? If so, what steps would an arbitrageur follow? What would be the arbitrage profit?
10. Suppose that on the next trading day ( $t=1$ ), Index XYZ increases 10% (i.e., from 100 to 110), each of the stocks that make up ETF XYZ rises to \$2.20, and ETF XYZ rises to \$11.50. Is there an arbitrage opportunity? If so, what steps would an arbitrageur follow? What would be the arbitrage profit?
11. For the previous exercise, explain how the actions of arbitrageurs would eliminate any potential arbitrage profits.
12. Why would institutions with long-term horizons (e.g., endowments) view Real Estate Investment Trusts (REITs) as risky investments compared to private real estate investments?

## Solutions

1. Property unit trusts (PUTs) are unlisted investment vehicles comprised of a portfolio of properties held in the name of a trust. PUTs are the most important open-end investment product used by pension funds and insurance funds to obtain exposure to the U.K. real estate market. The prices of PUTs are calculated using appraisals.

(Section 17.1.1)

2. The six advantages of listed real estate funds are:
  1. They help diversify real estate specific risk (similar to the case of unlisted real estate funds).
  2. These types of funds are liquid and divisible.
  3. They provide instant exposure to a real estate portfolio.
  4. They convey information to the investors.
  5. Some listed real estate funds allow the targeting of subsectors or regions (similar to the case of unlisted real estate funds).
  6. They provide tax benefits, such as exemption from corporate taxes (similar to the case of unlisted real estate funds).

(Section 17.2.3)

3. First, the illiquidity of non-traded REITs may give the false impression of low return volatility. Second, these types of REITs command high fees and frequently entail significant conflicts of interests. And third, leverage is often used to finance current

dividend payments. This practice sometimes conceals their inability to generate future dividends.

(Section 17.2.6)

4. Unlisted real estate funds suffer from cash drag because cash invested by investors in these types of funds will most likely not be drawn by the fund manager right away. Instead, cash will be drawn from investors as it is required by the fund to buy real estate assets. As a result, investors will not attain immediate full exposure to real estate assets when they provide cash to unlisted real estate funds.

(Section 17.1.5)

5. The answer is no. The correct answer would be: Lower accuracy of smoothed appraisals relative to market prices.

(Section 17.3.2)

6. When an ETF becomes overpriced relative to its NAV, an arbitrageur would (1) short-sell the ETF in the market, (2) buy eligible and representative shares for the ETF's underlying portfolio, (3) convey the shares to the corresponding fund in exchange for the acquisition of new shares in the ETF, and (4) use the new ETF shares to cover the original short position in the ETF.

(Section 17.4.2)

7. The consultant's assessment is not necessarily correct. His assessment, which would imply that REIT prices are informationally efficient, is only one of the two primary interpretations of the return divergence that has been amply documented between real estate property prices and REITs. The other potential explanation to this return divergence, which is not mentioned by the consultant, is that the REIT's returns and their high volatility may emanate from a risk source that is uncorrelated with the underlying economic fundamental factors affecting real estate property prices, such as volatility in the U.S. stock market driven by illiquidity and market stress. As stated in the book, there is considerable disagreement on which of these two explanations is more accurate. A third explanation that has also been proposed argues that the real estate market is segmented (defined as differences in pricing of similar assets trading in separate markets, attributable to the differences in the markets themselves).

(Section 17.4.4)

8. At  $t=0$ , there were no arbitrage opportunities. At  $t=1$ , Index XYZ declined 10% (from 100 to 90), each of the stocks that make up ETF XYZ also declined 10% to \$1.80, but shares of the ETF declined more (20%, from \$10 to \$8). ETF XYZ is therefore trading at a discount to its NAV and an arbitrageur would:

- Buy shares of ETF XYZ in the market. Let us suppose that the arbitrageur buys 1 ETF share for \$8.
- Tender the shares of ETF XYZ in exchange for shares in the ETF's underlying portfolio of stocks.
- Sell the shares received from the tender into the market. Since each of the stocks in the portfolio is trading at \$1.80, the arbitrageur would receive \$9 (i.e.,  $\$1.80 \times 5$ ). This generates an arbitrage profit of \$1 for each ETF.

(Section 17.4.2)

9. We were originally at an equilibrium situation, and now the index, the ETF and the stocks that constitute the ETF, all declined 10%. Therefore, there are no arbitrage opportunities in this case. The ETF is trading at the value that corresponds to its net asset value (NAV).

(Section 17.4.2)

10. At  $t=0$ , there were no arbitrage opportunities. At  $t=1$ , Index XYZ increased 10% (from 100 to 110), each of the stocks that make up ETF XYZ rose to \$2.20, but shares of ETF XYZ rose proportionally more (15%, from \$10 to \$11.50). ETF XYZ is trading at a premium to its NAV and an arbitrageur would:

- Short-sell the ETF in the market. Let us suppose that the arbitrageur short-sells 1 ETF share for \$11.50.
- Buy the shares of the five stocks that make up the ETF's underlying portfolio. At \$2.20 each, this amounts to \$11.
- Convey the shares to the ETF in exchange for the acquisition of new shares in ETF XYZ.
- Use the new ETF shares to cover the original short position in the ETF. This generates an arbitrage profit of \$0.50 for each share of the ETF.

(Section 17.4.2)

11. By short selling ETF shares, arbitrageurs will drive down the price of ETF XYZ until any overvaluation of this ETF with respect to its NAV disappears.

(Section 17.4.2)

12. Institutions such as endowments, which have long-term horizons, may perceive private (i.e., unlisted) real estate investments as having relatively low risk given their steady cash flow and low volatility in values in the long-term, when these investments might need to be liquidated. REITs, on the other hand, may be perceived as riskier due to the ample fluctuations exhibited by their market prices. Note that this is a question that deals with the important concepts of market segmentation and market clientele.

(Section 17.4.5)

## Chapter 18: International Real Estate Investments

### Exercises

#### Problems 1 to 2

A building has a \$15,000,000 depreciable base that will be evenly depreciated over 15 years (using straight-line depreciation). The marginal tax rate is 35% and the discount rate is 7%.

1. Calculate the present value of the 15-year tax shield.
2. Assuming that the building is sold after 15 years for a value above its original cost, what would be the net gain to the taxpayer from being able to deduct depreciation? Note: Assume that both the tax rate and the discount rate remain at 35% and 7%, respectively.

#### Problems 3 to 8

An investment grows at 8% per year (pre-tax) during 10 years. Gains are taxed at 30% per year.

3. Calculate the future value of this investment if taxes are paid yearly.
4. Calculate the future value of the investment if taxes can be deferred.
5. Calculate how much more profit is allowed by the tax deferral.
6. Calculate the after-tax rate with deferral.
7. How much does the after-tax deferral of gains help increase after-tax gains?
8. What is the pre-tax equivalent to the after-tax gains with tax deferral?
9. Why might an investor's relationship with real estate managers be particularly important in the case of direct property ownership through partnerships with a small number of investors?
10. A U.S. real estate investor purchases a lot of land in Canada for 50,000,000 Canadian dollars (\$C). The spot exchange rate is \$C 1 = USD 1. If the price of this lot of land is expected to increase 8% per year (in \$C) and the Canadian dollar is expected to lose 5% per year with respect to the U.S. dollar, calculate the expected value of the property two years from now from the U.S. investor's point of view. Ignore any transaction costs. The investor has decided not to hedge the currency risk of this investment.

11. Suppose the case of a real estate investment held by a taxpayer who is in a 30% tax bracket on all income. The investor is considering a property that offers €2 million per year in depreciation over the next ten years. However, the depreciation will be recaptured for tax purposes when the property is sold at the end of ten years. Assuming an interest rate of 6.50%, what is the present value of the combined tax effects of depreciating the property and recapturing the depreciation? Assume, for computational simplicity, that the tenth and final year of depreciation is both deducted and recaptured in the tenth year.
12. Suppose that an investor is comparing the after-tax rates of return on an investment offering a pre-tax return of 4.70% per year in USD. Inside one investment wrapper, the return is fully taxed each year. Another wrapper defers taxation until the funds are withdrawn. The investor has a 12-year investment horizon and is in a 25% tax bracket on all income. Compute the after-tax returns of the investment using both wrappers.
13. An investment with a ratio of assets to equity (i.e., leverage) factor of 3.05 has a variance of returns of the underlying assets equal to 0.05. What is the variance of the returns of the levered equity?
14. A European investor purchases a U.S. property and values that property at the beginning of the year as being worth 20 million U.S. dollars. The investor expects that the property's value will remain constant a year from now when measured in U.S. dollars. The investor is confident that the property will generate a 5% cash flow during the year (in U.S. dollars) but wishes to know the total return (in Euros) under the following two scenarios: (1) if the euro appreciates 3% relative to the U.S. dollar, and (2) if the euro depreciates 4% relative to the U.S. dollar. Find the total return measured in Euros for each scenario. The investor has decided not to hedge the currency risk of this investment.
15. A Japanese investor that purchased a property in the U.S. is concerned about the total return of the property when expressed in Japanese Yen. The investor considers that the U.S. dollar total return has a standard deviation of 18% and estimates that the standard deviation of the exchange rate between the Yen and the U.S. dollar is 12%. Find the total variance of the Yen-based return of the property under the following scenarios regarding the covariance between the foreign exchange rate and the return on foreign real estate: (1) covariance = 0%, (2) covariance = 1%, and (3) covariance = 0.5%.
16. Suppose that a real estate investment company based in the U.K. has just invested \$40 million in a property located in the U.S. The combined potential gross income of the first year of operations has been estimated at \$3,000,000. However, it is unlikely that the property will be fully occupied all year round, and a 12% vacancy loss rate has been estimated. The fixed and variable expenses of the property for the first year of operations were estimated at \$370,000 and \$480,000, respectively. The current exchange rate \$/£ is 1.30. Calculate the estimated return on the first year to the U.K. company, assuming that the property value is expected to be the same a year from now (in U.S. dollars), and that the British pound is expected to appreciate 2% with respect to the dollar during the first year. The British company has decided not to hedge the currency risk of this

investment. Ignore taxes for simplicity and assume that income and expenses occur at the end of the year.

17. Suppose that a real estate investment company based in Belgium has investments in commercial real estate in Boston, Massachusetts, and in Miami, Florida. If the standard deviation of the returns of the €/€ is estimated to be 14%, the standard deviation of the returns of the portfolio of U.S. properties is 13% (when computed in U.S. dollars), and the correlation coefficient between the €/€ returns and the U.S. property returns is 0.05, calculate the total risk (standard deviation) of this investment from the point of view of the Belgian real estate investment company, assuming that currency risk is not hedged.

## Solutions

1. This building will allow deduction of an annual depreciation of \$1,000,000 per year [i.e., \$15,000,000 x (1/15)]. At a marginal tax rate of 35%, using formula 18.1 the annual depreciation tax shield is \$350,000 per year:

$$\text{Depreciation tax shield}_t = \text{Depreciation}_t \times \text{Tax}_t \quad (18.1)$$

The present value of the tax shield is:

$$\text{PV Depreciation Tax Shield} = \sum_{t=1}^T \frac{\text{Depreciation}_t \times \text{Tax}_t}{(1+Rf)^t} \quad (18.2)$$

At a discount rate of 7%, using formula 18.2 the present value of the 15-year tax shield is \$3,187,770 (i.e.,  $n = 15$ ,  $i = 7\%$ ,  $PMT = \$350,000$ ,  $FV = 0$ , compute  $PV$ ).

(Section 18.2.4)

2. In this case, the taxpayer will owe taxes on the recaptured depreciation of \$15,000,000. Given a tax rate of 35% and a discount rate of 7%, this tax liability of \$5,250,000 (i.e.,  $\$15,000,000 \times 0.35$ ) in 15 years has a present value of  $\$5,250,000/(1.07)^{15}$ , or \$1,902,842. Thus, the net gain to the taxpayer from being able to deduct depreciation is  $\$3,187,770 - \$1,902,842 = \$1,284,928$ .

(Section 18.2.4)

3. In this case, the investment would grow at:

$$\text{After-tax rate without tax deferral} = r \times (1 - \text{Tax Rate}) \quad (18.3)$$

$$\text{After-tax rate without tax deferral} = r \times (1 - \text{Tax Rate}) = 8\% \times (1 - 0.30) = 5.6\%$$

A dollar invested for 10 years earning 5.6% per year would grow to  $\$1 \times (1.056)^{10} = \$1.7244$  (or  $\$1 + \$0.7244$ ) in 10 years.

(Section 18.2.4)

4. \$1 growing for 10 years at 8%, with gains taxed at 30% at the end of 10 years, would grow as follows:

$$\text{After-tax rate with tax deferral} = [1 \times [(1 + r)^T - 1] \times (1 - \text{Tax Rate})] + 1$$

$$\text{After-tax future value of \$1} = [\$1 \times (1.08^{10} - 1) \times (1 - 0.30)] + 1 = \$1 + \$0.8113 = \$1.8113.$$

(Section 18.2.5)

5. In this example, the tax deferral allows accumulation of 12% more profit compared to the previous problem  $[(\$0.8113 - \$0.7244) / \$0.7244]$ .

(Sections 18.2.4 and 18.2.5)

6. The general formula for the after-tax rate using an annual taxation of gains that is equivalent to earning  $r^0\%$  for T years with tax deferral is:

$$\text{After-tax rate with tax deferral} = [1 + [(1 + r)^T - 1] \times (1 - \text{Tax Rate})]^{1/T} - 1 \quad (18.4)$$

$$\text{After-tax rate with tax deferral} = [1 + [(1 + 0.08)^{10} - 1] \times (1 - 0.30)]^{1/10} - 1 = 6.12\%$$

(Section 18.2.5)

7. Tax deferral of gains has the effect of increasing the after-tax gains from 5.6% to 6.12%.

(Sections 18.2.4 and 18.2.5)

8. The pre-tax rate equivalent to 6.12% after-tax is found by dividing by  $(1 - \text{Tax})$ :

$$6.12\% / (1 - 0.30) = 8.74\%. \text{ Thus, tax deferral of gains relative to annual taxation of gains is equivalent to being able to earn 8.74\% pre-tax rather than 8\%.}$$

(Section 18.2.4)

9. An investor's relationship with real estate managers may be particularly important in this case, because the real estate investor cannot rely on other investors to control and monitor the real estate manager. Compare this situation to the case of public equity investing, where an investor can remain passive in most cases.

(Section 18.3.1)

10. A U.S. investor would consider the value of the land in U.S. dollars. Therefore, from the U.S. investor's point of view, two years from now the property is expected to be worth (applying Equation 18.7 to a two year setting):

$$\text{\$C } 50,000,000 \times (1 + r)^2 \times (1 + fx)^2 = \text{\$C } 50,000,000 \times (1 + 0.08)^2 \times (1 - 0.05)^2 =$$

USD 52,633,800

(Section 18.3.5)

11. The benefit is a ten-year €600,000 annuity found by multiplying the annual depreciation amount by the tax rate (i.e., €2 million x 0.30, Equation 18.1). The cost is the need to pay taxes at the end of ten years on \$20 million (i.e., €2 million x 10 years), of recaptured depreciation (i.e., €6 million). The benefits and costs can be computed in a single step with an annual payment of €600,000, a future value of –€6 million,  $N = 10$ , and interest rate = 6.50, for a net benefit (present value) of €1,116,941.92. This amount may be viewed as the value of an interest-free loan generated by the tax shield.

(Section 18.2.4)

12. The wrapper with annual taxation is computed using Equation 18.3 as  $4.70\% \times (1 - 0.25) = 3.53\%$  (rounded). The wrapper with deferred taxation is computed using the following equation from Section 18.2.5 (we already used the equation in Exercise 4):

$$\text{After-tax rate with tax deferral} = \left[ \left[ 1 \times \left[ (1 + r)^T - 1 \right] \times (1 - \text{Tax Rate}) \right] + 1 \right]$$

$$\text{After tax future value of \$1: } \left[ \left[ \$1 \times (1.0470^{12} - 1) \times (1 - 0.25) \right] + 1 \right] = \$1 + \$0.5514 = \$1.5514$$

(Section 18.2.5)

13. Use Equation 18.6:

$$\sigma_{lev} = L \times \sigma_{assets} \quad (18.6)$$

Note that the asset variance needs to be converted to a standard deviation (volatility) by taking the square root:  $L \times \sigma_{assets} = 3.05 \times (0.05^{0.5}) = 0.682$ . The resulting standard deviation is converted to a variance of the levered equity by squaring to generate 0.4651.

(Section 18.2.7)

14. Under the scenario of a 3% appreciation in the euro relative to the U.S. dollar, the total return in Euros (approximate) would be 2%, found as the sum of the 5% U.S. dollar return minus the 3% strengthening in the euro relative to the dollar. Under the scenario of a 4% depreciation in the euro, the total return in Euros (approximate) would be 9% (i.e., 5% dollar cash return + 4% euro depreciation). The exact answer can be found using equation 18.7:

Under the scenario of a 3% appreciation in the euro relative to the U.S. dollar, the total return in Euros (approximate) would be:  $1 \times (1 + r) \times (1 + fx) = [\$1 \times (1 + 0.05) \times (1 - 0.03)] - 1 = 1.85\%$

Under the scenario of a 4% depreciation in the euro, the total return in Euros (approximate) would be:  $1 \times (1 + r) \times (1 + fx) = [\$1 \times (1 + 0.05) \times (1 + 0.04)] - 1 = 9.2\%$

(Section 18.3.5)

15. Equation 18.8 expresses the variance of the investor's total return viewed in the investor's home currency as the sum of two variances (i.e., the variance of the foreign exchange rate and the variance of the foreign real estate asset return in its currency), and twice the covariance between the two:

$$\sigma_d^2 = \sigma_{fx}^2 + \sigma_r^2 + 2 \text{cov}(fx, r) \quad (18.8)$$

First, note that the variances are 0.0324 (i.e.,  $0.18^2$ ) and 0.0144 (i.e.,  $0.12^2$ ). For scenario 1, the total variance is the sum of the variances:  $0.0324 + 0.0144 = 0.0468$ . Under scenario 2, the total variance adds in twice the covariance for a total of 0.0668. Finally, for scenario 3, the total variance is  $0.0568$  [i.e.,  $0.0324 + 0.0144 + (2 \times 0.5\%)$ ].

(Section 18.3.5)

16. From CAIA Level I, we know that the effective gross income from the property in the first year is expected to be  $\$3,000,000 - (\$3,000,000 \times 0.12) = \$2,640,000$ . The fixed and variable expenses of the property were estimated at  $\$370,000$  and  $\$480,000$ , respectively, for a total operating expense of  $\$850,000$  for the first year. Thus, the net operating income (NOI) arising from this property in the first year is estimated to be:

$$\begin{aligned} \text{NOI} &= \text{Effective gross income} - \text{Operating expenses} \\ &= \$2,640,000 - \$850,000 = \$1,790,000 \end{aligned}$$

Therefore, the expected return on the investment during the first year, expressed in dollars, is equal to  $\$1,790,000/\$40,000,000 = 4.48\%$ .

However, the British company needs to calculate the returns in pounds, given that its domestic currency is the British pound. Considering that the pound is expected to appreciate 2% with respect to the dollar, at the end of the year the NOI, expressed in pounds, will be  $\$1,790,000 \times (1/1.30 \text{ \$/\pounds}) \times (1 - 0.02) = \pounds 1,349,385$  (rounded). This provides an expected return (in pounds) equal to  $\pounds 1,349,385/[\$40 \text{ million} \times (1/1.30 \text{ \$/\pounds})] = 4.39\%$  (rounded). Notice that we could have obtained this same result by multiplying the return obtained earlier and expressed in U.S. dollars by 1 minus the expected appreciation of the pound with respect to the U.S. dollar:  $4.48\% \times (1 - 0.02) = 4.39\%$

(Section 18.4.1)

17. The total risk of this investment from the point of view of the Belgian company is the variance of the international real estate investment return, expressed in domestic currency terms (i.e., in € for a Belgian-based company) or  $\sigma_d^2$ :

$$\sigma_d^2 = \sigma_{fx}^2 + \sigma_r^2 + 2 \operatorname{cov}(fx, r) \quad (18.8)$$

Given that  $\rho_{fx,r} = \frac{\operatorname{cov}(fx, r)}{\sigma_{fx}\sigma_r}$ , we can find

$$\operatorname{cov}(fx, r) = 0.05 \times 0.14 \times 0.13 = 0.000910$$

Therefore,

$$\sigma_d^2 = \sigma_{fx}^2 + \sigma_r^2 + 2\operatorname{cov}(fx, r) = 0.14^2 + 0.13^2 + 2 \times 0.000910 = 0.03832$$

The standard deviation of the international real estate investment returns is 19.58% (rounded), which is the square root of the variance 0.03832.

(Section 18.3.5)

## Chapter 19: Infrastructure as an Investment

### Exercises

1. What are public–private partnerships (PPPs)? What is project finance?
2. List the twelve attributes of infrastructure as defensive investments.
3. What are the equity and debt infrastructure financing options/vehicles available?
4. Which infrastructure investments are often viewed as a close proxy for core real estate assets? Why?
5. Which infrastructure investments are often viewed as a close proxy for opportunistic real estate assets? Why?
6. Explain the correlation and the beta between infrastructure investments and the overall equity market.
7. How can a passive management strategy be applied by an infrastructure fund?

### Solutions

1. A PPP is a government service or private business venture for providing a public asset or service that is funded and operated through a partnership between a government and one or more private companies.

Project finance is the long-term financing of projects by a number of investors or sponsors that provide loans to the operation. The financing costs are serviced fully by the cash flows from the project and are usually non-recourse loans guaranteed by all of the assets of the project, including the revenue-producing contracts.

(Section 19.1.4)

2. The twelve attributes of infrastructure as defensive investments are:
  - Inelastic demand
  - Monopolistic market positions
  - Regulated entities
  - Capital-intensive setup, low operating costs
  - Low volatility of operating cash flows
  - Resilience to economic downturns

- Technology risk
- Long-term horizons
- Inflation-indexed cash flows
- Stable yield
- Low correlation with other asset classes
- Attractive risk-adjusted returns

(Section 19.3)

3. The equity infrastructure financing options are: listed (infrastructure stocks) and unlisted (infrastructure project/SPE).

The debt infrastructure financing options are: Capital market (government infrastructure bonds, corporate bonds, and project bonds), and private debt (loans to infrastructure companies and project loans).

(Section 19.4)

4. Infrastructure businesses such as oil pipelines, electricity transmission cables, and roads bear some analogy to core real estate assets. This is because the stable cash flows generated by this type of mature infrastructure assets are similar to the rental income flows provided by core real estate. However, infrastructure assets usually have more potential for upside and downside variation than the fixed rentals in core real estate.

(Section 19.6.2)

5. Infrastructure greenfield projects, such as constructing new airports, new power plants, or maritime facilities, have a distinctive developmental component that is sometimes viewed as a close proxy for opportunistic real estate. Remember, however, that real estate can often be riskier than infrastructure at the development stage. The riskiness will depend on asset-specific risks and the degree of mitigation.

(Section 19.6.2)

6. Private infrastructure assets tend to exhibit low beta and a weak correlation to the overall equity markets. This is because the performance of infrastructure investments is less influenced by changes in demand and market cycles compared to the case of equity investments in elastic goods. It must be noticed that while price smoothing may explain some of the apparent low correlation between unlisted infrastructure investments and equity markets and other asset classes, the true correlation is nonetheless likely to still be fairly low due to the relative stability of their cash flows.

(Section 19.3.11)

7. A passive management strategy can be applied by an infrastructure fund when the manager holds a minority stake in a company or portfolio of companies and leaves the decision making and the management of the assets to another investor or government shareholders.

Passive managers can hold a larger number of investments within their portfolios because they may be able to make smaller individual investments. They also monitor their companies or portfolio of companies closely and offer input on certain areas such as financing. Many managers are open to active or passive management, although they may have a bias towards one of the two styles.

(Section 19.5.2)

## Chapter 20: Farmland and Timber Investments

### Exercises

#### Problems 1 to 6

Pension fund XYZ is a U.S. pension fund that has only invested in traditional investments until now. XYZ is considering allocating funds to real estate assets, including farmland and timber investments. To this end, XYZ hires a consultant to determine the potential diversification benefits of being exposed to farmland and timber investments. The pension fund is also interested in knowing the following specific aspects related to these investments: how their returns are measured, whether these returns are correlated or uncorrelated to changes in inflation and currency fluctuations, the potential effects that on these investments may have world population and diet consumption dynamics, and whether there are benefits to accessing farmland and timber investments by investing in agriculture-related equities. The consultant has just handed in a report to pension fund XYZ addressing these questions.

1. At the beginning of the report, the consultant comments that in NCREIF's farmland index ... *"Investment returns are reported on a leveraged basis; while there may be properties in the index that have no leverage, returns are reported as if there is leverage."* Is this comment correct? Explain
2. The consultant states that... *"Empirical evidence suggests that investments in farmland are a good inflation hedge."* Is this statement correct? Explain.
3. The consultant comments that... *"Empirical evidence suggests that a stronger dollar is associated with decreases in land prices in the U.S."* Is this statement correct? Explain.
4. The consultant predicts that... *"It is expected that diets around the world will continue to be shifting towards lower per capita meat consumption, thus causing a decreased demand for feed grains."* Is this prediction consistent with the literature discussed in the book? Explain.
5. The consultant suggests that... *"It is also possible to access commodity-oriented returns via investment in agricultural companies with listed equities. Agriculture-related equity investments are active at all points in the value chain and have a very low market beta."* Is the consultant's assertion on the market beta of agricultural equities correct? Explain.
6. The consultant suggests that... *"Coastal farmland returns have significantly different macroeconomic sensitivities than core farmland in primarily agricultural states."* Is this comment correct? Explain.

7. Why could currency hedging be particularly costly when a U.S. institution invests in timber in emerging markets?
8. A parcel of farmland experiences no change in the percentage of solar radiation captured by the crop canopy or its units of total solar radiation. A new seed would cause a 10% increase in the crop yield and allow the crop to experience a 15% increase in photosynthetic efficiency. What would be the change in the percentage of the total dry matter of the crop that is harvestable?

## Solutions

1. This comment is incorrect because investment returns are reported on an unleveraged basis. Also, while there may be properties in the index that have leverage, returns are reported as if there is no leverage.

(Section 20.4.3)

2. This statement is correct. Farmland is expected to be a hedge against inflation because it is a real asset that is related to food and energy production. Farmland should be a good inflation hedge because its supply is largely inelastic and increasing valuations will lead to relatively marginal increases in supply.

(Section 20.1.1)

3. This statement is incorrect because empirical evidence shows that a stronger dollar is associated with *increases* in land prices in the U.S. This may be due to a stronger dollar being a proxy for monetary policy, or may be a reflection on both land values and the price of the dollar of the impact of increased external demand for U.S. farm products.

(Section 20.4.2)

4. This prediction is inconsistent with the literature discussed in the book. The evidence suggests that diets have actually experienced a shift towards *higher* per capita meat consumption. This higher per capita meat consumption throughout the world will increase demand for feed grains. The degree to which this increased demand might not be fulfilled by superior crop yields will create pressure for the expansion of farmland.

(Section 20.2.2)

5. This assertion is incorrect. Empirical evidence actually suggests that a significant component of returns to agricultural equity investments is equity market beta. Market risk either needs to be hedged out, or accepted as a significant dilution to the expected benefits of investing in agriculture-related assets.

(Section 20.3.1)

6. This comment is correct. According to Geman and Martin (2010), one major factor that tends to be present in coastal farmland, and which can partially explain this difference, is urbanization and residential or commercial real estate use value.

(Section 20.4.3)

7. Currency hedging can be costly for two main reasons in the case of timber investments in emerging markets. First, there is the long-term nature of timber investments. This first reason also applies to developed markets. Second, investors have the problem that arises from the difficulty of hedging currency risk in a number of emerging markets (e.g., lack of enough currency derivatives, illiquidity, and transaction costs).

(Section 20.6.3)

8. Using Equation 20.1 (but expressed in terms of changes), the change in the crop yield can be expressed as the product of the increase (>1) or decrease (<1) in each of the four components:

$$\Delta Y / Y = \Delta S / S \times \Delta I / I \times \Delta E / E \times \Delta H / H \quad (20.1)$$

Where:

$Y$  = yield

$S$  = total solar radiation over the area per period

$I$  = fraction of solar radiation captured by the crop canopy

$E$  = photosynthetic efficiency of the crop (total plant dry matter per unit of solar radiation)

$H$  = harvest index (fraction of total dry matter that is harvestable)

With  $\Delta Y / Y = 1.10$  and  $\Delta E / E = 1.15$ ,  $\Delta H / H$  must equal 0.9565 (i.e.,  $1.10/1.15$ ), indicating a 4.35% decline (i.e.,  $0.9565 - 1$ ) in the percentage of the total dry matter of the crop that is harvestable.

(Section 20.3.2)

## Chapter 21: Investing in Intellectual Property

### Exercises

1. Describe the post-production film stage.

#### Problems 2 to 5

*Four Cats Production, LLC* is currently in the pre-production phase of its fifth feature film, a horror movie that is expected to appeal to a wide range of audiences, both in the U.S. and internationally. The company is seeking investors who are interested in investing in the movie, which is scheduled to begin production in September 2016. The company estimates a budget of U.S. \$1,000,000 for producing the film. The investment proposal offered by *Four Cats Production, LLC* includes, among others, the assertions commented in the following questions.

2. “Investors may be aware that the majority of movie productions in the U.S. film industry are profitable.” Is it this correct? Explain.
3. “This is a horror movie, and evidence suggests that this is among the least risky of the film genres.” Is it this assertion correct? Explain.
4. “We expect that the theatrical exhibition of our production in the U.S. will last for a year.” Is it this prediction reasonable? Why?
5. “We plan to produce a sequel if the film is successful. Evidence in the film industry suggests that sequels tend to generate greater revenues and have lower risk” Is it this assertion correct? Explain.

#### Problems 6 to 7

6. Suppose that a hedonic pricing model has been estimated for the oil painting prices of a hypothetical artist during a certain period of time using the following equation:

$$P = B_0 + B_1A + B_2Y + B_3DNY + B_4DD$$

Where:

$P$  = Price of the painting in US\$

$A$  = Total area of the painting (in square inches)

$Y$  = Year in which the auction of the painting took place (measured as 1990 =1, 1991 = 2, etc.)

$DNY$  = A Dummy variable that takes the value of 1 if the painting was auctioned in New York City and 0 if it was auctioned in London.

$DD$  = A Dummy variable that takes the value of 1 if the painting was executed before 1995 or 0 if it was executed after 1995.

Using Ordinary Least Squares, we get the following estimated equation (p-values in parenthesis):

$$P = 32,456 + 17.5A + 84.3Y + 6.1DNY + 133.9DD; R^2 = 0.61$$

(0.043) (0.079) (0.563) (0.098)

Interpret the values of the coefficients obtained in the regression.

7. Are the regression coefficients of the variables obtained in the regression statistically significant at 5%?
8. What is the masterpiece effect in the art markets? Is it empirically observed?
9. What are the regulatory risks to investing in patents?
10. Describe the available empirical evidence regarding returns on R&D.

## Solutions

1. This is the final stage of film production. In this stage, the video/film is assembled by the video/film editor (film editing, scoring, titles and credits, dubbing, special effects, soundtrack music rights or composition), and the film is released to cinemas.

(Section 21.2.2)

2. It is incorrect. In the case of the film industry, and similar to venture capital, profitability is highly skewed to the right. This means that a small percentage of films have a very high profitability, while the remaining large percentage has little or no profitability.

(Section 21.2.5)

3. It is correct. Evidence presented in the book suggests that horror movies are the least risky of all genres.

(Section 21.2.5)

4. This prediction is unreasonable. Evidence suggests that the window of theatrical exhibitions is around six months. One year is too optimistic.

(Section 21.2.1)

5. This assertion is correct. According to empirical evidence, sequels are associated with greater revenues and lower risk.

(Section 21.2.4)

6. For every square inch increase in the total area of a painting, the price of the painting increases by \$17.5

For every year increase in the auction date, the price of the painting increases \$84.3.

If the auction takes place in New York City, the painting is worth \$6.1 more.

If the work of art was executed before 1995, the painting is worth \$133.9 more.

*Note: Remember that the hedonic pricing model was also presented in Chapter 15 in the context of real estate investments.*

(Section 21.3)

7. The only regression coefficient that is significant at 5% is the coefficient that corresponds to the area of the painting (i.e.,  $0.043 < 0.05$  or 5%).

Neither the coefficient for the year in which the auction of the painting took place nor the coefficient for the Dummy variable that takes the value of 1 if the painting was executed after 1995 are statistically significant at 5%. However, they are both statistically significant at 10% (i.e.,  $0.10 > 0.079 > 0.05\%$ , and  $0.10 > 0.098 > 0.05\%$ ).

The coefficient for the Dummy variable that takes the value of 1 if the painting was auctioned in New York is not statistically significant at 5% (i.e.,  $0.563 > 0.05$ ).

*Note: Remember that the hedonic pricing model was also presented in Chapter 15 in the context of real estate investments.*

(Section 21.3)

8. The masterpiece effect conjectures that the returns to the most expensive works of art are qualitatively different from the rest of the market. Of six studies evaluated by Ashenfelter and Graddy (2006), only one finds a positive masterpiece effect.

(Section 21.3.3)

9. Patents are government-issued rights, and as such, there always exists the risk that a government either changes the corresponding intellectual property authority or imposes new regulations on licensing/sales activities.

(Section 21.4.8)

10. Empirical evidence suggests that the private returns to R&D are positive and greater than those of other forms of capital investment.

(Section 21.4.1)

## Chapter 22: Key Concepts in Commodity Markets

### Exercises

1. Why does the primary focus on commodity investments tend to be on commodity futures markets?
2. What is convenience yield?

### Problems 3 to 7

Suppose the current cash price of one barrel of Brent crude oil is \$90, while the four-month futures price is \$87 per barrel. The annual storage cost is 6% and the annual cost of funding is 5%.

3. Calculate the implied convenience yield.
4. Calculate the total cost of carry for the previous exercise.
5. Going back to Exercise 3, suppose now that the current cash price of one barrel of Brent crude oil is \$87, while the four-month futures price is \$90 per barrel (notice that we have reversed the spot and futures prices with respect to Problem #1). The annual storage cost remains at 6% and the annual cost of funding also remains at 5%. Calculate the implied convenience yield.
6. Calculate the total cost of carry for the previous exercise.
7. The current spot price for Brent crude oil is \$102 per barrel, while the four-month futures price is \$105 per barrel. If the four-month expected future spot price is \$111 per barrel, calculate the implied risk premium expressed in U.S. dollars.
8. The spot price of a commodity is \$9 while its nine-month futures price is \$9.40. The annual financing rate is 5%, the annual spoilage rate is 3%, and the storage cost per month is \$0.03 per dollar for the length of the contract. Calculate the implied annual convenience yield. Assume simple interest rather than compounded interest for simplicity and because of the relatively short period of time.
9. The spot price per bushel of a commodity is \$10.50. The total cost of carry per month is as follows:

Storage costs/Month: \$0.08 per bushel

Insurance/Month: \$0.03 per bushel

Spoilage rate/Month: 0.50%

Financing rate/Month: 0.50%

The transport costs to and from storage are \$0.05 each. What would be the total cost of carry for four months, assuming round trip transportation costs and ignoring commissions and transactions costs? What would be the corresponding break-even futures price? Assume simple interest rather than compounded interest for simplicity and because of the relatively short period of time.

10. Suppose that the spot price of gold is \$1,500 per ounce; the futures price of gold for delivery in six months is \$1,600 per ounce, and interest rates are 0.50% per month. Assume that the only carrying costs are the financing costs. There are no transactions costs. Describe in detail how to structure a successful arbitrage. Assume simple interest rather than compounded interest for simplicity and because of the relatively short period of time.
11. Suppose that the spot price of gold is \$1,500 per ounce; the futures price of gold for delivery in six months is \$1,500 per ounce, and interest rates are 0.50% per month. Assume that the only carrying costs are the financing costs. There are no transactions costs. Describe in detail how to structure a successful arbitrage. Assume simple interest rather than compounded interest for simplicity and because of the relatively short period of time.
12. Briefly explain the unbiased expectations hypothesis, normal backwardation, and the preferred habitat hypothesis.
13. Commodity prices tend to be dollar-denominated. What is the typical effect of a general depreciation of the U.S. dollar on commodity prices?
14. Why is the supply of non-storable commodities fixed in the short-run?
15. Briefly explain the behavior that commodity prices usually exhibit during the different phases of the business cycle.

## Solutions

1. The primary focus on commodity investments tends to be on commodity futures markets for two equally important reasons. First, the majority of commodity investments are directly or indirectly conducted through futures and forwards. Second, futures markets are the primary venue for price discovery in most commodity markets.

(Section 22.3)

2. Convenience yield is the benefit that comes from physical possession of an asset. It is an economic benefit, not a monetary benefit. It is a measure of the *convenience* of having an asset available to use. It can also be regarded as a measure of how much a buyer would pay to avoid the inconvenience of constantly ordering new quantities of an asset

and worrying that the supply of the asset will not arrive when needed. Convenience yields vary with the level of inventories. As inventories decline, the convenience yield rises, as consumers will pay more to ensure adequate supplies to operate their businesses.

(Section 22.3.1)

3. The implied convenience yield can be calculated from equations 22.1 and 22.2 (and noticing that spoilage costs are \$0 in this exercise):

$$\text{Cost of Carry} = \text{Financing Cost} + \text{Storage Cost} + \text{Spoilage Cost} - \text{Convenience Yield} \quad (22.1)$$

$$\text{Break-Even Futures Price} = \text{Spot} + \text{Cost of Carry} \quad (22.2)$$

$$87 - 90 = 90 \times (0.05 + 0.06 - c) \times (4/12)$$

which can be solved as follows:

$$3 \left( \frac{87-90}{90} \right) = 0.05 + 0.06 - c$$

Solving for  $c$  we find: 21% per year

(Sections 22.3.3, and 22.3.4)

4. The total cost of carry is:

$$\text{Cost of Carry} = \text{Financing Cost} + \text{Storage Cost} + \text{Spoilage Cost} - \text{Convenience Yield} \quad (22.1)$$

From Equation 22.1, we can obtain (once again, remember that spoilage costs are \$0 in this exercise):

$$(0.05 + 0.06 - 0.21) \times (4/12) = -0.0333 \text{ or } -3.33\% < 0$$

In this example, it is not surprising that the total cost of carry is negative (i.e., the convenience yield is greater than the cost of funding and storage), because the spot price (\$90) is greater than the futures price (\$87). In this case, the futures market is said to be in backwardation and the term structure of futures prices will be downward sloping.

(Section 22.2.3)

5. The implied convenience yield can be obtained manipulating equation 22.3:

$$\text{Futures Price} = \text{Spot Price} + \text{Costs} - \text{Convenience Yield} \quad (22.3)$$

$$90 - 87 = 87 \times (0.05 + 0.06 - c) \times (4/12)$$

Solving for  $c$  we find: 0.66% per year.

(Section 22.3.5)

6. The total cost of carry is:

$$\text{Cost of Carry} = \text{Financing Cost} + \text{Storage Cost} + \text{Spoilage Cost} - \text{Convenience Yield} \quad (22.1)$$

$$(0.05 + 0.06 - 0.0066) \times (4/12) = 0.035 \text{ or } 3.5\% > 0$$

In this case, the total cost of carry is positive (i.e., the convenience yield is smaller than the cost of funding and storage), because the spot price (\$87) is lower than the futures price (\$90). In this case, the futures market is said to be in contango and the term structure of futures prices will be upward sloping. Remember that spoilage costs are \$0 in this exercise.

(Section 22.2.3)

7. The implied risk premium is equal to \$6 (i.e., \$111- \$105).

(Sections 22.4.2 and 22.4.3)

8. The nine-month financing cost is  $\$9.00 \times 0.05 \times 9/12$ , or \$0.3375; the nine-month spoilage cost is  $\$9.00 \times 0.03 \times 9/12$ , or \$0.2025; and the storage cost is  $\$0.03 \times 9$ , or \$0.27. The convenience yield (CY) must satisfy equation 22.3:

$$\text{Futures Price} = \text{Spot Price} - \text{Convenience Yield} + \text{Costs} \quad (22.3), \text{ or}$$

$$\begin{aligned} \text{Futures Price} &= \text{Spot price} - \text{Convenience Yield} \\ &+ (\text{Financing Costs} + \text{Spoilage Costs} + \text{Storage Costs}) \end{aligned}$$

$$\text{Futures Price} = \$9.40 = \$9.00 + \$0.3375 + \$0.2025 + \$0.27 - \text{CY}$$

$$\text{CY} = \$0.41 \text{ for } \$9 \text{ of spot covering 9 months}$$

$$\text{Annual Convenience Yield in Percentage} = 0.41/9 \times 12/9 = 6.07\% \text{ per year}$$

(Section 22.3.5)

9. The break-even futures price is calculated using formula 22.2:

$$\text{Break-Even Futures Price} = \text{Spot} + \text{Cost of Carry} \quad (22.2)$$

The total monthly cost/bushel is equal to:  $\$0.08 + \$0.03 + (\$10.50 \times 0.50\%) + (\$10.50 \times 0.50\%) = \$0.215$ . The total storage costs for 4 months would be:  $\$0.86$  (i.e.,  $\$0.215 \times 4$ ). Adding the round trip transportation costs, the total costs of carry are:  $\$0.96$  (i.e.,  $\$0.86 + \$0.10$ ). Therefore, the break-even futures price (spot + carry) is equal to  $\$11.46$  (i.e.,  $\$10.50 + \$0.96$ ).

(Section 22.3.4)

10. According to Equation 22.2:

$$\text{Break-Even Futures Price} = \text{Spot} + \text{Cost of Carry} \quad (22.2)$$

In this case Futures price  $>$  Spot price  $\times$  (1 + Cost of carry), because  $\$1,600 > \$1,500 + \$45$  (i.e.,  $\$1,500 \times 0.5\% \times 6$  months). This is an example of a cash-and-carry arbitrage.

In  $t = 0$ : Borrow  $\$1,500$  for six months at  $0.50\%$  per month and purchase an ounce of gold in the spot market for  $\$1,500$ . Simultaneously, sell a futures contract for the delivery of gold in six months for  $\$1,600$ . The total cash flow is  $\$0$ .

In  $t = 6$  months: Deliver the ounce of gold purchased in  $t = 0$  against the futures contract. The arbitrageur would receive  $\$1,600$  and repay the loan ( $\$1,500$ ) and interest ( $\$1,500 \times 0.5\% \times 6$  months =  $\$45$ ), for a profit of  $\$55$ .

(Section 22.3.4)

11. According to Equation 22.2:

$$\text{Break-Even Futures Price} = \text{Spot} + \text{Cost of Carry} \quad (22.2)$$

In this case Futures price  $<$  Spot price  $\times$  (1 + Cost of carry), because  $\$1,500 < \$1,500 + \$45$  (i.e.,  $\$1,500 \times 0.5\% \times 6$  months). This is an example of a reverse cash-and-carry arbitrage.

In  $t = 0$ : Short sell an ounce of gold in the spot market for  $\$1,500$  and deposit the proceeds for six months at  $0.50\%$  per month. Simultaneously, buy a futures contract for the delivery of gold in six months for  $\$1,500$ . The total cash flow is  $\$0$ .

In  $t = 6$  months: The deposit would have grown to  $\$1,545$  [initial deposit of  $\$1,500$  plus interest ( $\$1,500 \times 0.5\% \times 6$  months =  $\$45$ )]. The arbitrageur would pay  $\$1,500$  for the delivery of an ounce of gold by the party having the short futures contract position and then use that ounce of gold to cover the open short position, for a profit of  $\$45$ .

(Section 22.3.4)

12. The theories for why commodity forward curves slope up or down are similar to theories proposed to explain why yield curves slope up or down.

The unbiased expectations hypothesis holds that the price of an asset for delivery in the future must be the same as the market's current forecast of the spot price of the asset on the future delivery date, and hence forward prices are unbiased estimators of future spot prices. This corresponds to a zero risk premium.

Normal backwardation is the tendency of commodity futures contracts to trade at prices below the rational expectations price. Keynes argued in 1930 that commodity futures prices should typically be lower than the rational expectations prices defined in the unbiased expectations hypothesis. Normal backwardation suggests the existence of a possible positive risk premium for long commodity futures positions.

The preferred habitat hypothesis holds that the relationship between expected spot rates and forward rates varies non-monotonically throughout the series of delivery dates due to supply and demand forces in local sections of the curve.

(Sections 22.4.2, 22.4.3 and 22.4.5)

13. A general depreciation of the dollar typically causes an increase in commodity prices, which are dollar-denominated. In theory, this is because commodity exporters from countries for which the national currency is not the U.S. dollar demand a higher price in return for the exchange rate loss, and vice versa. However, not all commodities are affected in the same magnitude.

(Section 22.7)

14. The supply of non-storable commodities is fixed in the short-run because investment in commodity production can take years. Only in the long-run do further investments in commodity infrastructure lead to an increase in their supply.

(Section 22.7)

15. At the beginning of a recession, unemployment increases, consumer demand falls, and wages increase less than under normal circumstances, or even decline. Demand for commodities is low, which reduces commodity prices. Once central banks realize the economy is in a recession, they would typically reduce real interest rates, and commodity prices are expected to increase again, as long as the market perceives that the economy will begin to improve in the near future.

In a period of strong expansion, consumer demand is high; unemployment is low, and wages increase more than under normal circumstances. This causes an increase in inflation, which, in turn, raises commodity prices (as long as commodities exhibit the inflation hedging property). As the demand for commodities increases during the economic expansion (most commodities are required as inputs to firms' production), an

increase in inflation is observed and central banks are induced to raise real interest rates so as to prevent the economy from overheating. With a lag of several months, the higher real interest rate lessens the demand for commodities, leading to a decline in commodity prices.

(Section 22.1.1)

## Chapter 23: Allocation to Commodities

### Exercises

1. What do empirical studies suggest regarding the correlation of commodity sectors with each other (e.g., the correlation between energy sector and metals sector commodities)?
2. Are commodity investments good hedges against event risk?
3. Do the correlations of commodity futures with stocks and bonds tend to become more positive, more negative, or remain the same as holding periods increase?
4. What is the difference between directional strategies and relative value strategies? Explain briefly.
5. What is the difference between fundamental directional strategies and quantitative directional strategies?

### Problems 6 to 8

Assume the following scenario. In April, a spreader observes contango in the crude oil forward curve. July and December light sweet crude oil futures on the NYMEX are trading at \$55.45 and \$62.27, respectively. The size of the NYMEX light sweet crude oil contract is 1,000 barrels. The spreader anticipates a flattening of the curve and narrowing of the spread between the two maturities.

6. What positions (long or short) should she take in July and December light sweet crude oil futures?
7. Suppose that the spreader takes a position of long 5 July contracts and short 5 December contracts, and that in June an oversupply of crude in the world markets causes the price of the July contract to decline to \$45.33, while the December contract declines to \$49.03. Calculate the total gain (loss) of the spread.
8. Suppose that the spreader takes 5 long July positions and 5 short December positions, and that in May political turmoil in oil-producing countries causes the price of the July contract to increase to \$63.08 and the December contract to increase to \$69.63. Calculate the total gain (loss) of the spread.
9. This problem has been partially adapted from NYMEX's publication Crack Spread Handbook (2001). Suppose that an independent refiner is worried about the possibility of increasing oil costs (input) and falling refined product (heating oil and gasoline) prices (output). The refiner will use a crack spread to hedge this risk.

On June 17, the refiner enters an obligation in the cash market to buy 60,000 barrels of crude oil on July 15 at prevailing market prices. The refiner has also entered an obligation to sell 840,000 gallons (20,000 barrels) of heating oil and 1,680,000 gallons (40,000 barrels) of gasoline on August 28 at prevailing market prices. August crude oil futures contracts are trading at \$87.54/bbl., September heating oil contracts are trading at \$110.05/bbl. and September gasoline futures contracts are trading at \$108.31/bbl. Each one of these contracts is for the equivalent to 1,000 barrels. In the cash market, crude oil is trading at \$88.10/bbl., gasoline at \$2.6181 per gallon, and heating oil at \$108.94/bbl. 42 gallons of gasoline are equivalent to one barrel of gasoline.

Which positions in crude oil futures, heating oil futures and gasoline futures contracts should the refiner take on June 17 through a 3:2:1 crack spread?

*Note: Remember that a 3:2:1 crack spread means that 3 barrels of oil are used to produce 2 barrels of gasoline and 1 barrel of heating oil.*

10. Wheat typically trades in contracts for delivery of 5,000 bushels. Assume that May wheat contracts currently sell for \$6.30 per bushel, which is \$0.12 more than the futures price of wheat contracts for delivery in July, due to anticipated harvesting. A commodity trader anticipates that abnormal weather will increase the difference in price between these two contracts to \$0.26. Describe the calendar spread position that the trader should take. If the trader is correct, what will be the profit of the calendar spread if she buys/sells 50 contracts?

## Solutions

1. Empirical evidence suggests that commodity sectors have a low correlation with each other. Therefore, commodities can offer uncorrelated or low correlation investment opportunities across various commodity markets. Energy sector commodities do not have high positive correlations with other sectors, because higher energy prices can weigh on economic growth and therefore slow down demand for other commodities.

(Section 23.1.3.2)

2. The evidence suggests that commodity investments are good hedges for event risk. The reason for this is that, whereas equity prices tend to be impacted negatively by political or economic distress and by natural disasters, commodity prices usually react positively to such incidents. This characteristic of commodity returns is advantageous for investors because it results in further reduced correlations between stocks and commodities in periods of market stress or crisis, which is precisely when diversification benefits are most desired.

(Section 23.1.2.3)

3. The empirical evidence suggests that the correlation of commodity futures with stocks and bonds, which tends to be negative, also tends to become more negative as the holding

period increases. This pattern suggests that the potential benefits of diversification provided by commodity futures may only be realized at longer horizons.

(Section 23.1.1.3)

4. Directional strategies convey a view on market direction, and thus consist in either long or short positions. Relative value strategies try to identify overpriced and underpriced securities, while hedging away some or all of the market exposure.

(Section 23.2)

5. Fundamental directional strategies are supported by an examination of supply and demand factors for commodities or commodity sectors. They can be based on macroeconomic factors (e.g., economic growth, interest rate forecasts, and currency forecasts) or on industry-specific factors (e.g., number of cattle in feed lots). Quantitative directional strategies use technical analysis or quantitative models to attempt to identify mispriced commodities.

(Section 23.3)

6. The spreader should go long July and short December light sweet crude oil futures.

(Section 23.5.1.2)

7. The loss on the long July contract is:  $-\$55.45 + \$45.33 = -\$10.12$

The gain on the short December contract is:  $\$62.27 - \$49.03 = \$13.24$

Total gain on the spread =  $-\$10.12 + \$13.24 = \$3.12$

The total gain of the spread is:

Position P&L = P&L barrel  $\times$  Contract size  $\times$  Position size

=  $\$3.12 \times 1,000 \times 5 = \$15,600$

(Section 23.5.1.3)

8. The gain on the July contract is:  $-\$55.45 + \$63.08 = \$7.63$

The loss on the December contract is:  $\$62.27 - \$69.63 = -\$7.36$

Total gain on the spread =  $\$7.63 + (\$7.36) = \$0.27$

The total gain of the spread is:

Position P&L = P&L barrel  $\times$  Contract size  $\times$  Position size

$$= \$0.27 \times 1,000 \times 5 = \$1,350$$

(Section 23.5.1.3)

9. On June 17, the refiner should initiate a long position in crude oil and a short position in heating oil and gasoline to fix a substantial portion of his refining margin through a 3:2:1 crack spread. He does this by going long 60 August crude oil futures contracts at \$87.54/bbl., while selling 20 September heating oil contracts at \$110.05/bbl. and 40 September gasoline futures contracts at \$108.31/bbl.

(Section 23.5.2)

10. The calendar spread position that the trader should take is long May contracts and short July contracts, because she expects May contracts to increase in price relative to July contracts (from \$0.12 to \$0.26 per bushel).

It is not necessary to know absolute prices in calculating the profit or loss of a spread trade. In this example, the spread between the two dates is assumed to increase from \$0.12 per bushel to \$0.26 per bushel. Using Equation 23.1, the profit is found to be \$35,000:

$$\text{Position P\&L} = \text{P\&L}_{\text{bushel}} \times \text{Contract} \times \text{Position Size} \quad (23.1)$$

$$\text{Position P\&L} = (\$0.26 - \$0.12) / \text{bushel} \times 5,000 \text{ bushels} \times 50 \text{ contracts} = \$35,000$$

(Section 23.5.1.3)

## Chapter 24: Accessing Commodity Investment Products

### Exercises

1. Define the return to commodity beta.
2. What is the primary benefit of obtaining commodity exposure through derivatives contracts, rather than direct physical ownership?
3. What is the primary vehicle used by institutional investors to obtain indirect commodity exposure?
4. In the context of obtaining commodity exposure, what are three major drawbacks of over-the-counter commodity index swaps?
5. Explain why equity of firms that derive a significant part of their revenue from the sale of physical commodities might offer weak exposure to the underlying commodities.
6. Explain why high grade bonds of commodity producing firms offer weaker exposure to commodities than high yield bonds of commodity producing firms.
7. What is the principal advantage of master limited partnership (MLP) structures in obtaining commodity exposure?
8. State four ways in which commodity-based exchange traded notes (ETNs) are different from commodity-based exchange traded funds (ETFs).
9. Relative to the first-generation commodity indices, what are the main distinguishing characteristics of second- and third-generation commodity indices?
10. Define roll return in the context of commodity futures investments.
11. What part of commodity index methodology tends to have the largest impact on index returns?

### Problems 12 to 16

Consider the following simple commodity index composed of two commodities (oil and silver) over a three-day period. The figures are hypothetical. The spot index uses futures with the same expiration months used in calculating the excess return and total return indices. The index rolls on day 3. The number of contracts held for each commodity in the index is fixed.

## CAIA Level II Workbook, September 2019

	Day 1	Day 2	Day 3
<b>Contract Prices (\$)</b>			
Crude Oil (November)	50	47	55
Silver (December)	2200	2210	2280
Crude Oil (December)			52
Silver (March)			2260
<b>Number of Contracts</b>			
Crude Oil	100	100	100
Silver	5	5	5
<b>Interest Rate</b>			
U.S. T-Bill	3.00%	3.20%	3.40%
<b>Index Weights</b>			
Crude Oil	31.25%	29.84%	31.52%
Silver	68.75%	70.16%	68.48%
Total	100%	100%	100%

12. Calculate the index weights of oil and silver on each day.
13. Calculate the spot index values.
14. Calculate the excess return index values. Assume that the index had a value of 10,000 at the close of day 1.
15. Calculate the total return index values. Assume that the index had a value of 10,000 at the close of day 1.
16. Calculate the returns for the spot, excess return, and total return indices.

### Solutions

1. The return to commodity beta is defined as the fundamental risk-based return from holding a passive long position in a commodity.  
  
(Section 24-Introduction)
2. The primary benefit of obtaining commodity exposure through derivatives contracts is the ability to benefit from price changes in the commodity without the need to store it.  
  
(Section 24.1)
3. The primary vehicle used by institutional investors for obtaining exposure to commodity indices is commodity index swaps.  
  
(Section 24.2)
4. The main drawbacks of commodity index swaps are:

- Limited access: commodity index swaps are available only to large, highly credit-worthy investors
- Limited exit: the secondary market for commodity index swaps is not liquid
- Additional risks: swaps experience greater counterparty risk than commodity futures markets

(Section 24.2.1)

5. Many such firms hedge their principal commodity exposures, which can significantly affect the degree of commodity exposure the firm provides to investors. Furthermore, there is evidence that commodity producers engage in selective hedging, in which they actively alter their hedge ratios based on their views of future commodity prices. Furthermore, public commodity-based equities are subject to significant market risk and business risk.

(Section 24.2.2)

6. High grade bonds of commodity producing firms have low sensitivity to the underlying commodity markets. High yield bonds, where the default or political risk is high, are more correlated with the prices of commodities produced by the issuing firms.

(Section 24.2.3)

7. The principal advantage of master limited partnership (MLP) structures is in avoiding corporate taxation. Income from qualifying MLPs is distributed directly to investors.

(Section 24.2.5)

8. The four ways are:
  - i. ETNs are zero coupon instruments
  - ii. The return to the ETN is subject to the credit-worthiness of the issuer
  - iii. The price of the ETN is based on a contractually designated relationship with the underlying index
  - iv. ETNs may qualify for capital gains tax treatment if held for a sufficiently long period of time

(Section 26.2.4)

9. Second- and third- generation enhanced indices have been developed in an attempt to provide a number of developments such as:
  - Unique roll methodologies
  - Unique weighting methodologies
  - Enhanced rebalancing methodologies
  - Rules-based trading strategies

(Section 24.4)

10. Roll return, or roll yield, is the portion of the return to a futures contract that is due to the change in basis.

(Section 24.5)

11. Weighting methodology probably explains the largest portion of commodity index returns. A weighting methodology establishes the degree of diversification or concentration on particular commodities or sectors. Weighting methodologies can also include active weights and short positions for long/short or short-biased indices.

(Section 24.6.4)

12. The index weight on oil, on day 1, is:

$$(\$50 \times 100) / [(\$50 \times 100) + (\$2,200 \times 5)] = 31.25\%$$

The index weight on silver, on day 1, is:

$$(\$2,200 \times 5) / [(\$50 \times 100) + (\$2,200 \times 5)] = 68.75\%$$

Following the same procedure, we can find the index weights for oil and silver on days 2 and 3. Results are shown at the end of the following table.

	Day 1	Day 2	Day 3
<b>Contract Prices (\$)</b>			
Crude Oil (November)	50	47	55
Silver (December)	2200	2210	2280
Crude Oil (December)			52
Silver (March)			2260
<b>Number of Contracts</b>			
Crude Oil	100	100	100
Silver	5	5	5
<b>Interest Rate</b>			
U.S. T-Bill	3.00%	3.20%	3.40%
<b>Index Weights</b>			
Crude Oil	31.25%	29.84%	31.52%
Silver	68.75%	70.16%	68.48%
Total	100%	100%	100%

It can be seen that the index weight of oil in the index decreased on the second day. This is because the index holds a fixed position in each commodity, so with the price of oil declining (at a time when the price of silver rose slightly), the portion of the index represented by oil decreased, while the portion of the index represented by silver

increased. Also, notice that the weights for day 3, a day when the index rolls, use the prices for the new contracts (December crude oil at \$52, and March silver at \$2,260).

(Section 24.8.3)

13. The spot index value for day 1 is:

$$(\$50 \times 100) + (\$2,200 \times 5) = 16,000.$$

The same procedure yields an index value of 15,750 for day 2. The spot index value for day 3 (a date when the index rolls), was calculated using the prices for the new contracts as follows:

$$(\$52 \times 100) + (\$2,260 \times 5) = 16,500.$$

(Section 24.8.3)

14. The excess return index was calculated, for day 2, as follows:

$$10,000 \times [(\$47 \times 100) + (\$2,210 \times 5)] / [(\$50 \times 100) + (\$2,200 \times 5)] = 9,844$$

(Section 24.8.3)

15. The total return index was calculated, for day 2, as follows:

$$10,000 \times \{1 + [(9,844 - 10,000) / 10,000]\} \times (1 + 0.03 / 360) = 9,845$$

The same procedure yields an index value of 10,564 for day 2.

The following table shows the spot, excess return and total return index values of the indices calculated in the previous exercises.

CAIA Level II Workbook, September 2019

	Day 1	Day 2	Day 3
<b>Contract Prices (\$)</b>			
Crude Oil (November)	50	47	55
Silver (December)	2200	2210	2280
Crude Oil (December)			52
Silver (March)			2260
<b>Number of Contracts</b>			
Crude Oil	100	100	100
Silver	5	5	5
<b>Interest Rate</b>			
U.S. T-Bill	3.00%	3.20%	3.40%
<b>Index Weights</b>			
Crude Oil	31.25%	29.84%	31.52%
Silver	68.75%	70.16%	68.48%
Total	100.00%	100.00%	100.00%
<b>Index Values</b>			
Spot Index	16,000.00	15,750.00	16,500.00
Excess Return Index	10,000.00	9,843.75	10,562.50
Total Return Index	10,000.00	9,844.57	10,564.32

(Section 24.8.3)

16. The last three lines in the following table show the results.

	Day 1	Day 2	Day 3
<b>Contract Prices (\$)</b>			
Crude Oil (November)	50	47	55
Silver (December)	2200	2210	2280
Crude Oil (December)			52
Silver (March)			2260
<b>Number of Contracts</b>			
Crude Oil	100	100	100
Silver	5	5	5
<b>Interest Rate</b>			
U.S. T-Bill	3.00%	3.20%	3.40%
<b>Index Weights</b>			
Crude Oil	31.25%	29.84%	31.52%
Silver	68.75%	70.16%	68.48%
Total	100.00%	100.00%	100.00%
<b>Index Values</b>			
Spot Index	16,000.00	15,750.00	16,500.00
Excess Return Index	10,000.00	9,843.75	10,562.50
Total Return Index	10,000.00	9,844.57	10,564.32
<b>Index Returns</b>			
Spot Index		-1.56%	4.76%
Excess Return Index		-1.56%	7.30%
Total Return Index		-1.55%	7.31%
Realized Roll Return		0.00%	2.54%

Let us illustrate some of the calculations for each index (results rounded):

The spot index return was calculated, for day 2, as follows:

$$[(15,750-16,000)/16,000] \times 100 = -1.56\%.$$

The same procedure was used to calculate the return of the excess return index and the return of the total return index.

The realized roll return was calculated on day 3 (a day when the index rolls) as:

$$\text{Return on excess return index} - \text{Return on spot index: } 7.30\% - 4.76\% = 2.54\%$$

(Section 24.8.3)

## Chapter 25: Managed Futures

### Exercises

#### Problems 1 to 2

An investor takes a long position in five December oil futures contracts towards the close of the trading day on July 6. Oil futures prices are U.S. \$50. The contract size is 1,000 barrels; the futures contract requires an initial margin of \$9,500 and has a maintenance margin level set at \$7,500.

Ignore commissions and interest rates for the following two problems.

- Calculate the total daily gain (loss), the cumulative gain (loss), the margin account balance, and any potential margin call that the investor may receive assuming the following futures prices during the next few days:

Day	Futures price (US\$)	Daily gain (loss) (US\$)	Cumulative gain (loss) (US\$)	Margin balance (US\$)	Margin call (US\$)
July-6	50	-	-	?	-
July-7	47.8	?	?	?	?
July-8	47.8	?	?	?	?
July-9	45	?	?	?	?
July-10	46.5	?	?	?	?

- If the investor had closed out the long oil futures position at the close on July 10, what would have been his/her cumulative gain or loss?
- CTA Fund ABC* has a margin-to-equity ratio of 24%. Calculate the margin that *CTA Fund ABC* would be required to maintain if the fund had \$120 million in assets under management.
- Comment on the empirical evidence on the benefits of managed futures (CTAs) regarding diversification and performance.
- Suppose a CTA is using the signal-to-noise ratio (SNR) to measure the level of divergence for the following price series corresponding to six days: \$73, \$71, \$68, \$69, \$66, \$63. Calculate the signal-to-noise ratio and indicate whether the signal is strong.

6. Suppose the S&P 100 Index, German Government bonds, gold, crude oil, and Treasury notes have 100-day signal-to-noise ratios (SNRs) of 0.2, 0.1, 0.4, 0.2, and 0.3, respectively. Calculate the market divergence index (MDI).

Problems 7 and 8

7. Consider a CTA with capital of USD 20 million. The CTA has determined that 12% of its capital should be allocated to trading in the gold market. The sizing function is estimated to be 0.7. The size of each futures contract is 100 ounces, and assuming a current price of USD 1,300 per ounce, the notional value of each contract will be USD 130,000. Finally, assume that the annualized volatility target is 26% and that the annualized realized volatility using near-term futures prices for the past 30 days has been 33%. Calculate the number of futures contracts that the CTA should have in his portfolio.
8. Continuing with the previous problem, suppose the sizing function is still 0.7 and the risk loading is 0.4%. The daily price volatility of gold is estimated to be USD 12, and each contract is for 100 ounces. Calculate the number of futures contracts in gold that the should be held as a long position.

**Solutions**

1. The following table shows the respective calculations.

Day	Futures price (US\$)	Daily gain (loss) (US\$)	Cumulative gain (loss) (US\$)	Margin balance (US\$)	Margin call (US\$)
July-6	50	-	-	47,500	-
July-7	47.8	-11,000	-11,000	36,500 = 47,500 ←	36,500 + 11,000 = 47,500
July-8	47.8	0	-11,000	47,500	
July-9	45	-14,000	-25,000	33,500 = 47,500 ←	33,500 + 14,000 = 47,500
July-10	46.5	7,500	-17,500	55,000	

The initial margin balance is equal to \$47,500 (i.e., \$9,500 × 5). On July 7, oil futures prices for December delivery declined to \$47.80. This meant that the investor lost \$11,000 on that day [i.e., (47.80-50.00) × 5 contracts × 1,000 barrels per contract]. The investor’s margin balance account would have been debited by \$11,000. The investor received a margin call on that date, because the margin balance declined to \$36,500 (i.e., \$47,500 – \$11,000), which is below the maintenance margin of \$37,500 (i.e., \$7,500 × 5 contracts). The investor would have needed to deposit \$11,000 in the margin account so that the balance would return to the initial margin of \$47,500.

On July 8, the futures price closed at the same level as in the previous day and therefore no daily gain or loss was recorded on that day. On July 9, oil futures prices for December delivery declined to \$45.00. This meant that the investor lost \$14,000 on that day [i.e.,  $(45.00-47.80) \times 5 \text{ contracts} \times 1,000 \text{ barrels per contract}$ ]. The investor's margin balance account would have been debited by \$14,000. As in July 7, the investor received a margin call on that date, because the margin balance declined to \$33,500 (i.e.,  $\$47,500 - \$14,000$ ), which is below the maintenance margin of \$37,500 (i.e.,  $\$7,500 \times 5 \text{ contracts}$ ).

On July 10, oil futures prices for December delivery rose to \$46.50. This meant that the investor gained \$7,500 on that day [i.e.,  $(46.50-45.00) \times 5 \text{ contracts} \times 1,000 \text{ barrels per contract}$ ]. The investor's margin account would have been credited \$7,500. The new balance on the margin account would have been \$55,000. The investor is allowed to withdraw any amount in excess of the initial margin (in this case, \$7,500) from the margin account.

(Section 25.1)

2. To close-out the long position on 5 December oil futures contracts, the investor would have taken a short position on 5 December oil futures contracts. The cumulative loss on July 10 would have been \$17,500, ignoring commissions paid and interests received on the margin account.

(Section 25.1)

3. The margin that *CTA Fund ABC* would be required to maintain is equal to \$120 million  $\times 0.24 = \$28,800,000$ .

(Section 25.1)

4. In terms of diversification benefits, managed futures represent an alternative investment that has recorded excellent performance in both up and down stock, currency, and commodity markets. Furthermore, managed futures exhibit low correlation to traditional asset classes, and so their inclusion in a portfolio of traditional assets may reduce its risk, while potentially increasing portfolio returns.

Regarding performance, managed futures have historically provided risk-return profiles comparable to those of many traditional investments and superior to those offered by long-only investments in commodities.

(Section 25.4.3)

5. The signal-to-noise ratio is the ratio of the overall trend to a series of price changes during the same period. In this case,  $n = 6$ , as there are six days in the signal observation period. Using Equation 25.1, the SNR is:

$$SNR_t(n) = \frac{|P_t - P_{t-n}|}{\sum_{i=0}^{n-1} |P_{t-i} - P_{t-i+1}|}$$

$|63 - 73|$  divided by  $|71 - 73| + |68 - 71| + |69 - 68| + |66 - 69| + |63 - 66|$ , which is equal to  $10/12 = 0.833$ . This indicates a very strong trend.

(Section 25.3.4)

- First, we notice that gold has the largest SNR of the five series presented, which means that the trend signal is the highest for gold over the past 100 days. German Government bonds have the smallest SNR, which means that its trend signal is the lowest. Using Equation 25.2, the MDI for all included markets would be the average SNR:

$$MDI_t(n) = \frac{1}{M} \sum_{i=1}^M SNR_t^i(n) = \frac{0.2+0.1+0.4+0.2+0.3}{5} = 0.24$$

This MDI value can be compared to SNRs from previous periods to verify whether markets are trending.

(Section 25.3.4)

- Given these figures, the number of futures contracts based on Equation 25.3 will be as follows:

$$\begin{aligned} \text{Number of Futures Contracts} &= \text{Sizing Function} \times \frac{\text{Risk Loading} \times \text{Equity}}{\text{Notional Value}} \times \frac{RVol_T}{RVol_R} \\ \text{Number of Futures Contracts} &= 0.7 \times \frac{12\% \times \$20,000,000}{\$130,000} \times \frac{26\%}{33\%} \approx 10 \end{aligned}$$

(Section 25.5.3)

- The trader will take a long position in gold futures contracts based on Equation 25.4:

$$\begin{aligned} \text{Number of Contracts} &= \text{Sizing Function} \times \frac{\text{Risk Loading} \times \text{Capital}}{PVOL_R \times \text{Contract Size}} \\ \text{Number of Contracts} &= 0.7 \times \frac{0.4\% \times \$20,000,000}{\$12 \times 100 \text{ ounces}} \approx 47 \end{aligned}$$

(Section 25.5.3)

## Chapter 26: Investing in CTAs

### Exercises

#### Problems 1 to 2

Albert Mitropoulos is the founder and sole principal of *Larose Capital, Inc.*, a registered Commodity Trading Advisor (CTA). *Larose Capital, Inc.* utilizes a trading system that is intended to profit from daily volatilities in selected U.S. futures contracts, with a trading window that is normally longer than one day.

Table 1 shows the initial margin requirement for four selected futures contracts (S&P 500 Stock Index, Eurodollars, U.S. Long Treasury, and gold futures contracts). The value of the account holding the positions presented in Table 1 was \$1,000,000 on January 28, 2009. Table 2 states the notional values of this portfolio on February 4, 2009. Mr. Mitropoulos employs a stop-loss trading rule set at 1% of the notional value of each contract. The one-day Value at Risk (*Var*) of the portfolio has been estimated at \$8,668, assuming a 95% confidence interval.

**Table 1**

<b>Initial margin requirements for four selected futures contracts (as of January 28, 2009)</b>	
<b>Futures Contract</b>	<b>Initial Margin Requirement</b>
S&P 500 Stock Index	\$30,938
Eurodollars	\$1,485
U.S. Long Treasury	\$4,320
Gold	\$5,399
Total Initial Margin of a Portfolio Holding	
1 Contract in each of the Futures Markets Above	\$42,142

**Table 2**

<b>Notional contract values of four futures contracts (February 4, 2009)</b>	
<b>Contract</b>	<b>Notional Contract Value</b>
S&P 500 Stock Index	\$207,250
Eurodollars	\$987,650
U.S. Long Treasury	\$126,640
Gold	\$90,166
Size of Notional Positions	\$1,411,706

1. Calculate the margin-to-equity ratio (January 28, 2009) of a portfolio holding one contract in each of the four futures markets.
2. Calculate the Capital at Risk (CaR) on February 4, 2009, at 1%, for a portfolio holding one contract in each of the four futures markets.
3. Estimates of daily volatility,  $\sigma$ , and daily mean return,  $\mu$ , of a CTA are reported to be 2.1% and 0.04%, respectively. What is the daily Value at Risk (*VaR*) of this CTA at a 95% confidence level? Note: The critical value of  $\alpha$  for the 95% confidence level is -1.6448.
4. Suppose the net asset values (NAVs) of a CTA at the end of the first six months of the year were \$98 (January), \$103 (February), \$99 (March), \$97 (April), \$96 (May), and \$98 (June). Calculate the maximum drawdown of the fund during this period.
5. The following table contains the hypothetical monthly returns earned by a CTA during 2015. Calculate the omega ratio, assuming that the target return was a 6% annual return.

<b>Hypothetical Monthly Return of a CTA (Target Rate = 6% per Year)</b>	
	Realized Monthly Return
Jan-15	21.02%
Feb-15	2.01%
Mar-15	-15.40%
Apr-15	12.32%
May-15	1.06%
Jun-15	3.56%
Jul-15	-11.09%
Aug-15	22.45%
Sep-15	-5.34%
Oct-15	9.94%
Nov-15	-4.74%
Dec-15	-6.78%

6. Does the empirical evidence suggest that CTAs provide downside protection during periods of market stress?
7. Briefly describe the three approaches to benchmarking managed futures performance presented in the book.
8. Should CTA return profiles be characterized as being long volatility or as being long gamma?

9. Consider an account with \$150,000 cash invested with a mandate that risk exposures, fees, and returns be set equal to \$250,000 through the use of leverage. Identify the trading level, funding level, and notional level.

### Solutions

1. The margin-to-equity ratio is 4.21% (i.e., \$42,142 / \$1,000,000).

(Section 26.3.2)

2. The CaR is \$14,117 (i.e., \$1,411,706 × 0.01).

(Section 26.3.3)

3. The daily *VaR* at 95% confidence level will be calculated as follows:

$$VaR = (-1.6448 \times 2.1\%) + 0.04\% = -3.41\% \text{ (see Equation 26.7)}$$

(Section 26.3.4)

4. The highest NAV of the CTA was attained in February (\$103), while the lowest NAV was registered in May (\$96). Therefore, the maximum drawdown is (rounded):

$$[\text{Min} (\$96/\$103) - 1] \times 100 = -6.80\% \text{ (see Equation 26.8)}$$

(Section 26.3.5)

5. The following table contains the calculations needed to compute the omega ratio (see also Equation 26.9). For each realized annualized monthly return, one first needs to determine whether the realized return was greater or less than the target level. These differences are presented in two columns called upper partial moment and lower partial moment. The target return in this problem is 6% per year (0.5% per month). The averages of these upper and lower partial moments are calculated to be (rounded) 5.74% and 3.82%, respectively. Finally, the omega ratio is 1.50, or the ratio of these two figures (i.e., 5.74 / 3.82). In this case, the omega ratio is greater than one, which means that the investment has provided more opportunities to earn a return that exceeds the target level.

	Realized Monthly Return	Above Target Return	Below Target Return	Upper Partial Moment	Lower Partial Moment
Jan-15	21.02%	1	0	20.52%	0.00%
Feb-15	2.01%	1	0	1.51%	0.00%
Mar-15	-15.40%	0	1	0.00%	15.90%
Apr-15	12.32%	1	0	11.82%	0.00%
May-15	1.06%	1	0	0.56%	0.00%
Jun-15	3.56%	1	0	3.06%	0.00%
Jul-15	-11.09%	0	1	0.00%	11.59%
Aug-15	22.45%	1	0	21.95%	0.00%
Sep-15	-5.34%	0	1	0.00%	5.84%
Oct-15	9.94%	1	0	9.44%	0.00%
Nov-15	-4.74%	0	1	0.00%	5.24%
Dec-15	-6.78%	0	1	0.00%	7.28%
Average				5.74%	3.82%
Omega					1.50
Target Rate	6.00%	per year			
	0.50%	per month			

(Section 26.3.7)

- CTAs (measured using the Barclay Trader Index Discretionary and the Barclay Trader Index Systematic indices) provided positive returns during periods of market stress, in particular, during the post-Internet bubble (8/2000–12/2002) and the financial crisis (9/2008–10/2008). This is one of the major benefits of CTA investing.

(Sections 26.1.3 and 26.1.4)

- The first approach consists of using an index of long-only futures contracts. Because CTAs are as likely to be long as to be short, this approach is not particularly helpful.

The second approach is to use peer groups, where managed futures are usually benchmarked to indices representing active or passive futures trading. Active benchmarks of futures trading reflect the actual performance of a universe of CTAs. Unfortunately, there are a number of issues that arise when using hedge fund/CTA databases.

Finally, CTAs may be compared to passive benchmarks of futures trading. These passive indices correspond to the performance of an individual trading system (as opposed to the performance of CTAs themselves).

(Section 26.4)

8. The book argues that even though CTA return profiles may suggest that these investment vehicles are long volatility, it is more suitable to describe CTAs as being long gamma. Trend-following CTAs increase their positions' deltas as prices move in their favor, which is the essential characteristic of a long-gamma position.

(Section 26.1.6)

9. Equation 26.1 provides the relationship between the three levels.

$$\text{Trading Level} = \text{Funding Level} + \text{Notional Level} \quad (26.1)$$

The \$150,000 is the funding level, since it is the cash contributed. The \$250,000 meets the definition of the trading level. Therefore, the \$100,000 used to lever the funding level to the trading level represents the notional level.

(Section 26.3.2)

## Chapter 27: Relative Value Strategies

### Exercises

#### Problems 1 to 3

Ana Limburg, CAIA, is the manager of a convertible arbitrage hedge fund. Ms. Limburg has done a preliminary analysis of the convertible bonds of *Beta Company, Inc.* The following table presents a summary of the terms offered by Beta's convertible 2% 2017 bond, which is currently trading at 88% of its face value.

<b>Fixed income features</b>	
Issuer	Beta Company, Inc.
Rating	BBB
Coupon	C = 2% (annual)
Issue date	January 1, 2015 (today)
First coupon date	December 31, 2015 (in one year)
Accrued interest	0
Maturity	December 31, 2017 (in T = 3 years)
Nominal value	\$1,000
Risk-free rate	$R_F = 2.5\%$ per year
Issuer credit spread	CS = 300 bps above the risk free rate
<b>Equity features</b>	
Issuer	Beta Company, Inc.
Stock price	$S_0 = \$92$ per share
Stock dividend	None
<b>Conversion features</b>	
Conversion ratio	CR = 9
Call protection	None

1. Calculate the conversion price of Beta's convertible bond.
2. Calculate Beta's convertible bond parity.
3. Calculate Beta's convertible bond conversion premium.

#### Problems 4 to 6

Haruki Watanabe is the manager of a convertible arbitrage hedge fund. Mr. Watanabe is in the process of valuing the convertible bonds of *Alpha Company, Inc.* The following table presents a summary of the terms offered by Alpha's convertible 3% 2020 bond. The current market price of this bond is \$984.15.

<b>Fixed income features</b>	
Issuer	Alpha Company, Inc.
Rating	BBB+
Coupon	C = 3% (annual)
Issue date	January 1, 2016 (today)
First coupon date	December 31, 2016 (in one year)
Accrued interest	0
Maturity	December 31, 2020 (in T = 5 years)
Nominal value	\$1,000
Risk-free rate	$R_F = 1.5\%$ per year
Issuer credit spread	CS = 400 bps above the risk free rate
<b>Equity features</b>	
Issuer	Alpha Company, Inc.
Stock price	$S_0 = \$92$ per share
Stock price change volatility	$\sigma = 22\%$ per year
Stock dividend	None

- Calculate the pure bond price (also known as straight bond price) of Alpha's convertible bond.
- What is the value of the call option on the underlying stock?

#### Problems 6 to 7

Ray J. Royston is the fund manager of *Aqua Capital*, a convertible arbitrage hedge fund. Today is January 1, 2016. Mr. Royston is analyzing the convertible bonds of *Company ABC*. More specifically, he is analyzing a convertible bond from this company that pays a 3.5% annual coupon and which matures in exactly two years (on December 31, 2017). The bond has a face value of \$100.

Mr. Royston has estimated a binomial tree for this bond's convertible bond parity (see Figure 1 below) and a binomial tree for the convertible bond value (see Figure 2 below), where  $t=1$  is December 31, 2016, and  $t=2$  corresponds to December 31, 2017.

Figure 1 Binomial tree for ABC's 3.5% 2017 convertible bond parity

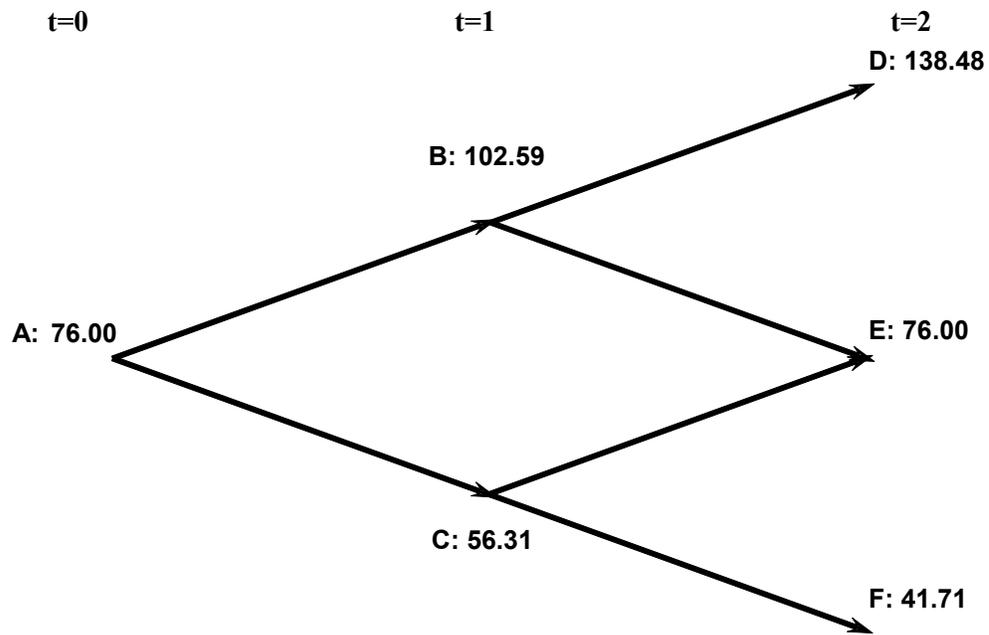
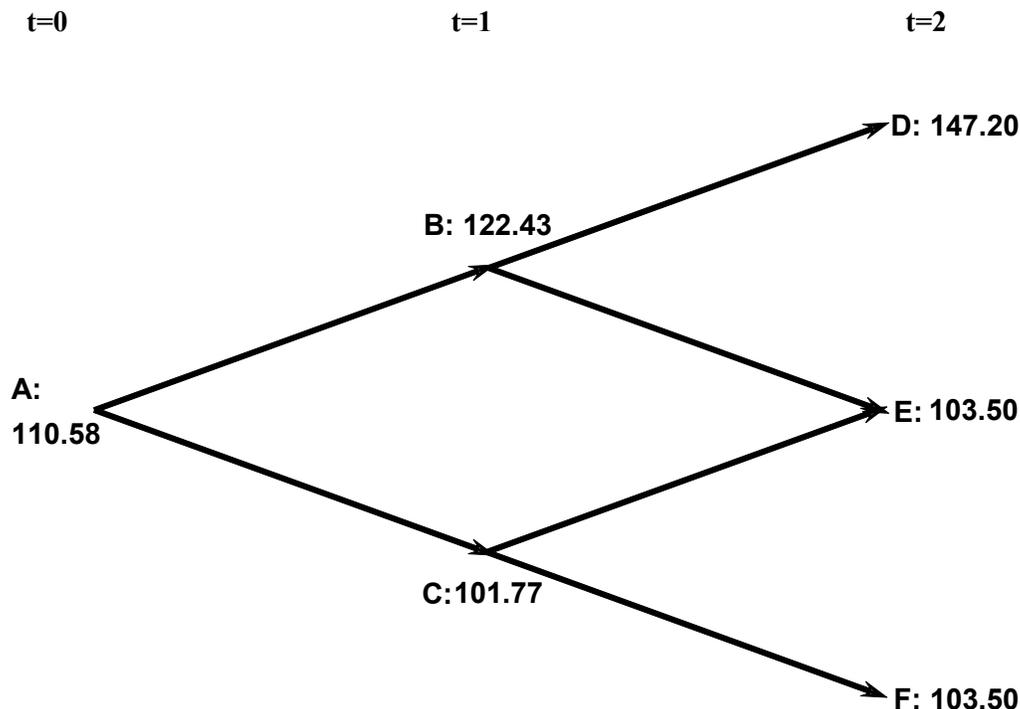


Figure 2 Binomial tree for ABC's 3.5% 2017 convertible bond value



6. What is the value of delta when measured at the initial node (node A) for ABC's convertible bond?
7. At time  $t=2$ , in which case, if any, should conversion occur?
8. What are the major drawbacks of the component approach valuation of convertible securities?

#### Problems 9 to 10

Suppose the following convertible arbitrage strategy, in which the manager takes a long position in a convertible bond and then shorts an appropriate amount of the underlying stock in order to create a delta-hedged portfolio. The initial price of a convertible bond is 111% of face value (FV). The face value of the bond is \$1,000 and the coupon rate is 4%. Coupons are annual and are paid at the end of the year. The total amount of capital invested in this trade is \$1,110,000, of which \$225,500 is equity and \$884,500 is borrowed. 1,000 bonds with a total face value of \$1,000,000 are purchased. The bond's conversion ratio is 36.148 shares of stock. The delta of the option is estimated to be 0.67. Finally, the current price of the common stock is \$28.29.

It is assumed that the manager closes these positions after one year, a time at which bond and stock prices are 116% of face value, and \$30.67, respectively. The short rebate is 1.5%, borrowing costs are 2.5%, and the stock has a dividend yield of 0.5%.

9. Calculate the annual cash flows from interest income from the bond, the short rebate from the stock, the cost of leverage, and the dividend payments on the shorted shares.
10. What are the total annual cash flows from purchasing and selling the bond, and from shorting and covering the stock.
11. Calculate the percentage return with respect to the total capital invested for each of the following: Bond income, short interest rebate, dividend payment, arbitrage return, and the cost of leverage.
12. Calculate the return on assets, the return on equity, and the contribution of leverage to the return on assets.

## Solutions

1. The conversion price is the price at which shares are indirectly purchased via the convertible security. In this exercise, the face value of the bond is \$1,000 and the conversion ratio is 9. Therefore, the conversion price is:  $\$1,000/9 = \$111.11$  (rounded).  
  
(Section 27.2.4)
2. Parity is the total value of the shares into which a bond can be converted based on the current market price of the shares. In this exercise, parity is: 9 shares per bond  $\times$  \$92 per share = \$828. Parity is usually quoted as a percentage of the par amount of the bond, which in this exercise is \$1,000. Therefore, parity is  $\$828/\$1,000 = 82.8\%$ .  
  
(Section 27.2.4)
3. The answer is 6.28%, as calculated by  $(\text{bond price} - \text{parity})/\text{parity} = (88 - 82.8)/82.8 = 6.28\%$  (rounded).  
  
(Section 27.2.4)
4. The pure bond price of Alpha's convertible bond is \$893.24 (in a financial calculator,  $n=5$ ,  $i=5.5$ ,  $PMT = 30$ ,  $FV = 1,000$ , and solve for  $PV$ ).  
  
(Section 27.2.5)
5. Using Equation 27.1, the call option value is:

$$\text{Convertible Bond} = \text{Straight Bond} + \text{Call Option on the Underlying Stock} \quad (27.1)$$

Call Option on the Underlying Stock = Convertible Bond - Straight Bond

$$\$984.15 - \$893.24 = \$90.91$$

(Section 27.2.5)

6. Delta measures the sensitivity of the value of the convertible bond to changes in its stock price (i.e., the underlying asset). In node A, Delta is 0.45 (rounded), calculated as:

$$(122.43 - 101.77) / (102.59 - 56.31)$$

(Section 27.2.8)

7. Conversion should occur only in node D. This is the only node for which, at  $t=2$ , the value of ABC's 3.5% 2017 convertible bond is greater than \$103.5 (i.e., the face value of the bond and its annual coupon, to be paid at that time).

(Section 27.2.6)

8. The major shortcomings of the component approach are:

9. It uses the Black-Scholes options pricing formula, which is suitable only for European type options and cannot be used to deal with early termination clauses.
10. It does not consider the credit risk of the issuer; and
11. It does not consider special conditions and contractual covenants such as callability.

(Section 27.2.5)

9. The bond's conversion ratio is 36.148 shares of stock and thus the bond position can be converted into 36,148 shares. The annual cash flows from interest income from the bond, the short rebate from the stock, the cost of leverage and the dividend payments on the shorted shares are (some rounding):

Exercise: Sources of Returns for Convertible Arbitrage		
Source of Return/Cost	Return/Cost	Assumptions/Computations
Interest income from long bond	\$40,000	4% coupon on \$1,000,000 face value
Short rebate from short stock		Shares shorted = $36,148 \times 0.67 = 24,219$
		Total amount shorted = $24,219 \times \$28.29 = \$685,160$
	\$10,277	Rebate = $\$685,160 \times 1.50\% = \$10,277$
Cost of leverage		2.5% cost of borrowing
	\$(22,113)	$\$884,500 \times 2.5\% = \$22,113$
Dividend payments on shorted shares		0.5% dividend yield on shares
	\$(3,426)	$\$685,160 \times 0.5\% = \$3,426$
Total annual cash flows	\$24,738	

(Section 27.2.11)

10. The total annual cash flows from purchasing and selling the bond, and from shorting and covering the stock are:

Exercise: Sources of Returns for Convertible Arbitrage		
Source of Return/Cost	Return/Cost	Assumptions/Computations
Bond return	\$50,000	1,000 bonds purchased at 111% FV and sold at 116% FV
Stock return	\$(57,641)	24,219 shares shorted at \$28.29 and covered at \$30.67
Total arbitrage cash flow	\$(7,641)	

Notice that the strategy ended up resulting in a negative arbitrage cash flow. However, the annual cash flows from the previous exercise (interest income from the bond, the short rebate from the stock, the cost of leverage and the dividend payments on the shorted shares) were \$24,738. Therefore, the total cash flow is still positive:  $\$24,739 - \$7,641 = \$17,097$ .

(Section 27.2.11)

11. The answers are:

Exercise: Sources of Returns for Convertible Arbitrage		
Source of Return/Cost	Return/Cost	Assumptions/Computations
Bond income	3.60%	\$40,000 income on \$1,110,000 investment
Short interest rebate	0.93%	\$10,277 income on \$1,110,000 investment
Dividend payment	-0.31%	\$(3,426) cost on \$1,110,000 investment
Arbitrage return	-0.69%	\$(7,641) loss on \$1,110,000 investment
Cost of leverage	-1.99%	\$(22,113) cost on \$1,110,000 investment

(Section 27.2.11)

12. From exercise 11, we know that the total annual cash flows from purchasing and selling the bond, and from shorting and covering the stock, were \$17,097. The sources of returns for this convertible arbitrage are then:

<b>Exercise: Sources of Returns for Convertible Arbitrage</b>		
<b>Source of Return/Cost</b>	<b>Return/Cost</b>	<b>Assumptions/Computations</b>
Return on assets	1.54%	\$17,097 income on \$1,110,000 investment
Return on equity	7.58%	\$17,097 income on \$225,500 equity investment
Contribution of leverage	6.04%	7.58%-1.54%

(Section 27.2.11)

## Chapter 28: Hedge Funds: Directional Strategies

### Exercise

#### Problems 1 to 3

Howard Jenkins is a global macro hedge fund manager. Mr. Jenkins relies primarily on economic theories and financial models to analyze market movements, detect policy mistakes of governments and central banks, or extract implied market expectations and compare them to his estimates.

Mr. Jenkins has been analyzing the US\$/Euro relationship, as well as the anticipated inflation rates in the U.S. and in the Euro-zone. He anticipates that the inflation rate in the U.S. will be 2.50%, and 1.50% in the Euro-zone. The spot exchange rate (US\$/Euro) is 1.32.

1. According to Purchasing Power Parity (PPP), what is the expected percentage change in the US\$/Euro quotation between today and one year from now?
2. According to Purchasing Power Parity (PPP) and the information presented above, should one expect any currency to depreciate over time against the other?
3. According to the CAIA readings, to which school of thought on the sources of returns for global macro fund managers may Mr. Jenkins most likely be discussing?

#### Problems 4 to 5

Mary A. Davies, CAIA, is the global macro hedge fund manager of *World Forex Fund*, a macro hedge fund specializing in trading in the foreign exchange markets of mature and emerging economies. Ms. Davies is currently observing the following data for the U.S. dollar and the British pound:

Spot exchange rate 1 GBP = USD 1.80  
 Forward exchange rate 1 GBP = USD 1.82  
 1-year USD LIBOR rate = 2.00%  
 1-year £ LIBOR rate = 2.75%

4. Given the above figures, describe the carry trade that Ms. Davies should implement.
5. Calculate the expected spot exchange rate for the British pound one year from now.

6. Suppose that the prices of gold in Berlin and London are Euro 1,200 and GBP 1,300 per ounce, respectively. If the Law of One Price holds, what should be the exchange rate between the GBP and the Euro?
7. Suppose annual short-term interest rates in the U.S. and Japan are 4% and 1%, respectively. In addition, the current spot rate and 1-year forward rate for the USD/Yen are \$0.0099 and \$0.010, respectively. Does covered interest rate parity hold, assuming zero transactions costs?

Problems 8 and 9

Suppose that annual interest rates in the U.S. and the U.K. are 3% and 2.5%, respectively. In addition, the current spot rate and the 1-year forward rate for USD versus GBP are 1.20 USD/GBP, and 1.25 USD/GBP, respectively.

8. Demonstrate that an arbitrage opportunity exists.
9. Calculate the arbitrage profit assuming that either USD 1 million or GBP 1 million is available to be borrowed at the respective interest rates shown above.
10. Suppose short-term rates in South Africa and the U.S. are 6% and 2%, respectively. The current value of the South African Rand (ZAR) in terms of the USD is \$0.1200. Suppose that, after 1 year, the spot value of the Rand in terms of USD is \$0.1198. Assuming zero transactions costs or bid-ask spreads, was a carry trade (assuming borrowing in USD and lending in ZAR) profitable in this case?

Problems 11 to 12

*Altamira Investments* is a fund of hedge funds that was founded in 1997. The fund has been performing due diligence on the following two equity long/short hedge funds to determine whether they should be added to the fund's current holdings: *Hudson Investment Fund* and *Cambridge Star Fund*. The following are some highlights of each of these two equity long/short funds:

*Hudson Investment Fund* follows a contrarian approach and employs traditional valuation metrics (e.g., book-to-market, price-earnings ratios (P/E), and ratio of P/E to earnings growth rate) to search for undervalued companies.

*Cambridge Star Fund* is a corporate governance activist fund, which takes a very public stance on its investments and has been very open about criticizing current management and the board of directors of the companies in which they invest. Recently, in two well-publicized cases, the fund was very effective in changing the composition of the board of directors of two companies.

11. Which approach (e.g., value, growth, momentum, etc.) is most likely to categorize the investment style of *Hudson Investment Fund*?

12. According to the CAIA reading, are corporate governance activist funds effective in changing the composition of a company's board of directors?

Problems 13 to 15

Consider a long/short manager with \$200 of assets under management. The fund only has the following two positions: Long \$200 of Company Alpha, where Alpha pays a \$3.50 dividend at the end of the year, and short \$70 of Company Beta, where Beta pays a \$2.00 dividend at the end of the year.

Suppose we wanted to attribute the total performance of this long/short fund over a given specific period of one year. We also assume that no other trades were executed over that year.

Suppose shares of Alpha go up 13% over the year and shares of Beta go down by 6% over the same year. Suppose that the short rebate is 2% per year where the interest rate on proceeds from the short sales is 3% and the cost to borrow the Beta shares is 1% per year.

13. Calculate the total dollar return earned from the long position.
14. Calculate the total dollar return earned from the short position.
15. Suppose now that the shares of Beta went up by 7% over the same year, instead of the previously stated negative return of 6%. Calculate the total dollar return earned from the short position.
16. Which investment vehicles are considered as 13F securities?
17. Suppose the case of a long/short manager with \$100 of assets under management and only two positions:
- Long \$100 of shares of Company XYZ, which pays a \$2 dividend
  - Short \$70 of shares of Company ABC, which pays a \$3 dividend

Suppose that the objective is to attribute the total performance of this long/short fund over the specific period of one year. Also, assume that no other trades were executed over that year, that XYZ's share price rises 5% over the year, and that ABC's share price declines 10% over the same year. Assume that the short rebate is 2%, and is composed of the rate of return paid to the fund on the proceeds of the short sale (2.50% per year) and the cost to borrow the ABC shares (0.50% per year). Finally, assume that the fund is able to post its long shares as collateral for the short sales. Note that there is no excess cash. Calculate the total dollar return. Ignore commissions for simplicity.

18. Repeat the previous problem, assuming that XYZ's share price rises 2% over the year, and that ABC's share price rises 10% over the same year.
19. On February 3, 2005, Qwest announced a \$6.3 billion offer to acquire MCI. On February 10, Verizon also made an offer to acquire MCI, matching Qwest's offer. On February 10, shares of Verizon were trading at \$36, MCI was trading at \$20, and Qwest was trading at \$4.20. Qwest, MCI and Verizon were three U.S. companies belonging to the telecommunications industry. The typical merger arbitrage hedge fund would go long the shares of the target company (MCI) and short the shares of the bidding companies (Qwest and Verizon).

In the following months, a battle for the acquisition of MCI developed. By October 10, 2005, Verizon had won the bidding contest and paid \$8.44 billion for MCI. At that moment, Verizon was trading at \$30 per share, MCI at \$25.5, and Qwest at \$4.20. Calculate the profit (loss) that the hedge fund would have obtained by following the strategy depicted in the previous paragraph. Suppose for simplicity that the hedge fund takes long or short positions, depending on the case, of 100,000 shares of Verizon and Qwest, and 200,000 shares in the case of MCI. Assume that the short rebate is 1%, and is composed of the rate of return paid to the fund on the proceeds of the short sale (1.50% per year) and the cost to borrow the shares (0.50% per year). Finally, assume that the fund is able to post its long shares as collateral for the short sales. Calculate the total dollar return. Ignore commissions and dividends for simplicity.

Problems 20 to 22

Hedge fund XYZ is a sector-specific hedge fund dedicated to the biotech sector. The partners at XYZ consider that they have superior abilities to pick out-performing stocks in the biotech sector. The current market value of XYZ's portfolio stands at \$10,000,000. XYZ uses a short-sale strategy to eliminate general market risk from the fund, where an exchanged-traded fund (ETF) of the general market is sold short. The last price of the market ETF was \$75. XYZ sells ETFs based on the following model. Assume a zero riskless rate:

$$\text{Return on XYZ portfolio} = \alpha + \beta \times \text{Market Return} + \text{error}$$

The estimated model using the ETF yields the following regression result:

$$\text{Return on XYZ portfolio} = 2\% + 1.5 \times \text{Market Return}$$

20. How much of the market index ETF should XYZ sell short? (Express the answer in total dollar amount and in number of ETF shares).
21. If the aggregate market rises 10%, construct a hedged portfolio to demonstrate that XYZ will be expected to generate a portfolio return equal to its alpha.
22. If the aggregate market declines 10%, construct a hedged portfolio to demonstrate that XYZ will be expected to generate a portfolio return equal to its alpha.

## Solutions

1.  $(1.025/1.0150) - 1 = 0.99\%$  (rounded).  
(Section 28.3.10)
2. Over time, one should expect the U.S. Dollar to depreciate against the Euro.  
(Section 28.3.10)
3. This is the school of thought known as the model-based global macro manager.  
(Section 28.3.3)
4. A carry trade will involve borrowing in U.S. dollars and lending in British pounds without hedging the exchange rate risk.  
(Sections 28.3.8, 28.3.3, and 28.3)
5.  $1.80 \text{ U.S.}\$/\text{£} \times (1.02/1.0275) = 1.7869 \text{ U.S.}\$/\text{£}$  (rounded)  
(Section 28.3.8)
6.  $\text{GBP } 1,300 / \text{Euro } 1,200 = 1.0833 \text{ GBP/Euro}$  (rounded)  
(Section 28.3.10)
7. In this case, the yen is the FCU and the dollar is the DCU. Thus,

$$(1 + r_{FCU}) \times \frac{\text{Forward Price of } FCU}{\text{Spot Price of } FCU} = (1 + r_{DCU})$$

$$(1 + 0.01) \times \frac{0.010}{0.0099} < (1 + 0.04)$$

The right-hand-side of the equation is greater than the left-hand-side. Therefore, the above equality does not hold. This is because the interest rate differential between the U.S. and Japan is approximately 3%, whereas the Yen only appreciated 1% in the 1-year forward rate when compared to the current spot rate. Therefore, covered interest parity is NOT satisfied.

(Section 28.3.8)

8. In this case, we have that (See Equation 28.10):

$$(1 + r_{FCU}) \times F_t/S_t = (1 + r_{DCU})$$

$$(1 + 0.025) \times 1.25/1.20 > (1 + 0.03)$$

It can be seen that the left-hand-side of the equation (1.0677) is greater than the right-hand-side (1.03), and therefore covered interest rate parity does not hold and there are arbitrage opportunities.

(Section 28.3.8)

9. In this case, an arbitrageur would follow the following steps:

$$\text{Since } F_t/S_t > [(1+r_{DCU})/(1+r_{FCU})]$$

Then, to restore equilibrium:

$F_t$  should fall

$S_t$  should rise

$r_{DCU}$  should rise

$r_{FCU}$  should fall

An arbitrageur would:

$F_t$  should fall → Sell forward at  $F_t$

$S_t$  should rise → Buy spot at  $S_t$

$r_{DCU}$  should rise → Borrow at  $r_{DCU}$

$r_{FCU}$  should fall → Lend at  $r_{FCU}$

Therefore, in  $t=0$ , an arbitrageur: borrows USD 1 million at 3%, converts this amount to GBP at the current spot rate of 1.20 USD/GBP (i.e., USD 1,000,000/1.20 GBP/USD = GBP 833,333), invests the GBP proceeds at 2.5%, and enters a position in the forward market to exchange the GBP deposit and interest received in one year for USD at the rate of 1.25 USD/GBP.

In  $t=1$ , the GBP deposit would have grown to GBP 854,166 (i.e., GBP 833,333 × 1.025), the investor would convert this amount to USD via the forward contract, resulting in USD 1,067,708 (i.e., GBP 854,166 × 1.25 USD/GBP), and she would then pay off the USD debt assumed in  $t=0$ , which is equal to USD 1,030,000 (amount initially borrowed plus interest). The resulting arbitrage profit is equal to USD 1,067,708 – USD 1,030,000 = USD 37,708.

(Section 28.3.8)

10. First, because the short-term rate is higher in South Africa than in the U.S., the carry trade requires an investor to borrow short-term in the U.S. at 2% per year and invest the proceeds in ZAR denominated instruments, earning 6% per year. Suppose the investor

borrow \$1 million. After conversion into ZAR, the investor invests (1 million USD / 0.12) in ZAR denominated instruments. After 1 year, this investment will grow to  $(1/0.12) \times (1+0.06)$  million ZAR, and after conversion into USD, it will be:

$$(1 \text{ million USD} / 0.12) \times (1+0.06) \times 0.1198 = 1,058,233 \text{ USD}$$

This sum is more than what the investor will need to repay the loan acquired in the U.S.: 1.02 million USD. In this case, the slight decline in ZAR was not enough to offset the gain from investing in higher yielding instruments denominated in ZAR. This carry trade generated a profit of 38,233 USD (i.e., 1,058,233 USD – 1,020,000 USD).

(Section 28.3.8)

11. The investment style of Hudson Investment Fund is most likely categorized as a value approach.

(Section 28.2.2)

12. The answer is yes- empirical evidence suggests that these types of hedge funds are effective in changing the composition of a company's board of directors.

(Section 28.2.5)

13. \$29.50 [i.e.,  $(\$200 \times 0.13) + \$3.5$ ]

(Sections 28.2.7 and 28.2.8.3)

14. \$3.6 [i.e.,  $(\$70 \times 0.06) - \$2.00 + (\$70 \times 0.02)$ ]

(Sections 28.2.7 and 28.2.8.3)

15. -\$5.5 [i.e.,  $(-\$70 \times 0.07) - \$2.00 + (\$70 \times 0.02)$ ]

(Sections 28.2.7 and 28.2.8.3)

16. A 13F security only includes the following investment vehicles:

- Exchange-traded (NYSE, AMEX) or NASDAQ-quoted stocks
- Equity options and warrants
- Shares of closed-end investment companies
- Certain convertible debt securities

(Section 28.2.8.2)

17. The following exhibit illustrates the cash flows:

Dollar returns from long position (XYZ):	
Price appreciation / depreciation	+\$5.00 (\$105.00 – \$100.00)
Dividends received	+\$2.00
Margin interest cost of longs if leveraged	\$0.00
Interest earned on cash	\$0.00
Total dollar change from long position	+\$7.00
Dollar returns from short position (ABC):	
Price depreciation/appreciation	+\$7.00 (\$70.00 - \$63.00)
Short rebate	+\$1.40 (0.02 × \$70.00)
Dividend payments	-\$3.00
Total dollar change from short position	+\$5.40
Total dollar return	+\$12.40

In this case, the long/short investor would have earned a gross return of 12.4% (i.e., the profit of \$12.40 divided by investor capital of \$100). In fully invested, unlevered funds, long positions equal the amount of investor capital. In the example, the long side was fully invested and unlevered, so there was no margin interest expense and no interest income earned on cash.

(Section 28.2.8.3)

18. The following exhibit illustrates the cash flows:

Dollar returns from long position (XYZ):	
Price appreciation/depreciation	+\$2.00 (\$102.00 – \$100.00)
Dividends received	+\$2.00
Margin interest cost of longs if leveraged	\$0.00
Interest earned on cash	\$0.00
Total dollar change from long position	+\$4.00
Dollar returns from short position (ABC):	
Price depreciation/appreciation	-\$7.00 (\$70.00 - \$77.00)
Short rebate	+\$1.40 (0.02 × \$70.00)
Dividend payments	-\$3.00
Total dollar change from short position	-\$8.60
Total dollar return	-\$4.60

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In this case, the long/short investor would have suffered a loss of 4.6% (i.e., the loss of \$4.60 divided by investor capital of \$100). In fully invested, unlevered funds, long positions equal the amount of investor capital. In the example, the long side was fully invested and unlevered, so there was no margin interest expense and no interest income earned on cash.

(Section 28.2.8.3)

19. The hedge fund would, on February 10:

- Sell short 100,000 shares of Verizon @ \$36 and receive proceeds of \$3,600,000
- Sell short 100,000 shares of Qwest @ \$4.2 and receive proceeds of \$420,000
- Buy 200,000 shares of MCI @ \$20, thus spending \$4,000,000

By October 10, 2005, the returns to each of these positions are as follows:

Dollar Returns from Long Positions in MCI:		
Dollar Returns from Price Change	200,000 x (25.50-20)	\$1,100,000.00
Dollar Returns from Short Positions in Verizon:		
Dollar Returns from Price Change	100,000 x (36-30)	\$600,000.00
Rebate	100,000 x 36 x 1%	\$36,000.00
Dollar Returns from Short Positions in Quest:		
Dollar Returns from Price Change	100,000 x (4.20-4.20)	\$0.00
Rebate	100,000 x 4.2 x 1%	\$4,200.00
<b>Total</b>		<b>\$1,740,200.00</b>

(Section 28.2.7)

20. Given that the portfolio's beta with the market is 1.5, a total of \$15,000,000 of the market ETF should be short sold. At the last price of \$75, this implies that 200,000 (i.e., \$15,000,000/\$75) shares of the ETF should be sold.

(Section 28.2.5)

21. Assuming an alpha of 2% and a beta of 1.5 for the portfolio:

$t=0$	Initial Value	$t=1$ ETF market +10%
Long portfolio	\$10,000,000.00	\$11,700,000.00
Short ETF position	\$15,000,000.00	\$13,500,000.00
<b>Total</b>	<b>\$25,000,000.00</b>	<b>\$25,200,000.00</b>
<b>Return on Hedged Portfolio</b>		<b>2.00%</b>

In general, alpha is given by

$$(\text{Return on XYZ portfolio} - \text{Riskless rate}) = \alpha + \beta \times (\text{Return on the Market} - \text{Riskless Rate}) + \text{Error}$$

If the riskless rate were not zero, the estimated alpha had to be adjusted.

The expected return on the long portfolio in  $t=1$  is  $E(\text{XYZ}) = \text{Alpha} + \text{Beta} \times \text{RM} = 2\% + 1.5 (10\%) = 17\%$ , and thus the market value of the long portfolio is  $\$10,000,000 \times 1.17 = \$11,700,000$ .

The value of the short position declines by  $10\% \times 15,000,000$ . Thus, the fund experiences a  $\$1,500,000$  loss on the position. Given zero short-term rates, there is no return on the proceeds from the short sale.

The total value of the hedge portfolio increased from  $\$25,000,000$  to  $\$25,200,000$ . Therefore, XYZ earned  $\$200,000$  when the market went up 10%. This profit represents 2% of the value of the long portfolio, which is the alpha that XYZ is supposed to be able to produce based on their superior skills to select out-performing stocks in the biotech sector.

(Section 28.2.5)

*Note: Review Chapter 32 of Level I book for a refresher on alpha-beta separation and portable alpha.*

22. Assuming an alpha of 2% and a beta of 1.5 for the portfolio:

$t=0$	Initial Value	$t=1$ ETF market -10%
Long portfolio	\$10,000,000.00	\$8,700,000.00
Short ETF position	\$15,000,000.00	\$16,500,000.00
Total	\$25,000,000.00	\$25,200,000.00
Return on Hedged Portfolio		2.00%

Where:

The expected return on the long portfolio in  $t=1$  is  $E(\text{XYZ}) = \text{Alpha} + \text{Beta} \times \text{RM} = 2\% + 1.5 \times (-10\%) = -13\%$ , and thus the market value of the long portfolio is  $\$10,000,000 \times 0.87 = \$8,700,000$ .

The expected return on the short ETF position is +10% in  $t=1$  and thus the market value of the ETF rises to  $\$15,000,000 \times 1.1 = \$16,500,000$ .

As in the previous exercise, the total value of the hedged portfolio increased from \$25,000,000 to \$25,200,000. Therefore, XYZ earned \$200,000 when the market went down 10%. Once again, this profit represents 2% of the value of the long portfolio, which is the alpha that XYZ is supposed to be able to generate based on their superior abilities to select out-performing stocks in the biotech sector.

(Section 28.2.5)

## Chapter 29: Hedge Funds: Credit Strategies

### Exercises

1. Suppose a loan that has \$150 million of principal and \$12 million of interest due at the end of the year. The probability of default (PD) for the borrower is estimated to be 1.5%. If there is a default, the lender expects to be able to recover \$40 million four years after the default. Find the exposure at default (EAD), the present value (PV) of the sum to be recovered, the recovery rate (RR), the loss given default (LGD), and the expected loss using an interest rate of 10%.
2. Describe the relationship between the probability of default and the credit spread with respect to the following four important properties of the Merton model: 1. Sensitivity to maturity, 2. Sensitivity to asset volatility, 3. Sensitivity to leverage, and 4. Sensitivity to the riskless rate.
3. Suppose that the assets of XYZ Corporation are worth \$150 million. Calculate XYZ's distance to default (DD) if its default trigger is estimated to be \$80 million, and the volatility of its assets is 30% per year.
4. Suppose there were 300 firms with distance to default (DD) equal to 1.5 at the beginning of 2015 in a sample of European corporations. Of this total, seven defaulted by the end of the year. Estimate the expected default frequency (EDF) empirically. Interpret the result obtained.
5. Company 123 has an actual default intensity of 0.13. Find (1) the expected time to default for Company 123, (2) the probability of survival, and (3) the probability of default over the next three periods.
6. Suppose that the riskless rate is 1% and that the face value of a one-year zero coupon bond issued by a start-up firm is \$30 million. What is the current price of the bond if it has a default intensity of 7%?
7. Suppose the case of a one-year zero-coupon bond with a credit spread of 4% and a recovery rate estimated to be 70%. Find the risk-neutral default intensity.
8. List the five determinants of Altman's Z-Score.
9. Why are the debts of a company in financial distress particularly suitable for investments through vehicles with flexible mandates?
10. What are the main characteristics of investing in distressed opportunities in Germany?
11. Why is it difficult to hedge risks in the case of asset-based lending (ABL) strategies?

## Solutions

1. These values are given as follows (with some rounding):

$$\text{EAD} = \$150 \text{ million principal} + \$12 \text{ million interest} = \$162 \text{ million}$$

$$\text{PV of sum to be recovered} = \$40 \text{ million} / 1.10^4 = \$27.32 \text{ million}$$

$$\text{RR} = \text{PV of sum to be recovered} / \text{EAD} = \$27.32 \text{ million} / \$162 \text{ million} = 0.168642$$

$$\text{LGD} = \text{EAD}(1 - \text{RR}) = \$162 \text{ million} (1.0 - 0.168642) = \$134.68 \text{ million}$$

$$\text{Expected loss} = \text{LGD} \times \text{PD} = \$134.68 \text{ million} \times 1.5\% = \$2.0202 \text{ million}$$

Note that LGD can also be found as EAD – Present value of sum to be recovered:  
 $\$162 \text{ million} - \$27.32 \text{ million} = \$134.68 \text{ million}$

(Section 29.1.4)

2. The relationship between the probability of default and the credit spread with respect to the following four properties of the Merton model is as follows:

1. Sensitivity to maturity: The probability of default increases, at a decreasing rate, as the time to maturity increases. The credit spread increases with maturity initially but then begins to decline slightly as maturity increases.

2. Sensitivity to asset volatility: The probability of default increases, at a decreasing rate, as the volatility of the asset increases. The credit spread will also increase as the volatility of the asset increases.

3. Sensitivity to leverage: As leverage increases, both the probability of default and the credit spread increase.

4. Sensitivity to the riskless rate: As the riskless rate increases, the mean return on the firm's assets (which under Merton's model is implicitly assumed to be equal to the riskless rate plus a constant risk premium) increases, reducing the probability of default and the credit spread.

(Section 29.3.5)

3. The DD of XYZ is found using Equation 29.16 as (rounded):

$$\text{DD} = (150 - 80) / (150 \times 0.3) = 1.56$$

XYZ Corporation is 1.56 standard deviations of asset volatility away from default.

(Section 29.4.2)

4. The estimate of the EDF is found using Equation 29.17:

$$\text{EDF} = \frac{\text{Number of Firms That Defaulted within One Year with DD} = n}{\text{Total Number of Firms in the Population with DD} = n} \quad (29.17)$$

$$\text{EDF} = 7/300 = 2.33\% \text{ (rounded)}$$

Based on historical observation, we might expect 2.33% of European firms with DD = 1.5 to default within one year.

(Section 29.4.3)

5. The expected time to default of any company is  $(1/\lambda)$ , which in the case of Company 123 is  $1/0.13$  or (rounded) 7.69 periods. Both remaining problems are solved using Equation 29.18.

$$p(t) = \exp(-\lambda \times t) \quad (29.18)$$

The probability of survival is  $e^{-0.13 \times 3}$ , which equals 0.677 (rounded). The probability of default is simply 1.0 minus the probability of survival:  $1.0 - 0.677$ , or 0.323 (rounded).

(Section 29.5.1)

6. We need to use equation 29.20:

$$D_0 = e^{-r \times T} (\text{Prob}_{\text{No Default}} \times K + \text{Prob}_{\text{Default}} \times 0) = e^{-r \times T} (e^{-\lambda \times T} \times K + (1 - e^{-\lambda \times T}) \times 0) = e^{-(r+\lambda) \times T} K \quad (29.20)$$

Substituting:

$$D_0 = e^{-(0.01+0.07) \times 1} \times 30 = \$27.69 \text{ million (rounded)}$$

(Section 29.5.2)

7. We need to use equation 29.22:

$$\lambda \times (1 - \text{RR}) \approx \text{Credit Spread} \quad (29.22)$$

Using Equation 29.22, the implied risk-neutral default intensity is 0.1333:

$$0.04 = \lambda \times (1 - 0.7)$$

$$\lambda = 13.33\%$$

(Section 29.5.3)

8. The five determinants of Altman's Z-Score are:
1. Working Capital/Total Assets.
  2. Retained Earnings/Total Assets.
  3. Earnings before Interest and Taxes/Total Assets.
  4. Market Value of Equity/Book Value of Total Liabilities.
  5. Sales/Total Assets.

(Section 29.7.2)

9. There are two reasons why the debts of a company in financial distress possess characteristics that make them particularly suitable for investments through vehicles with flexible mandates. First, a hedge fund vehicle is not bound by ratings restrictions (unlike a traditional credit mandate). Thus, hedge funds specializing in distressed debt investing have the ability to be a provider of liquidity to investors with traditional credit mandates. Second, investing in distressed securities often also allows capturing a liquidity risk premium (in addition to earning a default risk premium). This is especially the case for issuers or issuances that are smaller.

(Section 29.8.6)

10. The fundamental changes in the bankruptcy reform (enacted by the German parliament in 2012) aligned Germany's restructuring laws with practices in the U.S. and the U.K., and created new prospects to preserve entities as going concerns. The changes also created a process of potential transfer of equity to creditors. In the new rules, creditors have more say when choosing an administrator. They also provide a DIP-type loan. However, a consensual (out-of-court) approach is still the preferable method unless the debtor is forced to file for insolvency.

(Section 29.9.3)

11. Asset-based lending strategies are usually long-only strategies. Hedging is difficult because borrowers tend to be small, due to the unique features of the specific ABL facility, and because the nature of small businesses is highly idiosyncratic. Furthermore, hedging a long portfolio constituted by small issuers with a short portfolio of larger bond issuers (because of the difficulty in finding borrowers for middle market bonds) creates basis risk.

(Section 29.12.7.3)

**Chapter 30: Volatility, Correlation, and Dispersion Products****Exercises**

## Problems 1 to 4

Suppose that the current price of an equity index is  $S_0 = \$100$  with an annualized implied volatility of  $\sigma_0 = 25\%$ . Both the dividend yield and the short-term risk rate are equal to zero. A volatility trader believes the implied volatility will increase from 25% to 40% within the next weeks. To profit if the forecast comes true, the trader is considering a hedged position in an at-the-money call option (i.e.,  $K = \$100$ ) with the time to expiration of 0.2 years. The current price of the call option for each share of the index is  $C(100, 100, 25\%, 0.2) = \$4.46$ . Suppose that the trader borrows \$446 to establish a long position in the option (each option's contract is for 100 shares). The delta of the option is 0.522. The trader calculates the gamma (defined as  $\partial\Delta/\partial S$ ) and the vega (defined as  $\partial C/\partial\sigma$ ) of the positions, which are 3.56 and 1.781, respectively. Note: The value of vega indicates that the position will change by \$17.81 for each 1% change in implied volatility.

1. How can the position become delta hedged?
2. Calculate the change in the value of the position if there is an increase in implied volatility from 25% to 40%.
3. Calculate the return generated by the trader on the initial position (assuming that there is an increase in implied volatility from 25% to 40%). Is this profit likely to be obtainable?
4. Suppose that the price of the underlying stock declines to \$73 as time to maturity reaches 0.1 years, and implied volatility is 40%. In this case, the vega of the position will decline to 4.87. Calculate the estimated profit.
5. Suppose that 100 contracts are entered on the long side of a futures contracts on the VIX at a price of 18.00. If the contract settles at 18.90, how much will the trader be required to pay or receive?
6. Suppose that the nearby VIX futures contract has 12 days to settlement and a price of 18.10, while the first deferred contract has 42 days to settlement and a price of 18.30. Calculate the price of a hypothetical contract with 30 days to settlement.
7. A correlation swap based on four assets has a notional value of \$1,000,000 and a strike correlation rate of 0.30. One of the assets experiences returns that have zero correlations with the other three assets. Three of the assets experience actual realized return correlations between each other of 0.70. The market weights of the assets are all equal. Calculate the net payment to be made and identify whether the net payment is received by the buyer or the seller.

8. Explain how a short position in an iron condor can be created.
9. 20 futures contracts on the VIX are entered on the long side at a price of 13.00. How much will the trader be required to pay or be entitled to receive if the contract settles at 14.70?
10. Suppose that October calls on a certain stock with strike prices of \$60 and \$70 are available. Explain how a pure vertical spread and a ratio spread can be created.
11. Suppose that company XYZ is set to release earnings in a few days, and the implied volatility of one-month options has risen considerably more than the implied volatility of two-month options. A trader anticipates that the spread between the two implied volatilities will narrow after the earnings announcement due to a decline in the volatility of the one-month option. What options strategy should the trader implement?

## Solutions

1. Since the delta of the option is 0.522, the position will be delta hedged by shorting  $\Delta = 0.522 \times \$100 = \$52.2$  worth of the underlying index.  
  
(Section 30.2.5)
2. Everything else being the same, an increase in implied volatility from 25% to 40% will increase the position's value (remember that each option is for 100 shares) by  $1.781 \times (0.40 - 0.25) \times 100$  shares per option's contract = \$26.715  
  
(Section 30.2.4, 30.2.5, and 30.6.2)
3. The trader has apparently generated a 5.99% return on the initial position of \$446 (i.e.,  $(\$26.715/\$446) \times 100$ ). In reality, the profit is likely to be substantially lower and even close to zero. This is because as the volatility increases, the price of the underlying asset is likely to decline in price. Even though the position is delta hedged, one needs to account for changes in the vega as the price moves lower. In particular, the vega will decline substantially.  
  
(Section 30.2.4, 30.2.5, and 30.6.2)
4. In this case, the profit could be around  $4.87 \times (0.40 - 0.25) \times 100$  shares per options contract = \$73.05.  
  
(Section 30.2.4, 30.2.5, and 30.6.2)
5. A long position in a single futures contract over the life of the contract will receive \$1,000 for every point by which the VIX at the settlement date exceeds the price at which

the contract was entered, or will pay \$1,000 for every point by which the VIX falls short of the contract price. The trader is long and will thus receive:

100 contracts  $\times$  \$1,000 per point  $\times$  (18.90 points – 18.00 points) = \$90,000 on a mark-to-market basis if the contract settles at 18.90.

(Section 30.4.3.2)

6. A hypothetical contract with 30 days to settlement can be estimated using Equation 30.3 as the following linear combination of the contracts with 12 and 42 days to settlement, noting that there are 30 days between the settlements of the two contracts:

$$30 - \text{Day Hypothetical Contract Price} = \frac{P_S \times T_S}{T_1 - T_S} + P_1 \frac{30 - T_S}{T_1 - T_S} \quad (30.3)$$

Where:  $P_S$  is the price of the shorter-term contract,  $T_S$  is the number of days to settlement of the shorter-term contract,  $P_1$  is the price of the longer-term contract, and  $T_1$  is the number of days to settlement of the longer-term contract.

$$30 - \text{Day Hypothetical Contract Price} = \frac{18.10 \times 12}{42 - 12} + 18.30 \frac{30 - 12}{42 - 12} = 18.22$$

(Section 30.4.3.4)

7. The four assets have six realized correlations. Three of the correlations are 0.70 and three are 0.00. Given that the asset weights are equal, the average realized correlation is 0.35. The payment amount is calculated as:  $(0.35 - 0.30) \times \$1,000,000$  or \$50,000. The payment is made by the seller to the buyer.

(Section 30.4.4.1)

8. A short position in an iron condor is created when a trader sells an out-of-the-money bull spread and an out-of-the-money bear spread. A bull spread is created shorting a call and going long another call having a strike price that is lower than that of the long call. A bear spread is created shorting a call and going long another call having a strike price that is greater than that of the long call. Bull and bear spreads can also be created using put options. Bull spreads and bear spreads were detailed in CAIA Level I.

(Section 30.2.3)

9. The trader will be entitled to receive \$34,000 (i.e., 20 contracts  $\times$  \$1,000 per point  $\times$  1.70 points) on a mark-to-market basis if the contract settles at 14.70.

(Section 30.4.3.2)

10. A pure vertical spread would be long October 60 strike calls and short the *same* number of contracts of October 70 strike calls.

A pure vertical spread would be long October 60 strike calls and short a *different* number of contracts of October 70 strike calls.

(Section 30.5.1.1)

11. A trader may sell one-month options and buy two-month options in anticipation that the spread between the two implied volatilities will narrow after the earnings announcement (due to the expected decline in the volatility of the one-month option). Notice that the trader profits when the spread between the implied volatilities of the two options narrows following the announcement, but only if the price movement of the stock does not cause larger losses due to the position's negative gamma.

(Section 30.5.2)

## Chapter 31: Hedge Fund Replication

### Exercises

1. What are the potential benefits of replication products?
2. How does the fund bubble hypothesis explain a general rise in the beta of hedge fund indices and the corresponding decline in their alphas?
3. How does the capacity constraint hypothesis explain the general rise in the beta of hedge fund indices and the corresponding decline in their alphas during the past two decades?
4. How does the increased allocation to active funds hypothesis explain the general rise in the beta of hedge fund indices and the corresponding decline in their alphas during the past two decades?
5. Critique the following statement: “*Hedge replication products cannot provide alpha because they are not managed by skilled managers.*”
6. Is it possible to identify top-tier hedge fund managers a priori, and do hedge fund managers display significant performance persistence?
7. What is the underlying assumption behind the factor-based approach?
8. *Acquirer Inc.*, initiates a hostile takeover bid for *Target Inc.*, on March 2, 2016. The initial bid is at a price of \$26 in cash for each share of common stock of *Target Inc.* The day the deal is announced, *Target Inc.* closes at \$26.43. On the same day, stock of *Acquirer Inc.* closes at \$62.74. Subsequently, *Acquirer Inc.* increases the bid price initially to \$27.50 and finally to \$33.00, before completing the acquisition on July 28, 2016. The acquisition process has taken a total of 149 days to complete from the day of initiation of the first bid. On the day the deal is completed, the price of *Acquirer Inc.* is \$68.12. Suppose a fund manager is implementing a merger arbitrage using this deal, and buys shares of *Target Inc.* and sells short shares of *Acquirer Inc.* after the bid is announced. The short rebate rate is 1.5%, and neither of the companies paid dividends between March and July, 2016. Calculate the profit from the strategy assuming that the fund manager buys 1,000 shares of *Target Inc.* and sells short 300 shares of *Acquirer Inc.*

### Problems 9 to 10

Assume that a convertible bond with a \$1,000 face value is trading at 104% of par. The bond pays semiannual coupons at an annual rate of 6%. The bond converts to 24 shares of stock and currently has a delta of 0.591. The current stock price is \$22.38.

9. Calculate the number of shares that need to be sold short to make the convertible bond delta neutral.
10. Suppose the stock price moves up by 1%. Continuing with the previous exercise, show that the gain in the value of the convertible bond is exactly offset by the loss in value of the stock.

## Solutions

1. The most important benefit from investing in replication products is the enhancement of absolute and risk-adjusted portfolio returns (and hence they are also named *return enhancers*). This benefit can arise from earning alpha (typically measured relative to the performance of all underlying traditional or alternative beta exposures), or by investing in alternative beta exposures that are underweighted or not held in traditional portfolios. Liquidity risk is another source of return not available in traditional investments. Finally, a time-varying traditional source of beta (e.g., a dynamic beta that results from actively managing a portfolio) could be considered an alternative source of beta.

(Section 31.2)

2. The fund bubble hypothesis assumes that skilled hedge fund managers can earn substantially superior returns than successful fund managers in the traditional space. This hypothesis asserts that the number of less qualified managers in the hedge fund industry increases with the supply of capital to hedge funds. The correspondingly inferior returns provided by these new hedge funds dilute the aggregate industry performance.

(Section 31.3.2)

3. The capacity constraint hypothesis asserts that alpha is essentially a zero-sum game and that, therefore, only a few managers can be expected to consistently deliver alpha. The per capita amount of alpha available in the marketplace has declined substantially with AUM growing almost exponentially since the early 1990s. According to this hypothesis, alpha will be expected to continue to decline unless new sources of alpha are discovered.

(Section 31.3.2)

4. The increased allocation to active funds hypothesis argues that as investments in hedge funds becomes more popular; the aggregate performance of the industry will be adversely affected by the decisions of investors who have allocations to these funds as well as to traditional assets. In other words, the systematic risks or betas of hedge funds will increase as more capital flows into the industry. For instance, during periods of financial market turmoil, investors may be forced to liquidate both their traditional and their alternative investments, increasing the correlation between these two asset classes.

(Section 31.3.2)

5. First of all, and by definition, a replication product will capture the alpha offered by the benchmark (this should be true at least in an extreme case where a replication product can perfectly replicate the return properties of the benchmark). Further, replication products bear lower fees than actively managed portfolios and therefore enhance the possibility of providing alpha to investors who invest in these products. In the end, whether replication products can provide alpha is an empirical question.

(Section 31.3.4)

6. Empirical evidence (both from the academia and from the industry) provides mixed results on these issues. For instance, some of the studies suggest that top-tier hedge funds do exhibit return persistence. However, the outperformance of these top-tier hedge funds tends to disappear as time passes and as capital flows to these top-performing funds. Other researchers have not found performance persistence among hedge fund managers, and if they find any, it tends to erode after only a few months.

(Section 31.4.1)

7. The underlying assumption behind the factor-based approach is that a set of asset-based factors can explain a significant portion of a fund's returns.

(Section 31.5)

8. The following table describes the profit by the fund manager from merger arbitrage involving the acquisition of *Target Inc.* by *Acquirer Inc.* Note that some hedge funds will choose not to hedge a cash merger transaction with a short position in the acquirer's stock.

Profit-and-Loss Statement for the Example Merger Arbitrage Trade	
Description	Amount
Gain on <i>Target's Inc.</i> long position: 1,000 shares $\times$ (\$33.00 – \$26.43)	\$6,570.00
Loss on <i>Acquirer's Inc.</i> short position: –300 shares $\times$ (\$68.12 – \$62.74)	–\$1,614.00
Short rebate at 1.5% rate: 1,000 shares $\times$ \$62.74 $\times$ 1.5% $\times$ 149/365	<u>\$384.18</u>
Total profit from strategy	\$5,340.18
 Initial investment: 1,000 shares $\times$ \$26.43	 \$26,430.00
 Return on investment over 149 days: \$5,340.18 / \$26,430	 20.21%
Annualized return: $(1.2021)^{(365/149)} - 1$	56.96%

(Section 31.7.2)

9. The number of shares that need to be sold short to make the convertible bond delta neutral is (rounded) 27.46 ( $\$1,040 \times 0.591 / \$22.38$ ). Therefore, the dollar value of stock held short to create a delta-neutral position is \$614.55 ( $27.46 \times \$22.38$ ).

(Section 31.7.3)

10. A 1% stock price increase will cause the value of the convertible bond to increase by more than 0.591% (the delta of the convertible bond), because the positive gamma of the option means that the bond's delta will increase as the stock price increases.

The following table shows the value of the portfolio before and after a 1% increase in the stock price. After a 1% increase in the stock price, the value of the short position in stock (which has a gamma of zero) becomes  $-\$620.70$  ( $-\$614.55 \times 1.01$ ). At the same time, the value of the convertible bond becomes greater than  $\$1,046.15$  ( $1,040 \times 1.00591$ ) because the delta of the convertible increased as the stock price increased.

Hedging of Convertible Bonds (amounts in \$)

	Before	After	Change
Long convertible bond	1,040.00	1,046.15	6.15
Short stock	-614.55	-620.70	-6.15
Portfolio value	425.45	425.45	

Note that this is what is supposed to happen when the convertible bond is perfectly delta-hedged. However, as the stock price fluctuates, the hedge ratio needs to be constantly adjusted to keep the portfolio delta neutral.

(Section 31.7.3)

## Chapter 32: Funds of Hedge Funds and Multistrategy Funds

### Exercises

- The pension fund of ABC University is considering allocating to hedge fund investments. Laura Monahan, a member of the pension fund's investment committee, has been arguing that the best way to access the hedge fund asset class is by investing through a fund of hedge funds (FOF). To this end, she has been analyzing *123 Associates*, a fund of hedge funds that was founded in 2002. The manager selection process at *123 Associates* attempts to identify investment managers that specialize in merger arbitrage, distressed securities, and short sales and that have recorded superior returns through different market cycles. The fund currently has investments in thirty hedge fund managers. What is manager selection risk? Should an investment in *123 Associates* protect the pension fund of ABC University from manager selection risk?
- Calculate equally weighted and equally risk-weighted allocations to the following strategies.

Strategies (2001-2008)	Annualized Return	Standard Deviation
CISDM Equity Market-neutral	5.6%	2.0%
CISDM Fixed Income Arbitrage	3.6%	4.8%
CISDM Convertible Arbitrage	3.3%	6.2%
CISDM Distressed Securities	7.6%	6.0%
CISDM Merger Arbitrage	4.8%	3.4%
CISDM Emerging Markets	7.9%	10.5%
CISDM Equity Long/Short	4.4%	6.0%
CISDM Global Macro	6.4%	3.3%

Source: Edited from Schneeweis, Crowder, and Kazemi (2010)

- List the seven disadvantages of funds of hedge funds (FoFs) discussed in the book.
- According to empirical evidence, how do funds of hedge fund (FoFs) compare to single hedge funds in terms of drawdowns, standard deviation of returns, and average returns?
- Mary Helstrom is a young, high net worth individual. Until now, Mary has invested her financial wealth in U.S. large cap stocks. However, recent financial turmoil has prompted Mary to revise her investment strategy. She is considering investing a portion of her financial wealth in funds of hedge funds (FoFs). Using the information presented in the following table, calculate the expected return and standard deviation of returns of a portfolio that is 80% invested in U.S. stocks and 20% invested in FoFs. Interpret the results obtained.

1991-2008	Annualized Return	Standard Deviation	Correlation with FOF

U.S. Stocks (S&P 500)	7.90%	14.40%	0.58
CISDM Funds of Funds Diversified Index	7.90%	5.10%	1

Source: Edited from INGARM, "The Benefits of Hedge Funds," August 2009.

- How do funds of hedge funds (FoFs) compare to multistrategy hedge funds (MSFs) regarding fees?
- What is funding bias?
- List the six desirable characteristics of hedge fund indices that are used to benchmark investment performance.

## Solutions

- The answer is yes, an investment in *123 Associates* should protect the pension fund of ABC University from manager selection risk. This risk arises when investing in individual hedge funds because selecting individual hedge funds exposes investors to the risk of significantly underperforming the overall return of the hedge fund asset class. The dispersions of returns of both hedge funds and FoFs have traditionally been very high, and both exhibit a broadening trend. A wrong fund selection decision could have a negative impact on performance.

(Section 32.10.2)

- The following table shows the allocations. The equally weighted method is easy to apply; each strategy is allocated the same weight of 12.5% (i.e., 100%/8). In the case of the equally risk-weighted method, to obtain the allocations to each strategy, first one needs to use Equation 32.1:

$$\text{Equal risk weight } i = \frac{1/\text{Annualized Standard Deviation } i}{\sum_{i=1}^n 1/\text{Annualized Standard Deviation } i}$$

Where: The numerator is the inverse of each strategy's whole-period annualized standard deviations and the denominator is the sum of the inversed standard deviations.

Strategies (2001-2008)	Equally Weighted	Equally risk-weighted
CISDM Equity Market-neutral	12.50%	26.38%
CISDM Fixed Income Arbitrage	12.50%	10.99%
CISDM Convertible Arbitrage	12.50%	8.51%
CISDM Distressed Securities	12.50%	8.79%
CISDM Merger Arbitrage	12.50%	15.52%
CISDM Emerging Markets	12.50%	5.02%
CISDM Equity Long/Short	12.50%	8.79%

When analyzing the allocations generated by the equally-risk method, it is not surprising that Equity Market-Neutral, the strategy with the lowest risk (with a low 2% annual standard deviation), is assigned the highest allocation (26.38%) of all the strategies. On the other hand, Emerging Markets had the highest standard deviation (10.5%) and is therefore assigned the lowest allocation (5.02%).

(Sections 32.4.2 and 32.4.3)

3. The seven disadvantages of FoFs are: Existence of a double layer of fees, performance fees on portions of the portfolio (netting risk), administrative delay risk (tardy reports and other information), lack of transparency, exposure to other investors' cash flows, lack of control, and lack of customization.

(Section 32.7)

4. Empirical evidence presented in the book indicates that FoFs have fairly low drawdowns and standard deviations, and lower drawdowns and standard deviations than the average individual hedge fund. However, during the same period (1990-November 2011) average returns on FoFs were only a little more than half of those of individual hedge funds. These results can be explained by the double layer of fees charged by FoFs and by the upward bias in the reported performance of individual hedge funds caused by survivorship bias.

(Section 32.9.4)

5. The expected return of the portfolio  $E(R_p)$  is equal to the weight of each asset in the portfolio multiplied by its expected return:

$$E(R_p) = 0.80 \times 7.9\% + 0.20 \times 7.9\% = 7.9\%$$

The formula for the standard deviation of returns of the portfolio ( $\sigma_p$ ) is:

$$\begin{aligned} \sigma_p &= [(w_{SP500})^2 \times \sigma_{SP500}^2 + (w_{FOF})^2 \times \sigma_{FOF}^2 + (2 \times w_{SP500} \times w_{FOF} \times \sigma_{SP500} \times \sigma_{FOF} \times \rho_{SP500, FOF})]^{1/2} \\ &= [(0.80)^2 \times (0.144)^2 + (0.20)^2 \times (0.051)^2 + (2 \times 0.80 \times 0.20 \times 0.144 \times 0.051 \times 0.58)]^{1/2} \\ &= 12.14\% \end{aligned}$$

Where:  $w$  are the weights of each asset in the portfolio and  $\rho$  is the correlation coefficient between the returns of the two assets.

In this case, the expected return of the portfolio is exactly the same as the return on each of the assets, which is 7.9%. The benefit from adding funds of hedge funds to the portfolio of U.S. large cap stocks resides in the reduction in portfolio risk that is achieved (the standard deviation of the portfolio declines from 14.4% to 12.14% when funds of hedge funds are added to the U.S. stock portfolio). The decline would be larger if a higher percentage of FoFs is added to the portfolio of U.S. stocks.

(Section 32.4.4)

*Note: Review the book, Investments, by Bodie, Kane, and Marcus if you need to refresh concepts related to the calculation of expected returns and risk of portfolios of two risky assets.*

6. FoFs charge two fees to investors: the fees charged by the underlying hedge funds, and an additional layer of fees. In practice, investors in FoFs do not have to pay the apparently high fees that would result from adding the two layers of fees just described, because FoFs are able to negotiate fee breaks with underlying managers.

Many MSFs do not have this additional layer of management and incentive fees. However, they may pass on the cost of their infrastructure to the fund, and in many cases, these costs may be considerable. In the end, MSF fees may be lower than those of FoFs (and the underlying managers), because of the reduction of netting risk.

(Section 32.8)

7. Funding bias exists when the returns to hedge funds available in databases are biased upward (compared to the case in which the full hedge fund universe would not have existed if there were no funds of hedge funds). In other words, FoFs discourage bad hedge funds from being launched or, if created, from remaining in business too long. Thus, this phenomenon creates an upward bias in hedge fund returns observed in databases. The existence of funding bias offers an important monitoring and due diligence service for the whole industry. Funding bias should not be confused with reporting biases.

(Section 32.9.4)

8. The six desirable characteristics of hedge fund indices that are used to benchmark investment performance are: Representativeness, unambiguousness, verifiability, accountability, replicability, and reasonableness.

(Section 32.10.1)

## Chapter 33: Hedge Fund Operational Due Diligence

### Exercises

1. What are the four primary ways in which hedge funds deal with cash?

### Problems 2 to 7

*XYZ Due Diligence* is a firm specializing in performing hedge fund due diligence on behalf of its clients, which are mostly institutional investors. Susan McGraw and Ernest Williams are two of the firm's due diligence experts. They are having a preliminary meeting intended to estimate the operational risk of *123 Fund*, a long/short equity hedge fund dedicated to large and mid size U.S. stocks that was founded in 2011. *123 Fund* currently has \$15 million in assets under management (AUM).

2. At the beginning of the meeting, Ms. McGraw points out to Mr. Williams that she is concerned about *123 Fund's* delays in reporting its NAV to investors. The fund's net asset values (NAVs) from the previous six months were distributed to investors as follows:

- The NAV for January, was distributed to investors on February 21<sup>th</sup>
- The NAV for February, was distributed to investors on March 22<sup>th</sup>
- The NAV for March, was distributed to investors on April 23<sup>th</sup>
- The NAV for April, was distributed to investors on May 25<sup>th</sup>
- The NAV for May, was distributed to investors on June 25<sup>th</sup>
- The NAV for June, was distributed to investors on July 28<sup>th</sup>

Are the concerns expressed by Ms. McGraw justified?

3. Mr. Williams is worried because he found out that a month ago an employee working at *123 Fund* took a long position on ETF ABC, which is based on diversified world stock markets, for his personal account. Mr. Williams is convinced that this is a case of front running. Is Mr. Williams's concern justified?
4. Ms. McGraw has been going through a batch of brokerage statements of employees from *123 Fund*. The statements were provided to her by the fund's compliance department, which in turn received them directly from the employees. Ms. McGraw has just found out that an employee from the fund sold shares of a company from his personal account at a steep loss before the minimum holding period was reached. Are there any concerns from these findings?
5. Mr. Williams notices that *123 Fund* has an internal compliance department, with a third-party compliance consultant to supplement the work of the internal compliance function. Mr. Williams is concerned that the coexistence of an internal compliance department and

a third-party compliance consultant may not be best practice for a hedge fund, as each one of them would be superseding the other. Is the concern by Mr. Williams justified?

6. *XYZ Due Diligence* has produced a brief summary memorandum that outlines only the key concerns from the operational due diligence (ODD) process conducted on *123 Fund*. This is the only document that *XYZ* will provide to their clients on the ODD conducted on *123 Fund*. Is this considered best practice?
7. A potential investor in *123 Fund* has read the ODD report that *XYZ Due Diligence* produced on this fund. The investor concludes that *123 Fund* “carries an unacceptable level of operational risk.” Should this investor decide to allocate assets to *123 Fund*?

## Solutions

1. The ways in which hedge funds deal with cash can be grouped into the following four primary categories:

1. Cash for fund expenses. These include frequent recurring expenses (e.g., office rent and salaries), and less frequent expenses (e.g., audit and legal bills).
2. Cash to facilitate trading. Besides the usual expenses inherent to trading (e.g., brokerage commissions), hedge funds may also have positive cash balances on account with trading counterparties (e.g., with a swap counterparty).
3. Cash flows to and from investors. This is cash arising from capital inflows (i.e., subscriptions) and outflows (i.e., redemptions).
4. Unencumbered cash. This cash is not currently being used for trading but may be used in the future for either trading or for another reason. Hedge funds usually earn interest on this type of cash by depositing it in liquid assets (e.g., checking accounts or interest-bearing money market accounts).

(Section 33.3.1)

2. First, NAVs are typically distributed to investors within a number of days of the end of each month. This delay arises because the production of the final NAV is subject to independent valuations for positions, and can also be caused by other reasons such as personnel turnover (at either the hedge fund or the administration firm). Having said this, in the case of *123 Fund*, it seems to be somewhat difficult to justify distributing NAVs to investors three weeks or more after the end of the previous month, as can be seen it happened in the previous six months. Furthermore, *123 Fund* is a long/short equity fund dedicated to large and mid size U.S. stocks and thus, in principle, one would think that their positions would be relatively easy to value, and that there is no need for delays of three weeks or more. Perhaps more worrisome is the tendency for *123 Fund's* NAVs to be distributed to investors with larger delays each month, indicating the presence of an operational signaling effect. In summary, Ms. McGraw's concerns are justified, and *XYZ Due Diligence* should perform further due diligence in an attempt to further investigate any undiagnosed problems.

(Section 33.4.2)

3. The concerns by Mr. Williams are not warranted. Personal account dealing is an example of a common hedge fund compliance policy. The policies implemented regarding personal account dealing usually apply to employees, their significant others, as well as other immediate family members. The majority of personal account dealing procedures defines a universe of securities (known as covered securities), to which the policies apply. In practice, most hedge funds typically exclude investments in exchange-traded funds from the universe of covered securities, because of the reduced likelihood that an employee would front-run anticipated hedge fund trades through ETFs. Furthermore, also notice that the relatively small amount of AUM of *123 Fund* make it rather difficult to argue that an employee would be front running anticipated trades by the fund using an ETF that, to make the case even weaker, is based on world stock markets (and *123 Fund* invests in large and mid size U.S. stocks).

(Section 33.5.1)

4. Yes, there are a few concerns with this finding. First, it is considered best practice for the compliance department of a hedge fund to collect employee brokerage statements *directly* from brokers and independent of the employee. This is not what happened at *123 Fund*, where statements were provided to the fund's compliance department directly by the employees.

The fact that an employee from the fund sold shares of a company from his personal account at a steep loss before the end of the minimum holding period is acceptable if *123 Fund* employs a hardship exemption procedure. This exemption is commonly allowed to limit excessive losses in employees' personal accounts.

(Section 33.5.2)

5. The concern by Mr. Williams is unwarranted. It is generally considered best practice for a hedge fund to use a third-party compliance consultant to supplement the work of the internal compliance function.

(Section 33.5.5)

6. While such summary memos are efficient for review, it is often considered best practice to generate a more detailed document. These detailed documents typically begin with an executive summary section, which summarizes the key findings from the operational due diligence review. It is also considered best practice to detail fund and firm strengths uncovered during the ODD process. The other sections of the report typically provide

detailed analysis of each of the operational risk review areas covered during the ODD process.

(Section 33.6)

7. The common conclusion for an investor in this case would be to make no immediate investment with the hedge fund. However, this decision may be reevaluated to make an allocation in the future if *123 Fund* makes operational improvements.

(Section 33.7)

## Chapter 34: Regulation and Compliance

### Exercises

Problems 1 to 4

*Alpha, LLC* is a U.S. hedge fund that has hired a legal consultant to help determine whether the fund adapts to the mandates contained in the Dodd-Frank Act. The legal consultant is making a preliminary presentation to *Alpha*.

1. At the beginning of the presentation, the consultant expresses that “...*The Volcker Rule is a key component of the Dodd-Frank Act and restricts the ways that investment banks can invest in private equity funds, hedge funds, and proprietary trading strategies, and also regulates trading in derivatives.*” Is this assertion correct? Explain.
2. Further in the presentation, the consultant comments that “...*Under the Securities Exchange Act of 1934 as modified by the Dodd-Frank Act, an accredited investor is defined as a natural person who either (1) has a net worth exceeding USD 1 million, excluding the value of his primary home; or (2) has earned at least USD 200 thousand singularly in each of the past two years or USD 300 thousand jointly with a spouse. A qualified purchaser is defined as an individual investor with USD 5 million or an institutional investor with USD 25 million in investable assets; there is no further requirement.*” Is that assessment correct?
3. Towards the end of the presentation, the consultant comments “...*The Dodd-Frank Act requires an adviser who beneficially owns more than 1% of a class of publicly traded equity securities to file disclosure reports.*” Is this comment by the consultant correct? Explain.
4. Finally, the consultant states that “...*Under the Dodd-Frank Act, any person who aids or abets a violation by another person is liable, but to a lesser extent, of fines and penalties as the primary violator.*” Is this statement correct? Explain.
5. *XYZ* is a non-U.S. hedge fund that has 12 U.S. clients. Under the Dodd-Frank Act, does *XYZ* have to register with the SEC?
6. *123* is an unregistered U.S. hedge fund dedicated to the convertible arbitrage strategy. In the last monthly letter to its investors, *123* included the following testimonial from Jack Laffite, one of the fund’s current investors: “*123 is as solid as a rock, they managed to generate positive returns when the rest of the convertible funds were losing money during the recent market turmoil.*” Is the inclusion of Jack’s testimonial by *123* in its monthly letter legal or prohibited? Does the answer to this question change if *123* were registered with the SEC?

7. *MNO* is a U.S. hedge fund. The fund currently has \$200 million in assets under management (AUM). Its client base is mostly retail. The fund charges performance-based fees and has a strong compliance program. According to the SEC, are there any factors contributing to categorize *MNO*'s hedge fund manager as a high-risk profile?
8. Hedge fund *ABC* is a merger arbitrage hedge fund registered in New York. *ABC* has just sent a written communication to its partners explaining the recent performance of the fund. *ABC*'s communication states that the fund generated a net of fees return (although custodial fees were not netted out) of 2.5% during the past quarter. No mention is made about the aggregate equity market performance during the same period. *ABC*'s communication presents gross performance figures side by side with net figures. The communication also discloses how the fund's performance was calculated indicating that the highest fee charged to a client was deducted to arrive at the net of fees performance figure. According to the SEC, is the chief compliance officer (CCO) of hedge fund *ABC* in full compliance? Explain.
9. Does the current European Union (EU) regulatory scheme provide for a universal set of penalties?
10. Which financial centers in Asia desire to become the next centers for hedge funds? Are the costs of starting and running a hedge fund in these centers higher or lower than those in New York?

## Solutions

1. The statement is incorrect because the Volcker Rule restricts the ways that commercial banks (and not investment banks) can make the investments commented in the question.  
  
(Section 34.2.1)
2. Yes, it is correct.  
  
(Section 34.2.2)
3. The comment by the consultant is incorrect. The Dodd-Frank Act requires an adviser who beneficially owns more than 5% (and not 1%) of a class of publicly traded equity securities to file disclosure reports. This filing must be done within 10 days of the acquisition of those securities, identifying, among other things, the source and amount of funds used for the acquisition and the purpose of the acquisition.  
  
(Section 34.2.5)
4. The statement is incorrect because under the Dodd-Frank Act, any person who aids or abets a violation by another person is liable to the same extent of fines and penalties as the primary violator.

(Section 34.2.2)

5. Under the Dodd-Frank Act, overseas hedge funds with more than 15 U.S. clients will have to register with the SEC. *XYZ* only has 12 U.S. clients and, therefore, it does not have to register with the SEC. A hedge fund must complete and file Form ADV once it is determined that it must register with the SEC.

(Section 34.2.3)

6. The inclusion of an investor's testimonial by an investment adviser in any written communication addressed to more than one person is prohibited. This prohibition applies to both registered and unregistered investment advisers. In order for a hedge fund manager to avoid violating the rule against fraudulent, deceptive, or manipulative activities, its chief compliance officer (CCO) must review all documents that communicate information to investors to make sure they conform to regulatory guidelines.

(Section 34.2.4.1)

7. Yes, the following three factors contribute to a high-risk profile for *MNO*'s hedge fund manager: the fund has a large amount of AUM, its client base is retail, and fees are charged based on performance. In theory, the fact that *MNO* has a strong compliance program helps to somewhat lessen these three high risk factors.

(Section 34.2.4.3)

8. The CCO is not in full compliance with the SEC regarding the following issue: The fund manager must provide information on the effect of market or economic conditions on the performance results presented. According to the exercise, *ABC* made no mention about the aggregate equity market performance during the quarter over which *ABC* presented its results. This may mislead some investors.

On the other hand, the CCO was in compliance regarding the following four issues:

- i. Performance results were presented net of fees
- ii. The fact that custodial fees were not netted out is acceptable
- iii. Gross performance figures were presented side by side with net figures
- iv. *ABC* disclosed to investors that the highest fee charged to a client was deducted from performance results, and explained how the performance figure was calculated

(Section 34.2.4.1)

9. The current EU regulatory scheme does not provide for a universal set of penalties. These are established within the legal framework of each member state. The Alternative

Investment Fund Managers Directive (AIFMD) provides that the penalties should be “effective, proportionate, and dissuasive.”

(Section 34.3.4.2)

10. In recent years, Hong Kong and Singapore appear to be vying to become the next centers for hedge funds to rival those of New York and London. The costs of starting and running a hedge fund in these two financial centers are much lower than those in New York. Income tax rates are also lower. Hong Kong and Singapore require hedge funds to register with the appropriate government regulatory body.

(Section 34.4)

**Chapter 35: Structured Products I:**  
**Fixed-income Derivatives and Asset-backed Securities**

**Exercises**

1. Suppose the parameters of the Vasicek model are  $\mu = 3\%$  (i.e., the long-term mean level of the short-term interest rate), and the following speed of adjustment parameter is given as  $K = 0.9$  and  $\sigma = 1\%$ . If the current short-term rate is 2%, what would be the expected short-term rate for the next period?
2. Firm ABC buys an interest rate cap from Bank 123. The cap is for four years, is settled quarterly, has a strike rate of 6%, and has a notional value of \$60 million. What are the payments, if any, from Bank 123 to firm ABC in the first four quarters if the reference rates for those quarters are, respectively, 3.5%, 5%, 6%, and 8%?
3. Firm ABC buys an interest rate floor from Bank 123. The floor is for four years, is settled quarterly, has a strike rate of 6%, and has a notional value of \$20 million. What are the payments, if any, from Bank DEF to Firm XYZ in the first four quarters if the reference rates for those quarters are, respectively, 3%, 5%, 7%, and 9%?
4. Suppose a two-year bond pays an annual coupon of \$7 and has a face value of \$100. The one-year interest rate today is 2.79%, and with equal probability, one-year interest rates between the first year and the second year will be either 3.23% or 2.44%. Calculate the current value of the bond.
5. Consider again the case of the two-year bond of the previous exercise. Now assume that this bond can be called at \$104 in one year. What should the current price be? Note, if the bond is called, the coupon payment is still paid.
6. Calculate the value of the implicit or embedded call option that the issuer has to call the bond.
7. Suppose that pension fund XYZ has entered into an agreement to pay six-month LIBOR in exchange for receiving (from bank B) a fixed interest rate of 3.5% per annum every six months for four years, on a notional principal of \$10 million. Calculate the resulting cash flows from the point of view of the pension fund, assuming the six-month LIBOR rates (expressed as rates per year with semiannual compounding) depicted in the following table.

Date	6-Month LIBOR
May 2, Year 1	4.10%
November 2, Year 1	3.90%
May 2, Year 2	3.75%
November 2, Year 2	3.65%
May 2, Year 3	3.40%
November 2, Year 3	3.30%
May 2, Year 4	3.70%
November 2, Year 4	3.95%

8. If the absolute prepayment speed (ABS) rate is 1.1% at month 10 after origination, calculate the single monthly mortality (SMM). Assume that there are 90 days in each quarter.

### Solutions

1. Inserting the given values into Equation 35.2 produces:

$$E[r_{t+1}] = r_t + k(u - r_t) \quad (35.2)$$

$$E[r_{t+1}] = 0.02 + 0.9(0.03 - 0.02) = 0.029 = 2.90\%$$

(Section 35.2.1)

2. The solution is found using Equation 35.7:

$$\text{Cap Payment} = \text{Max}[(\text{Reference Rate} - \text{Strike Rate}), 0] \times \text{Notional Value} / m \quad (35.7)$$

Where  $m = 4$  and the strike rate is equal to 6%. For the fourth quarter, the formula is  $(8\% - 6\%) \times \$60,000,000/4$ , which is equal to \$300,000. The four answers are \$0, \$0, \$0, and \$300,000. Notice that the fourth quarter is the only quarter for which the reference rate is above the strike rate.

(Section 35.4.1)

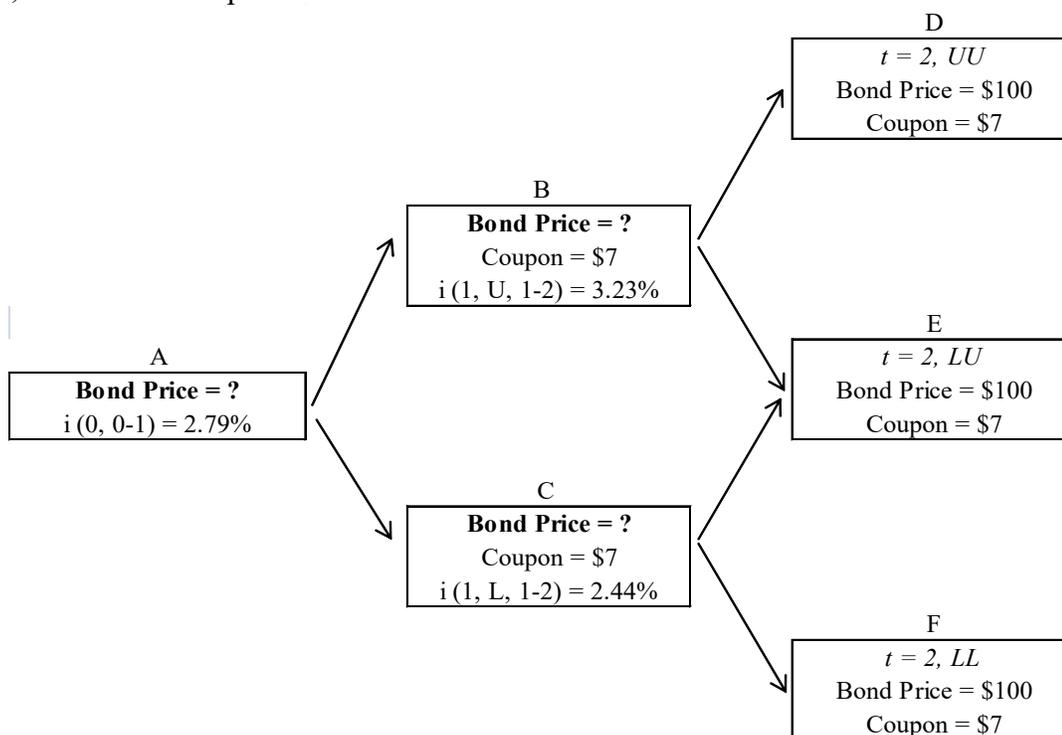
3. The solution is found using Equation 35.8:

$$\text{Floor Payment} = \text{Max}[(\text{Strike Rate} - \text{Reference Rate}), 0] \times \text{Notional Value} / m \quad (35.8)$$

Where  $m = 4$  and the strike rate equal to 6%. For the second quarter, the formula is  $(6\% - 5\%) \times \$20,000,000/4$ , which is equal to \$50,000. The four answers are \$150,000, \$50,000, \$0, and \$0.

(Section 35.4.1)

4. First, we draw the respective binomial interest rate tree:



Then, we proceed to calculate bond prices at nodes B and C as follows, assuming that the probabilities of an up move and a down move are each 50%:

$$\text{Bond Price (Node B)} = \frac{1}{1+0.0323} [0.5 \times (100 + 7) + 0.5 \times (100 + 7)] = \$103.65$$

$$\text{Bond Price (Node C)} = \frac{1}{1+0.0244} [0.5 \times (100 + 7) + 0.5 \times (100 + 7)] = \$104.45$$

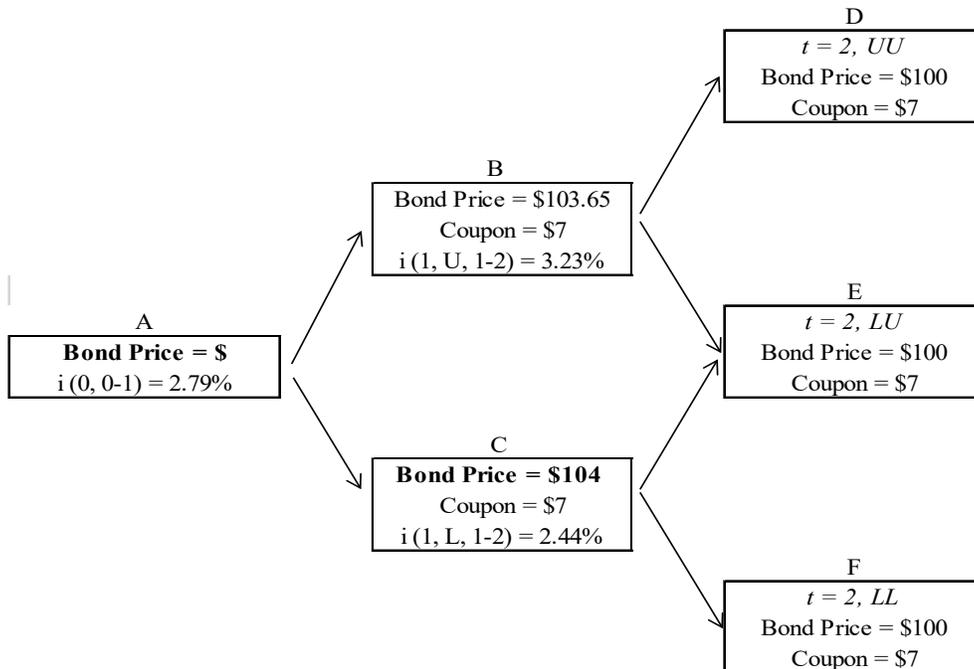
Finally, we calculate the current value of the bond at node A:

$$\text{Bond Price (Node A)} = \frac{1}{1+0.0279} [0.5 \times (103.65 + 7) + 0.5 \times (104.45 + 7)]$$

$$= \$108.04$$

(Section 35.4.2)

5. In this case, the bond would be called in node C in year 1 because the bond price at that node (\$104.45) exceeds \$104. We have drawn the respective binomial interest rate tree in the following binomial tree.



Bond Price (Node A) =

$$\frac{1}{(1 + 0.0279)} (0.5 \times (103.65 + 7) + 0.5 \times (104 + 7)) = 107.82 \text{ (rounded)}$$

(Section 35.4.2)

6. Notice that, as expected, the current value of the callable bond (i.e., \$107.82) is now lower than the current price of the non-callable bond (i.e., \$108.04). The reason is that the bond would be called if we move to the lower node C in one year. The difference between the two bond values is the value of the implicit call option that the issuer has to call the bond:

Value of call option = Value of noncallable bond – Value of callable bond

$$\text{Value of call option} = \$108.04 - \$107.82 = \$0.22$$

(Section 35.4.2)

7. On May 2<sup>nd</sup> of year 1, the six-month LIBOR rate was 4.10%. This is the rate that would have been applied to the floating payment made six months later, on November 2<sup>nd</sup>. Therefore, the first floating cash flow paid by the pension fund was equal to \$205,000. This payment was calculated as follows:  $(4.10\%/2) \times \$10,000,000$ . The same procedure can be followed to find the floating rate payments that were made in future periods. The net cash flow to the pension fund is equal to the difference between the fixed cash flow to be received [i.e.,  $(3.5\%/2) \times \$10,000,000 = \$175,000$ ], and the floating cash flow to be paid. In practice, only the net cash flows, or the difference between the fixed and floating rate payments, are exchanged.

Date	6-Month LIBOR (%)	Floating Cash Flow (\$)	Fixed Cash Flow (\$)	Net Cash Flow (\$)
May 2, Year 1	4.10			
November 2, Year 1	3.90	205,000	175,000	-30,000
May 2, Year 2	3.75	195,000	175,000	-20,000
November 2, Year 2	3.65	187,500	175,000	-12,500
May 2, Year 3	3.40	182,500	175,000	-7,500
November 2, Year 3	3.30	170,000	175,000	5,000
May 2, Year 4	3.70	165,000	175,000	10,000
November 2, Year 4	3.95	185,000	175,000	-10,000
May 2, Year 5		197,500	175,000	-22,500

(Section 35.4.3)

8. According to formula (35.11):

$$SMM = \frac{ABS}{1 - [ABS \times (M - 1)]} \quad (35.11)$$

where  $M$  is the number of months after the loan originated.

$$SMM = \frac{0.011}{1 - [0.011 \times (10 - 1)]} = 0.0122$$

(Section 35.6)

## Chapter 36: Structured Products II: Insurance-Linked Products and Hybrid Securities

### Exercises

1. Suppose a three-year cat bond covering U.S. wind has just been issued. Based on the equation estimated by Bodoff and Gan (2009), calculate the total coupon rate (%) to investors for this bond, assuming an expected loss of 1.20% per annum, and that three-year LIBOR is 1.30% per annum.

*Note: Bodoff and Gan (2009) obtained the following equation, which approximates the spread, when issued, of any cat bond that covers U.S. wind:*

$$\text{Spread} = 3.33\% + 2.40 \times \text{Expected Loss (\%)} \quad (36.4)$$

2. A life insurance owner has a life expectancy of seven years and a life insurance policy with a death benefit of \$1,000,000. His annual premium on the policy is 5%, and its cash surrender value is \$250,000. Find the excess of the NPV of the policy to its cash surrender value if the market discount rate is 9%.
3. Consider a three-year, €1,000,000 non-amortizing loan at 10% PIK (payment in kind) annual compounding interest rate. Calculate the total PIK interest to be paid by the borrower.
4. A five-year bond with an initial principal amount of \$5,000,000 is a non-amortizing loan with a 8% PIK annual compounding interest rate. Calculate all the cash payments that investors will receive assuming that there is no default.
5. Suppose a €20 million loan is arranged as part of a profit participation model. The loan starts in January 2016, and principal will be repaid at maturity, which is in six years. The profit participation scheme (PPS) is 5% of EBIT (earnings before interest and taxes), and annual floors and caps of €320,000 and €350,000, respectively, are set up. Calculate the profit participation amounts to be received by the lender during each year, assuming the yearly sales and EBIT shown in the following table.

**Table: Profit Participation Model  
(Amounts in €)**

Financials / Year	2016	2017	2018	2019	2020	2021
<b>Sales</b>	21,000,000	22,500,000	24,000,000	27,500,000	28,000,000	29,100,000
<b>EBIT</b>	6,200,000	6,500,000	6,800,000	7,200,000	7,100,000	7,800,000

### Solutions

1. First, using Equation 36.4 the spread should be equal to:

$$\text{Spread (\%)} = 3.33\% + 2.40 \times 1.20\% = 6.21\%$$

Then, using Equation 36.1, the total coupon rate to investors should be equal to:

$$\text{Total Coupon Rate to Investors} = \text{LIBOR} + \text{Spread} \quad (36.1)$$

$$\text{Total Coupon Rate} = 1.30\% + 6.21\% = 7.51\%$$

(Section 36.2.4)

2. The present value of seven years of \$50,000 premium payments represents a liability to the policy owner of  $-\$251,648$  (i.e.,  $N = 7$ ,  $i = 9$ ,  $PMT = \$50,000$ ,  $FV = 0$ , and calculate  $PV$ ). The present value of the death benefit in seven years is  $+\$547,034$  (i.e.,  $N = 7$ ,  $i = 9$ ,  $PMT = 0$ ,  $FV = \$1,000,000$ , and calculate  $PV$ ). The net present value to the policy owner is  $\$295,386$  (i.e.,  $\$547,034 - \$251,648$ ), which exceeds the cash surrender value by  $\$45,386$  (i.e.,  $\$295,386 - \$250,000$ ).

(Section 36.3.5)

3. The total PIK interest to be paid by the borrower is calculated as follows. The PIK interest owed for the first year would be  $\text{€}100,000$  (i.e.,  $\text{€}1,000,000 \times 0.10$ ), which is paid in a security and is added to the principal amount of the debt, increasing the total amount owed to  $\text{€}1,100,000$  at the end of the first year. During the second year, the 10% annual rate is applied against the new principal balance, resulting in a total amount of  $\text{€}110,000$  (i.e.,  $\text{€}1,100,000 \times 0.10$ ). Finally, during the third year, the 10% annual rate is applied against the new principal balance, resulting in a total amount of  $\text{€}121,000$  (i.e.,  $\text{€}1,210,000 \times 0.10$ ). The total PIK interest, which will be paid in the third year, amounts to  $\text{€}331,000$  (rounded), which is calculated as  $\text{€}100,000 + \text{€}110,000 + \text{€}121,000 = \text{€}331,000$ . Notice that we could have also arrived at the result calculating:  $\text{€}1,000,000 \times (1.10)^3 - \text{€}1,000,000 = \text{€}331,000$ .

(Section 36.4.4.2)

4. Without amortization and with the PIK feature, there will be no cash interest payments prior to maturity. The principal of the bond will increase at the 8% PIK annual compounding interest rate throughout the entire maturity of the bond (five years). The  $\$5,000,000$  principal amount increased with compounding for five years at 8% grows to  $\$7,346,640$  which is the total cash due when the bond matures in five years (i.e.,  $N = 5$ ,  $i = 8$ ,  $PMT = \$0$ ,  $PV = \$5,000,000$ , and calculate  $FV$ ).

(Section 36.4.4.2)

5. The following table shows the payments for each of the six years. For example, in 2016, the PPS provides a payment of  $\text{€}310,000$  (i.e., 5% of  $\text{€}6,200,000$ ). This is slightly lower than the floor payment of  $\text{€}320,000$ ; therefore, the floor would be binding in 2016. In 2017 and 2018, and reflecting the continuing rise in sales and EBIT of the previous years, the PPS is now greater than the floor of  $\text{€}320,000$ , but still lower than the cap of  $\text{€}350,000$ .

Therefore, the PPSs of €325,000 and €340,000 are the payments to be received by the lender during those two years, respectively. The PPS payments for 2019, 2020 and 2021 (€360,000; €355,000; and €390,000, respectively) exceed the cap payment of €350,000; reflecting the continued increase in sales and EBITs. Thus, PPS payments during those three years are capped at €350,000 in each year. Note that in the following table the highlighted cells correspond to the actual PPS applicable to each year.

**Table: (Combined) Profit Participation Model (Amounts in €)**

Financials / Year	2016	2017	2018	2019	2020	2021
<b>Sales</b>	21,000,000	22,500,000	24,000,000	27,500,000	28,000,000	29,100,000
<b>EBIT</b>	6,200,000	6,500,000	6,800,000	7,200,000	7,100,000	7,800,000
<b>PPS</b>	310,000	325,000	340,000	360,000	355,000	390,000
<b>CAP</b>	350,000	350,000	350,000	350,000	350,000	350,000
<b>FLOOR</b>	320,000	320,000	320,000	320,000	320,000	320,000

€20 million PP loan starting in January 2016

PPS: 5% of EBIT

Tenor: 6 Years

Principal repayment at maturity

Floor: €320,000 annually

Cap: €350,000 annually

(Section 36.4.4.3)

# Level II Glossary

## Chapter 1 Keywords

Section #	Keyword & Definition
1.1	<b>Asset Allocation</b> refers both to the process followed by a portfolio manager to determine the distribution of an investor's assets to various asset classes and to the resulting portfolio weights.
1.4	<b>Constraint</b> is a condition that any solution must meet.
1.5.4	<b>Degree of risk aversion</b> indicates the trade-off between risk and return for a particular investor and is often indicated by a particular parameter within a utility function, such as $\lambda$ in Equation 1.5.
1.8.4	<b>Efficient frontier</b> is the set of all feasible combinations of expected return and standard deviation that can serve as an optimal solution for one or more risk-averse investors.
1.3.1	<b>Endowments</b> are funds established by not-for-profit organizations to raise funds through charitable contributions of supporters and use the resources to support activities of the sponsoring organization.
1.5.2	<b>Expected utility</b> is the probability weighted average value of utility over all possible outcomes.
1.4	<b>External constraints</b> refer to constraints that are driven by factors that are not directly under the control of the investor.
1.8.5	<b>Hurdle rate</b> is an expected rate of return that a new asset must offer to be included in an already optimal portfolio.
1.3.2	<b>Individually managed accounts</b> are no different from private savings plans, in which the asset allocation is directed entirely by the employee.
1.6.1	<b>Internal constraints</b> refer to those constraints that are imposed by the asset owner as a result of its specific needs and circumstances.
1.2	<b>Investment policy statement</b> includes the asset allocator's understanding of the objectives and constraints of the asset owners, the menu of asset classes to be considered, whether active or passive approaches will be used, and how often and under what circumstances the allocation will be changed.

- 1.3.2 National pension funds** are run by national governments and are meant to provide basic retirement income to the citizens of a country.
- 1.4 Objective** is a preference that distinguishes an optimal solution from a suboptimal solution.
- 1.3.2 Private defined benefit funds** are set up to provide prespecified pension benefits to employees of a private business.
- 1.3.2 Private defined contribution funds** are set up to receive contributions made by the plan sponsor into the fund.
- 1.5.1 Risk averse** is if an investor's utility function is concave, which in turn means that the investor requires higher expected return to bear risk.
- 1.1 Security selection** is the process through which holdings within each asset class are determined.
- 1.5.2 Utility** is a measurement of the satisfaction that an individual receives from investment wealth or return.
- 1.5.2 Utility function** is the relationship that converts an investment's financial outcome into the investor's level of utility.

## Chapter 2 Keywords

Section #	Keyword & Definition
2.4.3	<b>Betting against beta anomaly</b> has documented that portfolios consisting of low-beta stocks have outperformed the market in the past.
2.1.5.3	<b>Conditional expectation models</b> obtain estimates of expected returns that are functions of the current values of a set of predictive variables.
2.1.5.2	<b>Economically meaningful signals</b> are those signals with rational, intuitive explanations for their expected predictive power.
2.2	<b>Estimation risk</b> refers to the risk that the estimated parameters that are used as inputs in the mean-variance approach could be different from the true values of those parameters.
2.1.3.1	<b>Forgone loss carryforward</b> arises when an existing investor loses the fee benefits of owning a fund below its high-water mark.
2.2.1	<b>Funding liquidity risk</b> arises when the investor is unable to obtain financing, cannot roll over currently available debt, or lacks liquidity to meet capital commitments.
2.4.3	<b>Leverage aversion theory</b> argues that large classes of investors cannot lever up low volatility portfolios to generate attractive returns and that, as a result, low volatility stocks and portfolios are underpriced.
2.2.1	<b>Liquidity penalty function</b> reflects the cost of illiquidity and the preference for liquidity.
2.2.1	<b>Market liquidity risk</b> arises when an event forces an investor to sell an asset that is not actively traded and there are a limited number of active market participants.
2.5.4	<b>Momentum crash</b> occurs when those assets with recent overperformance (i.e., those assets with momentum) experience extremely poor performance relative to other assets.
2.3	<b>Risk budgeting</b> is a valuable tool for analyzing a portfolio's risk-return profile and imposing risk constraints desired by asset owners.
2.4	<b>Risk parity</b> uses the results of risk budgeting to create portfolios in which each asset contributes the same amount to the total risk of the portfolio.

- 2.2.3** **Robust optimization** selects final solutions that incorporate estimation error directly into the modeling process.
- 2.1.3.1** **Underwater** (i.e., whose net asset value is below the most recent high-water mark) does not accrue performance fees until a new high-water mark is achieved.
- 2.4.3** **Volatility anomaly** is the idea that low volatility stocks are underpriced and therefore offer higher expected risk-adjusted returns.

## Chapter 3 Keywords

Section #	Keyword & Definition
3.1	<b>Community foundations</b> are based in a specific geographical area, concentrating the charitable giving of the region's residents.
3.1	<b>Corporate foundations</b> are sponsored by corporations, with gifts provided by the corporation and its employees.
3.1	<b>Corpus</b> is the nominal value of the initial gift, while spending the income generated by the gift to benefit the stated purpose.
3.5.4	<b>Equity options hedges</b> are positions established in equity options for the primary purpose of reducing the equity risk of a portfolio, such as the purchase of a put option.
3.3	<b>Endowment model</b> is the asset allocation of major endowments and foundations, which typically includes substantial allocations to alternative investments.
3.1	<b>Foundations</b> are similar to endowments but tend to differ in a number of ways: (1) foundations are grant-making institutions, whereas endowments tend to be funds established by educational, health-care, or religious organizations; (2) foundations tend to be finite lived, whereas endowments tend to be perpetual; (3) foundations are more subject to minimum spending requirements; and (4) foundations are less likely to be funded from ongoing donations.
3.4.3	<b>First-mover advantage</b> (i.e., benefits emanating from being an initial participant in a competitive environment): large endowments invested in many alternative asset classes years earlier than pension funds and smaller endowments did, and may therefore have an advantage.
3.1	<b>Independent foundations</b> are funded by an individual or a family.
3.5.1	<b>Inflation beta is</b> analogous to a market beta except that an index of price changes is used in place of the market index, creating a measure of the sensitivity of an asset's returns to changes in inflation.
3.2	<b>Intergenerational equity</b> is the investment goal of a manager who balances the need for spending on the current generation of beneficiaries with the goal of maintaining a perpetual pool of assets that can fund the operations of the organization to benefit future generations.

- 3.4.5** **Liquidity premiums** are higher returns earned by investing in less liquid assets that require long lockup periods.
- 3.5.2** **Liquidity-driven investing** is an investment approach emphasizing the role of the liquidity of investments and the time horizon of the investor in the asset allocation decisions.
- 3.4.1** **Market timing** is measured as the return earned from the variation of asset class weights versus the policy or target asset class weights.
- 3.4.4** **Network effect** is when an institution has built relationships with successful people and businesses that may be difficult for others to emulate.
- 3.4.6** **Non-discretionary investment consultant** makes recommendations to the endowment on asset allocation, manager selection, and a wide variety of other issues, but leaves the ultimate decision to a vote of the investment committee.
- 3.1** **Operating foundations** have the greatest similarity to endowments, as the income generated by an endowment is used to fund the operations of the charitable organization.
- 3.4.6** **Outsourced CIO (OCIO)** is a model, in which the endowment gives discretionary authority to an external consultant who may make and implement prespecified decisions, such as manager selection and asset allocation decisions, without taking those decisions to a vote.
- 3.5.2** **Overcommitment strategy** making capital commitments in excess of the targeted investment amount.
- 3.4.1** **Rebalance** (i.e., transact so as to cause portfolio weights to return to prespecified values) to strategic asset allocation weights by selling outperforming asset classes and buying underperforming ones.
- 3.2** **Return target** is a level of performance deemed necessary to satisfy the goals of the owners or beneficiaries.
- 3.2** **Spending rate** is the fraction of asset value spent each year.✎ U.S. law requires that foundations spend a minimum of 5% per year on operating expenses and charitable activities.
- 3.5.1** **Total return investor** (i.e., an investor who considers both income and capital appreciation as components of return) may realize that a 5% current yield is not needed in order for the endowment to have a spending rate of 5%.

## Chapter 4 Keywords

Section #	Keyword & Definition
4.3.2	<b>Accumulated benefit obligation (ABO)</b> is the present value of the amount of benefits currently accumulated by workers and retirees.
4.6.1	<b>Accumulation phase</b> is a time when individuals are working and saving a portion of their income and growing their assets to provide for a comfortable retirement.
4.1.3	<b>Cash balance plan</b> is basically a defined benefit plan, where the pension benefits are maintained in individual record-keeping accounts that show the participant the current value of his or her accrued benefit and facilitate portability to a new plan.
4.2.4	<b>Cash flow matching approach</b> is employed when the hedging portfolio is constructed such that its estimated future cash inflows match the expected outflows associated with liabilities at each prospective point in time.
4.3.5	<b>Cost of living adjustment (COLA)</b> increases the benefits paid to employees along with the rate of inflation
4.6.1	<b>Decumulation phase</b> is when assets are drawn down to support spending during retirement.
4.6.4	<b>Deferred annuity</b> is when an investor pays a lump sum to an insurance company for cash flows that are scheduled to start at some date in the future.
4.3	<b>Defined benefit plan</b> is when the employer takes all of the investment risk while offering a guaranteed, formulaic benefit to retirees.
4.5.1	<b>Defined contribution plan</b> is a retirement plan offered by an employer who makes a specified contribution on behalf of each covered employee on a regular basis such as a percentage of the employee's salary.
4.5.3	<b>Drifting asset allocation</b> is where a lack of rebalancing where the allocations to asset classes change based on returns of each asset class with the highest-returning asset classes growing as a share of the portfolio.

- 4.2.4 Duration matching approach** is when the duration of the hedging bucket matches the duration of the liabilities.
- 4.3.4 Frozen pension plan** is one where employees scheduled to receive defined benefit (DB) pension benefits will no longer continue to accrue additional years of service in the plan.
- 4.3.3 Funded status** of a pension plan is the amount of the plan's current assets compared to its projected benefit obligation (PBO) or accumulated benefit obligation (ABO).
- 4.6.4 Immediate annuity** is when an investor pays a lump sum to an insurance company for cash flows starting in the first year of the contract and guaranteed for some period.
- 4.3.5 Inflation-protected bonds** earn a real coupon while the principal value rises with the rate of inflation.
- 4.3.5 Liability-driven investing (LDI)** seeks to reduce surplus volatility by building a portfolio of assets that produces returns that are highly correlated with the change in the plan's liabilities.
- 4.5.1 Matching contribution** is a voluntary contribution made by an employee that is augmented by additional contributions by the employer.
- 4.6.2 Mortality tables** show the distribution of the expected age of death or probability of death for various current ages across a specified population.
- 4.2.4 Overlay approach** is when the plan sponsor employs derivatives to create a hedging bucket.
- 4.3.3 Pension plans** can vary sharply over time, assets of the plan grow with employer contributions, decline with retiree benefit payments, and change daily with returns to the investment portfolio.
- 4.3.3 Pension surplus** is the amount of assets in excess of a pension plan's projected pension benefit.
- 4.4 Progressive system** is where lower paid workers get relatively higher benefits than those earned by higher paid workers when measured by a percentage of salary.
- 4.3.2 Projected benefit obligation (PBO)** is the present value of the amount of benefits assumed to be paid to all future retirees of the firm.
- 4.3 Retirement income-replacement ratio** is the pension benefit as a portion of final salary as in a defined benefit plan.

- 4.3.3** **Surplus risk** of a pension plan is the economic exposure to the spread between the assets and liabilities of a pension plan and can be measured as the volatility and tracking error of the difference between the value of the assets relative to the present value of the liabilities.
- 4.5.4** **Target-date fund** has risks that are managed relative to a specified horizon date, which allows employees to choose a single investment option without worrying about rebalancing or changing investments as the horizon date approaches.
- 4.3.4** **Terminated pension plan** is no longer operated by the employer.

## Chapter 5 Keywords

Section #	Keyword & Definition
5.1.1	<b>Capital account surplus</b> occurs in a country when the amount of imported capital exceeds the amount of exported capital.
5.3.4	<b>Conservative investment opportunity cost</b> is where the longer conservative assets are left in cash the greater the lost returns relative to what could have been earned on a balanced portfolio that includes investments in risky assets.
5.1.1	<b>Current account deficit</b> is when the value of a country's imports of goods and services exceeds the value of its exports, meaning that more currency is flowing out of the country to purchase these goods and services than is flowing in from selling goods and services.
5.1.3	<b>Depletion</b> is the rate of extraction of a commodity relative to the remaining in-ground stocks.
5.2.3	<b>Development funds</b> (sovereign wealth) are investment holding companies that have socio-economic objectives such as economic diversification, the development of strategic industries, or poverty alleviation.
5.3.3	<b>Dutch disease</b> occurs when large currency inflows (such as from the sale of large quantities of commodities) damages the long-run health of a country's other sources of economic prosperity (such as the country's manufacturing sector).
5.6.1	<b>Norway model</b> is when asset allocations are dominated by highly diversified liquid assets that are managed at extremely low costs, which seem to be the opposite of the Yale model, which maximizes exposure to illiquid assets invested with external managers.
5.2.2	<b>Pension reserve funds</b> are designed to invest for high total returns in preparation for estimated future pension-like liabilities.
5.5.1	<b>Protectionist policies</b> favor domestic companies that are funded by the SWF over foreign companies in a given industry. Protectionism can take the form of quotas, tariffs, or governmental subsidies to domestic firms.

- 5.1.1 Reserve account** of a central bank consists of the central bank's holdings of foreign currencies and is operated by the central bank to conduct transactions involving foreign currencies.
- 5.3.4 Reserve adequacy** is the estimated size for stabilization fund reserves that is considered necessary before starting to invest in risky assets and moving funds into a total return portfolio.
- 5.2.2 Reserve investment funds** are included in a country's reserve accounting as part of its reserves, but the funds invest in a total return portfolio in order to overcome the opportunity costs of the cash and fixed income dominated stabilization funds.
- 5.2.2 Savings funds** are designed to bring intergenerational equity to a commodity-producing country by investing today's commodity revenues into a total return fund designed to benefit future generations.
- 5.2.1 Stabilization funds** serve a countercyclical purpose through collecting excess commodity revenues during times of high commodity prices, and distributing saved wealth during times of low commodity prices.
- 5.3.3 Sterilization** is a macroeconomic policy in which a central bank or the government takes actions to counter the effects of an economic event (such as a commodity boom) and a balance of payments surplus on the country's economy.

## Chapter 6 Keywords

Section #	Keyword & Definition
6.6.3	<b>Balancing portfolios</b> are two buckets used as counterweights to a pool of assets that, for some reason, cannot be adjusted itself. In this case, the lifestyle assets are never expected to be sold or rebalanced.
6.8.1	<b>Charity</b> is the giving of money or time to social causes, typically to meet more immediate needs and without accountability on behalf of the recipient.
6.3.2	<b>Completion portfolio</b> is a collection of assets that is managed with the objective of diversifying and managing the aggregated risks of the concentrated portfolio and the completion portfolio.
6.3.2	<b>Concentrated wealth</b> occurs when the vast majority of the assets are poorly diversified such as being held in a single company.
6.6.4	<b>Concierge services</b> are where the family office will attend to mundane details that most people have to deal with in their daily lives such as personal shopping and travel arrangements.
6.7.2	<b>Dynastic wealth</b> is an amount of wealth so large that it has substantial potential to be maintained for a large number of generations.
6.8.1	<b>Family estate planning</b> is the process for planning the distribution of assets upon the death of preceding generations.
6.8.1	<b>Estate taxes</b> are levied in many jurisdictions by governments on accumulated wealth after the death of its owner.
6.8.2	<b>Finance first</b> investors would like to earn an investment return competitive with market returns and commensurate with the risk of the investment and place relatively less priority on social impact.
6.6.2	<b>Free ports</b> are specialized, climate-controlled repositories for art and other valuable goods belonging to the very wealthy--similar to a custody bank for stock certificates.
6.8.2	<b>Impact alpha</b> is the theory that ventures choosing to do the right things from a social perspective will ultimately be rewarded in the marketplace with above-market financial

returns, or that ventures that have socially objectionable operations have substantial risks of generating below-market financial returns.

**6.8.2 Impact first** is where investors have a greater focus on the social good of their investments, and may accept projects with higher financial risk or lower financial returns.

**6.8.2 Impact investing** is an investment approach that seeks to earn financial returns while generating measurable and positive social impact.

**6.7.4 Inheritance** is the distribution of assets after the death of the older generation.

**6.6 Lifestyle assets** include art, homes, wine, airplanes, cars, and boats, where the purchase and collection follows from the lifestyle preferences or the passions of one or more family members.

**6.3.2 Liquidity event** is a large generation of wealth such as the sale of the family business in a merger transaction or in an initial public offering.

**6.5.2 Long-term capital gains** are taxed when investment gains are earned on assets held for longer than one year.

**6.8.2 Negative screening** is when investors intentionally eliminate companies from their portfolio that are deemed to have a negative impact on the world, such as from pollution, harmful products, or unfair employment practices.

**6.6 Passion assets or Lifestyle assets** include art, homes, wine, airplanes, cars, and boats, where the purchase and collection follows from the lifestyle preferences or the passions of one or more family members.

**6.8.1 Philanthropy** is the giving of money or time with the intent of making a lasting change.

**6.8.2 Positive screening** is a new concept where companies are added to the portfolio when they are perceived to do good in the world, such as producing helpful products and having high wages and benefits and good working conditions for their workers and suppliers worldwide, even in areas of extreme poverty.

**6.5.2 Short-term capital gains** in the United States are trading profits recognized on an investment held for less than one year.

**6.7.4 Succession planning** is the process of naming a new leader of the family business and potentially a new governance structure after the death or retirement of the founder or current leader of the business.

**6.5.1 Tax efficiency** is the efficacy with which wealth is managed so as to maximize after-tax risk-adjusted return.

## Chapter 7 Keywords

Section #	Keyword & Definition
7.6	<b>Adverse selection</b> takes place before a transaction is completed, when the decisions made by one party cause less desirable parties to be attracted to the transaction.
7.6.9	<b>Bad-leaver clause</b> may trigger a for-cause removal of the GP and investments to be suspended until a new fund manager is elected or, in the extreme, the fund is liquidated.
7.4	<b>Blind-pool</b> is the nature of LP investments, in which investors don't know the underlying portfolio companies before committing capital.
7.5	<b>Build and harvest</b> , or grow and compete, is a phase of the life cycle of the GP-LP relationship in which the funds thrive and grow.
7.3.3	<b>Co-investment</b> refers to the practice of investors being invited by GPs to make direct investments in portfolio companies.
7.5	<b>Decline</b> a phase of the life cycle of the GP-LP relationship when competition is lost.
7.3.3	<b>Direct investment in private equity</b> eschews PE funds altogether, as the PE investment program makes investments straight into a portfolio company (without intermediation), similar to a co-investment but without the input of a PE fund manager.
7.6	<b>Distribution waterfall</b> defines how returns are split between the LP and GP and how fees are calculated.
7.3.2	<b>Drawdowns</b> are capital calls made by GPs once they have identified a company in which to invest.
7.1	<b>Early stage</b> is split into seed stage and start-up stage.
7.5	<b>Entry and establish</b> is a phase of the life cycle of the GP-LP relationship involving the initial funds.
7.5	<b>Exit</b> is a phase of the life cycle of the GP-LP relationship when they gave up, made it or transition to new managers.

- 7.1**            **Expansion stage** is the stage a company is in (also called the development capital stage), which may or may not have reached profitability, but has already established the technology and market for its new product.
- 7.6.4**        **Fee-offset** arrangement may be implemented, in which fees are fully or partially netted against management fees.
- 7.3.4**        **General partners (GPs)** are fund managers who manage the investment of private equity funds.
- 7.6.9**        **Good-leaver clause** enables investors to cease additional funding of the partnership with a vote requiring a qualified majority, generally more than 75% of LPs.
- 7.6.7**        **Hurt money** is a capital contribution made by GPs to a PE fund, usually 1% and should be made in cash rather than through the waiver of fees.
- 7.0**            **Informal PE market** is one which comprises angel capital and what is often referred to—not without justification—as family, friends, and fools.
- 7.3.2**        **In-kind distributions** are distributed to investors in the form of securities of a portfolio company.
- 7.7.1**        **Lemons** are investments or products expected to perform far below expectations.
- 7.5**            **Life cycle of the GP–LP relationship** focuses on the long term pattern of GPs as they create multiple funds through time.
- 7.3.4**        **Limited partners (LPs)** pool money to invest in privately held companies.
- 7.6**            **Limited partnership agreement (LPA)** defines the legal framework of a private equity fund and its terms and conditions.
- 7.6.2**        **LP advisory committee (LPAC)** responsibilities are defined in the LPA and normally relate to dealing with conflicts of interest, reviewing valuation methodologies, and any other consents predefined in the LPA.
- 7.0**            **Organized PE market** is where professional management is provided by intermediaries.
- 7.7.1**        **Pay promote** encompasses the use of both carried interest and annual management fees on co-investments to keep the GP incentivized.
- 7.6.2**        **Qualified majority** is generally more than 75% of LPs as opposed to the 50% required for a simple majority.
- 7.3.2**        **Realizations** are when proceeds of portfolio companies, such as sales, interest, dividends, or recapitalization, are distributed to investors.

- 7.1 **Replacement capital** refers to a strategy in which capital is provided to acquire existing shares in a company from another PE investment organization.
- 7.1 **Rescue** refers to a strategy in which capital is provided to help established companies recover profitability after experiencing trading, financial, operational, or other difficulties.
- 7.3.4 **Secondary transactions in private equity** are times when investors sell their shares to other investors (even though LP shares are illiquid) before the termination of the fund.
- 7.4.2.1 **Scaling down** is when fund of funds can mediate potential size issues through sharing administrative expenses and making such investments less cost-intensive.
- 7.4.2.1 **Scaling up** is when fund of funds can mediate potential size issues through pooling of commitments of smaller investors and providing each of them with sufficient diversification.
- 7.5 **Spinouts** are a phase of the life cycle of the GP-LP relationship when there is a transition to new managers.
- 7.1 **Start-up stage** is when further financing is provided to establish the company and begin to market its new product

## Chapter 8 Keywords

Section #	Keyword & Definition
8.3	<b>Absolute return</b> is simply whatever an asset or a portfolio returned for a given period.
8.1	<b>Appraised asset class</b> is valued not by the consensus reflected in market prices being traded by many market players but by the professional opinions of a few experts.
8.3	<b>Asset-based benchmark</b> is constructed using public or private securities as its constituents.
8.6.1	<b>Bailey criteria</b> is a grouping of characteristics or properties that an investment benchmark should possess in order to be a useful gauge.
8.2.5	<b>Cash flow J-curve</b> is a representation of the evolution of the net accumulated cash flows from the investors to the fund, which are increasingly negative during the early years of existence before making a U-turn and becoming positive in the later years of the fund's life.
8.8.1	<b>Commitment-weighted IRR</b> is an average calculated by weighting the rates of return by commitment.
8.2.4	<b>Distribution to paid-in ratio (DPI)</b> , or realized return, is the ratio of the cumulative distribution to investors to the total capital drawn from investors.
8.4	<b>Listed PE index</b> refers to an index whose components are share prices of publicly traded PE firms.
8.2.5	<b>NAV J-curve</b> is a representation of the evolution of the NAV of a fund versus the net paid in (NPI), which first decreases during the early years of the fund's existence and then improves in its later years.
8.3	<b>Peer-group-based benchmark</b> is constructed using portfolios of investment managers as its constituents.

- 8.5.1 Peer-group cohort** refers to a group of private equity funds or investments that share some important characteristics.
- 8.8.1 Pooled IRR** is a measure that attempts to capture investment timing and scale, and is calculated by treating all funds as if they were one composite fund.
- 8.4.2 Public market equivalent (PME ratio)** is an index return measure that uses market indices to reflect the opportunity cost of capital.
- 8.3 Relative return** is the difference between an absolute return and the returns on the asset or portfolio to which it is compared.
- 8.2.4 Residual value to paid-in ratio (RVPI)** is the ratio of the total value of unrealized investments at a stated time to the total capital drawn from investors until that time.
- 8.2.1 Total value to paid-in (TVPI)** is the ratio of the current value of remaining investments within a fund, plus the total value of all distributions to date, relative to the total amount of capital paid into the fund to date.

## Chapter 9 Keywords

Section #	Keyword & Definition
9.2.2	<b>Blue-chip team</b> is one that has been able to generate a top-quartile performance for all of its funds through at least two business cycles (i.e., a sequence of more than three funds).
9.3	<b>Defaulting investor</b> is one who has previously reneged on capital commitments or is at risk of defaulting due to financial distress.
9.8.7	<b>Exit timing</b> refers to the period during which portfolio companies are expected to be sold and exit values are realized.
9.8.7	<b>Exit value</b> refers to the price that the fund can receive when portfolio companies are sold through initial public offerings (IPOs) or strategic sales.
9.2.2	<b>Emerging team</b> is one with limited joint history but with all the characteristics to become an established team.
9.2.2	<b>Established team</b> is one that has been able to generate a top-quartile performance for most of its funds (more than three funds) through at least two business cycles.
9.1.1	<b>Gatekeepers</b> are professional advisers operating in the PE market on behalf of their clients: in particular, consultants and account managers, funds of funds, and placement agents.
9.2.2	<b>Joint experience</b> is the duration of experience as a management team.
9.0	<b>Monitoring phase</b> takes place at the fund level and focuses on financial performance and the manager's structural and behavioral developments.
9.2.2	<b>Reemerging team</b> is a previously blue-chip or established team that has been through a restructuring following recent poor performance or some significant operational issues and has regained the potential to reemerge as an established or a blue-chip team.
9.8	<b>Secondary transactions</b> refer to the buying and selling of preexisting limited partnership interests in private equity and other alternative investment funds.
9.8.1	<b>Synthetic secondaries</b> are portfolio companies which are packaged up and sold to another manager, usually with the backing of a secondary fund specialist.
9.2.2	<b>Track record</b> is financial performance of a manager team based on their previous ventures.

## Chapter 10 Keywords

Section #	Keyword & Definition
10.5.3	<b>Balance sheet</b> summarizes assets, liabilities, and partners' capital
10.3	<b>Compromise documentation</b> allows investors to collect part of a document or a sample of a document for their files while still allowing the fund to appropriately manage any document distribution concerns.
10.6.2	<b>Desk review</b> is limited to a review based solely on documents collected and perhaps conference or video calls.
10.4.3	<b>Exculpation</b> is a contractual term that relates to freeing someone from blame.
10.5.3	<b>Income statement</b> provides a summary of income and expenses.
10.4.3	<b>Indemnification</b> relates to a duty to make good on a loss.
10.1.2	<b>Investment due diligence (IDD)</b> , focuses on gaining a detailed understanding of a fund manager's investment strategy with the ultimate goal of determining whether or not the strategy is appropriate for the investor.
10.7	<b>Meta risks</b> are the qualitative risks beyond explicit measurable financial risks. They include human and organizational behavior, moral hazard, excessive reliance on and misuse of quantitative tools, complexity and lack of understanding of market interactions, and the very nature of capital markets in which extreme events happen with far greater regularity than standard models suggest.
10.4.3	<b>Offering memorandum</b> seeks to accomplish four key functions: 1. Limited partner education 2. Risk disclosure 3. Risk assignment 4. Assignment of decision-making authority.
10.1.1	<b>Operational due diligence (ODD)</b> refers to the process of evaluating operational risk—a specific type of risk that must be addressed to ensure that investors will not be subject to financial or reputational risks of investing in funds that may experience large losses for noninvestment reasons.

- 10.3** **Operational risk profile** is an outline or summary of potential losses or other exposures of a fund due to errors or failures within the fund's functions other than those purely attributable to the fund's investment strategy.
- 10.9** **Operational scalability** refers to the firm's ability to build on existing systems in order to continue to support growth in an organized manner, including via the addition of new resources, without material disruption.
- 10.5.3** **Opinion letter** is an auditor's summary opinion of a financial statement.
- 10.4.3** **Private placement memorandum** is used interchangeably with **Offering Memorandum** and seeks to accomplish four key functions such as limited partner education, risk disclosure, risk assignment, assignment of decision-making authority.
- 10.5.3** **Qualified audit opinions** may be used to designate acceptable deviations from accounting standards.
- 10.4.3** **Risk assignment** in the context of fund documentation refers to anticipated ways for placing responsibility for different risks with different parties.
- 10.5.3** **Schedule of investments** typically details portfolio holdings and may classify them in summary form according to predefined categories such as by sector or region.
- 10.4.3** **Side letter** is an agreement between an investor and the fund that amends the OM to afford a specific investor with certain negotiated provisions.
- 10.5.3** **Statement of assets and liabilities**, commonly known as the balance sheet, provides a summary of assets, liabilities, and partners' capital.
- 10.5.3** **Statement of cash flows** outlines the movements of cash throughout the fund as well as financing-related cash flow activities.
- 10.5.3** **Statement of changes** outlines items related to partner capital allocations, contributions, and withdrawals.
- 10.5.3** **Statement of operations**, commonly known as the income statement, this section provides a summary of income and expenses.
- 10.5.1** **Valuation committee** is a common governance mechanism often used to facilitate internal GP oversight of valuation.

## Chapter 11 Keywords

Section #	Keyword & Definition
11.3.1	<b>Bottom-up approach</b> is based on fund manager research, in which the emphasis is on screening all investment opportunities in the targeted PE markets and picking the perceived best fund managers.
11.4.1	<b>Core portfolio</b> typically aims to exploit established relationships, with institutional-quality fund managers raising funds that are expected to generate a predictable base return.
11.4.1	<b>Core-satellite approach</b> seeks to merge passive investing with active management in an attempt to outperform a benchmark.
11.4.4	<b>Cost-averaging</b> is an approach which sets an annual investment target for each PE fund type, or a more or less constant target throughout funding cycles, thus avoiding any inclination to try to time the cycles.
11.4.4	<b>Market-timing approach</b> involves varying investment levels across vintage years in an effort to invest more in years with better prospects and less in years with inferior prospects.
11.3.1	<b>Mixed approach</b> either starts with a bottom-up strategy, to which increasing top-down optimization is added, or starts as an iterative short process cycle, in which bottom-up screenings are followed by top-down analysis and then by bottom-up screenings.
11.0	<b>Modern portfolio theory (MPT)</b> is based on Nobel Prize–winning economist Harry Markowitz’s insight that because they have unique risk and return characteristics, less than perfectly correlated assets can be combined in a way that maximizes return for any given level of risk.
11.4.3	<b>Naïve diversification</b> or 1/N heuristics, which equally weight assets in a portfolio, usually produces reasonably diversified portfolios that are somewhat surprisingly close to the efficient frontier.
11.4.4	<b>Recency bias</b> is the tendency to think that trends and patterns we observe in the recent past will continue in the future.

**11.4.1** **Satellite portfolio** can be interpreted as a bet on radical changes, which aims to explore new relationships (or opportunities).

**11.3.1** **Top-down approach** analyzes the macroeconomic conditions surrounding the targeted PE markets and then determines the weights and the combination of industry sectors, countries, fund styles, and so on that are best for meeting the PE program objectives under the likely scenarios.

## Chapter 12 Keywords

### Section #    Keyword & Definition

- 12.5**            **Cash flow at risk** is the maximum deviation between actual cash flows and a set level (e.g., a budget figure) due to changes in the underlying risk factors within a given time period for a given confidence level.
- 12.3.2**        **Commitment risk** describes the situation in which an LP may become a defaulting investor if the proceeds of exiting funds are not sufficient to pay the capital calls of newly committed funds.
- 12.1**            **Market risk** is economic uncertainty with regard to the estimation and establishment of a price for an illiquid asset.
- 12.1**            **Private equity financial risk** is considered to comprise mainly market risk, the risk of losses caused by adverse movements in market prices, and liquidity risk.

## Chapter 13 Keywords

### Section # Keyword & Definition

- 13.1.2**      **Cyclical illiquidity** is illiquidity caused by market conditions such as financial stress.
- 13.1.4**      **Exit risk** is the risk that an investor is unable to redeem or liquidate his investment at the time of his choosing or would exit at depressed valuations.
- 13.2.1**      **Follow-on funding** occurs when a particular fund makes an investment subsequent to having been a participant during a prior round of financing.
- 13.1.3**      **Funding risk**, also referred to as default risk within the private equity industry, is the risk that an investor will not be able to pay his capital commitments to a private equity fund in accordance with the terms of the obligation to do so.
- 13.2.2**      **Harvesting period** of an investment occurs in the later years of the fund, after the investment has matured and changed in value, and marks the time when the fund seeks to exit its investment.
- 13.3**        **Liquidity line** is a line of credit secured from external sources.
- 13.3**        **Sell-off of limited partnership shares** can be a source of liquidity in which the sale of shares in the partnership takes place in secondary markets.
- 13.5.1**      **Strategic commitment steering** is the long-term management of investment commitments, with the main objective of building up and maintaining a balanced and stable portfolio in line with the investment strategy.
- 13.1.2**      **Structural illiquidity** is illiquidity inherent in the terms of an investment, such as a lockup provision.

## Chapter 14 Keywords

Section #	Keyword & Definition
14.4	<b>Anticipated inflation rate</b> is the expected rate of change in overall price levels.
14.2.3	<b>Bottom-up asset allocation</b> refers to an emphasis on the relative attractiveness of individual investment opportunities as the primary driving factor of the asset allocation process.
14.3.3	<b>Commercial real estate</b> includes the following property sectors: office buildings, industrial centers, data centers, retail (malls and shopping centers, also referred to as “strips”), apartments, health-care facilities (medical office buildings and assisted-living centers), self-storage facilities, and hotels.
14.4	<b>Escalator clause</b> periodically adjusts lease payments based on some agreed upon measure of inflation.
14.4	<b>Fisher effect</b> states that nominal interest rates equal the combination of real interest rates and a premium for anticipated inflation.
14.5	<b>Four-quadrant model</b> allows for the simultaneous assessment of the long-run equilibrium within and between the real estate space and asset markets.
14.3.3	<b>Housing real estate</b> includes many property types, such as single-family homes, town houses, condominiums, and manufactured housing.
14.3.4	<b>Private real estate equity</b> is an investment which involves the direct or indirect acquisition and management of actual physical properties that are not traded on an exchange.
14.3.4	<b>Public real estate investment</b> entails the buying of shares of real estate investment companies and investing in other indirect exchange-traded forms of real estate (including futures and options on real estate indices and exchange-traded funds linked to real estate).
14.3.5	<b>Primary real estate market</b> is one in which real estate assets are said to trade if the geographic location of the real estate is in a major metropolitan area of the world, with numerous large real estate properties or a healthy growth rate in real estate projects.

- 14.5** **Real estate system** consists of three components: the market for real estate space, the asset market, and the construction industry. The four-quadrant model is a graphic representation of the dynamics of a real estate system; hence, it is also referred to as a systems dynamic model.
- 14.3.3** **Residential real estate** includes many property types, such as single-family homes, town houses, condominiums, and manufactured housing.
- 14.3.5** **Secondary real estate markets** include moderately sized communities as well as suburban areas of primary markets.
- 14.3.5** **Tertiary real estate markets** tend to have less recognizable names, smaller populations, and smaller real estate projects.
- 14.2.2** **Top-down asset allocation** emphasizes allocation based on the analysis of the macro environment and risk premiums, and their expected impact on general categories or types of portfolio investments.
- 14.4** **Unanticipated inflation rate** is the realized rate of inflation minus anticipated inflation.

## Chapter 15 Keywords

### Section #    Keyword & Definition

- 15.5**        **Appraisal error** is the difference between a particular empirical appraised value and the unobservable true market value.
- 15.6**        **Appraisal-based indices** are derived from the property values estimated by appraisers, which may track a particular subpopulation.
- 15.6.1.1**    **Cost approach** assumes that a buyer will not pay more for a property than it would cost to build an equivalent one.
- 15.7.2**        **Hedonic pricing method (HPM)** assumes that each property attribute, such as lot size, has its own market, and that the price of each attribute is determined by its demand and supply.
- 15.6.1.1**    **Income approach** values real estate in a way similar to the discounted cash flow method used for valuing stocks and bonds.
- 15.5**        **Purely random error or noise** arises because of the structure of the real estate market, where transactions involve negotiations between two parties and the resulting transaction price is one value from a range of prices that could have resulted from those negotiations.
- 15.7.1**        **Repeat-sales method (RSM)** regresses the percentage price changes observed in properties onto a sequence of time-dummy variables.
- 15.5**        **Reservation price** is the lowest price at which a potential seller is willing to sell a property, or the highest price a potential buyer is willing to pay for a property.
- 15.6.1.1**    **Sales comparison approach** is when a real estate asset is evaluated against those of comparable (substitute) properties that have recently been sold.
- 15.0**        **Smoothed series** is when the resulting price or return series demonstrates a delayed response, due to perhaps the valuation methods used by appraisers responsible for publishing prices.

- 15.0** **Transaction noise** arises when real estate transaction prices contain errors that make those prices less reliable when compared to prices of more liquid assets.
- 15.5** **Transaction price error** is the difference between any given price observation and the unobservable true market value.
- 15.5** **Transaction price noise** is the difference between any given price observation and the unobservable true market value.
- 15.5** **Temporal lag bias** arises when transaction prices are related to past prices because of the structure of the market.
- 15.0** **Unsmoothing** is the process of removing the effects of smoothing from a data series by reducing the level of autocorrelation in a time series.

## Chapter 16 Keywords

### Section #    Keyword & Definition

- 16.6.3**    **Cap rate spread** is the excess of the cap rate over the yield of a default-free 10-year bond (such as the 10-year Treasury rate in the United States).
- 16.8.1**    **Property total return swap** is when the buyer of property exposure agrees to pay a fixed price each year over the life of the contract, and in return, the swap seller agrees to pay the annual total return of the applicable property index. Only the net cash flows are exchanged between the parties, and no cash is exchanged at the beginning of the life of the contract.
- 16.4**    **Real estate style boxes** use two categorizations of real estate to generate a box or matrix that can be used to characterize properties or portfolios, with primary, secondary, and tertiary markets on the vertical axis and core, value-added, and opportunistic on the horizontal axis.
- 16.1**    **Rollover** refers to changes in ownership, whereas real estate rollover more generally refers to changes in financing (e.g., converting a construction loan to a permanent mortgage loan) or changes in the nature of a real estate project that facilitate investment liquidity and capability to exit (e.g., completion and full leasing of a project).

## Chapter 17 Keywords

Section #	Keyword & Definition
17.1.1	<b>Authorized PUTs</b> are intended mainly for retail investors and offer exemption from capital gains tax on disposals of investments in the fund.
17.1.2	<b>Closed-ended real estate funds</b> issue a general number of shares to investors before any real estate investments are made. They have a specific investment period and fund-termination period, at which time the fund must distribute all cash flows to investors.
17.4.5	<b>Market clientele</b> is a general type of market participant that dominates a particular market.
17.2.6	<b>Non-traded REITs</b> were created in the United States in 1990, and even though they are registered with the Securities and Exchange Commission as public companies, their shares are not available on an exchange and are thus essentially illiquid (and therefore difficult to value).
17.1.1	<b>Open-ended real estate funds</b> have an infinite life and allow investments and redemptions (usually after an initial lockup period) at any time.
17.4.1	<b>Pooling of securities</b> is any collection of securities in a single entity, such as a mutual fund.
17.1.1	<b>Property authorized investment funds (PAIFs)</b> are investment vehicles authorized by the UK's Financial Conduct Authority that can invest in real estate directly or indirectly (mainly through shares in UK REITs).
17.1.1	<b>Property unit trusts (PUTs)</b> are the main open-end investment product used by pension funds and insurance funds to obtain a diversified exposure to the UK real estate market.
17.2.1	<b>Real estate operating company (REOC)</b> is similar to a REIT, except that a REOC reinvests its earnings into the business rather than passing them along to shareholders (and hence they do not get the same tax advantage enjoyed by investors in REITs).

**17.1.3** **Real estate funds of funds** invest in other real estate funds rather than investing directly in real estate assets.

**17.1.1** **Unauthorized PUTs** are unregulated unit trusts that may be offered only to institutional investors.

## Chapter 18 Keywords

Section #	Keyword & Definition
18.4.2	<b>Corporate debt of REITs</b> represents fixed-income securities that are issued by REITs and are similar to debt issued by other corporations.
18.4.2	<b>Commercial mortgage-backed securities (CMBS)</b> are securities that are backed by a pool of mortgages.
18.4.2	<b>Corporate debt of REITs</b> represents fixed-income securities that are issued by REITs and are similar to debt issued by other corporations.
18.4.2	<b>Direct real estate investments</b> are investments in physical real estate with little or no pooling or structuring.
18.3.4	<b>Economic risk</b> is the likelihood that macroeconomic conditions (e.g., changes in monetary and tax policies) and government regulation in a country will affect an investment.
18.4.2	<b>First mortgage claims</b> are loans that are backed by the property and have the first claim to the property in case of bankruptcy and liquidation.
18.4.2	<b>Listed real estate securities</b> involve the purchase of shares in publicly traded firms, such as REITs.
18.4.2	<b>Pooled investments in direct real estate investments</b> include investments in a fund that purchases physical property.
18.5	<b>Risk measurement risk</b> is the economic dispersion caused by inaccuracies in estimating the volatilities and correlations of investments.
18.1	<b>Roundtrip costs</b> are the total costs of buying and selling a residential property, including legal fees, sales and transfer taxes, registration fees, and real estate agents' costs and fees, also show a very high variance across countries.
18.4.2	<b>Real estate mezzanine debt</b> consists of debt instruments that represent a middle position in the capital structure of a real estate property.

## Chapter 19 Keywords

### Section #    Keyword & Definition

**19.1.2**        **Economic infrastructure assets** are assets with economic value that is driven by the revenue they generate.

**19.1.4**        **Project finance** is the long-term financing of projects, such as infrastructure, wherein the loans are supported by the cash flows from the project.

**19.1.2**        **Social infrastructure assets** are assets that have end users who are unable to pay for the services or that are used in such a way that it is difficult to determine how many services were used by each person.

## Chapter 20 Keywords

### Section #    Keyword & Definition

- 20.5.1**    **Agricultural infrastructure** is composed of substantial capital assets designed to enable or improve the efficiency of the production, handling, and distribution of agricultural commodities.
- 20.3.2**    **Crop yield** is a measure of agricultural productivity expressed in units produced per unit of land used for a specified unit of time.
- 20.1.3**    **Expropriation** is where a government takes ownership and/or control of assets belonging to foreign investors, either by direct action (nationalization or forced asset transfer) or indirect action, such as discriminatory taxation or predatory regulation.
- 20.4.4**    **Granger-causality analysis** is a hypothesis test to determine if one time series is useful in forecasting another.
- 20.4.3**    **Permanent cropland** refers to land with long-term vines or trees that produce crops such as grapes, cocoa, nuts, or fruit.
- 20.6.4**    **Rotation age** is the amount of time, usually expressed in years, for timber to reach the size for economically optimal harvesting.
- 20.4.3**    **Row cropland** is annual cropland that produces crops such as corn, cotton, carrots, or potatoes from annual seeds.

## Chapter 21 Keywords

Section #	Keyword & Definition
21.4.3	<b>Acquisition and licensing strategies</b> are generally built around agreements regarding royalty streams.
21.2.3	<b>Coproduction</b> is when two or more studios partner on a film, sharing the equity costs and, correspondingly, the risks and returns.
21.2.3	<b>Debt financing structures</b> include senior secured debt, gap financing, and super gap financing/junior debt.
21.2.3	<b>Equity financing structures</b> include slate equity financing, corporate equity, coproduction, and miscellaneous third-party equity financing.
21.2.2	<b>Film production stages</b> are: story rights acquisition, preproduction, principal photography/production, and postproduction.
21.2.3	<b>Foreign presale</b> occurs before the film is made, when the producer sells distribution rights for specific foreign territories for a fixed price; all, or nearly all, of this payment is due upon delivery of the completed film.
21.2.3	<b>Gap financing</b> covers the difference between the production budget and the senior secured debt, which can be collateralized by sales of unsold territories to distributors.
21.3.2	<b>Hammer prices</b> are final auction prices that do not include commissions to the auction house.
21.3.3	<b>Masterpiece effect</b> hypothesizes that the returns to the most expensive artworks are qualitatively different from the market as a whole.
21.1	<b>Mature intellectual property</b> is intellectual property that has developed and established a reliable usefulness.
21.2.3	<b>Negative pickup deal</b> occurs when a film distributor agrees to purchase a film from a producer for a fixed sum upon delivery of the completed film.
21.4.5	<b>Patent sale license-back (SLB) strategy</b> is in use when the patent holder sells one or more patents to a buyer, who then licenses those patents back to the original holder.

- 21.4.7 Patent pooling** in which multiple owners of related patents agree to jointly license a number of patents to external users, is more complex than in-house licensing because of the need to divide royalty income based on revenue-sharing formulas.
- 21.3.3 Quality effect** is when works of better-known artists are considered to be of higher quality and generate higher returns.
- 21.2.3 Slate equity financing** is when an outside investor (e.g., hedge fund or investment bank) funds a set of films to be produced by a studio.
- 21.1 Spillover effects** of an activity, also known as externalities, represent effects on other entities, such as benefits realized by other firms and consumers from the successful R&D of a firm.
- 21.2.3 Super gap financing** is a second level of gap financing, often syndicated, representing the final gap that the senior lender or gap financier does not want to risk.
- 21.1 Unbundled intellectual property** is intellectual property that may be owned or traded on a standalone basis.

## Chapter 22 Keywords

### Section #    Keyword & Definition

- 22.2.1**    **Agents of transformation** refers to commodity firms that perform the tasks of transforming commodities.
- 22.3.4**    **Cash-and-carry arbitrage** is a transaction designed to generate a riskless profit in which commodities are purchased in the spot market and sold in the futures market.
- 22.7**    **Commodity currencies** are the currencies of countries whose major exports are commodities.
- 22.3.1**    **Consumer surplus** is the difference between the highest price a buyer would be willing to pay (the buyer's reservation price) and the actual market price.
- 22.2.4**    **Financialization of commodities** is the expanded use of financial contracts and financial engineering to facilitate commodity trading.
- 22.2.2**    **Flat price risk** refers to risk arising from fluctuations in spot commodity prices.
- 22.4**    **Forward curve** is the relationship between time-to-delivery and commodity futures contract prices.
- 22.2.2**    **Funding liquidity risk** arises from potential losses due to limits on access to financing.
- 22.1.2.1**    **Hotelling theory** states that prices of exhaustible commodities, such as various forms of energy and metals, should increase at the prevailing interest rate—or, more specifically, the real increase in the net price of oil should increase at the real rate of interest.
- 22.4.5**    **Humped curve** means that the market is in contango in the short term, but gives way to backwardation for longer-maturity contracts.
- 22.5**    **Income return** (i.e., collateral yield) is the portion of the return of a commodity investment that results from the return on the cash collateral, which is usually a Treasury bill rate in the United States, although the cash collateral can be in other forms, such as Treasury Inflation-Protected Securities (TIPS), money market securities, and other liquid assets.

- 22.4.3 Liquidity preference hypothesis** holds that producers of bonds (borrowers) prefer long maturities, whereas consumers of bonds (lenders) prefer short maturities, distorting relative prices or rates from reflecting unbiased expectations.
- 22.2.2 Margin and volume risk** occurs when the profitability of traditional commodity merchandising depends on margins between purchase and sale prices, and the volume of transactions.
- 22.3.1 Marginal convenience yield** is the convenience yield that will match buyers with sellers and can be measured using market prices.
- 22.4.5 Preferred habitat hypothesis** is the relationship between expected spot rates and forward rates that varies non-monotonically throughout the range of delivery dates due to supply and demand pressures in localized regions of the curve.
- 22.2.3 Price speculation** in commodities is defined as the risky purchase (or sale) of a commodity-related asset with the expectation that the price of the asset will rise (or fall) to create the opportunity for a capital gain that exceeds the equilibrium compensation for bearing systematic risk.
- 22.4.5 Real options embedded in commodity markets** are implied options involving real assets.
- 22.8.1 Rebalancing yield** is the additional return produced by the process of rebalancing indexed commodity products.
- 22.4.2 Relative value arbitrage** is a practical trading strategy underpinned by market expectations models, in which speculators who identify prices on the forward curve that deviate from their expected values either can purchase or sell those commodities outright, or can enter into spread trades by purchasing the commodity at one point on the curve and selling it at another.
- 22.3.4 Reverse cash-and-carry arbitrage** is a transaction designed to generate a riskless profit in which an initial short position in the spot market is combined with a corresponding long position in the mispriced futures contract when the futures price is below break-even.
- 22.2.2 Spread risk** arises from positions that are exposed to relative price variations between contracts with different delivery dates.
- 22.4.4 Stock-out** is another factor incorporated into storage models, which occurs when storage effectively drops to zero, resulting in consumption being entirely dependent on production and transportation networks.

- 22.1.2.2** **Supercycles** occur when supply shocks create long periods of price increases followed by long periods of price declines.
- 22.2.1** **Transforming commodities** refers to the processes of altering a commodity in terms of space (i.e., location), time, and form.
- 22.4.2** **Unbiased expectation hypothesis** proposes that current futures prices represent the market's expectations of future spot prices.
- 22.4.5** **Volatility asymmetry** is a difference in values between two analogous volatilities, such as is the case with commodities, in which volatility tends to be higher when prices are rising than when they are falling.
- 22.4.4** **Working Curve** positively relates the slope of the forward curve to current levels of inventory such that low inventory levels tend to be associated with a negative slope.

## Chapter 23 Keywords

Section #	Keyword & Definition
23.6	<b>Commodity rights</b> reflect the current value of untapped commodity assets, such as oil reserves.
23.5	<b>Commodity spreads</b> are strategies that seek to take advantage of trading opportunities based on relative commodity prices that can be executed entirely in derivatives markets.
23.5.3.4	<b>Correlation trade</b> is a trade with an outcome that is driven by the statistical correlation between two values, in this case the values of two commodities that differ by location.
23.5.2	<b>Crack spreads</b> are hedges typically used by oil refineries reflecting the cracking or breaking apart of large oil molecules in the process of refining crude oil into gasoline and heating oil.
23.5.2	<b>Crush spreads</b> are hedges typically used by soybean processors, with its name derived from the physical crushing of soybeans into oil and meal.
23.2	<b>Directional strategies</b> take positions substantially exposed to systematic risk based on a forecast of market direction.
23.1.3.2	<b>Diversification return</b> is the enhanced average or expected geometric mean return from rebalancing (or other volatility reduction).
23.6.2	<b>Downstream producers</b> process or refine the output of the upstream producers into a marketable product.
23.6	<b>Enterprise value</b> is the residual value of corporate assets, equal to common equity plus preferred stock plus debt (less cash and other non-operating assets).
23.3	<b>Fundamental directional strategies</b> implement allocations based on an analysis of the underlying supply-and-demand factors for commodities or commodity sectors.
23.5.3.4	<b>Location spreads</b> are trades that involve the same commodity but different delivery and storage locations.
23.6.1	<b>Operational diversification</b> occurs across commodities, grades of commodity, and location to further reduce aggregate commodity price risk exposure.

- 23.6.1** **Operational hedging** is the attempt by a firm to add value by altering its physical activities in reaction to commodity price changes to mitigate the impact on profitability.
- 23.5.2** **Processing spreads** seek to take advantage of the relative price difference between a commodity and the products the commodity produces.
- 23.5.3.4** **Quality spreads** are similar to substitution spreads, except that the spread is across different grades of the same commodity.
- 23.3** **Quantitative directional strategies** use technical or quantitative models to identify overpriced and underpriced commodities based on spot price forecasts or mispriced futures term structures.
- 23.6.1** **Selective hedging** is the attempt to add value by market-timing the degree to which risk is hedged.
- 23.5.4** **Storage strategies** seek to profit from changes in the benefits and costs of commodity storage and often use leased storage facilities to hold physical commodities for delivery at a later date, when the return on storing a commodity exceeds its costs.
- 23.5.3** **Substitution spreads** are trades between commodities that can be substituted for one another in terms of either production or consumption.
- 23.5.1.1** **Synthetic weather derivative** is a derivative position with returns that are substantially driven by weather conditions.
- 23.5.4** **Transportation strategies** use spot commodity markets to execute location trades by moving commodities when the benefits of price differentials exceed transportation costs.
- 23.6.2** **Upstream commodity producers** are direct producers (extractors or growers) of commodities.

## Chapter 24 Keywords

### Section #    Keyword & Definition

- 24.3.3**    **Cash-and-call-strategy** is the most common structure for principal-guaranteed notes, in which the principal guarantee comes from the issuer purchasing maturity- and principal-matched zero-coupon bonds, while the commodity-linked upside exposure comes through the issuer purchasing call options.
- 24.2.6**    **Commodity exchange-traded note (ETN)** is a debt instrument that is traded on an exchange but is different from an ETF; instead of holding an independent basket of assets, the ETN is a note issued by a financial institution that promises to pay ETN holders the return on some index over a certain period of time, and then return the principal of the investment at maturity.
- 24.2**    **Commodity index swap** is an exchange of cash flows in which one of the cash flows is based on the price of a specific commodity or commodity index, whereas the other cash flow is fixed.
- 24.5**    **Dynamic asset allocation model** in the context of commodities is a portfolio weighting method that determines those commodities to be overweighted and/or underweighted, with adjustments in weights being made through time.
- 24.6.2**    **Excess return index** provides returns over cash and is linked to the price movements of a basket of commodity futures contracts.
- 24.7**    **First-generation commodity indices** tend to be heavily weighted in energy and hold long-only positions in front month contracts, rolling to the second month contracts regardless of the shape of the current term structure
- 24.2**    **Indirect commodity investments** are the most common method of obtaining commodity exposure involving equity, fixed income, and derivative instruments.
- 24.3.2**    **Leveraged note** is an indexed note that offers leveraged exposure (e.g., 3x) to a specified commodity index.
- 24.3.3**    **Participation note** is one where the principal guarantee comes from the issuer purchasing maturity- and principal-matched zero-coupon bonds, while the commodity-linked upside exposure comes through the issuer purchasing call options.

- 24.2.6** **Prepaid forward contracts** are fully collateralized forward contracts for delivery.
- 24.6.5** **Preroll strategies** are ones in which the contracts were rolled well before settlement and before the scheduled roll period.
- 24.3.3** **Principal-guaranteed notes** are structured products that offer investors the upside opportunity to profit if commodity prices rise, combined with a downside guarantee that some, potentially all (depending on the note's terms), of the principal amount will be returned at the maturity of the structure.
- 24.6.1** **Quantity-based index** holds a fixed quantity of contracts for each commodity, so that the index weights change each day in terms of percentage of value as futures prices change.
- 24.8.2.4** **Realized roll return** represents the recognition of the accrued gain/loss associated with rolling into higher-priced/lower-priced futures contracts and/or decreasing/increasing the quantity of contract held.
- 24.0** **Return to commodity beta** is the return from direct exposure to changes in commodity prices, which results from holding a passive long position in a commodity.
- 24.7** **Second-generation commodity indices** attempt to enhance returns through forward curve positioning to spread the roll period across points along the forward curve, or target different segments of the curve.
- 24.7** **Third-generation commodity indices** add yet another enhancement to second-generation commodity indices by including active commodity selection, which may be predicated on objective rules (such as using algorithms to assign weights based on specific criteria related to momentum, inventory levels, term structure signals, and so on) or could be discretionary.
- 24.8.2.3** **Total return** represents the return to a fully collateralized position in the commodity index, including the collateral return.
- 24.6.2** **Total return index** is a fully collateralized investment strategy, with the collateralization generally taking the form of Treasury bills.
- 24.6.1** **Value-based index** has fixed-component weights expressed as percentages of the value of the index.

## Chapter 25 Keywords

### Section #    Keyword & Definition

- 25.3.1**    **Adaptive Markets Hypothesis (AMH)** is an approach to understanding how markets evolve, how opportunities occur, and how market players succeed or fail based on principles of evolutionary biology. According to the AMH, concepts central to evolutionary biology govern market dynamics via the forces of competition, mutation, reproduction, and natural selection.
- 25.5.5**    **Alpha decay** is the speed with which performance degrades as execution is delayed. In the long-term perspective, alpha decay is much less important for trend following than it is for many shorter-term futures strategies.
- 25.5.3**    **Capital at risk** is a term used for the risk loading multiplied by the level of equity or capital.
- 25.1**        **Commodity Futures Trading Commission (CFTC)** was initiated in 1974 as a U.S. federal regulatory agency for all futures and derivatives trading.
- 25.1**        **Commodity pool operators (CPO)** invest in a number of underlying CTAs.
- 25.3.3**    **Divergence** is the evolutionary tendency or process by which the market ecology evolves in response to changes and structural shifts in the economy.
- 25.5.4**    **Equal dollar risk allocation** is a strategy that allocates the same amount of dollar risk to each market. This approach does not consider the correlation between markets and is similar to the 1/N approach.
- 25.5.4**    **Equal risk contribution** is a strategy that allocates risk based on the risk contribution of each market, taking correlation into account.
- 25.5.3**    **Futures contract dollar risk** is a measure of the riskiness of the underlying asset of the futures contract during the most recent K trading periods.
- 25.1**        **Futurization** is an industry term that is used for the movement from traditional OTC contracts to multilateral cleared contracts.

- 25.5.4 Market capacity weighting** is an approach in which capital is allocated as a function of individual market capacity. In futures markets, a market capacity weighting will depend on the market size, as measured by both daily volume and price volatility.
- 25.3.4 Market divergence index (MDI)** is a simple aggregate measure of divergence in prices, calculated as the average signal-to-noise ratio across markets.
- 25.2.3.1 Moving average crossover strategy** uses moving averages across different windows coupled with crossover rules to determine when a trend signals that it is time to take long or short positions.
- 25.2.3.4 Multi-strategy CTAs** combine a variety of strategy focuses to provide a diversified set of potential return sources and risk-reward profiles.
- 25.1 National Futures Association (NFA)** is an independent, industry-supported, self-regulatory body created in 1982.
- 25.5.3 Point value** is the gain or loss in the contract from a one-point change (e.g., USD 1) in the futures prices.
- 25.2.3.1 Resistance level** refers to a price at the top of a trading range. When a market moves above the resistance level, a breakout strategy creates a positive trend signal.
- 25.3.4 Signal observation period** is the look-back window for the calculation of the signal.
- 25.3.4 Signal-to-noise ratio** is the ratio of the overall trend to a series of price changes during the same period.
- 25.2.3.1 Support level** refers to a price at the bottom of a trading range. When a market moves below the support level, a breakout strategy creates a negative trend signal.
- 25.2.3.1 Time series momentum** is a trading strategy that takes long positions in outperforming assets and short positions in underperforming assets.
- 25.2.3.1 Trading signals** define the position in a particular market long or short.
- 25.2.3.1 Trailing stop** is a stopping rule that exits a position depending on the recent path of the price such that the stop price “trails” the current price.
- 25.5.3 Volatility targeting** is an approach where the size of the position is determined by the trader’s conviction in her signal, the volatility of the particular futures market, and a volatility target that is determined by the trader.

## Chapter 26 Keywords

Section #	Keyword & Definition
26.4.2	<b>Access bias</b> arises because some managers may not wish to be part of an investable index due to the restrictions that such indices may impose on them.
26.1.2	<b>Convex payout</b> is a profile characterized by an investment strategy that experiences a relatively high frequency of small losses and a relatively low frequency of very large gains.
26.2.1	<b>Crisis alpha</b> is the measure of a strategy's performance during market stress and is one of the most important portfolio benefits of trend-following strategies.
26.3.5	<b>Drawdown duration</b> is related to maximum drawdown and refers to the period between two peaks in the NAV (i.e., the amount of time it takes to go from one NAV high to another NAV high).
26.1.6	<b>Dynamic-trading-based long gamma strategy</b> is a portfolio management method that modifies portfolio weights through time using a method that causes relatively high probabilities of relatively small losses and relatively low probabilities of relatively large gains, resulting in a convex payoff profile.
26.3.2	<b>Funding level</b> is the total amount of cash or collateral that the investor posts to support the trading level.
26.3.1	<b>Implicit leverage</b> equals the notional value of the position divided by the initial margin.
26.3.2	<b>Margin-to-equity</b> ratio is expressed as the amount of assets held for meeting margin requirements as a percentage of the net asset value (NAV) of the investment account.
26.1.4	<b>Market stress</b> can be defined as a period during which there are larger structural shifts in the financial system, balance in supply and demand, valuation, and aggregate risk appetite.
26.3.5	<b>Maximum drawdown duration</b> measures the longest value of all the drawdown durations during a given period.

- 26.3.2** **Notional funding** gives investors the ability to leverage their managed futures account to a higher trading level than would exist with cash funding.
- 26.3.2** **Notional level** is the difference between the trading and funding levels.
- 26.3.7** **Omega ratio** is the ratio of the average realized return in excess of a given target return relative to the average realized loss relative to the same target return.
- 26.3.6** **Scenario analysis** is a market simulation applied to a portfolio to determine how it will perform under different market scenarios.
- 26.3.6** **Stress test** is a market simulation applied to a portfolio to determine how it will perform under different market scenarios.
- 26.3.2** **Trading level** is the base or denominator used in calculating returns of leveraged positions.
- 26.1.2** **Winning ratio of trades** is defined as the ratio of the number of profitable trades to the total number of trades.

## Chapter 27 Keywords

Section #	Keyword & Definition
27.3.1	<b>Beta neutral</b> portfolios generate returns that are uncorrelated with the market risk associated with the specified beta.
27.2.4	<b>Call protections</b> grant the issuer the right to call back the convertible bond before its stated maturity.
27.2.9	<b>Cash-flow strategy</b> generates the bulk of its return from the steady cash flows generated by the position. In this strategy, the hedge ratio is high and the goal is to create a cheap synthetic put and collect cash flows in the process.
27.3.3	<b>Co-integration approach</b> is a statistical technique that indicates the relationship between nonstationary time-series variables.
27.2.4	<b>Conversion premium</b> is the difference between the convertible bond price and parity, expressed as a percentage of parity.
27.1.4	<b>Efficiently inefficient</b> presents the idea that markets are, on average, just inefficient enough to compensate managers and investors for the costs and risks of pursuing skill-based strategies, but not too inefficient to present a large number of money managers with easy-to-exploit arbitrage opportunities.
27.1.3	<b>Fundamental risk</b> emanates from an unexpected change in the fundamental value of a security, causing an apparent arbitrage opportunity to generate losses on the part of the investor.
27.1.2	<b>Fundamental value</b> , also known as intrinsic value, refers to the value of an investment based on a comprehensive analysis of underlying economic factors and forces.
27.2.4	<b>Hard call</b> is call protection in which the issuer can call the bond at a prefixed price regardless of any other circumstances.
27.2.4	<b>In-the-money</b> refers to a convertible bond when its parity is higher than its face value.
27.2.7	<b>Junk or distressed convertibles</b> occur when the stock price is so low that it indicates substantial doubt about the issuer's ability to meet its convertible debt obligations.

- 27.1.3** **Leverage risk** arises because a fund manager who is using leverage may suffer temporary losses, and as a result, the lenders decide to reduce or eliminate the fund's line of credit.
- 27.1.3** **Market frictions** are impediments to costless trading—such as transaction costs, taxes, and regulations—that can create market imperfections and make it too costly or too risky to implement certain arbitrage strategies.
- 27.3.1** **Monetary neutral** has equal long and short exposures to a specified currency.
- 27.1.3** **Noise traders** are investors who trade securities for reasons not related to the fundamental value of securities.
- 27.3.4** **Noise traders risk** is performance dispersion caused by idiosyncratic trading.
- 27.2.4** **Parity** is the total value of the shares into which the bond can be converted based on the current market price of the shares.
- 27.1.2** **Risk arbitrage** is often used by the investment industry to describe profit opportunities that involve some limited risk but have the potential to provide large positive returns relative to the amount of risk involved.
- 27.3.1** **Sector neutral** portfolios generate returns that are uncorrelated with economic sectors, including industries or industry groups.
- 27.3.4** **Short-sale risk** could arise if the investor is forced to cover a short position because either the shares have been called in by the lenders or there is a short squeeze.
- 27.2.4** **Soft call** is call protection in which the issuer can call the bond only if the equity price has risen significantly above the strike price or some other hurdle rate.
- 27.3.4** **Synchronization risk** arises when market participants are slow to react to increased divergence between two stocks, leading the portfolio manager to consider closing the positions because the convergence has not taken place during a specific period.
- 27.2.9** **Synthetic put** is a portfolio that has the same payouts as a put but without a pure put as a component.
- 27.2.9** **Volatility trading** are strategies based on identifying mispriced securities resulting from divergences between expected and implied volatilities.

## Chapter 28 Keywords

Section #	Keyword & Definition
28.3.10	<b>Absolute purchasing power parity (PPP)</b> compares the price of a basket of goods across countries and states that the basket of goods should have the same price in all countries, adjusted using current exchange rates.
28.3.6	<b>Balance of payments</b> occurs as the capital account and current account will have offsetting flows, such as when current account deficit is offset by a capital account surplus.
28.1.2	<b>Betting against beta (BAB)</b> occurs when one takes long positions in low-beta assets and short positions in high-beta assets in anticipation of significant positive risk-adjusted performance.
28.2.3	<b>Bottom-up fundamental analysis</b> is to estimate the value of a company's stock based on firm-level forecasted sales, expenses, and earnings.
28.3.6	<b>Capital account</b> measures the net flow of financial transactions.
28.1.2	<b>Cognitive psychology</b> attempts to capture the many types of deviations from full rationality. Basically, it attempts to understand how people think.
28.3.8	<b>Covered interest rate parity</b> is similar to the cost-of-carry model of commodity markets, and it relates the spot and forward exchange rates to differences in short-term interest rates in the two countries.
28.3.6	<b>Current account</b> measures the balance of trade in goods and services.
28.1.2	<b>Dividend premium</b> is the difference between the average market-to-book-value ratios of dividend payers and nonpayers.
28.2.9	<b>DuPont model</b> is used to calculate ROE (return on equity) by multiplying the profit margin by the asset turnover and the leverage. These three ratios are net income/revenues, revenues/assets, and assets/book equity.

- 28.1.1** **Efficient Market Hypothesis (EMH)** states that securities markets incorporate all available information in the determination of the value of a security.
- 28.2.4** **Free cash flow to the firm (FCFF)** is the total cash flow that is available for distribution to shareholders and bondholders of the firm.
- 28.3.3** **Feedback-based global macro managers** assume that markets are rational most of the time but that there can exist periods of severe irrationality.
- 28.3.5** **Fisher effect** states that the nominal interest rate is approximately equal to the real interest rate plus the expected inflation rate.
- 28.2.5** **Generalists** invest across a wide universe of stocks.
- 28.2.4** **Gordon's growth model** estimates the value of a stock as the present value of a perpetual stream of dividends assumed to grow at a constant rate.
- 28.2.2** **Growth approach** to fundamental long/short equity investing is to overweight companies perceived as having higher potential to deliver large increases in revenues, earnings, and/or cash flows.
- 28.1.2** **High-quality assets** are securities that are safe, profitable, growing, and well managed.
- 28.3.3** **Information-based global macro managers** rely primarily on collecting micro-level information to better understand the global macro picture.
- 28.3.10** **Law of one price** states that, absent transaction and transportation costs, the same item should have the same price in all countries, adjusted using current exchange rates.
- 28.1.2** **Leverage aversion theory** predicts that leverage-constrained investors bid up high-beta assets.
- 28.1.2** **Loss aversion/disposition effect** captures the notion that investors typically prefer to avoid losses rather than acquire gains.
- 28.3.3** **Model-based global macro managers** rely primarily on financial models and economic theories to analyze market movements, detect policy mistakes of central banks and governments, or extract implied market expectations and compare them to sensible estimates.
- 28.2.4** **Perpetual growth model** estimates the value of a stock as the present value of a perpetual stream of dividends assumed to grow at a constant rate.
- 28.3.10** **Relative purchasing power parity (PPP)** provides a one-to-one link between inflation differential and exchange rate changes. The change in the exchange rate between two

countries should reflect the relative changes between local prices or the difference between the inflation rates of the two countries.

- 28.2.5** **Sector specialists** tend to invest within a specific equity sector, such as financials, health care, or technology.
- 28.1.2** **Sentiment** is broadly defined as beliefs about future cash flows and risks that are not justified by an objective analysis of the facts.
- 28.2.3** **SWOT analysis** is a framework in which an investment analysis is driven by four categories: strengths, weaknesses, opportunities, and threats.
- 28.2.3** **Top-down fundamental analysis** is applied by some long/short managers in which a company's perceived value is driven by a few broad investment and macroeconomic themes.
- 28.3.8** **Uncovered interest rate parity** is similar to covered parity, with the transactions left unhedged.
- 28.2.2** **Value long/short managers** employ traditional valuation metrics, such as the book-to-market ratio, earnings-to-price (E/P) ratio, dividend yield, and the ratio of P/E to earnings growth rate (i.e., the PEG ratio), to look for undervalued companies.
- 28.1.1** **Value trap** occurs when a security is undervalued but may stay undervalued for a prolonged period.

## Chapter 29 Keywords

### Section #    Keyword & Definition

- 29.9**            **Accordion feature** provides a borrower with enhanced flexibility, such as allowing the borrower to access a certain amount of additional borrowing, or allowing the borrower to have more access to liquidity, which is a matter of particular importance during distress.
- 29.8.1**        **Actual default** is the failure of the firm to make the payment of interest or principal on its obligations as required in the contract.
- 29.9.2**        **Administration of restructuring** transfers the control of the debtor into the hands of an administrator.
- 29.12.3**      **Advance rate** is the ratio of credit for every dollar of collateral.
- 29.12**        **Asset-based loan (ABL)** is a secured loan backed by various types of collateral pledged by the borrower.
- 29.12.7.4**    **Attachment of security interest** is a set of steps under U.S. laws in a secured transaction to make sure that the lender has legal rights to take possession of collateral in the event of default.
- 29.12.3**      **Borrowing base** is used in deciding how much credit to extend to a particular borrower and is determined by the amount of eligible collateral a borrower can pledge. In addition, the type of eligible collateral and the mix of assets within the collateral package determine an advance rate.
- 29.10.2**      **Classic distressed investing strategy** involves buying the loan or bond of a distressed borrower, holding the instrument through workout/bankruptcy, swapping part or all of the debt claims for equity of the newly reorganized entity, and finally exiting via sale to a strategic buyer or the public market through an initial public offering (IPO).
- 29.1**            **Credit** is money or funds granted by a creditor or lender to a debtor or borrower.
- 29.1**            **Credit events** that give rise to credit risk include bankruptcy, downgrading, failure to make timely payments, certain corporate events, and government actions.

- 29.7** **Credit score** is a measure that can be used to rank or assess the relative riskiness of firms or securities.
- 29.9.3** **Creditors committee** is a group in which investors have taken a cooperative approach to work among themselves and, in many cases, with management.
- 29.9.1** **Debtor-in-possession (DIP)** is a borrower who maintains control over the in-court restructuring process.
- 29.5.1** **Default intensity** determines both the expected time to default and the probability of survival. The expected time to default is 1 divided by the default intensity.
- 29.4.1** **Default trigger** is when the firm's total asset value is the face value of the zero-coupon bond, because it represents the asset value at which the firm would be on the brink of default.
- 29.4.2** **Distance to default (DD)** is approximately measured as the percentage difference between a firm's assets and its default trigger relative to the volatility of its assets.
- 29.8.3** **Distressed exchange** is classified by rating agencies as a default situation that occurs when the borrower repurchases the creditor's claim for cash, often at a great discount to the original par amount of the claim.
- 29.2** **Empirical approach to credit risk modeling** is based on the assumption that it is too difficult to model the company and its environment accurately.
- 29.8.3** **Exchange offer** is classified by rating agencies as a default that occurs when the borrower swaps out the original obligation for a new instrument, likely for a reduced principal.
- 29.4.3** **Expected default frequency (EDF)** theoretically or empirically measures the probability that loans of certain characteristics could default.
- 29.12.6** **Fixed charge coverage** is a ratio equal to  $(\text{EBIT} + \text{fixed charge}) / (\text{fixed charge} + \text{interest})$ .
- 29.4.1** **KMV model** is a structural credit risk model that uses Merton's model and estimates of the volatility and total value of the firm's underlying assets and equity to estimate the credit risk of the debt.
- 29.10.1** **Loan-to-own** is a strategy that is typically seen as being on the more hostile spectrum of approaches and begins with the investor providing a loan that can lead to the investor taking control.

- 29.12.1** **Lockbox** is a bank account set up to protect the lender by receiving collections of the accounts receivable—proceeds on recent activity to be applied against a revolver.
- 29.12.6** **Net leverage covenant**, one of the key covenants for a cash flow-based loan, is calculated as the amount of senior or total debt, net of cash, as a multiple of EBITDA.
- 29.8.4** **Operational restructuring** includes change in management, asset sale, spin-off, or various other ways of implementing cost reduction, including closing down or selling business lines.
- 29.9** **Out-of-court restructuring**, also known as a consensual restructuring, occurs when the borrower works with its creditors to reduce the debt burden.
- 29.12.7.4** **Perfect the security interest** is a legal step that lenders should take in order to help assure that no other party, such as another creditor or bankruptcy trustee, will be able to claim the same collateral in the event that the debtor becomes insolvent.
- 29.9.1** **Prepackaged filing** (“prepack”) means that when the debtor files for chapter 11, it does so with a plan of reorganization (POR) that has already been distributed, solicited, negotiated, and voted on by all the relevant classes of creditors.
- 29.12.5** **Revolver** is a credit line with a preapproved limit that’s available for a prespecified period. As the borrower takes out some capital, the amount of available credit is reduced by that amount.
- 29.12.5** **Revolving line of credit** is a credit line with a preapproved limit that’s available for a prespecified period. As the borrower takes out some capital, the amount of available credit is reduced by that amount.
- 29.9.2** **Scheme of arrangement** is a popular court-sanctioned process in the UK which can be used to bring about a reorganization of a solvent company or group structure, as well as an insolvent restructuring, including a debt-for-equity swap or other debt-reduction methodologies. In practice, schemes are often used to avoid insolvency.
- 29.12.3** **Seasonal overadvance** is a temporary allowance by which the lender allows for a higher advance rate to account for seasonal effects in which the working capital need of the borrower is higher.
- 29.8.8** **Steering committee or creditors’ committee** is a group of investors who have taken a cooperative approach to work among themselves and, in many cases, with management during bankruptcy proceedings.
- 29.8.1** **Technical default** is when a borrower is in breach of the covenants of its bond or loan obligations.

- 29.12.5** **Term loan** typically has either an amortizing or a bullet structure and is secured against longer-term assets (real estate, machinery).
- 29.8.5** **Terminating out debt** takes place when borrowers extend the maturity of their existing debt. These actions greatly improve the liquidity available to the company and can mask operational issues long before they are reflected in the pricing of the debt.
- 29.8.2** **Trade claims** make up a specific group of creditors to a distressed borrower, such as the debt owed to a vendor that provides products or services to a firm.
- 29.10.3** **Trading-oriented distressed strategy** seeks to capture the excess return premium that's implied in the price of debt instruments that are oversold when noneconomic sellers have to liquidate their holdings.
- 29.12.3** **Traditional overadvance**, which is typically used for an acquisition or an LBO, is when lenders allow for a greater advance rate with the additional borrowing being amortized over several years and can be added to an existing term loan or as a separate facility.
- 29.7.1** **Z-score model** predicts corporate distress by focusing on a set of financial ratios that are based on a firm's financial statements as well as the market value of the firm's equity.

## Chapter 30 Keywords

Section #	Keyword & Definition
30.6.6	<b>Black swan</b> is an event or occurrence that deviates beyond what is normally expected of a situation and that would be extremely difficult to predict.
30.4.3	<b>CBOE Volatility Index (VIX)</b> is a trademarked market-based approximation of the 30-day implied volatility of the S&P 500 that is calculated and disseminated in real time by the CBOE. The VIX serves as a direct underlier to futures contracts and to options.
30.4.4	<b>Correlation swap</b> is a derivative that transfers the risk the buyer to the seller that the actual average correlation among a specified set of individual stocks will differ from the swap's strike correlation.
30.5.2	<b>Horizontal spread</b> is a combination of long calls and short calls (or short puts and long puts) having the long options with one expiration date (the long leg) and the short options with a different expiration date but with the same strike prices.
30.2.7	<b>Implied volatility structure</b> is a representation of the various implied volatilities relative to their tenor, moneyness, or type.
30.2.3	<b>Iron butterfly</b> is a short position where the trader sells a bull spread and a bear spread such that the two spreads share the same middle strike price.
30.2.3	<b>Iron condor</b> is a short position where a trader sells an out-of-the-money bull spread and an out-of-the-money bear spread.
30.3	<b>Jump process</b> is often used to model a financial value that has potentially large discrete changes in the value rather having short-term changes that are all continuous and small.
30.3.2	<b>Mixture model</b> models equity market volatility as some mixture of two return distributions.
30.1.2	<b>Negative volatility risk premium</b> means that products that are long volatility tend to lose money on average (relative to the riskless rate).
30.2.7	<b>Options volatility surface</b> is a volatility structure that plots implied volatility for a wide variety of options in a given instrument across both expiration dates and strike prices.

- 30.6.7** **Performance drag** is the reduction in portfolio return when a specified strategy is added to a portfolio.
- 30.5.1.1** **Ratio spread** is a vertical spread with unequal numbers of long and short option positions.
- 30.3.2** **Regime change** occurs when an observed behavior of a financial series experiences a dramatic shift.
- 30.3.2** **Regime switching model** models equity market volatility as some mixture of two return distributions.
- 30.4.3.4** **S&P 500 Short-term VIX Futures Index** is a benchmark based on the estimated performance of a hypothetical VIX futures contract with a fixed time to settlement of 30 days formed using a time-weighted combination of the prices of the front and second month VIX futures contracts.
- 30.2.2** **Short straddle** is a position which contains a short call option and short put option on the same asset and with the same strike price.
- 30.2.2** **Short strangle** is a position which contains a short call option and short put option on the same asset but with different strike prices.
- 30.1.2** **Short volatility** positions tend to decline in value as return volatility rises. Short volatility positions include written options and long positions in traditional asset classes such as equities.
- 30.2.7** **Smile** is where out-of-the-money put options have higher levels of implied volatility than other options.
- 30.2.7** **Smirk** is where out-of-the-money put options have higher levels of implied volatility than other options.
- 30.6.1** **Tail risk funds** are designed specifically to provide their investors with protection against large broad market declines.
- 30.2.1** **Tenor** of an option or other contract is the length of time until the contract terminates.
- 30.5.1** **Vertical spread** is a combination of long calls and short calls (or short puts and long puts) having the long options with one strike price (the long leg) and the short options with a different strike price but with the same expiration dates.
- 30.4.3.3** **VIX term structure** is the relationship between the prices of VIX futures contracts and their settlement dates, usually expressed as a graph.

- 30.3.2** **Volatility clustering** occurs in a price series when large changes are likely to be followed by more large changes and periods of small changes are likely to be followed by more small changes.
- 30.1.1** **Volatility derivatives** are pure plays on volatility with returns that are driven substantially, explicitly, and directly by exposure to the volatility factor.
- 30.3.1** **Volatility diffusion** is the risk of volatility changes that represent the continuous accrual of small changes in the volatility of an asset through time.
- 30.3.1** **Volatility jump** is the risk of potentially large periodic and sudden upward changes in the level of volatility.
- 30.2.7** **Volatility skew** indicates that options that differ by moneyness have different implied volatilities.

## Chapter 31 Keywords

### Section #    Keyword & Definition

- 31.7.1**    **Algorithmic approach** does not rely on a predefined benchmark; it involves implementing a simplified version of the actual trading strategy employed by funds that follow the particular strategy.
- 31.1**        **Alternative betas** refer to exposures to risk, risk premiums, and sources of return that are not normally available through investments in traditional assets—or, if they are available, are commonly bundled with other risks.
- 31.3.2**    **Capacity constraint hypothesis** argues that most alpha is a zero-sum game. Therefore, only a few managers can offer alpha on a consistent basis. The growth in hedge fund assets under management sharply reduces the per capita amount of alpha available in the marketplace.
- 31.5.3**    **Exposure inertia** asserts that the overall weights of an index consisting of actively managed portfolios can be empirically estimated because the overall exposures change relatively slowly through time.
- 31.5**        **Factor-based approach** assumes that a significant portion of a fund's returns can be explained by a set of asset-based factors.
- 31.3.2**    **Fund bubble hypothesis** assumes that successful hedge fund managers can earn substantially greater incomes than successful fund managers in the traditional space. The hypothesis states that as the supply of investment capital to the hedge fund space increases, so does the number of less qualified managers who enter the industry and provide inferior returns that dilute the overall performance of the industry.
- 31.1**        **Hedge fund replication products** (also called clones or trackers) are created to capture the traditional and alternative betas underlying the expected return and risk of a hedge fund benchmark.
- 31.3.2**    **Increased allocation to active funds hypothesis** argues that as hedge fund investment becomes more popular, the performance of hedge funds will be adversely affected by the trading decisions of investors who have allocations to these funds as well as to traditional assets. The systematic risks or betas of hedge funds increase as more capital flows into them.

**31.6.1** **Payoff-distribution approach** aims to produce a return distribution that matches a desired distribution (e.g., that of the benchmark).

**31.5.3** **View commonality** is related to the fact that when the views of individual hedge fund managers (measured by their exposures) are aggregated in a hedge fund index, they tend to cluster into common themes that drive the overall performance of the index.

## Chapter 32 Keywords

### Section #    Keyword & Definition

- 32.7**        **Administrative delay risk** is economic exposure to consequences from tardy reports and other information.
- 32.7**        **Co-investor risk** occurs when co-investors are jointly affected by inflows and outflows, the latter of which may trigger an increase in leverage to finance redemptions when cash or liquidity in the underlying funds isn't readily available.
- 32.2.2**      **Concentrated FoFs** typically allocate assets to a relatively small number of hedge funds compared to diversified FoFs (typically 5 to 10).
- 32.9.4**      **Constituency effect** is when investors with lower wealth, less skill, and greater risk aversion are natural clients for FoFs.
- 32.7**        **Double layer of fees** in FoFs refers to the two layers of fees charged to investors, including those at the fund level and at the fund of funds level.
- 32.9.4**      **Funding bias** is noted when the returns to hedge funds observed in databases are biased upward compared to the full hedge fund universe that would have existed if there were no FoFs.
- 32.7**        **Funds-of-one**, or custom portfolios for a single investor, are not typically exposed to the issues of co-investor risk.
- 32.7**        **Netting risk** is an investor's exposure to economic loss from paying higher total fees as a result of paying incentive fees for funds with profits without offsetting reductions from funds with losses.
- 32.2.2**      **Single-strategy FoFs** allocate assets across several hedge funds (typically 5 to 15) following the same strategy, theme, or group of strategies.
- 32.2.2**      **Tactical FoFs** invest in a group of hedge funds (typically 5 to 10) to opportunistically gain exposure to a specific market factor.

## Chapter 33 Keywords

Section #	Keyword & Definition
33.4.3	<b>Asset verification</b> refers to the process by which an investor independently confirms a fund's level of asset holdings with third parties, such as fund administrators, prime brokers, and banks.
33.10	<b>Associate directors</b> are investors who support the work of the individual named to serve as the fund director.
33.10	<b>Audit holdback</b> is a mechanism by which a hedge fund manager may retain a portion of an investor's redeemed capital until the finalization of a hedge fund's audit.
33.10	<b>Board of directors</b> is a group of individuals who are responsible for fulfilling regulatory obligations, exercising legal rights, and providing limited independent oversight of funds.
33.9	<b>Dedicated operational due diligence approach</b> is an ODD framework in which an investment organization, such as a fund of hedge funds, has at least one employee whose full-time responsibility is vetting the operational risks of hedge fund managers.
33.10	<b>Director capacity</b> refers to the maximum number of board positions that a director may serve on in order to maintain effectiveness.
33.8.1	<b>Equity ownership model</b> is an approach in which an investigation would be performed on all personnel who have equity ownership in the management company of the hedge fund organization.
33.2	<b>Execution</b> refers to the process by which a fund completes a securities trade.
33.10	<b>Formal directors</b> are individuals named to serve as directors, often designated in the hedge fund offering memorandum.
33.5.1	<b>Front running</b> is related to poor operational oversight of personal account dealing at a hedge fund and when employees or others attempt to trade in advance of the firm's funds for their own accounts.
33.10	<b>Fund governance</b> can be defined as an interconnected system of controls and procedures that determine independence, transparency, and oversight throughout the fund.

- 33.5.2** **Hardship exemption** is when an employee is allowed to sell a security at a loss even if it is within the minimum holding period.
- 33.4.1** **Hedge fund prime brokers** are institutions that facilitate hedge fund trading by aggregating a portion, or all, of a hedge fund's cash and securities as well as providing services for leverage and short selling.
- 33.9** **Hybrid operational due diligence approach** refers to an approach that encompasses some combination of the three previously described approaches (i.e., dedicated, shared, and modular).
- 33.5.3** **Insider trading** is a scheme in which employees of a hedge fund use what is known as material nonpublic information (MNPI), sometimes referred to as insider information, in their investment process.
- 33.8.1** **Investment decision making authority model** is an approach focused on performing background investigations on those individuals who have the authority to make investment decisions and act (i.e., trade) on such decisions.
- 33.9** **Modular operational due diligence approach** is one whereby the ODD process is classified into functional components and divided among specialists with relevant domain-specific knowledge.
- 33.7** **Operational benchmarking** is the process of comparing operational best practices to the actual procedures in place at a fund.
- 33.4.2** **Operational signaling effect** is when individual operational issues (e.g., continued NAV production delays) can signal that there are undiagnosed operational problems present.
- 33.7** **Operational threshold issue** is an issue that must be satisfied in order to have a particular investor continue to consider allocating to a particular fund.
- 33.4.3** **Position verification** refers to the process of confirming the holdings of actual fund positions with third parties, such as prime brokers and custodians.
- 33.5.2** **Post-clearance** refers to the process by which the compliance department collects employee brokerage statements and then attempts to reconcile them to pre-clearance requests.
- 33.2** **Posting** refers to the process by which trades are logged internally at a fund, whether through order management or through fund accounting systems.
- 33.2** **Pro rata allocation** is a common allocation method by which a firm allots shares in the securities purchased to different funds based on predetermined proportionate amounts, such as assets under management, or a fund's predetermined desired allocation size.

- 33.5.2** **Pre-clearance** of personal account trades is a process by which employees must seek approval from compliance before executing a trade.
- 33.2** **Reconciliation** refers to the process by which a hedge fund conducts another internal review to ensure that the internal details of the trade (buy/sell, security description, trade size, and price) are accurately matched with the details provided by the fund's counterparties.
- 33.10** **Redemption gates** are a mechanism by which a hedge fund can limit the total amount of capital being redeemed from a fund at any single redemption period (e.g., quarterly).
- 33.10** **Reserve** is a general term describing a capital buffer that can be created by a hedge fund from invested capital to meet potential expenses.
- 33.5.2** **Restricted list** is a list of securities that the firm has prohibited employees from trading.
- 33.8.1** **Risk control model** is an approach in which background investigations are performed on all individuals, both investment and noninvestment focused, who control risk within an organization.
- 33.2** **Settlement (internal)** refers to the process of reconciling third party trade confirmations for executed trades with the firm's internal systems and trade blotters, and transferring the cash and securities to complete the trade.
- 33.9** **Shared operational due diligence approach** is a framework in which the responsibility for reviewing the operational risk exposures at hedge funds is shared by the individuals who have responsibility for investment due diligence.
- 33.2** **T+1 basis** means that for liquid securities, most reconciliations are typically completed one day after the trade date—referred to as T—the trade would be reconciled.
- 33.2** **Three-way reconciliation** or triangular reconciliation, is performed between the trading counterparties, the hedge fund itself, and the administrator.
- 33.2** **Trade blotter** is the running list of all trades desired and completed during each trading day.
- 33.2** **Trade break** is when a trade anticipated by the hedge fund failed to execute.
- 33.2** **Two-way reconciliation** is the reconciliation between the hedge fund's trading records and the prime broker.
- 33.3.1** **Unencumbered cash** is a primary category of hedge fund cash which relates to cash that is not currently being used for trading but may be used in the future for either trading or another purpose.

## Chapter 34 Keywords

### Section #    Keyword & Definition

- 34.2.2**    **Accredited investor** is defined as a natural person who either (1) has a net worth exceeding USD 1 million, excluding the value of his primary home; or (2) has earned at least USD 200 thousand singularly in each of the past two years or USD 300 thousand jointly with a spouse.
- 34.3.2**    **Alternative Investment Fund Managers Directive (AIFMD)** reflects the basic regulatory model of a directive and, in so doing, provides for each member state of the EU to carry out the following: Adopt and implement the aims of AIFMD; provide regulatory supervision and enforcement over alternative managers within its jurisdiction; certify that managers within its jurisdiction who desire an AIF; work within AIFMD guidelines in resolving enforcement and oversight disputes with member states as well as the EU.
- 34.3.3.7**    **Asset stripping rules** prevent an AIF from making a controlling private equity investment, having the nonlisted company take a loan, and then distributing the loan proceeds to themselves, and thereby creating leverage that may or may not create unnecessary risk.
- 34.2.1**    **Blue sky laws** are designed to protect state interests and prevent fraudulent activities within a state's borders.
- 34.2.4.3**    **Cause inspections** are initiated by the SEC for a particular reason, such as when it suspects that a fund manager may be violating federal securities laws.
- 34.2.4.2**    **Code of ethics** refers to the adviser's fiduciary duties to clients.
- 34.2.1**    **Dodd-Frank Act** is a set of federal regulations passed in 2010 in an attempt to prevent the recurrence of events that caused the 2008 financial crisis.
- 34.3.4.1**    **European Securities and Markets Authority (ESMA)** was created by the EU parliament with the power to write technical standards and bring about systems of mutual recognition.
- 34.3.3.6**    **European Systemic Risk Board (ESRB)** is a European regulatory body to oversee risk. AIFMD compliance regarding risk will fall under the ESRB in the EU and the FCA in the UK.
- 34.2.1**    **Financial Stability Oversight Council**, related to the Dodd-Frank Act, monitors the performance of companies deemed "too big to fail" in order to reduce the potential for the kind of widespread risk seen during the 2008 financial crisis.
- 34.4.3**    **Financial Supervisory Service (FSS)** is a Korean regulatory body which operates under the Financial Services Commission (FSC). It is responsible for inspection of financial institutions as well as enforcement of relevant regulations as directed by the FSC.

- 34.2.3** **Form ADV** specifies the investment style, assets under management, and key officers of the firm. The form must be updated annually and be made available as public record for companies managing in excess of \$25 million.
- 34.2.5** **Form PF** requires information on fund size, leverage, investor types and concentration, liquidity, and fund performance.
- 34.2.1** **The Investment Advisers Act of 1940** defines the role and responsibilities of an investment adviser.
- 34.2.5** **Large hedge fund advisers** have at least \$1.5 billion in assets under management attributable to hedge funds, and must file Form PF on a quarterly basis within 60 days of the end of each fiscal quarter.
- 34.2.5** **Large liquidity fund advisers** have at least \$1 billion in assets under management attributable to liquidity funds and registered money market funds, and must file Form PF on a quarterly basis within 15 days of the end of each fiscal quarter.
- 34.2.5** **Large private equity fund advisers** have at least \$2 billion in assets under management attributable to private equity funds, and must file Form PF on an annual basis within 120 days of the end of each fiscal year.
- 34.4.2** **Monetary Authority of Singapore (MAS)** is the primary hedge fund regulatory agency in Singapore.
- 34.2.1** **Orderly Liquidation Authority**, related to the Dodd-Frank Act, it monitors the performance of companies deemed “too big to fail” in order to reduce the potential for the kind of widespread risk seen during the 2008 financial crisis.
- 34.2.1** **Orderly Liquidation Fund** provides money to assist with the liquidation of financial companies that have been placed in receivership because of their financial weakness.
- 34.2.2** **Qualified purchaser** is defined as an individual investor with USD 5 million or an institutional investor with USD 25 million in investable assets.
- 34.2.3** **Regulatory assets under management (RAUM)** is defined as the securities portfolio (i.e., a portfolio in which at least 50% of the total value consists of securities, cash, and cash equivalents) to which the adviser provides continuous and regular supervisory or management services.
- 34.2.4** **Rule 206(4)-7** requires that each registered adviser establish an internal compliance program designed to facilitate performance of the adviser’s obligations under the Dodd-Frank Act. As part of this, each advising company must have a chief compliance officer (CCO) who develops compliance procedures for the adviser.
- 34.2.5** **Section 13(d)** requires an adviser who beneficially owns more than 5% of a class of publicly traded equity securities to file disclosure reports within 10 days of the acquisition of those securities, identifying, among other things, the source and amount of funds used for the acquisition and the purpose of the acquisition.

- 34.2.5** **Section 13(f)** requires a fund manager with investment discretion of \$100 million or more of publicly traded equity securities to file quarterly reports disclosing those holdings and the type of investment and voting authority exercised by the manager.
- 34.2.5** **Section 13(g)** provides an alternative short form to the beneficial ownership reporting scheme for acquisitions by qualified institutional investors and passive investors who acquire securities in the ordinary course of their business and not for the purpose of changing or influencing controls of the issuer.
- 34.2.5** **Section 13(h)** requires certain fund managers with investment discretion who are engaging in certain large levels of purchases and sales of national market system (NMS) securities to file with the SEC and also provide certain identifying information to broker-dealers who, in turn, must provide transaction-related information to the SEC on its request.
- 34.2.5** **Section 16** applies to fund managers who, investing for their own accounts or for the purposes of changing or influencing control of the issuer, own more than 10% of a class of a publicly traded company's outstanding equity securities.
- 34.2.1** **Securities Act of 1933** has two main goals: (1) to ensure more transparency in financial statements so investors can make informed decisions about investments, and (2) to establish laws against misrepresentation and fraudulent activities in the securities markets.
- 34.2** **Securities Exchange Act of 1934** provides governance of securities transactions on the secondary markets of the United States and regulates the exchanges and broker-dealers in order to protect the investing public.
- 34.4.4** **Securities and Exchange Surveillance Commission (SESC)** oversees hedge funds in Japan where managers are required to be licensed and register as investment managers as well as provide continuing reports on the actual business condition of the fund.
- 34.4.1** **Securities and Futures Commission (SFC)** is the primary regulator of hedge funds in Hong Kong, primarily concerned with transparency in investments and many of its regulations are geared toward ensuring that investors have adequate information to make informed decisions.
- 34.2** **Securities and Exchange Commission (SEC)** is an independent agency of the United States federal government and has primary responsibility for the enforcement of all federal securities laws and the regulation of the securities industry.
- 34.2.4.3** **Sweep inspections** (or theme inspections) typically occur when the SEC focuses on a number of investment advisers located in a particular geographic area or engaged in certain activities.
- 34.3.3.1** **Undertakings for Collective Investment in Transferable Securities (UCITS)** refer to a series of EU directives that established a uniform regulatory regime for the creation, management, and marketing of collective investment vehicles in the countries of the EU. UCITS funds typically invest in securities listed on public stock exchanges and regulated markets.
- 34.2.1** **Volcker Rule**, a key component of the Dodd-Frank Act, restricts the ways that commercial banks can invest in hedge funds, private equity funds, and proprietary trading strategies, and regulates trading in derivatives.

## Chapter 35 Keywords

Section #	Keywords & Definition
35.3	<b>Arbitrage-free models of the term structure</b> (also referred to as second generation models) use a different approach to model bond prices and the yield curve.
35.6	<b>Absolute prepayment speed (APS)</b> is defined as the monthly prepayment expressed as a percentage of the original collateral amount.
35.6	<b>Auto loan-backed securities (ALBS)</b> receive cash flows from customer payments assembled from a specific pool of auto loans or leases.
35.4.2	<b>Callable bonds</b> give the bond issuer the right to redeem the bond by returning a prespecific payment to the investor during the period designated in the terms of the bond.
35.4.1	<b>Cap</b> is a series of caplets, and its price is equal to the sum of the prices of the caplets, which, in turn, can be valued using various term-structure models and a procedure similar to the Black-Scholes option pricing model.
35.4.1	<b>Caplet</b> is an interest rate cap guaranteed for only one specific date.
35.2.4	<b>Cox, Ingersoll, and Ross model (CIR model)</b> alters the Vasicek model to make the variance of the short-term interest rate proportional to the rate itself, thereby disallowing negative interest rates.
35.7	<b>Credit card receivables (CCR)</b> is an asset-back security in which a pool of credit card receivables is used as collateral.
35.2	<b>Equilibrium models of the term structure</b> (also referred to as first generation models) make certain assumptions about the structure of fixed-income markets and then use economic reasoning to model bond prices and the term structure of interest rates.
35.4.1	<b>Floor</b> is a series of floorlets, and its price is equal to the sum of the prices of the floorlets.
35.4.1	<b>Floorlets</b> is an interest rate floor guaranteed for only one specific date.

- 35.3.1 Ho and Lee model** assumes that the short-term interest rate follows a normally distributed process, with a drift parameter that is chosen so that the modeled interest rates fit the observed term structure of interest rates.
- 35.4.1 Interest rate cap** one party agrees to pay the other when a specified reference rate is above a predetermined rate (known as the cap rate, which is similar to the strike price of a European call option).
- 35.4.1 Interest rate floor** one party agrees to pay the other when a specified reference rate is below a predetermined rate (known as the floor rate, which is analogous to the strike price of a European put option).
- 35.4.3 Interest rate swaps** exchange cash flows based on the difference between a fixed interest rate and a specified floating interest rate. Payments are based on a notional principal and a specified number of years, which typically range from two to 15 years.
- 35.7 Non-recourse loans** only allow the lender to collect the collateral at hand.
- 35.7 Recourse loan** would be a credit card or auto loan where the borrower is personally liable for repaying any outstanding balance on the loan.
- 35.4.3 Swap rate** refers to the fixed rate of an interest rate swap. Initially, the swap rate is set so that the present value of expected floating payments is equal to the present value of expected fixed payments.
- 35.4.3 Swap rate curve** displays the relationship between swap rates and the maturities of their corresponding contracts, having a concept analogous to that of the yield curve.
- 35.2.1 Vasicek's model** is a single-factor model of the term structure that assumes that the short-term interest rate drifts toward a prespecified long-term mean level.

## Chapter 36 Keywords

Section #	Keyword & Definition
36.2.2	<b>Attachment probability</b> is typically based on historical information about natural disasters, and indicates the estimated probability that the cat bond's attachment point will be reached.
36.4.3	<b>Bonus payment</b> is an extra negotiated payment in a debt contract, which can be fixed or variable.
36.2.2	<b>Cat bond attachment point of the trigger</b> is a numerical value indicating the point at which at least a fraction of principal must be "attached" to cover claims.
36.2	<b>Catastrophe bonds (Cat bonds)</b> are risk-linked debt securities that are designed to transfer specific risks from issuers—typically insurance or reinsurance companies—to investors.
36.2.3	<b>Complexity arbitrage</b> is the process of attempting to earn short-term, very low-risk profits from pricing discrepancies attributable to highly complicated investment features.
36.2.2	<b>Exhaustion point</b> is the level of claims loss at which the principal is "exhausted" and investors are not legally responsible for any additional claims.
36.3.3	<b>Extreme mortality risk</b> arises because of the threat of very high mortality rates due to natural disasters, pandemics, and terrorist attacks.
36.2.2	<b>Indemnity trigger</b> is a type of trigger that initiates principal reductions based on the level of actual excess claims paid by the issuer.
36.2.2	<b>Industry loss trigger</b> is a trigger in which principal reductions in the cat bond are based on index estimates made by an independent third party of the total industry losses due to the occurrence of an insured event.
36.1	<b>Insurance-linked securities (ILS)</b> are tradable financial instruments whose value is affected by an insured loss event, such as a natural disaster, longevity risk, or life insurance mortality.

- 36.3.4** **Life insurance settlements**, or life settlements, consist of the sale of a life insurance policy (or the transfer, bequest, or assignment of a life insurance policy or the benefits of such policies) by its owner to a third party.
- 36.3.1** **Longevity risk** is any potential risk that arises from a higher than initially projected life expectancy of pensioners and policyholders.
- 36.3.2** **Longevity swap contract** takes place when a pension plan administrator agrees to make fixed payments to a counterparty based on certain mortality assumptions, while the counterparty agrees to make floating payments based on either the pension plan's actual mortalities (indemnity-based contract) or an agreed-upon mortality index (index-based contract).
- 36.2.2** **Modeled trigger** coverage is based on claims generated by a computer model developed by an independent modeling company.
- 36.3.3** **Mortality risk** is the risk of a person (or group of individuals) passing away sooner than expected.
- 36.2.2** **Parametric trigger** offers coverage when a certain threshold is surpassed based on previously specified natural parameters.
- 36.4.3** **Payment in kind (PIK) interest** is an agreement, where periodic interest is paid by increasing the total principal via capitalization of the interest payments due rather than in cash.
- 36.4.5** **Project** is capital often used for specific purposes, such as real estate projects and infrastructure projects, either on a private basis or in a public-private partnership.
- 36.4.4.3** **Subordinated debt with profit participation** is a scheme that provides a risk balance between debt and equity to mezzanine lenders, offering a level of downside protection and also a way to participate in the upside potential.
- 36.3.4** **Surrender value** of a policy is the price at which the insurance company will buy back its commitments under the contract.
- 36.3.6** **Viatical settlement** is a transaction in which a sick policyholder sells his or her life insurance policy at a discount to its face value.
- 36.4.4.4** **Warrants** are similar to equity options, but they differ in that they are generally issued by unlisted firms and are thus regarded as OTC securities; are dilutive when issued by the firm itself; tend to have much longer maturities (often years) than equity options (which usually have maturities measured in months); and are not standardized securities.