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VALUING ASSETS IN FINANCIAL MARKETS

This note provides an overview of techniques used to value assets, including multiples, arbitrage pricing, and discounted cash flow (DCF). The emphasis is on the basic nature of valuation approaches and their logical underpinning. In particular, we focus on how techniques are applied to assets that are or might be traded in financial markets.

Estimating Value

Estimates of market value show up in many contexts. These run the gamut from appraising land or a family business, to assessing stock-option grants to executives, to acquiring large global firms, to launching initial public offerings of a company's equity, to making decisions about buying and selling stocks and bonds. Often, the goal is to estimate a current market price (i.e., what the asset would sell for in financial markets right now, given all the expectations and factors currently at work in the market). At times, the task can be quite easy when we can find traded assets that look just like the one we want to value. In other situations, however, value estimates are extremely difficult and imprecise. For instance, what is the value of a new technology?

Let's take an almost trivial example of a pretty easy valuation task. Suppose you own a share of stock in IBM and find that two seconds ago IBM shares traded on the New York Stock Exchange for $100 a share. The $100 is a very precise estimate of what your share will sell for as there is no difference among shares of IBM stock. The shares are perfect substitutes. So the $100 price for the share just traded is a very good estimate of the market value of the share you own. This is precisely what a mutual fund that invests in publicly traded stocks does when it estimates the net asset value (NAV) of shares in the fund. It simply takes current market prices of the stocks in its portfolio and values these holdings using those prices.[1]

[1] Even in this setting, care must be taken. Some mutual funds have gotten into trouble by letting favored clients transact at NAVs that have not been updated to reflect recent stock-price changes.

In any valuation challenge, it is important to understand your goal at the outset. In many instances, your objective is simply to estimate market pricing, not to outsmart or outguess the market. This is often the case when we are looking at how to price instruments like stock options. In other contexts, such as acquisition of a company, you may want to estimate both the market pricing of the asset and, separately, its value to you based on unique features of the proposed acquisition. Whatever the case, you will benefit from being armed with techniques that allow you both to understand what drives the values we observe in markets and to then take this information to value assets that are not currently traded.

Types of Valuation Techniques

All valuation techniques can be thought of as ways practitioners and researchers have devised to explain why someone is willing to pay a particular price for a particular asset. In the final analysis, the price will be whatever sellers and buyers agree upon. The valuation technique or approach helps us make sense of what these prices turn out to be. Valuation techniques start by considering the payoff characteristics of the asset. These typically include the timing, amount, and risk of the cash flows to the asset's owner. For the vast majority of assets, estimating value involves some combination of three approaches: multiples, arbitrage pricing, and DCF.

The most rudimentary approach is a relative valuation using multiples. For this approach, we compare the market value of other comparable traded assets to the asset whose value we wish to estimate. The logic is that financial markets will value similar assets in the same way. A second relative approach is based on the assumption that arbitrage will eliminate pricing inconsistencies in markets. In essence, we look for two different combinations of assets ("positions") that create the same cash payoffs. Market arbitrage should ensure that we will have to pay the same amount of money to purchase either of the two positions. This "law of one price" allows us to infer relative prices of the assets in the positions. For instance, it will allow us to estimate the value of a stock option if we know the value of the underlying stock. A third approach is to use DCF. Here we estimate the future cash flows of an asset and then discount the cash flows using some required return. Typically, we use a discount rate that reflects the way financial markets are currently pricing risk and time delays in receiving cash.

Multiples

Multiples simply compare a value ratio for one asset to another at a particular point in time. The first step is to identify other comparable assets that are traded in financial markets. Once we identify the set of comparable assets, these assets' market values are used as the basis for valuation by calculating ratios (multiples) of the value to some underlying asset characteristic. In valuing companies, the underlying characteristic is often some measure of earnings or cash flow but could be almost anything, including employees, stores, or customers. In valuing stocks, the most commonly used valuation multiple is the price-to-earnings ratio. Here, the common factor is earnings per share, and the valuation is on price paid in the market per dollar of earnings. For example, if comparable firms have a price-earnings ratio of 10 and your company has earnings per share of \$1.50, your stock is "valued" at \$15 a share (\$15 = 10 × \$1.50). Other commonly used multiples include price-to-book value, enterprise value to EBITDA,[2] and price to cash flow. In essence, any multiple approach uses some base (e.g., earnings in the price-earnings multiple) as the "common denominator" of value. Using different types of multiples allows the analyst to triangulate on value.

A primary difficulty in applying multiples is finding traded assets that are truly similar to the asset you wish to value. In practice, assets can differ in terms of risk, growth prospects, tax status, marketability, and so on. A second challenge is estimating the attributes of the assets themselves. Many an analyst has used reported-earnings data only to find out that a company's reporting practices failed to portray the true business condition. Such high-profile scandals as Enron and WorldCom are extreme examples. Certain situations, such as family businesses where salaries may not be at market levels, also require careful attention.

In the end, multiples provide relative measures of value. Given the way the other assets are valued, you estimate the value of a specific asset you are interested in.

Arbitrage valuation

Arbitrage valuation relies on the existence of active financial markets where individuals are looking for opportunities to profit from the relative mispricing of assets. The basic thrust of arbitrage valuation is that assets or a combination of assets with the same risk, amount, and timing of cash flows should sell for the same price—the so-called law of one price. It is not a natural law such as gravity or the speed of light, but rather an expression of the belief that if two assets with the same risk, amount, and timing of cash flows do not sell for the same price, you can profit from selling the higher-priced asset and buying the lower-priced asset. This trading would result in a situation where future inflows exactly match future outflows, but you make a cash profit today after selling and buying each asset. Financial markets would quickly react to eliminate this "free lunch" and drive prices back in line.

To illustrate a simple example of arbitrage valuation, suppose that each of three U.S. government bonds has a face value (par) of \$1,000 and a maturity of two years. Bond A has a coupon rate of 8% and pays \$40 every six months for two years and \$1,000 at the end of two years. Bond B has a coupon rate of 10%, paying \$50 every six months for two years and \$1,000 at the end. Finally, Bond C has a coupon of 12%, paying \$60 every six months for two years and \$1,000 at the end of two years. **Table 1** shows the relevant cash flows for each bond.

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[2] EBITDA is earnings before interest and taxes and excluding depreciation and amortization expense. The multiple itself is calculated as the ratio of total firm value or enterprise value (Debt + Equity) to EBITDA.

Table 1. Cash flow.

	6 Months	12 Months	18 Months	24 Months
Bond A	40	40	40	1,040
Bond B	50	50	50	1,050
Bond C	60	60	60	1,060

Given these cash flows, markets will price these bonds in a particular way. Specifically, it will turn out that the sum of the prices of Bond A and Bond C will be equal to twice the price of Bond B. To see this, consider taking a position that is buying Bond A and Bond C. Purchase of these two bonds yields a cash flow of $100 every six months for two years and $2,000 at the end of two years. This is precisely the same set of cash flows you'd get by taking a position of buying two B bonds. Arbitrage should then tell us that what we pay for the two positions up front should be the same. In symbols, the price of Bond A, P_A, plus the price of Bond C, P_C, should equal two times the price of Bond B, P_B, or

$$P_A + P_C = 2 \times P_B.$$

This is a simple but powerful valuation statement. If we know the value of two of the three bonds, we can determine the value of the third. The key assumption is that there is an active financial market, which will buy one side and sell the other if the equality does not hold. This principle is evident in all actively traded financial markets.[3]

Compelling examples of relative pricing derived from arbitrage valuations show up for a host of assets, including stocks, bonds, options, interest rates, and exchange rates. Often, arbitrage relationships involve transactions in a number of markets at the same time. This allows us to derive important relationships between prices in different markets.

Discounted-cash-flow valuation

A different approach to valuing an asset is DCF. Here, we estimate the set of relevant cash flows over time for an asset and then discount the cash flows using the appropriate required rate of return. This approach asserts that people buy financial assets for the cash benefits they anticipate. Moreover, they penalize these cash flows for both time and risk. The amount of the penalty will be determined by other alternatives that investors have in financial markets. For instance, investors can always put money in safe assets such as U.S. government bonds, in riskier

[3] Consider what happens if the equality doesn't hold. For example, suppose we had Bond B trading for $1,000, Bond A for $965, and Bond C for $1,025. Selling two of the B bonds would provide $2,000. You could then take $1,990 and buy one each of Bond A and Bond C and have exactly the same future cash flows. The $10 ($2,000 − $1,990) is precisely the arbitrage profit that would entice you to do this transaction. As market traders pursued this strategy, there would be downward pressure on the price of Bond B (as it was sold) and upward pressure on the other prices (as they were bought). So long as transaction costs of the trades are relatively low, we would expect prices to adjust until the equality holds (approximately).

assets such as stocks, or in mutual-fund portfolios that combine many assets. Any specific asset we are attempting to value competes with other assets for investor funds.

DCF valuations can adjust for time and risk in two quite different ways. The most widely used version of DCF has the discount rate account for both time and risk. In this approach, we estimate an asset's expected cash flows and discount those flows at a risk-adjusted rate. The rate captures how we expect financial markets to price cash flows with the types of risk and timing as the cash flows we project for the asset we are valuing. A second way to apply DCF uses a risk-free rate for discounting. Such a rate reflects only the time value of money and does not incorporate risk. In this application, risk is handled by adjusting the cash flows. Instead of using expected cash flows, we adjust the cash flows downward to their "certainty equivalents" as a penalty for risk. The **Appendix** provides an illustrative application of both versions of DCF.

In most cases, we cannot observe certainty equivalents. Moreover, we can often use market data to help estimate risk-adjusted discount rates. As a consequence, most DCF applications use the risk-adjusted required rate of return and expected cash flow to estimate value.

Valuation versus Pricing

In practical applications, some analysts distinguish "pricing" from "valuation." In this context, pricing refers to our best estimate of what the asset will sell for in the market, given assumed current market conditions. Valuation refers to our best estimate of what the assets would be worth if sold to market participants who knew what we did, agreed with us, and could capture all the benefits we capture from owning the asset. Is this distinction between price and value meaningful? It really depends on the context. If your goal is to estimate how the asset will be priced in the market now, then pricing and valuation are essentially the same thing. If your goal is to beat the market, or you distrust market prices, or you think the market price will not capture some of the value to you, pricing and valuation can be quite different. To illustrate, on the same day that a mutual fund used IBM's market price in calculating its NAV, you may hear the same fund's equity analyst comment that "IBM stock is selling in the market for $100, but I value it at $120 a share." So what is the "value"—$100 or $120? If your goal is to calculate transaction prices today, the "market value" is $100. If your goal is to predict a future price based on information you think is superior to the market, the "true or intrinsic value" is $120 from the analyst's perspective. As you approach any valuation challenge, be clear on what you are trying to estimate. Lack of clarity can lead to bad estimates and, even worse, bad decisions based on your estimates.

Summary

In practice, there are different ways to value assets in financial markets. Not surprisingly, we'll find that some situations lend themselves to one approach over another. Sometimes, we may be able to apply a number of approaches to the same valuation challenge. Triangulation of value estimates is common in practice and also very useful as any method has its flaws. In all applications, technique matters. Over time, bad analysis inevitably creates a track record of bad decisions. Technique alone, however, will not guarantee success. Good valuations reflect a deep understanding of the markets and the issues that affect the particular situation.

Appendix

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DCF: Risk-Adjusted Discount Rates versus Certainty Equivalents

To illustrate the two versions of DCF (risk-adjusted discount rates and certainty equivalents), let's consider an example. You are offered a gamble that involves flipping a coin where the immediate payoff is $100 if heads results and $10 if tails. The expected payoff[1] is $55. What would you pay to play? Because almost everyone is risk-averse, they would only be willing to pay something less than $55 to have the opportunity to play. For simplicity, let's assume $48 is the maximum amount that you (being risk-averse) would pay for the opportunity. In financial jargon, the $48 is your "certainty equivalent" of the uncertain payoff offered by the gamble. You are indifferent[2] between having $48 for certain and having the gamble that pays either $100 or $10 (with equal odds for each of the gamble's payoffs).

Now suppose you are offered the same gamble, but the flipping of the coin and the gamble's payoff is one year from today. Faced with this choice, you reconsider and say that the maximum that you are willing to pay today for the gamble is $45.28. This amount will be less than $48.00 because you have to wait a year before the gamble pays out.

Now we can characterize your "valuation" of the gamble in two ways. First, let's use a risk-adjusted required rate of return, as shown in **Equation 1**.

$$\$45.28 = \frac{\$55}{(1+K)} \tag{1}$$

where we discount the expected payoff using a risk-adjusted required rate of return, K. Based on a value of $45.28, your implied risk-adjusted required rate of return for this gamble is approximately 21.5%.

Alternatively, we could have characterized the valuation using a certainty equivalent, as shown in **Equation 2**.

$$\$45.28 = \frac{\$48}{(1+R_F)} \tag{2}$$

[1] An expected cash flow is just a probability-weighted average, which, in this case, is 0.5($100) + 0.5($10) = $55.

[2] If the gamble were offered for $47.99, you would pay to play. At an up-front cost of $48.01, you would not take the gamble. At a cost of $48.00, you would be just as happy to forgo the gamble as to pay for it.

In this case, we discount the certainty equivalent at a risk-free rate. This pricing is consistent with a risk-free rate of 6%.

Hence, we can apply DCF by either discounting expected payoffs at the risk-adjusted required rate of return (**Equation 1**) or discounting certainty equivalents using the risk-free rate (**Equation 2**). In **Equation 1**, risk is reflected in the higher discount rate. In particular, the risk-adjusted discount rate of 21.5% implies a risk premium of 15.5% above the risk-free rate of 6%. In **Equation 2**, risk is handled by using the certainty-equivalent cash flow of $48 as opposed to the expected cash flow of $55.

To use DCF to estimate values that the market might place on the assets, we need to be very careful in how we pick the ingredients in **Equation 1** or **Equation 2**. In **Equation 2**, best practice is to estimate the risk-free discount rate using the rate we see pricing other very safe (essentially risk-free) assets in the market (e.g., U.S. government bonds). Most of the time, however, it is very difficult, if not impossible, to get any market data on certainty equivalents to implement **Equation 2**. Remember that our personal judgment on a certainty equivalent may not reflect market pricing of risk.

In practice, the risk-adjusted discount rate is the more commonly used approach. In implementing that approach using **Equation 1**, we can still use market data to proxy the risk-free rate but we must also add a risk premium. In bond markets, risk premiums are often estimated using the difference in yields-to-maturity between categories of bonds (e.g., between bonds in different rating categories). Theoretical models, such as the capital asset pricing model, for estimating risk premiums are used in a wide range of settings. While application often requires substantial judgment, these risk-premium models can incorporate a host of market data to reflect market assessments of risk.