VALUATION—II

Review

We are exploring the case of the valuation of the Singer Furniture Company. This case developed out of the bust-up of the Singer Company. As you recall, Singer started as a sewing machine company. However, over the years it became a highly diversified manufacturing firm. The company made rifles during WWII, it had numerous small machine plants here in SC that made drills and vacuum cleaners. And, of course, it continued to make sewing machines.

In 1988, Singer was taken over by a corporate raider, Paul Bilzerian.[1] Bilzerian sold the Singer Sewing Machine name and operations to James Ting, a Hong Kong businessman. Ting sold Singer Furniture Company back to SFAC, Inc., a holding company controlled by Bilzerian. A dispute arose over payments that Bilzerian was supposed to make to Ting. Ting sued to regain control of the company. A question arose as to its value. What we tried to do was construct an estimate the value of SFC that would have been reasonable if the firm had been appraised in 1992.

We left off with the calculation of the asset beta for SFC. It was .79. We will use this shortly in the valuation of SFC.

Discount Cash Flow Formula Revisited

The DCF valuation method assesses the value of the company based on the earnings flowing from the productive assets and on-going operation of the enterprise. The purpose of the technique is to determine the present value equivalent to the stream of future earnings that makes the owner, current or prospective, indifferent between the cash equivalent and the rights to the earnings flows.

The DCF formula commonly used to value businesses is:

$$P = \sum_{t=1}^{5} \frac{CashFlow_t}{(1+r)^t} + \frac{CF_5/(r-g)}{(1+r)^5}$$

where P is the present value of the business, *Cash Flow* is the estimated net cash flow the enterprise is generating, g is the real growth rate in these cash flows in the long term, r is the discount rate. This formula assumes that the business will grow for a period of 5 years at a rate higher than the real growth rate. The cash flows forecast for these first 5 years will reflect this. Their mature value at the end of 5 years is then used in the constant growth formula and this, too, is discounted back from 5 years out. One way of thinking about this is to assume that the business is managed to maturity and then sold. The constant growth formula tells us what the sale price would be.

In the case of SFC, it was assumed that the business was mature and that the last year for which financials were available represented the cash flows that could be expected into the future. Based on this assumption, the constant growth formula is appropriate:

[1] Bilzerian gained notariety by going to jail for illegal stock trading. The SEC tried to pry the gains he made in the Singer deal and others away from him. He declared bankruptcy in Florida and kept his multimillion dollar home. It is claimed that he stashed a good bit out of the country.

$$P = \frac{CF}{r - g}$$

The Components of Cash Flow

The actual computation of cash flows to be used in the DCF method begins with earnings before interest expenses but after taxes. Several adjustments are made to these earnings after taxes in order to derive an estimate of expected future cash flow. These adjustments include the add-back of depreciation, and the deduction of capital expenditures and increases in working capital. These points are discussed below.

Add-back of depreciation

Consider the following example:

Sales		80,000
Cost of Goods Sold	-20,000	
Depreciation (deducted)	-40,000	
Earnings before Taxes		20,000
Taxes (35%)	-7,200	
Earnings after Taxes		12,800
Depreciation (added back)	+40,000	
Cash Flow (before cap. exp.)		52,800

As shown here, the cash flow exceeds earnings after taxes by $40,000 due to the add-back of depreciation. This point is very important for valuation. The value of a firm depends on the accrual of cash flows, not just profits. As depreciation is not an actual cash expense, it should be added back to profits after taxes in order to derive cash flows. Thus, not adding back depreciation to after-tax profits would underestimate the value of the firm. Depreciation is an expenses that the IRS allows to be deducted from current earnings when computing current tax liabilities. However, even though depreciation is a current tax shield, it is not a current expense. It represents the current recovery of cash that was used to purchase productive assets in the past. In that sense, it represents the cash flow associated with the value of the assets in place in the business. Hence, it is crucial to include this value in the cash flow of the company used to assess the value of the company.

Subtraction of capital expenditures

Capital expenditures are cash outflows. Capital expenditures are investments in the business that are expected to produce future cash flows. Capital expenditures are not automatically deducted from earnings in the income accounting statement because IRS rules do not allow the immediate expensing of capital expenditures. The add-back of depreciation and subtraction of capital expenditures translates the accounting picture of the firm, which is formed by guidelines based on the rules of taxation by government, into the financial picture of the cash-flow value of the enterprise.

Accounting for changes in net working capital

When a firm grows, there is a corresponding increase in working capital. The three primary components are accounts receivable, inventory, and accounts payable. From a valuation perspective, changes in working capital are not immediately reflected in the income statement. The income statement appears to show an increase in cash flow when the firm grows, but not all of the apparent increase in cash is available to the owners of the enterprise because some of it is taken up in the expansion of working capital. For example, an increase in accounts receivable from one year to the next implies that the cash inflow from sales is actually less than the sales level reported on the income statement. Consider the following example.

Sales			8,000,000
Accounts Receivable at beginning of Year	1,000,000		
Accounts Receivable at end of Year	1,500,000		
Net Change in Working Capital		500,000	
Cash Inflow			7,500,000

Thus, cash inflow is $500,000 less than sales due to the resulting increase in receivables. With respect to the other two primary components of working capital, increases in inventory have the same effect as increases in receivables, whereas increases in payables have the opposite effect. The basic calculation is to subtract increases in net working capital from earnings after taxes in the same fashion that depreciation is added back to those earnings.

Changes in working capital must be accounted for in the construction of cash flows using the DCF method of valuation. Because working capital often grows as earnings grow, a conservative approach is to assume that they grow at the same rate.

Construction of Cash Flows for Singer Furniture Company

To value a firm using the DCF model, historical financial figures are important only to the extent that they can be used to forecast future estimates of cash flows. The value of the firm depends on the expected future cash flows rather than the prior actual cash flows.

The Singer Furniture Company was taken over in 1989 by SFAC. We used the financials in 1991 as the forecast of the cash flows that could be expected from then on. The financial performance in the first two years were not as good, but arguably reflected the change in ownership and management. By the end of 1991, the business operation should have begun adjustment to this restructuring and the financial reports of that year present a reasonable picture of the cash flows that the business should have been expected to achieve into the future. We assumed, conservatively, that the business would not grow any larger in real terms. However, we did assume that growth would occur due to inflation. A benchmark growth rate of 3.92 percent based on the average annual compound inflation rate from 1982 through 1991 was used.[2]

TABLE 1 shows the cash flows for Singer Furniture Company. The values for earnings before interest and taxes, depreciation, capital expenditures, and working capital are based on the audited financial statements as of the end of 1991. Taxes are assumed to be 35 percent.

The value for Increases in Working Capital in 1991 is based on the assumption that the value of Working Capital in 1991 was the optimal value. If working capital in 1991 was optimal

[2] This value is computed from Ibbotson, 1995.

then it is predicted to grow over time based on the growth rate assumed for cash flows. Hence, this value is deducted from the Cash Flows Net of Taxes to arrive at the value of Net Cash Flows. This Net Cash Flow estimate is predicted to be the base level of real cash flows into the future. The formula for Increases in Working Capital in the year 1991 is ($g/(1+g)$) times Working Capital in 1991, where g is the growth rate (assumed in benchmark case to be driven only by inflation).

For the benchmark estimate of the value of SFC, it is assumed that the life of the firm is indefinite. In association with the values shown in TABLE 1, this implies that the capital expenditures deducted from the after-tax earnings of SFC in 1991 are expected to recur annually in order to replenish the capital stock of the company so that the stock of physical capital in place in 1991 can be maintained indefinitely.

Tax Shields

One final consideration in the valuation process is the treatment of debt. The DCF formula as it has been discussed thus far gives an estimate of the value of an unlevered company. Because of the way federal income taxes law treat interest payments, it is generally beneficial for firms to employ debt in their capital structure. Interest payments to bondholders are a tax deduction from earnings, but similar dividend payments to shareholders are not. In the process of valuation, the approach is straightforward. First the value of the all equity firm is computed based on the preceding components. Then the value of the tax shields created by shifting capital structure from all equity to part debt and part equity are computed. The overall value of the firm is the sum of the component parts.1

The value of tax shields provided by debt are calculated as follows. The interest expense from the income statement, which is the interest rate times the level of debt, is multiplied times the corporate tax rate that was used to devalue the taxable earnings as shown in TABLE 1.

Interest Expense = Borrowing Rate • Level of Debt

Annual Tax Shields = Interest Expense • Tax Rate

In other words, since corporate taxes are avoided on the interest expenses, the money that would have been paid to the government goes instead in the pocket of the stock holders. This number is the annual flow resulting from the tax savings. If debt is assumed to be a permanent part of the capital structure, the value of the firm is increased by the discounted present value of these tax shields. To compute the value of the firm associated with tax shields the annual flow is discounted to the present using a formula similar to the one used to discount the cash flows from earnings.

Two factors must be considered. A discount rate must be chosen, and an assumption about the long-run capital structure of the firm must be made. Two assumptions that are parsimonious in this regard are: First, the discount rate used to value the tax shields is the same as the interest rate that generates the interest expense, and second, the level of debt in the firm, rather than the debt to equity ratio, is expected to be a constant. Using these assumptions gives:

(a) Discounted Value of Tax Shields = Annual Tax Shields / Discount Rate

(b) = [Tax Rate • Debt • Interest Rate] / Interest Rate

(c) = Tax Rate • Debt

The divisor in line (a) includes the discount rate, *r*, but not the growth rate, *g*, from the constant growth formula because of the assumption that the debt level will remain constant. Next, the interest rate is substituted for the discount rate so that in line (b), the interest rate can be canceled out leaving line (c). Line (c) says that the capitalized value of the tax shields is simply the level of debt times the corporate tax rate. Note that if the debt to equity ratio is assumed to remain constant through time, the level of debt would grow and the capitalized value of the tax shields would be larger.

In the case of SFC, the long-term debt level is around $25 million and is assumed to be a permanent part of the capital structure of the business.

The Discount Rate

The discount rate for Singer Furniture Company was calculated based on the facts as known in 1992. The discount formula is:

$$r_{SFC} = r_f + \beta_{SFC} ERP$$

The beta that we use in the formula is the asset beta for the comparable firms that we discussed in the last lecture; its value is .79. In 1992, the 30-year U.S. Treasury Bond rate was 7.7 percent and the *ERP* was 7.3 percent, which at that time was the premium of common stocks over long-run T-bonds for the previous 70 years. (The possibility of a declining ERP or excessive growth was not yet imagined.)

Evaluating the formula using the estimates of the various component parts gives a rate appropriate to use in discounting the future cash flows of Singer Furniture Company of 13.47 percent.

The Implied Value Of Singer Furniture Company

Incorporating the discount rate, inflationary growth rate, and the estimated value of cash flows given in TABLE 1, the unlevered value of Singer Furniture Company can be calculated. TABLE 2 displays the valuation estimate. The unlevered value of SFC is shown in row (4) of TABLE 2. Row (6) shows the value of the tax shields that are afforded by the face value of the debt that company was carrying in 1991. The sum of the unlevered value plus the value of the tax shields represents the full value of the enterprise as it looked in 1991.

To arrive at the net equity value of the enterprise, the face value of the debt must be subtracted from the total value of the firm. This leaves the equity value of the firm and is shown in row (9) of TABLE 2. The per share value is given by dividing by the number of shares outstanding. The per share value is shown on the last row, (11), of TABLE 2. It is estimated to be $13.38 using the benchmark assumptions.

TABLE 1
Cash Flows to Singer Furniture Company, 1991

Earnings before Interest and Taxes		$3,110,465
less taxes at 35%	($1,088,663)	
Cash Flow Net of Taxes		$2,021,802
plus Depreciation in 1991	$3,372,857	
less Capital Expenditures in 1991	($1,431,682)	
less Increases in Working Capital	($1,100,241)	
Net Cash Flow		$2,862,736

Notes: EBIT, depreciation, capital expenditures, and working capital taken from SFC financials. The value for Increases in Working Capital is based on the assumption that the value of Working Capital in 1991, $29,189,109, was the optimal value. Increases in Working Capital are the growth rate divided by 1 plus the growth rate times Working Capital. Growth rate for cash flows shown in Table 2.

TABLE 2
Value of Singer Furniture Company

(1) Net Cash Flow	$2,862,736
(2) Growth Rate of Cash Flows	3.92%
(3) Discount Rate	13.47%
(4) Value of All Equity Firm	$29,966,883
(5) Annual Tax Shield (1991)	$986,560
(6) Value of Tax Shields (Debt Level times Tax Rate)	$8,976,508
(7) Value of Firm (levered)	$38,943,391
(8) Face Value of Debt	$25,647,166
(9) Value of Equity, Net of Debt	$13,296,225
(10) Shares Outstanding	993988
(11) Price of Stock per share	$13.38

Notes: The growth rate of cash flows is the annual average rate of inflation over the period 1982 through 1991, from Ibbotson, 1995, p. 204-205.

PROJECT EVALUATION: PROBLEMS AND ISSUES

Comparing DCF to Other Valuation Methods

The discounted cash flow valuation model forecasts the future cash flows of the corporation or assets and then discounts these cash flows back to the present to obtain the current or present value of the enterprise. Of all the valuation methods it is the least affected by unusual circumstances because it makes specific assumptions about the expected future cash flows of the business being valued. It relies on the use of comparable firms only to estimate the correct rate at which to discount the expected future cash flows. Most importantly, this approach is the fundamentally sound and theoretically correct way to value assets and firms. It is based on the principles of the financial and economic theory of asset pricing.

P/E Multiples

A common approach to valuing private companies and divisions of publicly-traded corporations is to apply price/earnings multiples from comparable firms that are publicly traded. The appeal of this approach is its simplicity. The drawback is that P/E multiples are indicators of equity values rather than total firm values and can often be influenced by accounting techniques as well as the fact that the market price of common stock embodies the capitalized value of the expectation of future events. These future events may imply cash flows that are very different from the current earnings of the enterprise.

Cash Flow Multiples

Some valuation experts use cash flow multiples to value firms. The cash flow multiple approach is similar to the P/E multiples technique in that it uses the market value of comparable firms. However, the cash flow multiple is preferable because the information necessary to implement it is more relevant. Rather than using earnings which are sensitive to accounting techniques, it uses cash flows. Even so, it still suffers from the fact that it uses the stock market valuation of the assets generating the current cash flows. These stock market valuations may be based on expectations of future rather than current cash flows.

Weighted Average Cost of Capital

An alternative way to measure the total value of the firm is to discount the total cash flows to the firm using the weighted average cost of capital. The formula for the weighted average cost of capital is given by:

$$r = r_D \cdot (1-\tau)\frac{D}{D+E} + r_E \frac{E}{D+E}$$

where r is the discount rate associated with the WACC, D is the value of debt, E is the value of equity, r_D is the interest rate on debt, r_E is the risk adjusted discount rate for equity, and τ is the tax rate on equity income.

The problem with this formula is that to use it we need to know everything we are trying to determine. Since E is the PDV of equity, we cannot implement this formula by looking at our own enterprise. However, we can look at comparable firms.

Other Methods of Project Valuation

There are two other methods of project evaluation than DCF that are fairly standard. They are the payback period and internal rate of return. Let's consider DCF in contrast to these other methods.

The payback period looks at the time necessary to recover the initial investment. Not very sophisticated and as a consequence not always an accurate description of the project. Internal rate of return is an analytical technique that determines the interest rate that causes the net present value of a project to be zero. In other words, if we were to apply the DCF rule, to a project we would get some number which is the dollar value of the project. The IRR method uses that same calculation but searches across interest rates until the highest rate is found, which is the one that sets the DCF to zero.

Consider the following set of projected cash flows from ventures A-D:

t	A	B	C	D
0	-1000	-1000	-1000	-1000
1	100	0	100	200
2	900	0	200	300
3	100	300	300	500
4	-100	700	400	500
5	-400	1300	1250	600
Payback	2	4	4	3
DCF	-406.8	510.7	530.9	519.5
IRR	n/a	20.9%	22.8%	25.4%

Notice that the payback period approach does not distinguish between projects B and C. Moreover, it does not recognize that project A is not good (unless you are a scam artist). Internal rate of return won't calc for project A, which is ok because it is negative DCF, but the problem of negative cash flows at the end messes up the IRR as well as the payback approach.

Based on IRR, project D is the best. Based on DCF, the nod would go to project C. Why is the IRR rule wrong? Under what circumstances might it be right?

Projects with different lives.

Consider two projects:

t	A	B
0	-10	-10
1	6	4
2	6	4
3		4.75
PV	.41	.500
PV(N,∞)	2.38	.202
IRR	13%	12.8%

Choice between simple one-time projects is simple. Use maximum present value rule. However, the IRR rule picks project A and because project A returns the cash flows sooner, we are suspicious that it has some value we are not capturing some important aspect of value in our maximum present value rule.

That suspicion is revealed if we consider that the projects may be replicated. Assume that the projects can be rolled over. When project A is completed after 2 years, another infusion of $10 can again recover two year's of $6 payouts. Similarly for project B after three years. What we need is a formula to characterize this value.

For one-period compounding:

$$PV(N,\infty) = PV(N) \cdot \left[\frac{(1+r)^N}{(1+r)^N - 1} \right]$$

where *PV*(*N*) is the net present value of the project that lasts *N* periods, and *PV*(*N,∞*) is that project replicated an infinite number of times.

For continuous compounding:

$$PV(N,\infty) = PV(N)\cdot\left[\frac{e^{-rN}}{1-e^{-rN}}+1\right].$$[3]

Duration

The analysis of projects with fixed lives raises the question of how to determine the optimal life of a project. While these kinds of problems can be elaborate, a simple case sets the tone. Consider growing trees. Trees are planted. As they grow, they increase in value. Call this *R*. *R* is a function of *t*, *R*(*t*). The present value of the tree project is

$$PV = R(t)e^{-rt} - c$$

where *c* is the cost of planting. The optimal life of the trees can be found by differentiating present value with respect to *t*:

$$\frac{dPV}{dt} = \frac{dR(t)}{dt}e^{-rt} - rR(t)e^{-rt} = 0$$

This simplifies to the Fisherian Rule. The trees should be cut when their growth rate in value is equal to the interest rate:

$$\frac{dR/dt}{R} = r$$

An example serves to illustrate. Let *c* be \$15; let the growth function be $R = A(1+t)^{1/2}$, where *A* is \$10; let *r* be .05. The derivative of the growth function is:

$$\frac{dR(t)}{dt} = \frac{1}{2}10(1+t)^{-\frac{1}{2}}$$

Fisher's Rule is then:

$$\frac{dR/dt}{R} = \frac{5(1+t)^{-1/2}}{10(1+t)^{1/2}} = \frac{1}{2(1+t)} = r$$

which gives *t**=9.

Naturally, we are lead to ask what would happen in this case if we allowed for replanting. As solved above, the tree project is a one-shot deal. The more common event is that the trees are cut and then replanted. In the case of replanting, the project can be characterized as:

$$PV = [R(t)e^{-rt} - c] + [R(t)e^{-rt} - c]e^{-rt} + [R(t)e^{-rt} - c]e^{-r2t} + \ldots$$

[3] If the original project is discounted using continuous compounding, its PV is .34 instead of .41.

That is, the project is undertaken once, and then again, and again. The cycle continues into the future infinitely. This process can be recast as one economic agent starting the project and then selling it after one cycle to another economic agent who will continue it. In this way we can rewrite the problem as:

$$PV = [R(t)e^{-rt} - c] + PVe^{-rt}$$

This formulation solves easily as:

$$PV = \frac{R(t)e^{-rt} - c}{1 - e^{-rt}}$$

After some uninteresting algebra, the optimization rule becomes:

$$\frac{dR(t^*)}{dt} = rR(t^*) + rPV^*$$

This says that at the optimal cutting time the appreciation in value of the trees is exactly equal to the opportunity cost of the standing timber plus the opportunity cost of the land.

Returning to our example, the solution in this case is a bit more cumbersome, but it can be shown that the optimal cutting time with replanting is slightly less than 5 years.

It is instructive to consider how the IRR treats the problem of the trees. In the single period problem, the internal rate of return solves the optimal life of the trees at 4 years. The algebra of this is shown below, but it is not particularly important. The main point is that the IRR rule very closely approximates DCF with replication, though it is not exactly correct. The reason that IRR is close in cases where replication is possible is because it implicitly assumes that the project that maximizes the internal rate of return is best because that return can be earned again and again. Generally, this is not so. This is why assessing projects based on their true discount rate and then choosing projects based on maximizing DCF is the proper strategy for maximizing wealth.

IRR in the Growth Problem

Maximize i subject to

$$R(t)e^{-it} = c \qquad 1.$$

Returning to our example where $R=A(1+t)^{1/2}$, substitute for R in (1) above and then take the log of both sides.

$$\ln A + \frac{1}{2}\ln(1+t) - it = \ln c$$

This simplifies to

$$\max_{\{t\}} i = \frac{\ln A + \frac{1}{2}\ln(1+t) - \ln c}{t}$$

which is maximized over the choice of t. The function has a unique maximum at around 4 years.

Constrained Capital Budgeting

What if you are offered a choice between two projects. One requires and initial investment of $100 but pays back $1000 in present value terms. The other requires an initial investment of $50,000 but pays back $2000. Which project is better?

The size of the difference in the numbers is staggering. No doubt every one of you has doubts that the second project is better even though it is the right choice based on the DCF rule. But how can this be? Is the rule missing something?

Our intuition about the choice between the two projects is based on some basic sense of risk. We see the first project as less risky and hence the better payoff. We simply cannot believe that the second $1000 is worth the risk of the extra $49,900 investment.

The DCF rule can be made to come into line with our intuition, at least somewhat, if we consider the problem of project evaluation from the prospective of a constrained capital budget. Simply enough, from a constrained cap. budget perspective, project one is a throw away. Of course we do it. Project two, however, may require tapping additional sources of finance.

This analysis can be summarized by using a DCF Index. Create an index for each project which is the present value of the cash inflows divided by the initial cash outflow. Thus, each positive DCF project has an DCF index that is greater than zero. Some by more, some by less. Next, a project capital exp. index is created by taking the ratio of the initial investment of each project and dividing by the capital budget. Projects are chosen by sorting through the alternative investments until the overall present value index is maximized subject to the capital budget constraint.

One last word: it is important to recognize that the DCF approach is built on the concept that the discount rate properly embeds risk into the decision making. Recognize that part of the intuition of balking at the proper choice between the two project alternatives listed above is that you may not fully appreciate the treatment of risk in the context of CAPM.