CHAPTER 2

APPROACHES TO VALUATION

Analysts use a wide range of models to value assets in practice, ranging from the simple to the sophisticated. These models often make very different assumptions about pricing, but they do share some common characteristics and can be classified in broader terms. There are several advantages to such a classification -- it makes it easier to understand where individual models fit into the big picture, why they provide different results and when they have fundamental errors in logic.

In general terms, there are three approaches to valuation. The first, discounted cashflow valuation, relates the value of an asset to the present value of expected future cashflows on that asset. The second, relative valuation, estimates the value of an asset by looking at the pricing of 'comparable' assets relative to a common variable such as earnings, cashflows, book value or sales. The third, contingent claim valuation, uses option pricing models to measure the value of assets that share option characteristics. Some of these assets are traded financial assets like warrants, and some of these options are not traded and are based on real assets – projects, patents and oil reserves are examples. The latter are often called real options. There can be significant differences in outcomes, depending upon which approach is used. One of the objectives in this book is to explain the reasons for such differences in value across different models and to help in choosing the right model to use for a specific task.

Discounted Cashflow Valuation

While discounted cash flow valuation is one of the three ways of approaching valuation and most valuations done in the real world are relative valuations, we will argue that it is the foundation on which all other valuation approaches are built. To do relative valuation correctly, we need to understand the fundamentals of discounted cash flow valuation. To apply option pricing models to value assets, we often have to begin with a discounted cash flow valuation. This is why so much of this book focuses on discounted cash flow valuation. Anyone who understands its fundamentals will be able to analyze and use the other approaches. In this section, we will consider the basis of this approach,

a philosophical rationale for discounted cash flow valuation and an examination of the different sub-approaches to discounted cash flow valuation.

Basis for Discounted Cashflow Valuation

This approach has its foundation in the present value rule, where the value of any asset is the present value of expected future cashflows that the asset generates.

$$\text{Value} = \sum_{t=1}^{t=n} \frac{CF_t}{(1+r)^t}$$

where,

n = Life of the asset

CF_t = Cashflow in period t

r = Discount rate reflecting the riskiness of the estimated cashflows

The cashflows will vary from asset to asset -- dividends for stocks, coupons (interest) and the face value for bonds and after-tax cashflows for a real project. The discount rate will be a function of the riskiness of the estimated cashflows, with higher rates for riskier assets and lower rates for safer projects. You can in fact think of discounted cash flow valuation on a continuum. At one end of the spectrum, you have the default-free zero coupon bond, with a guaranteed cash flow in the future. Discounting this cash flow at the riskless rate should yield the value of the bond. A little further up the spectrum are corporate bonds where the cash flows take the form of coupons and there is default risk. These bonds can be valued by discounting the expected cash flows at an interest rate that reflects the default risk. Moving up the risk ladder, we get to equities, where there are expected cash flows with substantial uncertainty around the expectation. The value here should be the present value of the expected cash flows at a discount rate that reflects the uncertainty.

The Underpinnings of Discounted Cashflow Valuation

In discounted cash flow valuation, we try to estimate the intrinsic value of an asset based upon its fundamentals. What is intrinsic value? For lack of a better definition, consider it the value that would be attached to the firm by an all-knowing analyst, who not only knows the expected cash flows for the firm but also attaches the right discount

rate(s) to these cash flows and values them with absolute precision. Hopeless though the task of estimating intrinsic value may seem to be, especially when valuing young companies with substantial uncertainty about the future, we believe that these estimates can be different from the market prices attached to these companies. In other words, markets make mistakes. Does that mean we believe that markets are inefficient? Not quite. While we assume that prices can deviate from intrinsic value, estimated based upon fundamentals, we also assume that the two will converge sooner rather than latter.

Categorizing Discounted Cash Flow Models

There are literally thousands of discounted cash flow models in existence. Oftentimes, we hear claims made by investment banks or consulting firms that their valuation models are better or more sophisticated than those used by their contemporaries. Ultimately, however, discounted cash flow models can vary only a couple of dimensions and we will examine these variations in this section.

I. Equity Valuation, Firm Valuation and Adjusted Present Value (APV) Valuation

There are three paths to discounted cashflow valuation -- the first is to value just the equity stake in the business, the second is to value the entire firm, which includes, besides equity, the other claimholders in the firm (bondholders, preferred stockholders, etc.) and the third is to value the firm in pieces, beginning with its operations and adding the effects on value of debt and other non-equity claims. While all three approaches discount expected cashflows, the relevant cashflows and discount rates are different under each.

The value of equity is obtained by discounting expected cashflows to equity, i.e., the residual cashflows after meeting all expenses, reinvestment needs, tax obligations and net debt payments (interest, principal payments and new debt issuance), at the cost of equity, i.e., the rate of return required by equity investors in the firm.

$$\text{Value of Equity} \ = \ \sum_{t=1}^{t=n} \frac{\text{CF to Equity}_t}{(1+k_e)^t}$$

where,

CF to Equity$_t$ = Expected Cashflow to Equity in period t

k_e = Cost of Equity

The dividend discount model is a specialized case of equity valuation, where the value of the equity is the present value of expected future dividends.

The value of the firm is obtained by discounting expected cashflows to the firm, i.e., the residual cashflows after meeting all operating expenses, reinvestment needs and taxes, but prior to any payments to either debt or equity holders, at the weighted average cost of capital, which is the cost of the different components of financing used by the firm, weighted by their market value proportions.

$$\text{Value of Firm} = \sum_{t=1}^{t=n} \frac{\text{CF to Firm}_t}{(1+\text{WACC})^t}$$

where,

CF to Firm$_t$ = Expected Cashflow to Firm in period t

WACC = Weighted Average Cost of Capital

The value of the firm can also be obtained by valuing each claim on the firm separately. In this approach, which is called adjusted present value (APV), we begin by valuing equity in the firm, assuming that it was financed only with equity. We then consider the value added (or taken away) by debt by considering the present value of the tax benefits that flow from debt and the expected bankruptcy costs.

Value of firm = Value of all-equity financed firm + PV of tax benefits +

Expected Bankruptcy Costs

In fact, this approach can be generalized to allow different cash flows to the firm to be discounted at different rates, given their riskiness.

While the three approaches use different definitions of cashflow and discount rates, they will yield consistent estimates of value as long as you use the same set of assumptions in valuation. The key error to avoid is mismatching cashflows and discount rates, since discounting cashflows to equity at the cost of capital will lead to an upwardly biased estimate of the value of equity, while discounting cashflows to the firm at the cost of equity will yield a downward biased estimate of the value of the firm. In the illustration

that follows, we will show the equivalence of equity and firm valuation. Later in this book, we will show that adjusted present value models and firm valuation models also yield the same values.

Illustration 2.1: Effects of mismatching cashflows and discount rates

Assume that you are analyzing a company with the following cashflows for the next five years. Assume also that the cost of equity is 13.625% and the firm can borrow long term at 10%. (The tax rate for the firm is 50%.) The current market value of equity is $1,073 and the value of debt outstanding is $800.

Year	Cashflow to Equity	Interest (1-t)	Cashflow to Firm
1	$ 50	$ 40	$ 90
2	$ 60	$ 40	$ 100
3	$ 68	$ 40	$ 108
4	$ 76.2	$ 40	$ 116.2
5	$ 83.49	$ 40	$ 123.49
Terminal Value	$ 1603.008		$ 2363.008

The cost of equity is given as an input and is 13.625%, and the after-tax cost of debt is 5%.

Cost of Debt = Pre-tax rate (1 – tax rate) = 10% (1-.5) = 5%

Given the market values of equity and debt, we can estimate the cost of capital.

WACC = Cost of Equity (Equity / (Debt + Equity)) + Cost of Debt (Debt/(Debt+Equity))

$$= 13.625\% \ (1073/1873) + 5\% \ (800/1873) = 9.94\%$$

Method 1: Discount CF to Equity at Cost of Equity to get value of equity

We discount cash flows to equity at the cost of equity:

PV of Equity $= 50/1.13625 + 60/1.13625^2 + 68/1.13625^3 + 76.2/1.13625^4$

$+ (83.49+1603)/1.13625^5 = \$1073$

Method 2: Discount CF to Firm at Cost of Capital to get value of firm

PV of Firm $= 90/1.0994 + 100/1.0994^2 + 108/1.0994^3 + 116.2/1.0994^4$

$+ (123.49+2363)/1.0994^5 = \$1873$

PV of Equity   = PV of Firm – Market Value of Debt

$$= \$\ 1873 - \$\ 800 = \$1073$$

Note that the value of equity is \$1073 under both approaches. It is easy to make the mistake of discounting cashflows to equity at the cost of capital or the cashflows to the firm at the cost of equity.

Error 1: Discount CF to Equity at Cost of Capital to get too high a value for equity

PV of Equity $= 50/1.0994 + 60/1.0994^2 + 68/1.0994^3 + 76.2/1.0994^4$

$$+ (83.49+1603)/1.0994^5 = \$1248$$

Error 2: Discount CF to Firm at Cost of Equity to get too low a value for the firm

PV of Firm $= 90/1.13625 + 100/1.13625^2 + 108/1.13625^3 + 116.2/1.13625^4$

$$+ (123.49+2363)/1.13625^5 = \$1613$$

PV of Equity   = PV of Firm – Market Value of Debt

$$= \$1612.86 - \$800 = \$813$$

The effects of using the wrong discount rate are clearly visible in the last two calculations. When the cost of capital is mistakenly used to discount the cashflows to equity, the value of equity increases by \$175 over its true value (\$1073). When the cashflows to the firm are erroneously discounted at the cost of equity, the value of the firm is understated by \$260. We have to point out that getting the values of equity to agree with the firm and equity valuation approaches can be much more difficult in practice than in this example. We will return and consider the assumptions that we need to make to arrive at this result.

A Simple Test of Cash Flows

There is a simple test that can be employed to determine whether the cashflows being used in a valuation are cashflows to equity or cashflows to the firm. If the cash flows that are being discounted are after interest expenses (and principal payments), they are cash flows to equity and the discount rate that should be used should be the cost of equity. If the cash flows that are discounted are before interest expenses and principal payments, they are usually cash flows to the firm. Needless to say, there are other items that need to be considered when estimating these cash flows, and we will consider them in extensive detail in the coming chapters.

II. Total Cash Flow versus Excess Cash Flow Models

The conventional discounted cash flow model values an asset by estimating the present value of all cash flows generated by that asset at the appropriate discount rate. In excess return (and excess cash flow) models, only cash flows earned in excess of the required return are viewed as value creating, and the present value of these excess cash flows can be added on to the amount invested in the asset to estimate its value. To illustrate, assume that you have an asset in which you invest $100 million and that you expect to generate $12 million per year in after-tax cash flows in perpetuity. Assume further that the cost of capital on this investment is 10%. With a total cash flow model, the value of this asset can be estimated as follows:

Value of asset = $12 million/0.10 = $120 million

With an excess return model, we would first compute the excess return made on this asset:

Excess return = Cash flow earned – Cost of capital * Capital Invested in asset

= $12 million – 0.10 * $100 million = $2 million

We then add the present value of these excess returns to the investment in the asset:

Value of asset = Present value of excess return + Investment in the asset

= $2 million/0.10 + $100 million = $120 million

Note that the answers in the two approaches are equivalent. Why, then, would we want to use an excess return model? By focusing on excess returns, this model brings home the point that it is not earning per se that create value, but earnings in excess of a required return. Later in this book, we will consider special versions of these excess return models such as Economic Value Added (EVA). As in the simple example above, we will argue that, with consistent assumptions, total cash flow and excess return models are equivalent.

Applicability and Limitations of DCF Valuation

Discounted cashflow valuation is based upon expected future cashflows and discount rates. Given these informational requirements, this approach is easiest to use for assets (firms) whose cashflows are currently positive and can be estimated with some reliability for future periods, and where a proxy for risk that can be used to obtain

discount rates is available. The further we get from this idealized setting, the more difficult discounted cashflow valuation becomes. The following list contains some scenarios where discounted cashflow valuation might run into trouble and need to be adapted.

(1) Firms in trouble: A distressed firm generally has negative earnings and cashflows. It expects to lose money for some time in the future. For these firms, estimating future cashflows is difficult to do, since there is a strong probability of bankruptcy. For firms which are expected to fail, discounted cashflow valuation does not work very well, since we value the firm as a going concern providing positive cashflows to its investors. Even for firms that are expected to survive, cashflows will have to be estimated until they turn positive, since obtaining a present value of negative cashflows will yield a negative[1] value for equity or the firm.

(2) Cyclical Firms: The earnings and cashflows of cyclical firms tend to follow the economy - rising during economic booms and falling during recessions. If discounted cashflow valuation is used on these firms, expected future cashflows are usually smoothed out, unless the analyst wants to undertake the onerous task of predicting the timing and duration of economic recessions and recoveries. Many cyclical firms, in the depths of a recession, look like troubled firms, with negative earnings and cashflows. Estimating future cashflows then becomes entangled with analyst predictions about when the economy will turn and how strong the upturn will be, with more optimistic analysts arriving at higher estimates of value. This is unavoidable, but the economic biases of the analyst have to be taken into account before using these valuations.

(3) Firms with unutilized assets: Discounted cashflow valuation reflects the value of all assets that produce cashflows. If a firm has assets that are unutilized (and hence do not produce any cashflows), the value of these assets will not be reflected in the value obtained from discounting expected future cashflows. The same caveat applies, in lesser degree, to underutilized assets, since their value will be understated in discounted cashflow valuation. While this is a problem, it is not insurmountable. The value of these

---

[1] The protection of limited liability should ensure that no stock will sell for less than zero. The price of such a stock can never be negative.

assets can always be obtained externally[2], and added on to the value obtained from discounted cashflow valuation. Alternatively, the assets can be valued assuming that they are used optimally.

(4) Firms with patents or product options: Firms often have unutilized patents or licenses that do not produce any current cashflows and are not expected to produce cashflows in the near future, but, nevertheless, are valuable. If this is the case, the value obtained from discounting expected cashflows to the firm will understate the true value of the firm. Again, the problem can be overcome, by valuing these assets in the open market or by using option pricing models, and then adding on to the value obtained from discounted cashflow valuation.

(5) Firms in the process of restructuring: Firms in the process of restructuring often sell some of their assets, acquire other assets, and change their capital structure and dividend policy. Some of them also change their ownership structure (going from publicly traded to private status) and management compensation schemes. Each of these changes makes estimating future cashflows more difficult and affects the riskiness of the firm. Using historical data for such firms can give a misleading picture of the firm's value. However, these firms can be valued, even in the light of the major changes in investment and financing policy, if future cashflows reflect the expected effects of these changes and the discount rate is adjusted to reflect the new business and financial risk in the firm.

(6) Firms involved in acquisitions: There are at least two specific issues relating to acquisitions that need to be taken into account when using discounted cashflow valuation models to value target firms. The first is the thorny one of whether there is synergy in the merger and if its value can be estimated. It can be done, though it does require assumptions about the form the synergy will take and its effect on cashflows. The second, especially in hostile takeovers, is the effect of changing management on cashflows and risk. Again, the effect of the change can and should be incorporated into the estimates of future cashflows and discount rates and hence into value.

(7) Private Firms: The biggest problem in using discounted cashflow valuation models to value private firms is the measurement of risk (to use in estimating discount rates), since

---

[2] If these assets are traded on external markets, the market prices of these assets can be used in the valuation. If not, the cashflows can be projected, assuming full utilization of assets, and the value can be

most risk/return models require that risk parameters be estimated from historical prices on the asset being analyzed. Since securities in private firms are not traded, this is not possible. One solution is to look at the riskiness of comparable firms, which are publicly traded. The other is to relate the measure of risk to accounting variables, which are available for the private firm.

The point is not that discounted cash flow valuation cannot be done in these cases, but that we have to be flexible enough to deal with them. The fact is that valuation is simple for firms with well defined assets that generate cashflows that can be easily forecasted. The real challenge in valuation is to extend the valuation framework to cover firms that vary to some extent or the other from this idealized framework. Much of this book is spent considering how to value such firms.

Relative Valuation

While we tend to focus most on discounted cash flow valuation, when discussing valuation, the reality is that most valuations are relative valuations. The value of most assets, from the house you buy to the stocks that you invest in, are based upon how similar assets are priced in the market place. We begin this section with a basis for relative valuation, move on to consider the underpinnings of the model and then consider common variants within relative valuation.

Basis for Relative Valuation

In relative valuation, the value of an asset is derived from the pricing of 'comparable' assets, standardized using a common variable such as earnings, cashflows, book value or revenues. One illustration of this approach is the use of an industry-average price-earnings ratio to value a firm. This assumes that the other firms in the industry are comparable to the firm being valued and that the market, on average, prices these firms correctly. Another multiple in wide use is the price to book value ratio, with firms selling at a discount on book value, relative to comparable firms, being considered undervalued. The multiple of price to sales is also used to value firms, with the average price-sales ratios of firms with similar characteristics being used for comparison. While these three multiples are among the most widely used, there are others that also play a role in

estimated.

analysis - price to cashflows, price to dividends and market value to replacement value (Tobin's Q), to name a few.

Underpinnings of Relative Valuation

Unlike discounted cash flow valuation, which we described as a search for intrinsic value, we are much more reliant on the market when we use relative valuation. In other words, we assume that the market is correct in the way it prices stocks, on average, but that it makes errors on the pricing of individual stocks. We also assume that a comparison of multiples will allow us to identify these errors, and that these errors will be corrected over time.

The assumption that markets correct their mistakes over time is common to both discounted cash flow and relative valuation, but those who use multiples and comparables to pick stocks argue, with some basis, that errors made by mistakes in pricing individual stocks in a sector are more noticeable and more likely to be corrected quickly. For instance, they would argue that a software firm that trades at a price earnings ratio of 10, when the rest of the sector trades at 25 times earnings, is clearly under valued and that the correction towards the sector average should occur sooner rather than latter. Proponents of discounted cash flow valuation would counter that this is small consolation if the entire sector is over priced by 50%.

Categorizing Relative Valuation Models

Analysts and investors are endlessly inventive when it comes to using relative valuation. Some compare multiples across companies, while others compare the multiple of a company to the multiples it used to trade in the past. While most relative valuations are based upon comparables, there are some relative valuations that are based upon fundamentals.

I. Fundamentals versus Comparables

In discounted cash flow valuation, the value of a firm is determined by its expected cash flows. Other things remaining equal, higher cash flows, lower risk and higher growth should yield higher value. Some analysts who use multiples go back to these discounted cash flow models to extract multiples. Other analysts compare multiples

across firms or time, and make explicit or implicit assumptions about how firms are similar or vary on fundamentals.

1. Using Fundamentals

The first approach relates multiples to fundamentals about the firm being valued – growth rates in earnings and cashflows, payout ratios and risk. This approach to estimating multiples is equivalent to using discounted cashflow models, requiring the same information and yielding the same results. Its primary advantage is to show the relationship between multiples and firm characteristics, and allows us to explore how multiples change as these characteristics change. For instance, what will be the effect of changing profit margins on the price/sales ratio? What will happen to price-earnings ratios as growth rates decrease? What is the relationship between price-book value ratios and return on equity?

2. Using Comparables

The more common approach to using multiples is to compare how a firm is valued with how similar firms are priced by the market, or in some cases, with how the firm was valued in prior periods. As we will see in the later chapters, finding similar and comparable firms is often a challenge and we have to often accept firms that are different from the firm being valued on one dimension or the other. When this is the case, we have to either explicitly or implicitly control for differences across firms on growth, risk and cash flow measures. In practice, controlling for these variables can range from the naive (using industry averages) to the sophisticated (multivariate regression models where the relevant variables are identified and we control for differences.).

II. Cross Sectional versus Time Series Comparisons

In most cases, analysts price stocks on a relative basis by comparing the multiple it is trading to the multiple at which other firms in the same business are trading. In some cases, however, especially for mature firms with long histories, the comparison is done across time.

a. Cross Sectional Comparisons

When we compare the price earnings ratio of a software firm to the average price earnings ratio of other software firms, we are doing relative valuation and we are making

cross sectional comparisons. The conclusions can vary depending upon our assumptions about the firm being valued and the comparable firms. For instance, if we assume that the firm we are valuing is similar to the average firm in the industry, we would conclude that it is cheap if it trades at a multiple that is lower than the average multiple. If, on the other hand, we assume that the firm being valued is riskier than the average firm in the industry, we might conclude that the firm should trade at a lower multiple than other firms in the business. In short, you cannot compare firms without making assumptions about their fundamentals.

b. Comparisons across time

If you have a mature firm with a long history, you can compare the multiple it trades today to the multiple it used to trade in the past. Thus, Ford Motor company may be viewed as cheap because it trades at six times earnings, if it has historically traded at ten times earnings. To make this comparison, however, you have to assume that your firm has not changed its fundamentals over time. For instance, you would expect a high growth firm's price earnings ratio to drop and its expected growth rate to decrease over time as it becomes larger. Comparing multiples across time can also be complicated by changes in the interest rates over time and the behavior of the overall market. For instance, as interest rates fall below historical norms and the overall market increases, you would expect most companies to trade at much higher multiples of earnings and book value than they have historically.

Applicability of multiples and limitations

The allure of multiples is that they are simple and easy to work with. They can be used to obtain estimates of value quickly for firms and assets, and are particularly useful when there are a large number of comparable firms being traded on financial markets and the market is, on average, pricing these firms correctly. They tend to be more difficult to use to value unique firms, with no obvious comparables, with little or no revenues and negative earnings.

By the same token, they are also easy to misuse and manipulate, especially when comparable firms are used. Given that no two firms are exactly similar in terms of risk and

growth, the definition of 'comparable' firms is a subjective one. Consequently, a biased analyst can choose a group of comparable firms to confirm his or her biases about a firm's value. An illustration of this is given below. While this potential for bias exists with discounted cashflow valuation as well, the analyst in DCF valuation is forced to be much more explicit about the assumptions which determine the final value. With multiples, these assumptions are often left unstated.

Illustration 2.2. The potential for misuse with comparable firms

Assume that an analyst is valuing an initial public offering of a firm that manufactures computer software. At the same time, the price-earnings multiples of other publicly traded firms manufacturing software are as follows:[3]

Firm	*Multiple*
Adobe Systems	23.2
Autodesk	20.4
Broderbund	32.8
Computer Associates	18.0
Lotus Development	24.1
Microsoft	27.4
Novell	30.0
Oracle	37.8
Software Publishing	10.6
System Software	15.7
Average PE Ratio	*24.0*

While the average PE ratio using the entire sample listed above is 24, it can be changed markedly by removing a couple of firms from the group. For instance, if the two firms with the lowest PE ratios in the group (Software Publishing and System Software) are eliminated from the sample, the average PE ratio increases to 27. If the two firms with the highest PE ratios in the group (Broderbund and Oracle) are removed from the group, the average PE ratio drops to 21.

---

[3] These were the PE ratios for these firms at the end of 1992.

The other problem with using multiples based upon comparable firms is that it builds in errors (over valuation or under valuation) that the market might be making in valuing these firms. In illustration 2.2, for instance, if the market has overvalued all computer software firms, using the average PE ratio of these firms to value an initial public offering will lead to an overvaluation of its stock. In contrast, discounted cashflow valuation is based upon firm-specific growth rates and cashflows, and is less likely to be influenced by market errors in valuation.

Asset Based Valuation Models

There are some who add a fourth approach to valuation to the three that we describe in this chapter. They argue that you can argue the individual assets owned by a firm and use that to estimate its value – asset based valuation models. In fact, there are several variants on asset based valuation models. The first is <u>liquidation value</u>, which is obtained by aggregating the estimated sale proceeds of the assets owned by a firm. The second is <u>replacement cost</u>, where you evaluate what it would cost you to replace all of the assets that a firm has today.

While analysts may use asset-based valuation approaches to estimate value, we do not consider them to be alternatives to discounted cash flow, relative or option pricing models since both replacement and liquidation values have to be obtained using one or more of these approaches. Ultimately, all valuation models attempt to value assets – the differences arise in how we identify the assets and how we attach value to each asset. In liquidation valuation, we look only at assets in place and estimate their value based upon what similar assets are priced at in the market. In traditional discounted cash flow valuation, we consider all assets including expected growth potential to arrive at value. The two approaches may, in fact, yield the same values if you have a firm that has no growth assets and the market assessments of value reflect expected cashflows.

Contingent Claim Valuation

Perhaps the most significant and revolutionary development in valuation is the acceptance, at least in some cases, that the value of an asset may not be greater than the present value of expected cash flows if the cashflows are contingent on the occurrence or

non-occurrence of an event. This acceptance has largely come about because of the development of option pricing models. While these models were initially used to value traded options, there has been an attempt, in recent years, to extend the reach of these models into more traditional valuation. There are many who argue that assets such as patents or undeveloped reserves are really options and should be valued as such, rather than with traditional discounted cash flow models.

Basis for Approach

A contingent claim or option pays off only under certain contingencies - if the value of the underlying asset exceeds a pre-specified value for a call option, or is less than a pre-specified value for a put option. Much work has been done in the last twenty years in developing models that value options, and these option pricing models can be used to value any assets that have option-like features.

The following diagram illustrates the payoffs on call and put options as a function of the value of the underlying asset:

Figure 2.1: Payoff Diagram on Call and Put Options
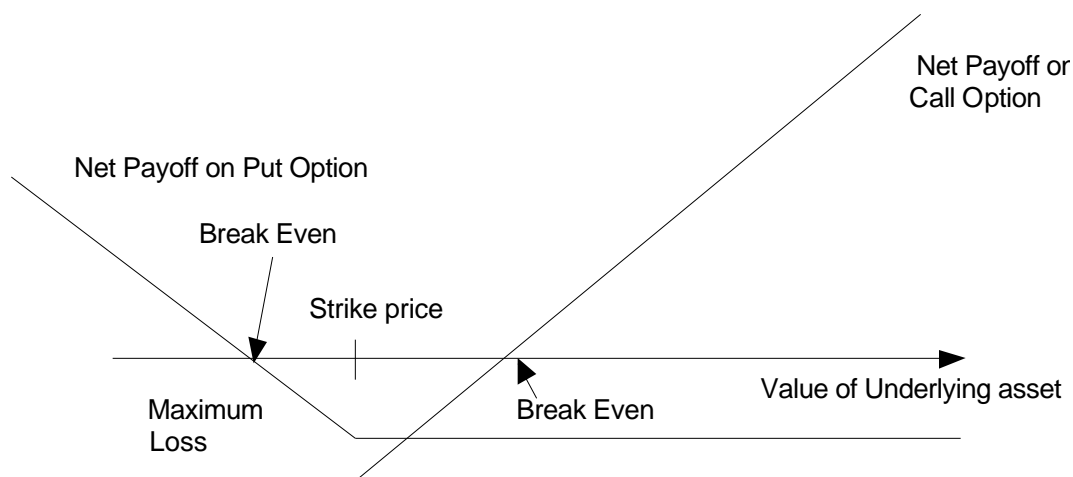
An option can be valued as a function of the following variables - the current value, the variance in value of the underlying asset, the strike price, the time to expiration of the option and the riskless interest rate. This was first established by Black and Scholes (1972) and has been extended and refined subsequently in numerous variants. While the Black-Scholes option pricing model ignored dividends and assumed that options would

not be exercised early, it can be modified to allow for both. A discrete-time variant, the Binomial option pricing model, has also been developed to price options.

An asset can be valued as an option if the payoffs are a function of the value of an underlying asset. It can be valued as a call option if the payoff is contingent on the value of the asset exceeding a pre-specified level.. It can be valued as a put option if the payoff increases as the value of the underlying asset drops below a pre-specified level.

Underpinnings for Contingent Claim Valuation

The fundamental premise behind the use of option pricing models is that discounted cash flow models tend to understate the value of assets that provide payoffs that are contingent on the occurrence of an event. As a simple example, consider an undeveloped oil reserve belonging to Exxon. You could value this reserve based upon expectations of oil prices in the future, but this estimate would miss the two non-exclusive facts.

1. The oil company will develop this reserve if oil prices go up and will not if oil prices decline.

2. The oil company will develop this reserve if development costs go down because of technological improvement and will not if development costs remain high.

An option pricing model would yield a value that incorporates these rights.

When we use option pricing models to value assets such as patents and undeveloped natural resource reserves, we are assuming that markets are sophisticated enough to recognize such options and to incorporate them into the market price. If the markets do not, we assume that they will eventually, with the payoff to using such models comes about when this occurs

Categorizing Option Pricing Models

The first categorization of options is based upon whether the underlying asset is a financial asset or a real asset. Most listed options, whether they are options listed on the Chicago Board of Options or convertible fixed income securities, are on financial assets such as stocks and bonds. In contrast, options can be on real assets such as commodities, real estate or even investment projects. Such options are often called real options.

A second and overlapping categorization is based upon whether the underlying asset is traded on not. The overlap occurs because most financial assets are traded, whereas relatively few real assets are traded. Options on traded assets are generally easier to value and the inputs to the option models can be obtained from financial markets relatively easily. Options on non-traded assets are much more difficult to value since there are no market inputs available on the underlying asset.

Applicability of Option Pricing Models and Limitations

There are several direct examples of securities that are options - LEAPs, which are long term equity options on traded stocks that you can buy or sell on the American Stock Exchange. Contingent value rights which provide protection to stockholders in companies against stock price declines. and warrants which are long term call options issued by firms.

There are other assets that generally are not viewed as options but still share several option characteristics. Equity, for instance, can be viewed as a call option on the value of the underlying firm, with the face value of debt representing the strike price and term of the debt measuring the life of the option. A patent can be analyzed as a call option on a product, with the investment outlay needed to get the project going representing the strike price and the patent life being the time to expiration of the option.

There are limitations in using option pricing models to value long term options on non-traded assets. The assumptions made about constant variance and dividend yields, which are not seriously contested for short term options, are much more difficult to defend when options have long lifetimes. When the underlying asset is not traded, the inputs for the value of the underlying asset and the variance in that value cannot be extracted from financial markets and have to be estimated. Thus the final values obtained from these applications of option pricing models have much more estimation error associated with them than the values obtained in their more standard applications (to value short term traded options).

Conclusion

There are three basic, though not mutually exclusive, approaches to valuation. The first is discounted cashflow valuation, where cashflows are discounted at a risk-adjusted

discount rate to arrive at an estimate of value. The analysis can be done purely from the perspective of equity investors, by discounting expected cashflows to equity at the cost of equity, or it can be done from the viewpoint of all claimholders in the firm, by discounting expected cashflows to the firm at the weighted average cost of capital. The second is relative valuation, where the value of the equity in a firm is based upon the pricing of comparable firms relative to earnings, cashflows, book value or sales. The third is contingent claim valuation, where an asset with the characteristics of an option is valued using an option pricing model. There should be a place for each among the tools available to any analyst interested in valuation.

Questions and Short Problems: Chapter 2

1. Discounted cash flow valuation is based upon the notion that the value of an asset is the present value of the expected cash flows on that asset, discounted at a rate that reflects the riskiness of those cash flows. Specify whether the following statements about discounted cash flow valuation are true or false, assuming that all variables are constant except for the variable discussed below:

  A. As the discount rate increases, the value of an asset increases.

  B. As the expected growth rate in cash flows increases, the value of an asset increases.

  C. As the life of an asset is lengthened, the value of that asset increases.

  D. As the uncertainty about the expected cash flows increases, the value of an asset increases.

  E. An asset with an infinite life (i.e., it is expected to last forever) will have an infinite value.

2. Why might discounted cash flow valuation be difficult to do for the following types of firms?

  A. A private firm, where the owner is planning to sell the firm.

  B. A biotechnology firm, with no current products or sales, but with several promising product patents in the pipeline.

  C. A cyclical firm, during a recession.

  D. A troubled firm, which has made significant losses and is not expected to get out of trouble for a few years.

  E. A firm, which is in the process of restructuring, where it is selling some of its assets and changing its financial mix.

  F. A firm, which owns a lot of valuable land that is currently unutilized.

3. The following are the projected cash flows to equity and to the firm over the next five years:

Year	CF to Equity	Int (1-t)	CF to Firm
1	$250.00	$90.00	$340.00
2	$262.50	$94.50	$357.00
3	$275.63	$99.23	$374.85
4	$289.41	$104.19	$393.59
5	$303.88	$109.40	$413.27
Terminal Value	$3,946.50		$6,000.00

(The terminal value is the value of the equity or firm at the end of year 5.)

The firm has a cost of equity of 12% and a cost of capital of 9.94%. Answer the following questions:

  A. What is the value of the equity in this firm?

  B. What is the value of the firm?

4. You are estimating the price/earnings multiple to use to value Paramount Corporation by looking at the average price/earnings multiple of comparable firms. The following are the price/earnings ratios of firms in the entertainment business.

Firm	P/E Ratio	Firm	P/E Ratio
Disney (Walt)	22.09	PLG	23.33
Time Warner	36.00	CIR	22.91
King World Productions	14.10	GET	97.60
New Line Cinema	26.70	GTK	26.00

  A. What is the average P/E ratio?

  B. Would you use all the comparable firms in calculating the average? Why or why not?

  C. What assumptions are you making when you use the industry-average P/E ratio to value Paramount Communications?