

## Asset

In business and accounting by **asset** is meant economic resources controlled by an entity as a result of *past* transactions or events and from which future economic benefits may be obtained.

### *Asset characteristics*

Assets have three essential characteristics:

- They embody a future benefit that involves a capacity, singly or in combination with other assets, in the case of profit oriented enterprises, to contribute directly or indirectly to future net cash flows, and, in the case of not-for-profit organizations, to provide services;
- The entity can control access to the benefit; and,
- The transaction or event giving rise to the entity's right to, or control of, the benefit has already occurred.

It is not necessary, in the financial accounting sense of the term, for control of access to the benefit to be legally enforceable for a resource to be an asset, provided the entity can control its use by other means.

It is important to understand that in an accounting sense an asset is not the same as ownership. In accounting, ownership is described by the term "equity," (see the related term shareholders' equity). Assets are equal to "equity" plus "liabilities."

The accounting equation relates assets, liabilities, and owner's equity:

$$\text{Assets} = \text{Liabilities} + \text{Owners' Equity},$$

The accounting equation is the mathematical structure of the balance sheet.

Assets are usually listed on the balance sheet. It has a normal balance, or usual balance, of debit (i.e., asset account amounts appear on the left side of a ledger).

Similarly, in economics an asset is any form in which wealth can be held.

Probably the most accepted accounting definition of **asset** is the one used by the International Accounting Standards Board <sup>[1]</sup>. The following is a quotation from the IFRS Framework: "An asset is a resource controlled by the enterprise as a result of past events and from which future economic benefits are expected to flow to the enterprise."

Assets are formally controlled and managed within larger organizations via the use of asset tracking tools. These monitor the purchasing, upgrading, servicing, licensing, disposal etc., of both physical and non-physical assets.

### *Classification of assets*

Assets may be classified in many ways. In a company's balance sheet certain divisions are required by generally accepted accounting principles (GAAP), which vary from country to country.

### **US GAAP**

U.S. Generally Accepted Accounting Principles (GAAP) are currently promulgated and codified by the Financial Accounting Standards Board (FASB) at the pleasure of the Securities and Exchange Commission (SEC)<sup>[4]</sup>, the government body authorized by the Securities Acts of 1933 and 1934 to prescribe accounting principles to be employed in public financial transactions.

Under US GAAP, the fundamental definition of an asset is as follows: "Assets are probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events."

The following is an example of classification according to US GAAP.

### **Current assets**

Current assets are cash and other assets expected to be converted to cash, sold, or consumed either in a year or in the operating cycle. These assets are continually turned over in the course of a business during normal business activity. There are 5 major items included into current assets:

1. **Cash** - it is the most liquid asset, which includes currency, deposit accounts, and negotiable instruments (e.g., money orders, checks, bank drafts).

2. **Short-term investments** - include securities bought and held for sale in the near future to generate income on short-term price differences (trading securities).
3. **Receivables** - usually reported as net of allowance for uncollectible accounts.
4. **Inventory** - trading these assets is a normal business of a company. The inventory value reported on the balance sheet is usually the historical cost or fair market value, whichever is lower. This is known as the "lower of cost or market" rule.
5. **Prepaid expenses** - these are expenses paid in cash and recorded as assets before they are used or consumed (a common example is insurance). See also adjusting entries.

The phrase *net current assets* (also called *working capital*) is often used and refers to the total of current assets less the total of current liabilities.

### **Long-term investments**

Often referred to simply as "investments." Long-term investments are to be held for many years and are not intended to be disposed in the near future. This group usually consists of four types of investments:

1. Investments in securities, such as bonds, common stock, or long-term notes.
2. Investments in fixed assets not used in operations (e.g., land held for sale).
3. Investments in special funds (e.g., sinking funds or pension funds).
4. Investments in subsidiaries or affiliated companies.

Different forms of insurance may also be treated as long term investments.

### **Fixed assets**

Also referred to as PPE (property, plant, and equipment), or tangible assets, these are purchased for continued and long-term use in earning profit in a business. This group includes land, buildings, machinery, furniture, tools, and certain wasting resources e.g., timberland and minerals. They are written off against profits over their anticipated life by charging depreciation expenses (with exception of land). Accumulated depreciation is shown in the face of the balance sheet or in the notes.

These are also called capital assets in management accounting.

## **Intangible assets**

Intangible assets lack physical substance and usually are very hard to evaluate. They include patents, copyrights, franchises, goodwill, trademarks, trade names, etc. These assets are (according to US GAAP) amortized to expense over 5 to 40 years with the exception of goodwill.

Some assets such as websites are treated differently in different countries and may fall under either tangible or intangible assets.

## **Other assets**

This section includes a high variety of assets, most commonly:

- long-term prepaid expenses
- long-term receivables
- intangible assets (if they represent just a very small fraction of total assets)
- property held for sale.

In a lot of cases this section is too general and broad, because assets could be classified into four above categories.

## **Valuation (finance)**

In finance, **valuation** is the process of estimating the market value of a financial asset or liability. Valuations can be done on assets (for example, investments in marketable securities such as stocks, options, business enterprises, or intangible assets such as patents and trademarks) or on liabilities (e.g., Bonds issued by a company). Valuations are required in many contexts including investment analysis, capital budgeting, merger and acquisition transactions, financial reporting, taxable events to determine the proper tax liability, and in litigation

### ***Asset valuation***

Valuation of financial assets is done using one or more of these types of models:

1. Relative value models determine the value based on the market prices of similar assets.
2. Absolute value models determine the value by estimating the expected future earnings from owning the asset discounted to their present value.

3. Option pricing models are used for certain types of financial assets (e.g., warrants, put options, call options, employee stock options, investments with embedded options such as a callable bond) and are a complex present value model. The most common option pricing models are the Black-Scholes-Merton models and lattice models.

Common terms for the value of an asset or liability are fair market value, fair value, and intrinsic value. The meanings of these terms differ. The most common term is fair market value defined as the cash price an item would sell for between a willing buyer and willing seller assuming they both have knowledge of the relevant facts and they have no compulsion to buy or sell. Fair value is used in different contexts and has multiple meanings. Some people use the term to mean the same thing as fair market value. Fair value is also a term used in accounting and law. It is used in generally accepted accounting principles (GAAP) for financial reporting and in law in shareholder rights legal statutes. In these cases, fair value is defined in the accounting literature or the law, respectively. Fair value may be different from fair market value in the accounting and legal contexts. Intrinsic value is an asset's true value regardless of the market price. When an analyst determines a stock's intrinsic value is greater than its market price, the analyst issues a "buy" recommendation and vice versa. The determination of intrinsic value may be subject to personal opinion and vary among individual analysts.

### ***Business valuation***

Businesses or fractional interests in businesses may be valued for various purposes such as mergers and acquisitions, sale of securities, and taxable events. An accurate valuation of privately owned companies largely depends on the reliability of the company's financial information. Public company financial statements are audited by Certified Public Accountants (US), Chartered Certified Accountants (ACCA) or Chartered Accountants (UK and Canada) and overseen by a government regulator. Private companies do not have government oversight and are generally not required to have their financial statements audited. Private company financial statements are commonly prepared to minimize taxes by lowering taxable income and the financial information may not be accurate. Public companies tend to want higher earnings to increase their share prices. Inaccurate financial information can lead to over- and undervaluation. In an acquisition, due diligence is commonly performed by the buyer to validate the representations made by the seller.

Financial statements prepared in accordance with generally accepted accounting principles (GAAP) usually express the values of the assets at their costs rather than their higher market values. For example, the balance sheet would reflect a piece of land at the purchase price rather than its appreciated value. Certain types of assets and liabilities such as securities held for sale will be reflected at their market values rather than their costs so that the company's financial information is more meaningful. This process is called "mark-to-market" but is subject to manager bias who may be compensated more with higher values. An extreme example of a company taking advantage of mark-to-market accounting to pump their own share price was Enron.

## **Business valuation methods**

### **Discounted cash flows method**

A method for determining the current value of a company using future cash flows adjusted for time value. The future cash flow set is made up of cash flows within the determined forecast period and a continuing value that represents the cash flow stream after the forecast period.

### **Multiples method**

A method for determining the current value of a company by using a sample of ratios from comparable peer groups. The specific ratio to be used depends on the objective of the valuation. The valuation could be designed to estimate the value of the operation of the business or the value of the equity of the business. When calculating the value of the operation the most commonly used ratio is the EBITDA multiple, which is the ratio of EBITDA (Earnings Before Interest Taxes Depreciation and Amortization) to the Enterprise Value (Equity Value plus Debt Value). When valuing the equity of a company, the most widely used multiple is the Price Earnings Ratio (PER) of stocks in a similar industry, which is the ratio of Stock price to Earnings per Share of any public company. Using the sum of multiple PER's improves reliability but it can still be necessary to correct the PER for current market conditions.

### ***Usage***

In finance, valuation analysis is required for many reasons including tax assessment, wills and estates, divorce settlements, business analysis, and basic bookkeeping and accounting. Since the value of things fluctates over time, valuations are as of a specific date e.g., the end of the accounting quarter or year. They may alternatively be mark-to-market

estimates of the current value of assets or liabilities as of this minute or this day for the purposes of managing portfolios and associated financial risk (for example, within large financial firms including investment banks and stockbrokers).

Some balance sheet items are much easier to value than others. Publicly traded stocks and bonds have prices that are quoted frequently and readily available. Other assets are harder to value. For instance, private firms that have no frequently quoted price. Additionally, financial instruments that have prices that are partly dependent on theoretical models of one kind or another are difficult to value. For example, options are generally valued using the Black-Scholes model while the liabilities of life assurance firms are valued using the theory of present value. Intangible business assets, like goodwill and intellectual property, are open to a wide range of value interpretations.

It is possible and conventional for financial professionals to make their own estimates of the valuations of assets or liabilities that they are interested in. Their calculations are of various kinds including analyses of companies that focus on price-to-book, price-to-earnings, price-to-cashflow and present value calculations, and analyses of bonds that focus on credit ratings, assessments of default risk, risk premia and levels of real interest rates. All of these approaches may be thought of as creating estimates of value that compete for credibility with the prevailing share or bond prices, where applicable, and may or may not result in buying or selling by market participants. Where the valuation is for the purpose of a merger or acquisition the respective businesses make available further detailed financial information, usually on the completion of a non disclosure agreement 1

It is very important to note that valuation is more an art than a science because it requires judgement:

1. There are very different situations and purposes in which you value an asset (e.g. company in distress, tax purposes, mergers & acquisitions, quarterly reporting). In turn this requires different methods or a different interpretation of the same method each time.
2. All valuation models and methods have their limitations (e.g., mathematical, complexity, simplicity, comparability) and could be widely criticized. As a general rule the valuation models are most useful when you use the same valuation method as the "partner" you are interacting with. Mostly the method used is industry or purpose specific;



3. The quality of some of the input data may vary widely
4. In all valuation models there are a great number of assumptions that need to be made and things might not turn out the way you expect. Your best way out of that is to be able to explain and stand for each assumption you make;

When a valuation is prepared all assumptions should be clearly stated, especially the context. It is improper, for example, to value a going concern, based on an assumption that it is going out of business, since then only a salvage value remains.

### *Valuation of mining projects*

In mining, valuation is the process of determining the value or worth of a mining property.

Mining valuations are sometimes required for IPO's, fairness opinions, litigation, mergers & acquisitions and shareholder related matters.

In valuation of a mining project or mining property, fair market value is the standard of value to be used. The CIMVal Standards are a recognised standard for valuation of mining projects and is also recognised by the Toronto Stock Exchange (Venture). The standards spearheaded by Spence & Roscoe, stress the use of the cost approach, market approach and the income approach, depending on the stage of development of the mining property or project.

### *Asset pricing models*

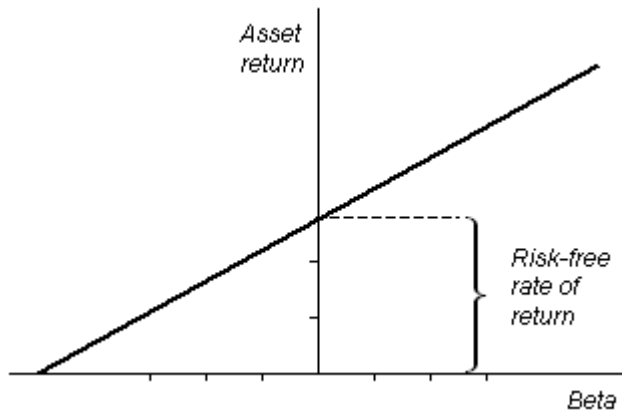
- Capital asset pricing model (CAPM)
- Arbitrage pricing theory (APT)
- Black-Scholes (for Options)

### **Capital asset pricing model**

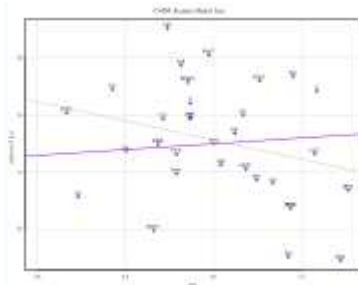
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The Security Market Line, seen here in a graph, describes a relation between the beta and the asset's expected rate of return.



An estimation of the CAPM and the Security Market Line (purple) for the Dow Jones Industrial Average over the last 3 years for monthly data.

The **Capital Asset Pricing Model** (CAPM) is used in finance to determine a theoretically appropriate required rate of return (and thus the price if expected cash flows can be estimated) of an asset, if that asset is to be added to an already well-diversified portfolio, given that asset's non-diversifiable risk. The CAPM formula takes into account the asset's sensitivity to non-diversifiable risk (also known as systematic risk or market risk), in a number often referred to as beta ( $\beta$ ) in the financial industry, as well as the expected return of the market and the expected return of a theoretical risk-free asset.

The model was introduced by Jack Treynor, William Sharpe, John Lintner and Jan Mossin independently, building on the earlier work of Harry Markowitz on diversification and modern portfolio theory. Sharpe received the Nobel Memorial Prize in Economics (jointly with Harry Markowitz and Merton Miller) for this contribution to the field of financial economics.

### *The formula*

The CAPM is a model for pricing an individual security (asset) or a portfolio. For individual security perspective, we made use of the security market line (SML) and its relation to expected return and systematic risk (beta) to show how the market must price individual securities in relation to their security risk class. The SML enables us to calculate the reward-to-risk ratio for any security in relation to the overall market's. Therefore, when the expected rate of return for any security is deflated by its beta coefficient, the reward-to-risk ratio for any individual security in the market is equal to the market reward-to-risk ratio, thus:

$$\begin{array}{l} \text{Individual security's} \\ \text{Reward-to-risk ratio} \end{array} = \begin{array}{l} \text{Market's securities (portfolio)} \\ \text{Reward-to-risk ratio} \end{array}$$

$$\frac{E(R_i) - R_f}{\beta_{im}} = E(R_m) - R_f$$

The market reward-to-risk ratio is effectively the market risk premium and by rearranging the above equation and solving for  $E(R_i)$ , we obtain the Capital Asset Pricing Model (CAPM).

$$E(R_i) = R_f + \beta_{im}(E(R_m) - R_f).$$

Where:

- $E(R_i)$  is the expected return on the capital asset
- $R_f$  is the risk-free rate of interest
- $\beta_{im}$  (the *beta coefficient*) the sensitivity of the asset returns to market returns, or also 
$$\beta_{im} = \frac{\text{Cov}(R_i, R_m)}{\text{Var}(R_m)}$$
- $E(R_m)$  is the expected return of the market
- $E(R_m) - R_f$  is sometimes known as the *market premium* or *risk premium* (the difference between the expected market rate of return and the risk-free rate of return). Note 1: the expected market rate of return is usually measured by looking at the arithmetic average of the historical returns on a market portfolio (i.e. S&P 500). Note 2: the risk free rate of return used for determining the risk premium is usually the arithmetic average of historical risk free rates of return and not the current risk free rate of return.

For the full derivation see Modern portfolio theory.

### ***Asset pricing***

Once the expected return,  $E(R_i)$ , is calculated using CAPM, the future cash flows of the asset can be discounted to their present value using this rate ( $E(R_i)$ ), to establish the correct price for the asset.

In theory, therefore, an asset is correctly priced when its observed price is the same as its value calculated using the CAPM derived discount rate. If the observed price is higher than the valuation, then the asset is overvalued (and undervalued when the observed price is below the CAPM valuation).

Alternatively, one can "solve for the discount rate" for the observed price given a particular valuation model and compare that discount rate with the CAPM rate. If the discount rate in the model is lower than the CAPM rate then the asset is overvalued (and undervalued for a too high discount rate).

### ***Asset-specific required return***

The CAPM returns the asset-appropriate required return or discount rate - i.e. the rate at which future cash flows produced by the asset should be discounted given that asset's relative riskiness. Betas exceeding one signify more than average "riskiness"; betas below one indicate lower than average. Thus a more risky stock will have a higher beta and will be discounted at a higher rate; less sensitive stocks will have lower betas and be discounted at a lower rate. The CAPM is consistent with intuition - investors (should) require a higher return for holding a more risky asset.

Since beta reflects asset-specific sensitivity to non-diversifiable, i.e. market risk, the market as a whole, by definition, has a beta of one. Stock market indices are frequently used as local proxies for the market - and in that case (by definition) have a beta of one. An investor in a large, diversified portfolio (such as a mutual fund) therefore expects performance in line with the market.

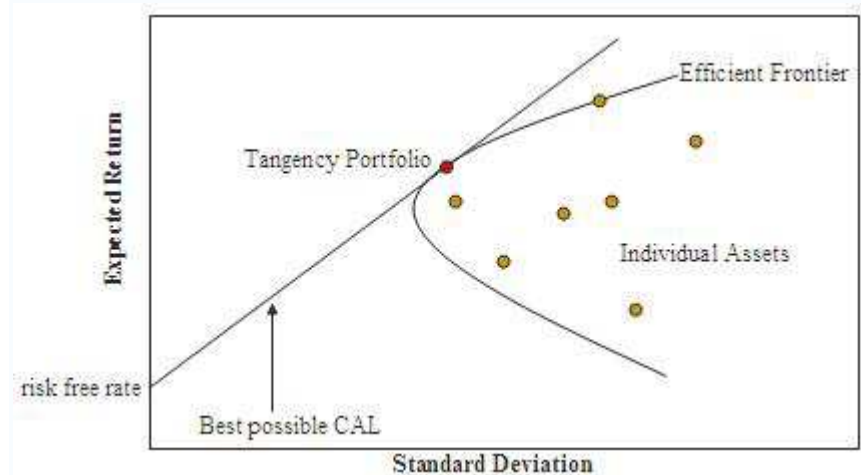
### ***Risk and diversification***

The risk of a portfolio comprises systemic risk and specific risk which is also known as idiosyncratic risk. Systemic risk refers to the risk common to all securities - i.e. market risk. Specific risk is the risk associated with individual assets. Specific risk can be diversified away to smaller levels by including a greater number of assets in the portfolio. (specific risks "average out"); systematic risk (within one market) cannot. Depending on

the market, a portfolio of approximately 30-40 securities in developed markets such as UK or US (more in case of developing markets because of higher asset volatilities) will render the portfolio sufficiently diversified to limit exposure to systemic risk only.

A rational investor should not take on any diversifiable risk, as only non-diversifiable risks are rewarded within the scope of this model. Therefore, the required return on an asset, that is, the return that compensates for risk taken, must be linked to its riskiness in a portfolio context - i.e. its contribution to overall portfolio riskiness - as opposed to its "stand alone riskiness." In the CAPM context, portfolio risk is represented by higher variance i.e. less predictability. In other words the beta of the portfolio is the defining factor in rewarding the systemic exposure taken by an investor.

### *The efficient frontier*



### Efficient Frontier

The CAPM assumes that the risk-return profile of a portfolio can be optimized - an optimal portfolio displays the lowest possible level of risk for its level of return. Additionally, since each additional asset introduced into a portfolio further diversifies the portfolio, the optimal portfolio must comprise every asset, (assuming no trading costs) with each asset value-weighted to achieve the above (assuming that any asset is infinitely divisible). All such optimal portfolios, i.e., one for each level of return, comprise the efficient frontier.

Because the unsystemic risk is diversifiable, the total risk of a portfolio can be viewed as beta.

### *The market portfolio*

An investor might choose to invest a proportion of his or her wealth in a portfolio of risky assets with the remainder in cash - earning interest at the risk free rate (or indeed may borrow money to fund his or her purchase of risky assets in which case there is a negative cash weighting). Here, the ratio of risky assets to risk free asset determines overall return - this relationship is clearly linear. It is thus possible to achieve a particular return in one of two ways:

1. By investing all of one's wealth in a risky portfolio,
2. or by investing a proportion in a risky portfolio and the remainder in cash (either borrowed or invested).

For a given level of return, however, only one of these portfolios will be optimal (in the sense of lowest risk). Since the risk free asset is, by definition, uncorrelated with any other asset, option 2) will generally have the lower variance and hence be the more efficient of the two.

This relationship also holds for portfolios along the efficient frontier: a higher return portfolio plus cash is more efficient than a lower return portfolio alone for that lower level of return. For a given risk free rate, there is only one optimal portfolio which can be combined with cash to achieve the lowest level of risk for any possible return. This is the market portfolio.

### *Assumptions of CAPM*

- All investors have rational expectations.
- There are no arbitrage opportunities.
- Returns are distributed normally.
- Fixed quantity of assets.
- Perfectly efficient capital markets.
- Separation of financial and production sectors.
- Thus, production plans are fixed.
- Risk-free rates exist with limitless borrowing capacity and universal access.
- The Risk-free borrowing and lending rates are equal.
- No inflation and no change in the level of interest rate exists.
- Perfect information, hence all investors have the same expectations about security returns for any given time period.

## *Shortcomings of CAPM*

- The model assumes that asset returns are normally distributed random variables. It is however frequently observed that returns in equity and other markets are not normally distributed. As a result, large swings (3 to 6 standard deviations from the mean) occur in the market more frequently than the normal distribution assumption would expect.
- The model assumes that the variance of returns is an adequate measurement of risk. This might be justified under the assumption of normally distributed returns, but for general return distributions other risk measures (like coherent risk measures) will likely reflect the investors' preferences more adequately.
- The model does not appear to adequately explain the variation in stock returns. Empirical studies show that low beta stocks may offer higher returns than the model would predict. Some data to this effect was presented as early as a 1969 conference in Buffalo, New York in a paper by Fischer Black, Michael Jensen, and Myron Scholes. Either that fact is itself rational (which saves the efficient markets hypothesis but makes CAPM wrong), or it is irrational (which saves CAPM, but makes EMH wrong – indeed, this possibility makes volatility arbitrage a strategy for reliably beating the market).
- The model assumes that given a certain expected return investors will prefer lower risk (lower variance) to higher risk and conversely given a certain level of risk will prefer higher returns to lower ones. It does not allow for investors who will accept lower returns for higher risk. Casino gamblers clearly pay for risk, and it is possible that some stock traders will pay for risk as well.
- The model assumes that all investors have access to the same information and agree about the risk and expected return of all assets. (Homogeneous expectations assumption)
- The model assumes that there are no taxes or transaction costs, although this assumption may be relaxed with more complicated versions of the model.
- The market portfolio consists of all assets in all markets, where each asset is weighted by its market capitalization. This assumes no preference between markets and assets for individual investors, and that investors choose assets solely as a function of their risk-return profile. It also assumes that all assets are infinitely divisible as to the amount which may be held or transacted.
- The market portfolio should in theory include all types of assets that are held by anyone as an investment (including works of art,

real estate, human capital...) In practice, such a market portfolio is unobservable and people usually substitute a stock index as a proxy for the true market portfolio. Unfortunately, it has been shown that this substitution is not innocuous and can lead to false inferences as to the validity of the CAPM, and it has been said that due to the inobservability of the true market portfolio, the CAPM might not be empirically testable. This was presented in greater depth in a paper by Richard Roll in 1977, and is generally referred to as Roll's Critique. Theories such as the Arbitrage Pricing Theory (APT) have since been formulated to circumvent this problem.

## Arbitrage pricing theory

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**Arbitrage pricing theory (APT)**, in Finance, is a general theory of asset pricing, that has become influential in the pricing of shares.

APT holds that the expected return of a financial asset can be modeled as a linear function of various macro-economic factors or theoretical market indices, where sensitivity to changes in each factor is represented by a factor specific beta coefficient. The model derived rate of return will then be used to price the asset correctly - the asset price should equal the expected end of period price discounted at the rate implied by model. If the price diverges, arbitrage should bring it back into line.

The theory was initiated by the economist Stephen Ross in 1976.

### *The APT model*

If APT holds, then a risky asset can be described as satisfying the following relation:

$$E(r_j) = r_f + b_{j1}RP_1 + b_{j2}RP_2 + \dots + b_{jn}RP_n$$
$$r_j = E(r_j) + b_{j1}F_1 + b_{j2}F_2 + \dots + b_{jn}F_n + \epsilon_j$$

where

- $E(r_j)$  is the risky asset's expected return,
- $RP_k$  is the risk premium of the factor,
- $r_f$  is the risk-free rate,
- $F_k$  is the macroeconomic factor,
- $b_{jk}$  is the sensitivity of the asset to factor  $k$ , also called factor loading,



- and  $\varepsilon_j$  is the risky asset's idiosyncratic random shock with mean zero.

That is, the uncertain return of an asset  $j$  is a linear relationship among  $n$  factors. Additionally, every factor is also considered to be a random variable with mean zero.

Note that there are some assumptions and requirements that have to be fulfilled for the latter to be correct: There must be perfect competition in the market, and the total number of factors may never surpass the total number of assets (in order to avoid the problem of matrix singularity), respectively.

### ***Arbitrage and the APT***

Arbitrage is the practice of taking advantage of a state of imbalance between two (or possibly more) markets and thereby making a risk free profit; see Rational pricing.

### **Arbitrage in expectations**

The APT describes the mechanism whereby arbitrage by investors will bring an asset which is mispriced, according to the APT model, back into line with its *expected* price. Note that under true arbitrage, the investor locks-in a *guaranteed* payoff, whereas under APT arbitrage as described below, the investor locks-in a positive *expected* payoff. The APT thus assumes "arbitrage in expectations" - i.e. that arbitrage by investors will bring asset prices back into line with the returns expected by the model portfolio theory.

### **Arbitrage mechanics**

In the APT context, arbitrage consists of trading in two assets – with at least one being mispriced. The arbitrageur sells the asset which is relatively too expensive and uses the proceeds to buy one which is relatively too cheap.

Under the APT, an asset is mispriced if its current price diverges from the price predicted by the model. The asset price today, should equal the sum of all future cash flows discounted at the APT rate, where the expected return of the asset is a linear function of various factors, and sensitivity to changes in each factor is represented by a factor specific beta coefficient.

A correctly priced asset here, may be in fact, a *synthetic* asset - a *portfolio* consisting of other correctly priced assets. This portfolio has the same exposure to each of the macroeconomic factors as the mispriced asset. The arbitrageur creates the portfolio by identifying  $x$  correctly priced assets (one per factor plus one) and then weighting the assets such that portfolio beta per factor is the same as for the mispriced asset.

When the investor is long the asset and short the portfolio (or vice versa) he has created a position which has a positive expected return (the difference between asset return and portfolio return) and which has a net-zero exposure to any macroeconomic factor and is therefore risk free (other than for firm specific risk). The arbitrageur is thus in a position to make a risk free profit:

Where today's price is too low:

The implication is that at the end of the period the *portfolio* would have appreciated at the rate implied by the APT, whereas the mispriced asset would have appreciated at *more* than this rate. The arbitrageur could therefore:

Today:

- 1 short sell the *portfolio*
- 2 buy the mispriced-asset with the proceeds.

At the end of the period:

- 1 sell the mispriced asset
- 2 use the proceeds to buy back the *portfolio*
- 3 pocket the difference.

Where today's price is too high:

The implication is that at the end of the period the *portfolio* would have appreciated at the rate implied by the APT, whereas the mispriced asset would have appreciated at *less* than this rate. The arbitrageur could therefore:

Today:

- 1 short sell the mispriced-asset
- 2 buy the *portfolio* with the proceeds.

At the end of the period:

- 1 sell the *portfolio*
- 2 use the proceeds to buy back the mispriced-asset
- 3 pocket the difference.

### ***Relationship with the capital asset pricing model***

The APT along with the capital asset pricing model (CAPM) is one of two influential theories on asset pricing. The APT differs from the CAPM in that it is less restrictive in its assumptions. It allows for an explanatory (as opposed to statistical) model of asset returns. It assumes that each investor will hold a unique portfolio with its own particular array of betas, as opposed to the identical "market portfolio". In some ways, the CAPM can be considered a "special case" of the APT in that the securities market line represents a single-factor model of the asset price, where Beta is exposure to changes in value of the Market.

Additionally, the APT can be seen as a "supply side" model, since its beta coefficients reflect the sensitivity of the underlying asset to economic factors. Thus, factor shocks would cause structural changes in the asset's expected return, or in the case of stocks, in the firm's profitability.

On the other side, the capital asset pricing model is considered a "demand side" model. Its results, although similar to those in the APT, arise from a maximization problem of each investor's utility function, and from the resulting market equilibrium (investors are considered to be the "consumers" of the assets).

### ***Using the APT***

#### **Identifying the factors**

As with the CAPM, the factor-specific Betas are found via a linear regression of historical security returns on the factor in question. Unlike the CAPM, the APT, however, does not itself reveal the identity of its priced factors - the number and nature of these factors is likely to change over time and between economies. As a result, this issue is essentially empirical in nature. Several *a priori* guidelines as to the characteristics required of potential factors are, however, suggested:

1. their impact on asset prices manifests in their *unexpected* movements
2. they should represent *undiversifiable* influences (these are, clearly, more likely to be macroeconomic rather than firm specific in nature)
3. timely and accurate information on these variables is required
4. the relationship should be theoretically justifiable on economic grounds

Chen, Roll and Ross identified the following macro-economic factors as significant in explaining security returns:

- surprises in inflation;
- surprises in GNP as indicated by an industrial production index;
- surprises in investor confidence due to changes in default premium in corporate bonds;
- surprise shifts in the yield curve.

As a practical matter, indices or spot or futures market prices may be used in place of macro-economic factors, which are reported at low frequency (e.g. monthly) and often with significant estimation errors. Market indices are sometimes derived by means of factor analysis. More direct "indices" that might be used are:

- short term interest rates;
- the difference in long-term and short term interest rates;
- a diversified stock index such as the S&P 500 or NYSE Composite Index;
- oil prices
- gold or other precious metal prices
- Currency exchange rates