2026

CFA®

Exam Prep

Schweser's Secret Sauce®

Private Wealth

Level III

KAPLAN SCHWESER

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KAPLAN SCHWESER

Topic Focus: Asset Allocation

SECRET SAUCE

Topic Weight on Exam	15%–20%
SchweserNotes™ Reference	Book 1, Pages 1–138

The Asset Allocation topic area is comprised of the capital market expectations (i.e., economics) readings and the asset allocation readings.

The economics material here is applied in nature and therefore, a big departure from the technical nature of economics testing at Levels I and II even though many of the concepts are the same (e.g., economic growth, monetary and fiscal policy, and international economics). In order to be successful at economics in Level III, you must be able to go beyond the mere technical aspects and be able to apply the concepts (e.g., forecasting). You will find some overlap of material here with behavioral finance, quantitative methods (from Level II), and foreign currency.

Next, we will take a look at mean variance optimization (MVO). You will recognize the basics from Levels I and II, but these readings emphasize the practical pitfalls of MVO and its application in the real world, so the focus is not on the math. Pure mathematical perfection can be misleading when you deal with actual clients. Keep a big picture and practical focus here and avoid the temptation to get buried in every detail.

To formulate capital market expectations, the analyst should use the following seven-step process.

Step 1:	Determine the specific capital market expectations needed according to the investor's tax status, allowable asset classes, and time horizon.
Step 2:	Investigate assets' historical performance as well as the determinants of (i.e., factor affecting) their performance.
Step 3:	Identify the valuation model used and its requirements.
Step 4:	Collect the best data possible.
Step 5:	Use experience and judgment to interpret current investment conditions.
Step 6:	Formulate capital market expectations.
Step 7:	Monitor performance and use it to refine the process.

Problems in Forecasting

Nine problems encountered in producing forecasts are: (1) limitations to using economic data; (2) data measurement error and bias; (3) limitations of historical estimates; (4) the use of ex post risk and return measures; (5) non-repeating data patterns; (6) failing to account for conditioning information; (7) misinterpretation of correlations; (8) psychological biases; and (9) model uncertainty.

Analysts are susceptible to six **psychological biases**:

1. Anchoring bias.
2. Status quo bias.
3. Confirmation bias.
4. Overconfidence bias.
5. Prudence bias.
6. Availability bias.

Trend Rate of Growth

Economic growth trend rates are subject to unexpected surprises or shocks that are exogenous to the economy and cannot be predicted.

Exogenous shocks are caused by numerous factors:

- Changes in government policies.

- Political events.
- Technological progress.
- Natural disasters.
- Discovery of natural resources.
- Financial crises.

Overall, the trend rate of growth is more (less) stable in developed (emerging) economies.

A basic model for forecasting the economic growth rate is the sum of three components:

- Labor input (based on growth in the labor force and labor participation).
- Capital per worker (which increases labor productivity).
- Total factor productivity (which is reflected in technological progress and changes in government policies).

Asset Returns and the Trend Rate of Growth

The trend rate of growth can also provide an estimate for long-term equity returns. The market value of equity can be expressed as the product of three terms: nominal GDP, earnings/GDP (which is the share of profits in the economy), and the P/E ratio.

Over long periods, the share of profits in the economy (earnings/GDP) and the P/E ratio cannot continually increase or decrease; thus, in the long-term, the growth rate of the total value of equity in an economy is linked to the growth rate of GDP.

This applies to the capital appreciation component of equity returns but not the dividend yield. The dividend yield (annual dividends/market value) can be derived from the dividend payout ratio (dividends/profit) divided by the profit multiple (market value/profit).

> Real GDP growth = labor input growth + labor productivity growth
>
> Nominal GDP growth = real GDP growth + inflation
>
> Long-term capital gains in equity markets = %Δ nominal GDP + %Δ profits/GDP + %Δ PE
>
> Long-term total domestic market equity return = capital gains + dividend yield

Market Forecasting

Econometric analysis uses statistical methods to explain economic relationships and formulate forecasting models. Structural models are based on economic theory, while reduced-form models are compact versions of structural approaches.

Economic indicators include leading indicators that move ahead of the business cycle with a reasonably stable lead time. They also include coincident and lagging

indicators that move with and after changes in the business cycle and can be used to confirm what is happening in the economy.

A *checklist approach* is more subjective and considers a series of questions. Judgment and perhaps some statistical modeling is used to interpret the answers and formulate a forecast.

The Business Cycle

Understanding business cycle phases is important for forming capital market expectations, but there are some limitations to business cycle analysis:

- Business cycles vary in duration and intensity, and their turning points are difficult to predict.
- Can be difficult to distinguish which effects result from shorter-term factors that arise from the business cycle and which are related to longer-term factors that affect the trend rate of economic growth.
- Returns in the capital market are strongly related to activity in the real economy, but they also depend on factors such as investors' expectations and risk tolerances.

The longer-term **business cycle** can be subdivided into five phases: the initial recovery, early expansion, late expansion, slowdown, and contraction.

Initial Recovery

- Duration of a few months.
- Business confidence is rising.
- Government stimulation is provided by low interest rates and/or budget deficits.
- Falling inflation.
- Large output gap.
- Low or falling short-term interest rates.
- Bond yields are bottoming out.
- Rising stock prices.
- Cyclical, riskier assets such as small-cap stocks and high yield bonds do well.

Early Expansion

- Duration of a year to several years.
- Increasing growth with low inflation.
- Increasing confidence.
- Rising short-term interest rates.
- Output gap is narrowing.
- Stable or rising bond yields.
- Rising stock prices.

Late Expansion

- High confidence and employment.

- Output gap eliminated and economy at risk of overheating.
- Inflation increases.
- Central bank limits the growth of the money supply.
- Rising short-term interest rates.
- Rising bond yields.
- Rising/peaking stock prices with increased risk and volatility.

Slowdown

- Duration of a few months to a year or longer.
- Declining confidence.
- Inflation is still rising.
- Short-term interest rates are at a peak.
- Bond yields have peaked and may be falling, resulting in rising bond prices.
- Yield curve may invert.
- Falling stock prices.

Contraction

- Duration of 12 to 18 months.
- Declining confidence and profits.
- Increase in unemployment and bankruptcies.
- Inflation tops out.
- Falling short-term interest rates.
- Falling bond yields, rising prices.
- Stock prices increase during the latter stages anticipating the end of the recession.

Inflation

Inflation means generally rising prices and is measured most frequently by consumer price indices. Inflation peaks in the latter stages of economic expansion and falls during a recession and the initial stages of recovery.

A decline in the level of inflation (but not negative inflation) is called *disinflation*.

Deflation refers to generally decreasing prices (i.e., a negative rate of inflation). Such a general decline in prices discourages all economic activity, encourages default on loans, and produces very low or negative interest rates. Following the financial crisis of 2007–09, some central banks adopted quantitative easing (an announced long term policy of wide spread purchase of both shorter- and longer-term financial assets in an effort to stimulate the economy). The detrimental effects of deflation cause central banks to prefer some level of (positive) inflation.

Inflation Expectations and Asset Classes

Inflation within expectations	Cash equivalents: Earn the real rate of interest Bonds: Shorter-term yields more volatile than longer-term yields

	Equity: No impact given predictable economic growth Real estate: Neutral impact with typical rates of return
Inflation above or below expectations	Cash equivalents: Positive (negative) impact with increasing (decreasing) yields Bonds: Longer-term yields more volatile than shorter-term yields Equity: Negative impact given the potential for central bank action or falling asset prices, though some companies may be able to pass rising costs on to customers Real estate: Positive impact as real asset values increase with inflation
Deflation	Cash equivalents: Positive impact if nominal interest rates are bound by 0% Bonds: Positive impact as fixed future cash flows have greater purchasing power (assuming no default on the bonds) Equity: Negative impact as economic activity and business declines Real estate: Negative impact as property values generally decline

Monetary Policy

The latter stages of an economic expansion are often characterized by increased inflation. As a result, central banks usually resort to restrictive policies towards the latter part of an expansion.

To spur growth, a central bank will cut short-term interest rates. This results in greater consumer spending, greater business spending, higher stock prices, and higher bond prices. Lower real interest rates also usually result in a lower value of the domestic currency, which is thought to increase exports. The equilibrium interest rate in a country (the rate that produces a balance between growth and inflation) is referred to as the *neutral rate*.

The Taylor rule determines the target interest rate using the neutral rate, expected GDP relative to its long-term trend, and expected inflation relative to its targeted amount. It can be formalized as follows:

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

Negative Interest Rates

A negative rate is defined as a net payment made to keep money on deposit at a financial institution or payment of a net fee to invest in short-term instruments.

Essentially the implicit advantages of being able to quickly transfer large amounts of money held on deposit to settle transactions outweighed the explicit cost of holding those deposits at negative rates. In other words, negative interest rates did not cause the expected large move into physical cash (which would have a more favorable interest rate at zero percent).

Fiscal Policy

If the government wants to stimulate the economy, it can decrease taxes and/or increase spending, thereby increasing the budget deficit. If they want to rein in growth, the government does the opposite.

There are two important aspects to fiscal policy. First, it is not the level of the budget deficit that matters, it is the change in the deficit. For example, a deficit by itself does not stimulate the economy, but increases in the deficit are required to stimulate the economy. Second, changes in the deficit that occur naturally over the course of the business cycle are not stimulative or restrictive.

The Yield Curve

When both fiscal and monetary policies are simulative, the yield curve is sharply upward sloping (i.e., short-term rates are lower than long-term rates), and the economy is likely to expand in the future.

When fiscal and monetary policies are restrictive, the yield curve is downward sloping (i.e., it is *inverted* as short-term rates are higher than long-term rates), and the economy is likely to contract in the future.

When fiscal and monetary policies are in disagreement, the implications for the economy are less clear.

- If monetary policy is stimulative while fiscal policy is restrictive, the yield curve will be upward sloping, though it will be less steep than when both policies are expansive (i.e., moderately steep).
- If monetary policy is restrictive while fiscal policy is stimulative, the yield curve will be flat.

International Considerations

Macroeconomic links refer to similarities in business cycles across countries. Economies are linked by both international trade and capital flows so that a recession in one country dampens exports and investment in a second country, thereby creating a slowdown in the second country. How the current account influences economic activity can be shown in the following formula:

$$\text{net exports} = \text{net private saving} + \text{government surplus}$$

Another link between economies results from **exchange rates**. A strong link is established when a smaller economy pegs its currency to that of a larger and more developed economy. Interest rates between the two economies will often reflect a risk premium indicating the market's confidence in the peg, with the smaller economy generally having higher interest rates. If confidence is high (low), the interest rate differential will be small (large).

Formal Tools

Statistical methods include sample statistics, shrinkage estimation, and time series estimation.

Discounted cash flow (DCF) models express the intrinsic value of an asset as the present value of future cash flows.

A **risk premium** or build-up model can also be used. The approach starts with a risk-free rate and then adds compensation for priced risks. Such models include equilibrium models, factor models, and building blocks.

Survey and Judgment

Capital market expectations can be formed using **surveys**. In this method, a poll is taken of market participants such as economists and analysts as to what their expectations are regarding the economy or capital market.

Judgment can also be applied to project capital market expectations. Although quantitative models provide objective numerical forecasts, there are times when an analyst must adjust those expectations using their experience and insight to improve upon those forecasts.

Forecasting Fixed Income Returns

DCF Analysis

DCF analysis works well when future cash flows are known or when they can be estimated reasonably accurately. Yield to maturity (YTM) is used as an estimate of expected return.

There is the assumption of holding the bond to maturity, which does not account for optionality, selling a bond prior to maturity, and interest rate changes (that impact bond prices and reinvestment returns). For example, falling (rising) interest rates will decrease (increase) reinvestment returns. For an investment horizon that is shorter than the Macaulay duration, the capital gain/loss impact will be more dominant than the reinvestment impact; therefore, falling (rising) interest rates will result in a higher (lower) realized return.

Risk Premium (Building Block) Approach

The short-term default-free rate matches the forecast horizon and is calculated from the most liquid instrument.

The term premium is driven by four primary factors: (1) inflation levels, (2) the cause of inflation (primarily driven by aggregate demand or supply), (3) supply and demand of short- and long-term default-free bonds, and (4) business cycles.

The credit premium compensates for the expected level of losses and for the risk of default losses, both of which are components of the credit spread. The credit premium for very high quality bonds is mainly driven by downgrade bias; for low(er) rated bonds, there is much more compensation for credit risk. Credit premiums are not positively related to maturity and tend to be higher at shorter maturities due to event risk and illiquidity of older bonds that are not actively traded but have a short time left to maturity.

The liquidity premium tends to be lowest at the earliest stages of a bond's life. The liquidity premium tend to be lower for bonds that are issued at close to par or market rates, new, large in size, issued by a frequent and well-known user, simple in structure, and of high credit quality.

Emerging Market Bond Risk

Key Risks

Emerging market debt offers the investor higher expected returns at the expense of higher risk.

Credit risk is the most significant risk, although economic, political, and legal risks are also important.

Assessing Health of an Emerging Market

Guidelines for bond investors to consider:

- Deficit-to-GDP ratio should be less than 4%; debt-to-GDP ratio should be less than 70%.
- Real growth rate should be at least 4%.
- Current account deficit should be less than 4% of GDP.
- Foreign debt levels should be less than 50% of GDP; debt levels should be less than 200% of the current account receipts.
- Foreign exchange reserves should be at least 100% of short-term debt.

Forecasting Equity Returns

Discounted Cash Flow Models

The advantage of these models is their correct emphasis on the future cash flows of an asset, and the ability to back out a required return. Their disadvantage is that they do not account for current market conditions, so they are viewed as being more suitable for long-term valuation.

The most common discounted cash flow model is the Gordon growth model or constant growth model. It is most useful to value mature markets growing at a constant rate:

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

Grinold and Kroner (2002)[1] take this model one step further by including a variable that adjusts for stock repurchases and changes in market valuations as represented by the price-earnings (P/E) ratio:

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

where:

$E(R_e)$ = expected equity return

D/P = dividend yield

$\%\Delta E$ = expected percentage change in total earnings

$\%\Delta S$ = expected percentage change in shares outstanding

$\%\Delta P/E$ = expected percentage change in the P/E ratio

Risk Premium Approach

To determine the expected return for equities, the analyst would start with the yield to maturity on a long-term government bond and add a single-equity risk premium. In contrast, bonds use a building block approach as discussed earlier.

Equilibrium Approach

The **Singer-Terhaar model** approach begins with the CAPM:

$R_i = R_f + \beta_{i,M} (R_M - R_f)$, or alternatively $RP_i = \beta_{i,M} \times RP_M$

where:

R_i = expected return on asset i

R_f = risk-free rate of return

$\beta_{i,M}$ = sensitivity (systematic risk) of asset i returns to the global investable market

R_M = expected return on the global investable market

RP_i = the asset's risk premium

RP_M = the market's risk premium

We can manipulate this formula to solve for the risk premium for debt or equity. First, consider the formula for beta.

$$\beta_{i,M} = \frac{Cov(R_i, R_M)}{Var(R_M)} = \rho_{i,M} \left(\frac{\sigma_i}{\sigma_M} \right)$$

where:

$\rho_{i,M}$ = correlation between the returns on asset i and the global market portfolio

σ_i = standard deviation of the returns on asset i

σ_M = standard deviation of the returns on the global market portfolio

$\text{Cov}(R_i,R_M)$ = covariance of asset i return with the global market portfolio return

Rearranging the CAPM, we arrive at the expression for the risk premium for asset *i*, RP_i:

$$RP_i = \beta_{i,M} RP_M = \rho_{i,M}\sigma_i \left(\frac{RP_M}{\sigma_M} \right)$$

The Singer-Terhaar model adjusts the CAPM for market imperfections, such as segmentation. When markets are segmented, capital does not flow freely across borders; in integrated markets, capital flows freely. If markets are segmented, two assets with the same risk can have different expected returns because capital cannot flow to the higher return asset. The presence of investment barriers increases the risk premium for securities in segmented markets.

In reality, most markets are neither fully segmented nor fully integrated. To adjust for partial market segmentation, estimate a risk premium assuming full integration and estimate a risk premium assuming full segmentation, and then take a weighted average of the two. Under the full segmentation assumption, the relevant global portfolio is the individual asset as its own market portfolio, meaning that the asset is perfectly correlated with itself.

Calculate the risk premium for asset *i* assuming a fully segmented market:

$$\text{if } \rho_{i,M} = 1 \Rightarrow RP_i^S = \sigma_i \left(\frac{RP_i^S}{\sigma_i} \right)$$

If no local market Sharpe ratio is given, then use the global market Sharpe ratio.

Lastly, take a weighted average of the two risk premiums (calculated under full integration and full segmentation) to calculate the asset's risk premium:

$$RP = \phi RP^G + (1 - \phi) RP^S$$

where ϕ measures the degree of the asset's integration with the global markets, and the superscripts are G (globally integrated) and S (segmented).

Forecasting Real Estate Returns

Real Estate Cycles

Given that supply is fixed at any given point in time, property values exhibit cyclicality, and demand will be strongly influenced by the quality and type of

property available.

Boom is characterized by increased demand driving up property values and lease rates, which induces construction activity.

Bust is characterized by falling demand leading to overcapacity and overbuilding, driving property values and lease rates down.

Capitalization Rates

The **capitalization rate**, or *cap rate*, is the ratio of net operating income (NOI) over the property value.

Assuming an infinite period:

- Cap rate = $E(R_{re})$ − NOI growth rate
- $E(R_{re})$ = cap rate + NOI growth rate

Assuming a finite period:

- $E(R_{re})$ = cap rate + NOI growth rate − %Δcap rate

Risk Premiums on Real Estate

- Term premium for holding long-term assets.
- Credit premium to compensate for the risk of tenant nonpayment.
- Equity risk premium for fluctuations in real estate values, leases, and vacancies.
- Liquidity risk premium to consider the inability of selling the asset quickly at a reasonable price.

Public vs. Private Real Estate

Investors with less wealth can choose publicly traded real estate, including REITs, to benefit from diversification. REITs are generally strongly correlated with equities in the short term and relatively highly correlated with direct real estate over long time horizons.

Because REITs use significant leverage, their returns and risks must be first unlevered to provide the appropriate comparison with direct real estate holdings. There are also significant differences between apartment, office, industrial, and retail classes.

Residential Real Estate Returns

Residential real estate is the largest class of developed properties. Overall, it outperformed equities on an inflation-adjusted basis with lower volatility.

Exchange Rate Forecasting

Trade Flows

The impact of net trade flows (gross trade flows less exports) tend to be relatively small on exchange rates assuming they can be financed.

Purchasing Power Parity (PPP)

PPP states that differences in inflation between two countries will be reflected in changes in the exchange rate between them. Specifically, the country with higher inflation will see their currency value decline.

PPP does not hold in the short term but holds better in the long term and when inflation differences are large and are determined through money supply.

PPP does not consider key items impacting exchange rates such as trade barriers and capital flows.

Current Account

When restrictions are placed on capital flows, exchange rate sensitivity tends to increase relative to the current account (trade) balance. In the absence of a trade imbalance the current account balance should be zero.

A non-zero current account balance (i.e., imbalance) will have the largest influence on exchange rates when they are persistent and sustained. However, it is not the size of the imbalance that matters as much as the length of the imbalance.

Capital Flows

The expected percentage change in the exchange rate can be computed as the difference between nominal short-term interest rates and the risk premiums of the domestic portfolio over the foreign portfolio:

$$E(\%\Delta S_{d/f}) = (r^d - r^f) + (Term^d - Term^f) + (Credit^d - Credit^f) + (Equity^d - Equity^f) + (Liquid^d - Liquid^f)$$

Adjustments to capital flows will place substantial pressure to exchange rates. Consideration must be given to capital mobility, uncovered interest rate parity (UIP), and portfolio balances and compositions.

In terms of capital mobility, when there is an improvement in investment opportunities in a country, the currency initially tends to see significant appreciation but overshoot. Following an extended level of stronger exchange rates in the intermediate term, investors will start to expect a reversal. Then the exchange rate in the long run will tend to start reverting once the investment opportunities have been realized.

UIP states that exchange rates should equal differences in nominal interest rates only and implies that the premium differentials in the above equation do not

matter. In contrast to UIP, **carry trades** involve borrowing in a low-rate currency and lending in a high-rate currency (the rate differences arising from improved investment opportunities in that country, for example). Carry trades have been shown to be successful in the past because they include a risk premium and that is a contradiction to UIP.

Strong economic growth in a country tends to correspond to an increasing share of that country's currency in the global market portfolio. Investors need to be induced (by higher interest rates, for example) to increase their allocations to that country and currency. As described above with capital mobility, that tends to weaken the currency and increase the risk premiums in the long-run. However, there are mitigating factors such as investors tending to have a strong home country bias, which leads them to absorb a larger share of the new assets. If growth is due to productivity gains, investors may fund it with financial flows and foreign direct investment.

Large current account deficits also weaken exchange rates, but if the deficits are due to large investment spending the deficits are easier to finance if the investments are expected to be profitable.

Volatility Forecasting

Variance-Covariance (VCV) Matrix

Estimating a constant VCV matrix can most easily be done from deriving variances and covariances from sample statistics. However, choosing the appropriate sample size for large portfolios will be critical.

The main advantage of using multifactor models for VCV matrices is that it significantly reduces the number of required observations. Correlations can be estimated from a few common factors, while variances require factors related to specific assets. The factor model also helps simplify the number of calculations used in the VCV matrix. However, factor-based VCV matrices are biased in that the inputs need to be estimated and will be misspecified, and they are inconsistent because as the sample size increases, the model does not converge to the true matrix.

Shrinkage Estimates

Combining information in the sample VCV matrix with a target matrix (e.g., factor-based VCV matrix) will result in more precise data and reduced estimation error.

The shrinkage estimate is a weighted average estimate of the sample and target matrix, with the same weights used for all elements of the matrix, including the variance and covariance factors. The resulting figures will be more efficient because they will have smaller error terms.

Smoothed Returns to Estimate Volatility

Analysts should adjust the data for the impact of smoothing (e.g., underestimating risk and overstating returns) by taking a weighted average of the current true returns and previously observed returns.

ARCH Models

Asset returns generally show periods of high and low volatilities, leading to volatility clustering. Those volatilities are addressed through autoregressive conditional heteroskedasticity (ARCH) models.

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[1]Richard Grinold and Kenneth Kroner, "The Equity Risk Premium," *Investment Insights* (Barclay's Global Investors, July 2002).

Effective investment governance models do the following:

- Establish long-term and short-term investment objectives.
- Allocate rights and responsibilities within the governance structure.
- Specify processes for creating an investment policy statement (IPS).
- Specify processes for creating a strategic asset allocation.
- Apply a reporting framework to monitor the investment program's stated goals and objectives.
- Periodically perform a governance audit.

Strategic asset allocation (SAA) combines capital market expectations and the investor's IPS. SAA is long term in nature. Studies have shown that SAA largely explains differences in portfolio returns.

Tactical asset allocation (TAA) involves short-term deviations from the SAA in an attempt to capitalize on capital market disequilibria (mispricing).

An **economic balance sheet** contains an individual's or organization's financial assets and liabilities, as well as any nonfinancial assets and liabilities (**extended portfolio assets and liabilities**) such as human capital and expected future expenditures. While these extended assets and liabilities are more difficult to quantify, their inclusion leads to more comprehensive decision-making.

Asset Allocation Approaches

Asset-only approaches manage the risk and return of the assets. Liabilities are considered only indirectly by setting a return objective sufficient to meet the needs of the client. Basic MVO is a common form of asset-only management. Risk is typically defined as the standard deviation of asset return (or some related concept, such as downside deviation) or deviation from the assigned benchmark.

Liability-relative approaches focus directly on managing assets in relation to quantifiable liabilities. The focus is on managing the expected return and risk of the surplus, where surplus is the present value of assets less the present value of liabilities (S = PVA − PVL). Risk may be defined as shortfall risk (the probability of insufficient assets to meet the liabilities), a need for additional contributions, or volatility of surplus.

Goals-based approaches view the client assets as made up of sub-portfolios, with each sub-portfolio managed in relation to meeting specific client objectives. Risk is the probability of not meeting a goal.

Both liability-relative and goals-based approaches consider client liabilities, but the liability-relative approach is focused on the more objective, quantifiable, and legal obligations of institutions, while the goals-based approach focuses on the more varied situations of individuals.

Asset Classes and the SAA Process

An asset class is a group of assets with similar investment characteristics. Each asset class will carry with it exposure to various risk factors such as equity market risk, interest rates, inflation, or currency. Thus, controlling asset class weights control the portfolio's risk exposures. The criteria for defining an asset class are as follows:

- Assets in an asset class should have similar attributes from both a descriptive and statistical perspective.
- Assets cannot be classified into more than one asset class.
- Asset classes should not be highly correlated to provide desired diversification.
- Asset classes should cover all possible investable assets.
- Asset classes should contain a sufficiently large percentage of liquid assets.

Granularity refers to the number of asset classes into which the world market is subdivided. SAA focuses on a smaller number (lower granularity) of distinctly different classes, such as domestic and international equity and fixed income. TAA may utilize more subdivided asset classes (increasing granularity), such as dividing the equity by market cap and categories such as value, growth, and emerging market. However, excessive granularity runs the risk of creating asset classes that are not distinctly different from each other.

An alternative to this traditional approach to asset allocation by asset class is allocation by risk factor. It assumes that the return of each class is driven by its exposure to underlying risk factors.

Neither the traditional asset class nor risk factor approach has been found to be superior; the choice comes down to how the client and manager choose to think about markets.

The process of determining the SAA for a given investor involves:

- Determining investor objectives, tolerance for risk, time horizon(s), and constraints.
- Selecting the asset allocation approach (from those we've discussed).
- Specifying the asset classes and capital market expectations.
- Developing potential asset allocations.

The **global market portfolio** can be used as a baseline portfolio for asset allocation. By definition, it contains all investable risky assets and, in portfolio theory, eliminates all diversifiable risk. By using it as a starting point, the biases of an individual client (or manager) are mitigated. The weights by asset class can then be tilted to meet the objectives of a given client.

The most passive investors can implement their SAA with broad index funds. More active investors can add TAA decisions at the asset class level and/or actively manage the assets within an asset class.

The inputs for mean variance optimization (MVO) are expected return, standard deviation, and correlations between the asset classes (or risk factors). The optimizer then solves for the efficient frontier (EF) and provides the asset allocation for each point on the EF. The EF is made up of the portfolios with the highest expected return for each level of risk.

MVO is constrained such that the asset allocation weights must sum to 100%. As a practical matter, it is also typically constrained to allow only positive weights. (No short sale positions, as very few portfolios will allow a strategic short position in any one asset class.) Practical constraints specific to a given client's situation, such as minimum or maximum weights, risk, or return, are often added.

Determining which portfolio to select off the EF can be based on several different approaches.

Utility maximization selects the highest risk-adjusted return (utility), where risk adjustment depends on the investor's risk aversion factor (lambda). Clients with higher risk aversion will tend toward the left side of the EF (lower return and risk), while those with less risk aversion tend toward the right. Utility is calculated as:

$$\mathrm{U_m} = \mathrm{E(R_m)} - 0.50 \times \lambda \times \mathrm{Var_m}$$

The 0.50 multiplier requires that expected return and standard deviation be input as decimals (e.g., 10% as 0.10, which will reduce the risk of errors).

Safety first selects the portfolio with the lowest probability of falling below a client-specified minimum acceptable return (MAR). Selecting the highest Roy's safety first (RSF) ratio (from a group of otherwise acceptable portfolios) is one way to implement the safety first approach:

$$\mathrm{RSF} = (\mathrm{R_P} - \mathrm{MAR})/\sigma_\mathrm{P}$$

Another approach to implementing safety first is to select the portfolio with highest expected return minus some agreed-upon number of standard deviations (often two).

Other approaches are to select the portfolio that meets the **required return** or does not exceed an allowable **level of risk**.

There are two approaches to the **risk-free asset** in asset allocation.

- In portfolio theory, the risk-free asset has a known return with, therefore, zero standard deviation and correlation to all other assets. Over a **single**

discrete time period, cash equivalents are likely to meet this definition. That leads to a capital allocation line (CAL) between r_f and the single tangent portfolio (T). Selecting this T from the EF produces the CAL with the highest Sharpe ratio. (Note that the Sharpe ratio is just RSF with r_f used as the MAR.) This CAL is superior to all other points on the EF. Portfolios to the left (right) of T are composed of T and investing in (borrowing at) r_f.

- Over **multiple time periods**, no true risk-free asset exists. Cash equivalents are simply a low-risk asset (but not zero standard deviation) that can be included in the MVO process, like any other asset class. Portfolios are then selected from the resulting EF. Because cash equivalents are handy to meet certain types of liquidity needs, a specific allocation to cash equivalents sufficient to meet client needs may be specified for the asset allocation.

In addition to specifying an allocation to cash equivalents to meet liquidity needs, other practical considerations to consider in applying MVO include:

- Human capital (HC) can be included as an asset class with its weight in the portfolio set by its actual value. In other words, managers cannot tell clients to change the value or nature of their HC. Stable, low-risk HC can be modeled as an inflation-protected bond. Higher-risk HC will have an increasing component of corporate bonds and equity.
- The investor's personal residence (and other assets that are designated to be held) can be treated as a fixed allocation in the portfolio with its investment characteristics based on an index of similar properties (or of the assets).
- Less liquid assets are more difficult to incorporate in the MVO. Reliable investment data is harder to obtain. A liquidity premium may need to be included in the expected return. Diversification within the asset class may be difficult. Three general approaches are possible:
    - Exclude the assets from MVO and simply retain them.
    - Model the assets using the expected characteristics of the investor's specific holdings.
    - Model the assets based on the best available broader asset class data.

Monte Carlo analysis is often used to complement MVO and analyze how an asset allocation mix may perform over time. Assumptions are made regarding the normal or non-normal return distributions of the asset classes. Rules for rebalancing, assumed turnover and taxes, inflation, and spending can be specified. A statistically based process is then applied to randomly vary what can happen by period to the portfolio. This process is repeated, perhaps hundreds of times or more. The results can be ranked from best to worst to quantify probabilities of various outcomes.

Criticisms of MVO and Solutions

It should be apparent that the mathematical elegance of MVO does not mean it is flawless. It is a model, and the output is only as good as the input. Criticisms and solutions to the criticisms are as follows.

Criticisms: MVO tends to produce highly concentrated asset allocations, as the math tends to concentrate the allocation of those asset classes with lower correlation to each other. In addition, the allocations can shift significantly for even modest changes in estimated return by asset class. There are various **solutions** to these two problems:

- **Reverse optimization** is less dependent on initial estimates of return. Correlations, standard deviations, and the weights of asset classes in the world market are used as the starting inputs. MVO is then used to solve for expected return by asset class. (Technically, the process solves for risk premiums.) These market consensus estimates of return are then used to construct the client's allocation.
- **Black-Litterman** starts with the consensus return estimates from reverse optimization. The manager then view adjusts those return estimates up or down and uses their view-adjusted estimates to run MVO and produce the efficient frontier and the associated asset allocations. Because both reverse optimization and Black-Litterman start with market weights, they are less dependent on initial return estimates and tend to include more asset classes in the final portfolios.
- **Resampling** deals directly with the uncertainty of estimating returns. It starts with MVO and the manager's best estimates of return and other inputs. Then the return data is varied up and down. Each variation produces a new EF and set of asset allocations. An average asset allocation for any point on the EF is then computed. By considering multiple possible allocations, the average allocation will be less affected by one more variation in return data and will likely include more asset classes.
- Another approach to broader asset class diversification is to directly constrain the MVO to **minimum and maximum allocations** by asset class.

Criticism: MVO assumes a normal distribution of returns. The **solution to MVO** is to use more sophisticated software that can incorporate other return distribution patterns.

Criticism: Diversification by asset class may not provide diversification by risk source. The **solution** is to use **factor-based allocation**. Sensitivities to risk factors can be determined by multifactor regression of historical asset class returns. Typical risk factors include the market risk premium (from the CAPM), market cap, value versus growth, market momentum versus mean reversion, duration, credit risk, and volatility. Some argue that correlations between risk factors are lower than between asset classes and that allocation by risk factor (rather than by asset class) provides better diversification.

Factor-based long/short portfolios can be used to indirectly invest in the underlying risk factors. For example, long U.S. Treasury bonds and short inflation-indexed bonds would benefit if inflation declines and suffer if inflation increases. The risk premium, standard deviation, and correlations of the risk factors can then be used in MVO to generate an efficient frontier and portfolio allocations by risk factor.

Criticism: MVO is a single-period model that ignores issues such as taxes, transaction costs, and inflation that cumulatively impact the portfolio over time. A related criticism is that standard MVO is assets only and does not consider liabilities. The **solutions** are to directly model the liabilities as part of the MVO and to use MCS to model how the portfolio may perform over time.

Incorporating the liabilities in the MVO is variously referred to as **asset liability management** and **liability-driven** or **liability-relative asset allocation**. The nature of the liabilities and the extent to which they can be quantified affect how appropriate this approach will be. In general, the more essential it is to meet the liabilities, the lower the discount used to determine their present value and the higher their PV. Approaches to liability-relative management include:

- **Surplus optimization:** The characteristics of the liabilities are defined and included in the MVO to generate a surplus efficient frontier. Like any MVO approach, this is a single-period perspective and is suitable for low- to high-risk portfolios.

- **A "two-portfolio" approach:** Sufficient funds are used to fully fund a portfolio of assets that best mimic the characteristics of the liabilities. This **mimicking portfolio** will closely track the liabilities and maximize the chance of meeting the future payout. Any remaining assets are allocated to a **return-seeking portfolio** and managed to maximize value added. A more aggressive variation on this approach may underfund the mimicking portfolio and allocate more funds to return seeking but monitor the total surplus and shift more funds to mimicking if the surplus deteriorates.

  Like any MVO approach, this is a single-period perspective. It is more suited to lower-risk portfolios.

- **Integrated asset-liability approach:** This is a more complex approach that assumes the client (typically an institution, such as a bank or insurance company) can simultaneously alter the characteristics of the assets and liabilities. It uses more complex modeling that can incorporate a multi-period perspective as well as linear and nonlinear relationships. It is suitable for low- to high-risk portfolios.

Liability-relative approaches are more suited to institutions with definable, quantifiable liabilities. A **goals-based** approach considers the liabilities but is more suited to individuals who tend to have multiple goals. Goals are first analyzed to determine a time horizon when the goal must be met and the required probability of success (meeting the goal).

Managers who use a goals-based approach may also use standard investment modules (sub-portfolios) that meet the typical goals of their clients. The manager can allocate funds to the appropriate module for each goal, and the total portfolio allocation is simply a result of the allocations within the modules. The appropriate module is the one that has the highest return at the acceptable probability of success over the required time horizon of the goal.