RISK AND RETURN

In evaluating investments, risk and return should be evaluated since they are important in decision making. You may have learnt of the tradeoff between risk and return i.e. the higher the risk, the higher the expected return, and vice versa.

Risk

Whenever you make a financing or investment decision, there is some uncertainty about the outcome. Uncertainty means not knowing exactly what will happen in the future. The greater the uncertainty, the greater the risk. Risk is the degree of uncertainty. Types of risks are discussed below

1. ***Cash flow risk*** *is the risk that the cash flows of an investment will not materialize as expected. For any investment, the risk that cash flows may not be as expected—in timing, amount, or both—is related to the investment's business risk.*
   - ***Business Risk****: **Business risk** is the risk associated with operating cash flows. Operating cash flows are not certain because the revenues and expenditures comprising the cash flows are also not certain.*
     - ✓ ***Revenues:*** *depending on economic conditions and the actions of competitors, prices or quantity of sales (or both) may be different from what is expected. This is **sales risk**.*
     - ✓ ***Expenditures:*** *operating costs are comprised of fixed costs and variable costs. The greater the fixed component of operating costs, the less easily a company can adjust its operating costs to changes in sales. The risk that comes about from the mix of fixed and variable costs is known as **operating risk**. The greater the fixed operating costs relative to variable operating costs, the greater the operating risk.*

- ***Financial risk*** *is the risk associated with how a company finances its operations. If a company finances with debt (Bonds), it is legally obligated to pay the amounts comprising its debts when due. By taking on fixed obligations, such as debt and long-term leases, the company increases its financial risk. If a company finances its business with equity, either generated from operations (retained earnings) or from issuing new equity, it does not incur fixed obligations and thus lowers its financial risk. Therefore, cash flow risk of a security includes both its business risk and its financial risk.*

- ***Default Risk***
  *When you invest in a bond, you expect interest to be paid (usually semiannually) and the principal to be paid at the maturity date. However, the more burdened a firm is with debt—required interest and principal payments— the more likely it is that payments promised to bondholders will not be made and that there will be nothing left for the owners. We refer to the cash flow risk of a debt security as **default risk** or **credit risk**. Technically, default risk on a debt security depends on the specific obligations comprising the debt. Default may result from:*
  - ■ *Failure to make an interest payment when promised (or within a specified period).*
  - ■ *Failure to make the principal payment as promised.*

■ *Failure to make sinking fund payments (that is, amounts set aside to pay off the obligation), if these payments are required.*
■ *Failure to meet any other condition of the loan.*
■ *Bankruptcy.*

Why do financial managers need to worry about default risk? Because they invest their firm's funds in the debt securities of other firms; because they are concerned about how investors perceive the risk of their own debt securities; and because the greater the perceived default risk of a firm's securities, the greater the firm's cost of financing.

2. Reinvestment Rate Risk

Another type of risk is the uncertainty associated with reinvesting cash flows, not surprisingly called ***reinvestment rate risk****.*

3. Interest Rate Risk

Interest rate risk *is the sensitivity of the change in an asset's value to changes in market interest rates. You should remember that market interest rates determine the rate we must use to discount a future value to a present value. The value of any investment depends on the rate used to discount its cash flows to the present. If the discount rate changes, the investment's value changes. Suppose you buy a Kenya Government Treasury bond that matures in five years. There is no default risk, since the government could simply print more money to pay the interest and principal. Does this mean there is no risk when you own a Treasury bond? No. You need to do something with the interest payments as you receive them and the principal amount when it matures. You could stuff them under your mattress, reinvest in another Treasury bond, or invest them otherwise. If yields have been falling, however, you cannot reinvest the interest payments from the bond and get the same return you are getting on the bond. When your Treasury bond matures, you face reinvestment risk.*

4. Purchasing Power Risk

Purchasing power risk *is the risk that the price level may increase unexpectedly. If a firm locks in a price on your supply of raw materials through a long-term contract and the price level increases, it benefits from the change in the price level and your supplier loses—the firm pays the supplier in cheaper currency. If a firm borrows funds by issuing a long-term bond with a fixed coupon rate and the price level increases, the firm benefits from an increase in the price level and its creditor is harmed since interest and the principal are repaid in a cheaper currency.*

5. Currency Risk

Currency risk is the risk that the relative values of the domestic and foreign currencies will change in the future, changing the value of the future cash flows. As financial managers, we need to consider currency risk in our investment decisions that involve other currencies and make sure that the returns on these investments are sufficient compensation for the risk of changing values of currencies.

Suppose you are evaluating the investment in a new product. You do not know and cannot know precisely what the future cash flows will be. But from past experience, you can at least get an idea of possible cash flows and the likelihood—the probability—they will occur.

SCENARIO	*CASH FLOW Ksh.*	*PROBABILITY OF CASH FLOW*
Product success	*4,000,000.00*	*40%*
Product flop	*–2,000,000.00*	*60%*

But what is the expected cash flow in the first year? The expected cash flow is the average of the possible cash flows, weighted by their probabilities of occurring:

Expected cash flow = 0.40(Ksh. 4,000,000) + 0.60(–Ksh. 2,000,000) = Ksh. 400,000.00 A general formula for expected value is:

Expected value=E(x) =p1x1+p2x2+p3x3+..... + pnxn +..... + pNxN, where
E(x) = the expected value
n = possible outcome
N = number of possible outcomes
pn = probability of the nth outcome
xn = value of the nth outcome

Example 2
The table below shows the returns expected from two products under different scenarios. Compute the expected return and risk.

	Probability	*Return*
Product A		
Success	*25*	*24*
Moderate Success	*50*	*10*
Failure	*25*	*-4*
Product B		
Success	*10*	*40*
Moderate Success	*30*	*30*

Measure of risk that does tell us something about how much to expect and the probability that it will happen is the standard deviation. The ***standard deviation*** *is a measure of dispersion that considers the values and probabilities for each possible outcome. The larger the standard deviation, the greater the dispersion of possible outcomes from the expected value. The standard deviation considers the distance (deviation) of each possible outcome from the expected value and the probability associated with that distance:*

Standard deviation of possible outcomes is given by:

$$\sqrt[2]{\sum_{n=1}^{N} Pn(x - E(X))^2}$$

Compute and fill the table below. As an investor, which of the 2 products would you choose? Why. Distinguish between the following investors- Risk neutral, risk averse, and risk preference.

	Expected return	*Standard Deviation*
Product A	*10%*	*9.9%*
Product B	*10%*	*18.57%*

RETURN AND THE TOLERANCE FOR BEARING RISK

Investors may fall into one of the following three categories:

- *Risk averse investors: These are investors who do not like risk- i.e. given two investments, they would choose the one with less risk for a given level of returns- like in the example above, most investors would choose product A to B. This is not to mean, however that risk averse investors cannot take risk. It means they will take more risk only when they feel that they are adequately compensated for it.*
- *Risk neutral investors are indifferent towards risk- they do not need additional compensation to bear more risk. In the above example, a risk neutral investor would choose either of asset A or B.*
- *A risk preference person likes risk—someone even willing to pay to take on risk. Are there such people? Yes. Consider people who play the lotteries (SMS), where the expected value is always negative: The expected value of the winnings is less than the cost of the lottery ticket/SMS.*

In evaluating investments, we assume that investors are risk averse, and that risk is something bad that ought to be avoided. Additional risk is to be taken only if there is adequate compensation in terms of higher returns.

This is the basis of the risk-return tradeoff- ***the higher the risk, the higher the expected return.***

EXPECTED RETURN, RISK AND DIVERSIFICATION

Businesses will rarely consider investing in one project at a time. Consider a roadside kiosk- the proprietor will rarely stock one product (say cigarettes), but rather in a collection of products (Cigarettes, soap, soft drinks e.t.c.). A bigger business will also have a collection of assets- buildings, inventory, stocks and bonds, e.t.c. A collection of investments is referred to as a portfolio. In any portfolio, one investment may do well while another does poorly. The projects' cash flows may be "out of sync" with one another. Diversification helps an investor to avoid ***putting all eggs in one basket,*** *just in case that particular basket gets torn! The investment in assets whose returns are out of step with one another is the whole idea behind diversification. Diversification is the combination of assets whose returns do not vary with one another in the same direction at the same time. Diversification is a way of reducing risk. Which is the other way of reducing risk?*

Expected return of a portfolio

In the example above, suppose you had Ksh. 20,000.00 and you decide to invest the cash in asset A and asset B as follows:

- *All the Ksh. 20,000 in asset B*

- *Ksh. 5000 in asset A, and Ksh. 15,000 in asset B*
- *Ksh. 10,000 in asset A and Ksh. 10,000 in asset B.*
- *Ksh. 15,000 in asset A and Ksh. 5000 in asset B*
- *All the Ksh. 20,000 in asset A*

What is the expected return from the portfolio in each case? The expected return from a portfolio is simply the weighted average of the returns of each asset in the portfolio. The weights used are the proportions of cash placed in each asset.

E(Rp) = W. E(Ra) + Wb. E(Rb) + ……. + Wn. E(Rn)

In the case above;

- *E(Rp)= (0%*10) + (100%*10) =*
- *E(Rp)= (25%*10) + (75%*10) =*
- *E(Rp)= (50%*10) + (50%*10) =*
- *E(Rp)= (75%*10) + (25%*10) =*
- *E(Rp)= (0%*10) + (100%*10) =*

Example 1

You have Ksh. 10,000 that you wish to invest. After surveying the market, you choose to put your money in Savings Development Bonds (SDBs) of the Government of Kenya that have a coupon of 12%, and in shares that have an expected return of 15%. What would be your expected return if:

- *You invest 90% of your cash in SDBs and 10% in shares?*
- *You invest 60% of your cash in SDBs and 40% in shares?*
- *You invest Ksh. 7,000 of your cash in SDBs and the remainder in shares?*

Risk of a portfolio (2 asset portfolio)

Unlike the expected return, the risk of a portfolio is NOT merely the weighted average of the risks of the securities in the portfolio! The formula below summarizes how to calculate risk (Variance) of a portfolio

$$wa^2 б a^2 + wa^2 б a^2 + 2wawbCov(ab)$$

Where: wa *is the weight of asset A in the portfolio*

$wbis\ the\ weight\ of\ asset\ B\ in\ the\ portfolio$

Бa *Is the standard deviation of returns of asset A*

Бb *Is the standard deviation of returns of asset B*

Pab *Is the correlation coefficient between the returns of asset A and asset B*

NB: *to get the standard deviation, you take the square root of the variance*

Computing the correlation coefficient

The correlation coefficient is a standardized measure of the degree of relationship between the returns of two assets. It is the tendency for two or more sets of data—in our case returns—to vary together. It will always fall between +1 and -1.

- *A correlation coefficient of +1 indicates a perfect, positive correlation between the two assets' returns.*
- *A correlation coefficient of –1 indicates a perfect, negative correlation between the two assets' returns.*
- *A correlation coefficient of 0 indicates no correlation between the two assets' returns.*
- *A correlation coefficients falling between 0 and +1 indicates positive, but not perfect positive correlation between the two assets' returns.*
- *A correlation coefficient falling between –1 and 0 indicates negative, but not perfect negative correlation between the two assets' returns.*

The correlation coefficient is computed as follows:

$$\rho ab = \frac{Cov(a,b)}{\text{б}a * \text{б}b}$$

Where Cov (a,b) is the covariance of returns between asset A and B.

And so, how do you compute covariance?

Take the following example of probability distributions of returns for asset A and asset B.

Probability	*Return on asset A (%)*	*Return on asset B (%)*
0.2	*8*	*17*
0.1	*10*	*13*
0.3	*12*	*9*
0.05	*13*	*12*
0.02	*10*	*12*
0.3	*11*	*8*
0.03	*15*	*6*

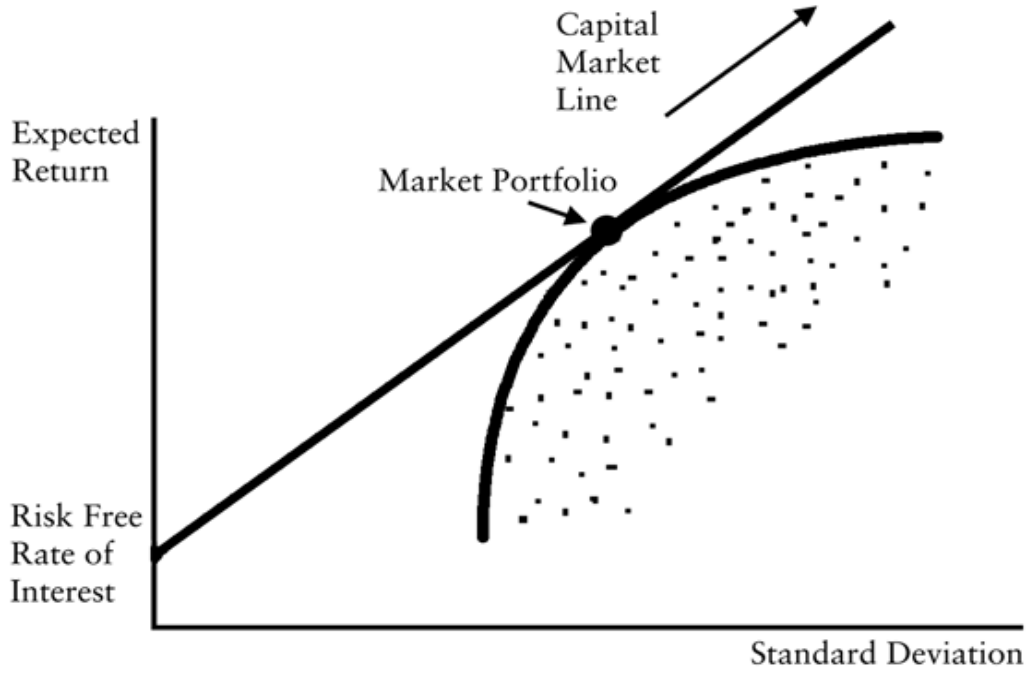
REQUIRED:

i. The expected return of asset A and of asset B.
ii. The variance and standard deviations of returns for assets A and B.
iii. The covariance of returns between asset A and B.
iv. The expected return and standard deviation of returns if you invested in a portfolio comprised of:
- *All in asset B*
- *20% of asset A and 80% of asset B.*
- *40% of asset A and 60% of asset B.*
- *60% of asset A and 40% of asset B*
- *80% of asset A and 20% of asset B*
- *All in asset A.*

CAPITAL ASSET PRICING MODEL

William Sharpe took the idea that portfolio return and risk are the only elements to consider and developed a model that deals with how assets are priced. This model is referred to as the ***capital asset pricing model (CAPM****).*
All the assets in each portfolio, even on the frontier, have some risk. Now let's see what happens when we add an asset with no risk—referred to as the risk-free asset. Suppose we have a portfolio along the efficient frontier that has a return of 4% and a standard deviation of 3%. Suppose we introduce into this portfolio the risk-free asset, which has an expected return of 2% and, by definition, a standard deviation of zero. If the risk-free asset's expected return is certain, there is no covariance between the risky portfolio's returns and the returns of the risk-free asset. A portfolio comprised of 50% of the risky portfolio and 50% of the risk-free asset has an expected return of (0.50)4% + (0.50)2% = 3%. What is the portfolio standard deviation? Compute. 0.0866.

If we look at all possible combinations of portfolios along the efficient frontier and the risk-free asset, we see that the best portfolios are no longer those along the entire length of the efficient frontier; rather, the best portfolios are now the combinations of the risk-free asset and one— and only one—portfolio of risky assets on the frontier. The portfolios comprised of the risk-free asset and this one risky portfolio are shown in Exhibit 10.8. These portfolios differ from one another by the proportion invested in the risk-free asset; as less is invested in the risk-free asset, both the portfolio's expected return and standard deviation increase.



Sharpe demonstrates that this one and only one portfolio of risky assets is the ***market portfolio****—a portfolio that consists of all assets, with the weights of these assets being the ratio of their market value to the total market value of all assets.*

If investors are all risk averse—they only take on risk if there is adequate compensation—and if they are free to invest in the risky assets as well as the risk-free asset, the best deals lie along the line that is tangent to the efficient frontier. This line is referred to as the ***capital market line (CML)****. If the portfolios along the capital market line are the best deals and are available to all investors, it follows that the returns of these risky assets will be priced to compensate investors for the risk they bear relative to that of the market portfolio. Since the portfolios along the capital market line are the best deals, they are as diversified as they can get—no other combination of risky assets or risk-free asset provides a better expected return for the level of risk or provides a lower risk for the level of expected return.*

The CML specifies the returns an investor can expect for a given level of risk. The CAPM uses this relationship between expected return and risk to describe how assets are priced. The CAPM specifies that the return on any asset is a function of the return on a risk-free asset plus a risk premium. The return on the risk free asset is compensation for the time value of money. The ***risk premium*** *is the compensation for bearing risk. Putting these components of return together, the CAPM says:*

Expected return on an asset = Expected return on a risk-free asset + Risk premium

The market portfolio therefore represents the most well-diversified portfolio—the portfolio that consists of all the assets in a market. The only risk in a portfolio comprising all assets is nondiversifiable risk. As far as diversification goes, the market portfolio is the best you can do, because you have included everything in it.

Thus, if we assume that investors hold well-diversified portfolios (approximating the market portfolio), the only risk they have is nondiversifiable risk. If assets are priced to compensate for the risk of assets and if the only risk in your portfolio is nondiversifiable risk, then it follows that compensation for risk applies to only nondiversifiable risk. Let's refer to this nondiversifiable risk as ***market risk****.*

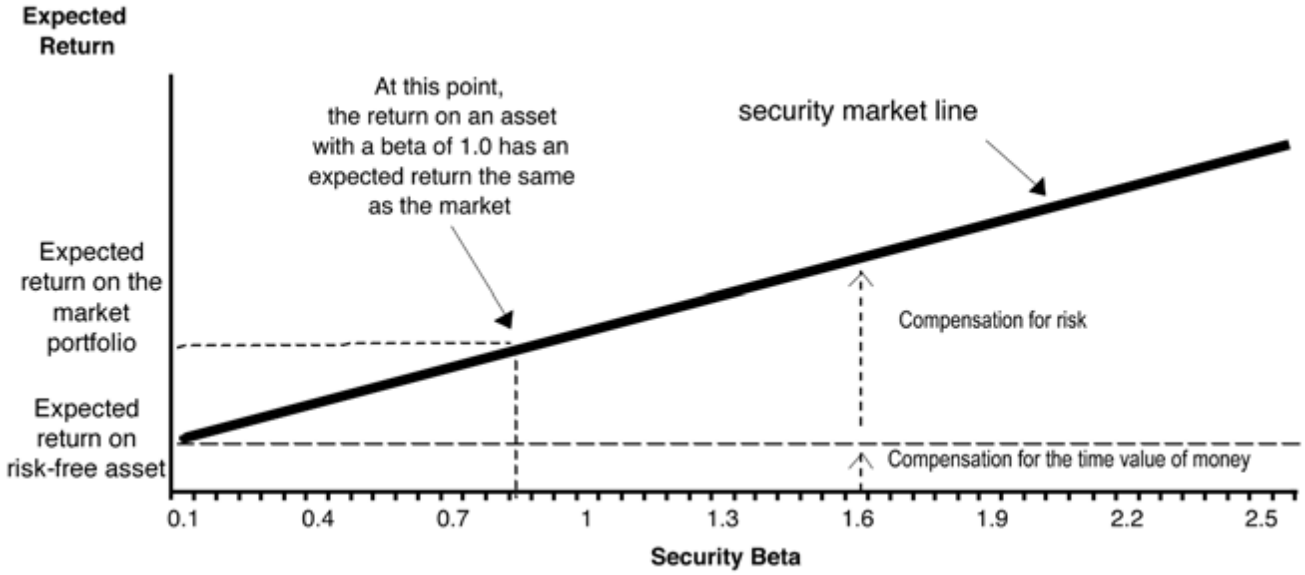
Because the market portfolio is made up of all assets, each asset possesses some degree of market risk. Since market risk is systematic across assets, it is often referred to as ***systematic risk****, and diversifiable risk is referred to as* ***unsystematic risk****. Further, the risk that is not associated with the market as a whole is often referred to as* ***company-specific risk*** *when referring to stocks, since it is risk that is specific to the company's own situation—such as the risk of lawsuits and labor strikes—and is not part of the risk that pervades all securities. The measure of an asset's return sensitivity to the market's return, its market risk, is referred to as that asset's* ***beta, ß****.*

The expected return on an individual asset is the sum of the expected return on the risk-free asset and the premium for bearing market risk. Let ri represent the expected return on asset i, rf represent the expected return on the risk-free asset, rm represent the expected return on the market, and Bi represent the degree of market risk for asset i. Then:

Rj= rm+Bi (rm-rf)

The term (rm – rf), is the market risk premium—if you owned all the assets in the market portfolio, you would expect to be compensated (rm – rf) for bearing the risk of these assets. B is measure of market risk, which serves to fine-tune the risk premium for the individual asset. For example, if the market risk premium were 2% and the B for an individual asset were 1.5, you would expect to receive a risk premium of 3% since you are taking on 50% more risk than the market. For each asset there is a beta. If we represent the expected return on each asset and its beta as a point on a graph and connect all the points. the result is the ***security market line (SML)****, as shown in Exhibit 10.9. As you can see in the figure:*
1. the greater the B, the greater the expected return.
2. If there were no market risk (beta = 0.0) on an asset, its expected return would be the expected return on the risk-free asset.
3. If the asset's risk is similar to the risk of the market as a whole (beta = 1.0), that asset's expected return is the return on the market portfolio.

EXHIBIT 10.9 ***Security Market Line that Describes the Relation Between Expected Asset Returns and Beta***



We can get a good idea of the portfolio's market risk by using a beta that represents the composition of the assets in the portfolio. To determine the portfolio's beta, we need to know the weighted average of the betas of the assets that make up the portfolio, where each weight is the proportion invested in each asset. Let Bp indicate the beta of the portfolio, wi indicate the proportion invested in each the asset i, and βi indicate the beta for asset i. If there are S assets in the portfolio, then:

Bp = w1B1+w2B2+w3B3+.....+wSBS

Limitations of the CAPM

As we have seen, the CAPM allows us to focus on the risk that is important in asset pricing—market risk. However, there are some drawbacks to applying the CAPM.

1. A beta is an estimate. For stocks, the beta is typically estimated using historical returns. But the estimate for beta depends on the method and period in which is it is measured. For assets other than stocks, beta estimation is more difficult.

2. The CAPM includes some unrealistic assumptions. For example, it assumes that all investors can borrow and lend at the same rate.

3. The CAPM is really not testable. The market portfolio is theoretical and not really observable, so we cannot test the relation between the expected return on an asset and the expected return of the market to see if the relation specified in the CAPM holds.

4. In studies of the CAPM applied to common stocks, the CAPM does not explain the differences in returns for securities that differ over time, differ on the basis of dividend yield, and differ on the basis of the market value of equity (the so called "size effect").