ANSWERS TO STUDY QUESTIONS

Chapter 22

22.1. Equilibrium asset pricing models are simplified representation of how the capital market perceives and prices risk (or other attributes of concern to investors) in the assets that are traded in the market. They are thus models of the *ex ante* risk premium required by investors. This means they can in principle be used to help forecast future long-run average returns. APMs have at least three major practical uses: tactically, to help find mis-priced assets or asset classes to guide short to medium term buy/sell decisions; strategically, to identify asset classes or types (or "styles") of investments that are appealing (or unappealing) in the long run to the investor based on long-run expected risk and return characteristics in relation to the investor's preferences; and finally, equilibrium asset price models provide a rigorous way to quantitatively adjust realized investment performance (*ex post* returns) for the amount of risk the investment was exposed to, based on the pricing of such risk in the capital market.

22.3. Beta is a "normalized" measure of risk because it is normalized to have a value of unity (1.0) for the capital investment market as a whole. The way a given investment asset actually affects the risk of a portfolio is based on the covariance of the asset with the portfolio. Hence, it is the covariance of an asset with the market that actually measures its risk in the asset marketplace. By dividing this covariance by the market's risk (variance), which is the definition of "beta," we measure asset risk relative to the market as a whole or (equivalently), relative to the risk of the "average" asset in the market.

22.5. The CAPM might in principle be applied either at the broad mixed-asset portfolio level across asset classes of which real estate is one, or it might be applied at a more granular level within the real estate asset class.

22.7. It is difficult to observe or know what are correct or reliable expectations about the risks (covariances or betas) of the assets, and therefore not everyone holds the same expectations about what those are, which is a tenet of the CAPM. Also, investors may care about more than just the volatility of their portfolio returns, for example, they may care about liquidity.

22.9. We would expect the sign of the market risk factor to be positive (requiring additional expected return), and that of the inflation risk factor to be negative (requiring less return, hence, a premium in asset price). Investors don't like market risk because it can't be diversified away and hence affects their wealth risk; thus, they discount the price they pay for assets with high market risk (positive expected return component). In contrast, investors like their wealth to be protected against inflation.

*22.11.

CAPM-Based Risk and Return Expectations

	Stocks	Bonds	Real Estate
Expected return ($E[r]$)	14.6%	8.6%	6.8%
Volatility	20.0%	10.0%	8.0%
Correlation with:			
Stocks	100.0%	60.0%	30.0%
Bonds		100.0%	−10.0%
Real Estate			100.0%

Based on the given data, the covariance table for the three asset classes is calculated as follows:

0.04	0.012	0.0048
0.012	0.01	−0.0008
0.0048	−0.0008	0.0064

(e.g., the real estate and stock covariance is 0.0048 = [0.3][0.08][0.2].)

The weighted covariance table is just $(1/3)^2$ times each of these values:

0.004444	0.001333333	0.000533333
0.001333	0.001111111	−0.000088889
0.000533	−0.000088889	0.000711111

The market portfolio variance is the sum over all nine of the above cells, equal to 0.009822.

The individual asset class covariances with the market portfolio are found as (1/3) times the sum of the individual covariances. For example, for stocks:

$$COV(r_S, r_M) = (1/3)\,(0.04 + 0.012 + 0.0048) = 0.018933$$

Similarly for bonds:

$$COV(r_B, r_M) = (1/3)\,(0.012 + 0.01 - 0.0008) = 0.007067$$

And for real estate:

$$COV(r_{RE}, r_M) = (1/3) + (0.0048 - 0.0008 + 0.0064) = 0.003467$$

Thus, the national wealth betas are

$$BETA(Stocks) = 0.018933/0.0098922 = 1.9276$$
$$BETA(Bonds) = 0.007067/0.0098922 = 0.7195$$
$$BETA(Real\ Estate) = 0.003467/0.0098922 = 0.3529$$

Given that the market portfolio has a 10% return, and the risk-free rate is 5%, the market price of risk (RP_M) is thus 5% ($E[r_M] - r_f = 10\% - 5\%$). Thus, the expected returns for each asset class, according to the CAPM are

$$\text{Stocks: } E[r_S] = r_f + \beta_S RP_M = 5\% + (1.9276)(5\%) = 5\% + 9.6\% = 14.6\%$$
$$\text{Bonds: } E[r_B] = r_f + \beta_B RP_M = 5\% + (0.7195)(5\%) = 5\% + 3.6\% = 8.6\%$$
$$\text{Real Estate: } E[r_{RE}] = r_f + \beta_{RE} RP_M = 5\% + (0.3529)(5\%) = 5\% + 1.8\% = 6.8\%$$