FIGURE 10.2 The Variables in Each Residual Income Valuation Equation

	entity value		common equity value		preferred stock value		minority interest		debt value		tax shield
	P_t uses	=	P_e uses	+	P_{ps} uses	+	P_{mi} uses	+	P_d uses		
	NOA_t	=	CE_t	+	PS_t	+	MI_t	+	L_t		
and	NOI_t	=	NI_t	+	PD_t	+	MIE_t	+	I_t	−	tx_tI_t
and discounts using											
	r_w		r_e		r_{ps}		r_{mi}		r_d		
weighted average of r_e, r_{ps}, r_{mi} and $(1 - tx)r_d$											

value of tx_tI_t is incorporated into entity value by using $(1 - tx)r_d$ in r_w computation.

the bottom of the Valuation Parameters sheet in *eVal* to find the internally consistent weighted-average cost of capital. You input the cost of equity capital, the cost of preferred equity, the cost of minority interests, and the pretax cost of debt capital on the Valuation Parameters sheet, and then with a little help from you, *eVal* figures out the weighted-average cost of capital that perfectly reflects the future tax savings.

The tax shield on interest is only an issue when valuing the common equity using this indirect approach. When valuing equity directly, interest payments and the associated tax deductions are just another type of expense that is tax-deductible, no different than utilities or marketing expenses. So if you didn't follow the discussion in this last section, you didn't really miss much.

10.3 DISCOUNTED CASH FLOW VALUATION

The discounted cash flow (DCF) model focuses on free cash flows rather than residual income flows. *eVal* computes the DCF model two ways: (1) Based on the free cash flows directly to common equity holders, and (2) Based on the free cash flows to all investors. With the "all investor" approach, the common equity is valued indirectly as the entity value less the value of the debt, the value of the preferred stock claims, and the value of the minority interest claims (just like the residual income to all investors model given in the previous section). The valuation attribute that drives the DCF model, in either form, is free cash flow. Chapter 6 describes in detail how this amount can be computed in several different, yet equivalent, ways. These derivations are shown in *eVal* on the Cash Flow Analysis sheet. We will give a few formulas for free cash flows here, but we refer you back to Chapter 6 for the details.

DCF to Common Equity

The *free cash flow to common equity* is the primary building block for all our valuation models. It is the net cash distributions to equity holders, labeled D_t. We can compute this amount directly as cash dividends plus stock repurchases

less equity issuances. Alternatively, we can use the clean surplus relation and compute D_t based on net income and the change in common equity. That is, the clean surplus relation in accrual accounting requires that

$$CE_t = CE_{t-1} + NI_t - D_t.$$

Rearranging this expression gives

$$D_t = NI_t - (CE_t - CE_{t-1}).$$

This is the cash flow that ultimately determines the value of a common equity claim. Discounting these flows at the cost of equity capital gives us the mother of all valuation models, the *DCF to Common Equity Model,* shown formally as

$$P_e = \sum_{t=1}^{\infty} \frac{D_t}{(1 + r_e)^t},$$

where

P_e is the value of the common equity,

D_t is the net cash distributions to common equity holders, and

r_e is the cost of equity capital.

Your forecasted financial statements describe net income and common equity forever into the future. From these amounts, we compute D_t and discount these flows at rate r_e. Nothing could be simpler, really. The knock on this model is that it is hard to develop much intuition for future D_t flows. D_t is the distribution of wealth to equity holders, which typically happens much later than the actual creation of wealth. Further, past D_t is a poor predictor of future D_t, so you really need to rely on the financial statements to derive forecasts of future D_t. Extrapolation alone won't get you very far.

Since all four of the valuation models we discuss in this chapter are algebraically equivalent, it is hard to argue which of the models is the "original version." Nonetheless, this model is probably the first, most basic, expression of the value of an equity security. The formal derivations of the other models typically start here.[2] Figure 10.3 illustrates the DCF valuation to common equity for Kohl's as of January 31, 2010. To see this in *eVal*, go to the DCF Valuations sheet (after changing the valuation date to January 31, 2010 on the Valuation Parameters sheet). The figure illustrates the computation of net distributions to common equity holders, labeled as the Free Cash Flow to Common Equity,

[2]It takes little work to derive the residual income model from the DCF to common equity model. Start with the DCF model and write D_t as $NI_t - (CE_t - CE_{t-1})$. For each future date, substitute for NI_t the value $RI_t + r_e CE_{t-1}$. The first term in the summation (when $t = 1$) is $(1 + r_e)^{-1}[RI_1 + r_e CE_0 - CE_1 + CE_0] = CE_0 + (1 + r_e)^{-1}RI_1 - (1 + r_e)^{-1}CE_1$. The second term in the summation (when $t = 2$) is $(1 + r_e)^{-2}[RI_2 + r_e CE_1 - CE_2 + CE_1] = (1 + r_e)^{-2}RI_2 + (1 + r_e)^{-1}CE_1 - (1 + r_e)^{-2}CE_2$. Adding these two terms together gives $CE_0 + (1 + r_e)^{-1}RI_1 + (1 + r_e)^{-2}RI_2 - (1 + r_e)^{-2}CE_2$. As you can see, we are building the residual income model term by term. Every time we add another term in the summation we add in the appropriately discounted RI_t term and cancel the last term in the previous sum. Since the summation is infinite, the last term is pushed out infinitely far into the future, and hence has zero present value.

FIGURE 10.3 Discounted Cash Flows to Common Equity for Kohl's
Valuation based on *eVal* defaults as of January 31, 2010.

DCF Valuations	($000)			
Company Name	KOHL'S CORP			
Most Recent Fiscal Year End	10-01-31			
Date of Valuation	10-01-31			
Cost of Common Equity	10.00%			
Terminal Growth Rate	3.00%			
Fiscal Year of Forecast	11-01-31	12-01-31	13-01-31	14-01-31
Valuation to Common Equity				
Free Cash Flow to Common Equity	681,779	724,931	769,408	815,126
Present Value of FCF	619,799	599,117	578,067	556,742
Present Value Beyond 10 Years	6,392,730			
Present Value of First 10 Years	5,241,733			
Forecast Equity Value Before Time Adj.	11,634,463			
Forecasted Value as of Valuation Date	12,216,186			
Less Value of Contingent Equity Claims	0			
Value Attributable to Common Equity	12,216,186			
Common Shares Outstanding at BS Date	307,000			
Equivalent Shares at Valuation Date	307,000			
Forecast Price/Share	$39.79			

$= NI_1 - (CE_1 - CE_0)$
$= 1{,}046{,}887 - (8{,}218{,}108 - 7{,}853{,}000)$

$= 724{,}931/(1+.10)^2$

$= 681{,}779/(1+.10)^1$

and a few present value computations for individual years. For details on the computation of free cash flow to common equity, we refer you to Chapter 6, and to the Cash Flow Analysis sheet in *eVal*. The present value for the first 10 years is added to the present value for all years after year 10 to arrive at the Forecast Equity Value Before Time Adjustments. The details of the present value computations and the time adjustments are discussed in a later section. Note that the final result, before time adjustments, is $11,634,463 thousand, exactly the same result we reached using the residual income models.

DCF to All Investors

When someone in practice says "the DCF model," this is the model they typically have in mind. This model is the warhorse of MBA programs. Unfortunately, because the computation of the *free cash flow to all investors* is rather involved, and because "all investors" models require a weighted-average cost of capital that anticipates future tax rates and leverage ratios, it is the rare user who can successfully compute the DCF to all investors model without error. By automating the required computations, *eVal* makes sure you don't mess up along the way.

Because of the long history this model has enjoyed, a number of different ways to compute the free cash flow to all investors have emerged. We summarize two methods here; we refer you to Chapter 6 for more detailed explanations or to the Cash Flow Analysis sheet in *eVal* for an example using Kohl's for the year ended January 31, 2010. The free cash flow to all investors, denoted here as C_t, is computed most directly as

$$C_t = NOI_t - (NOA_t - NOA_{t-1}).$$

In words, the free cash flow to all investors equals the net operating income less the increase in net operating assets. This should feel right. All investors together claim the cash flows that emanate from the use of the net operating assets. Free cash flow differs from NOI_t because accrual accounting recognizes some NOI_t dollars that are not yet cash dollars, which necessarily means they are still in NOA_t. Subtracting the increase in NOA_t from NOI_t leaves us with the cash that the entity generated from its operations over the period.

You can also compute the free cash flows directly from data given on the statement of cash flows. Just ask yourself, what cash went to each investor group? The company sent equity holders the net distribution D_t (i.e., common dividends plus stock repurchases less equity issuances). The firm sent debt holders interest, and less any increase in principle, denoted ΔL_t. Similarly, the firm sent preferred stockholders preferred dividends PD_t less any new issuances, denoted ΔPS_t; and the firm sent the minority interests MIE_t less any increase in the minority interest balance, denoted ΔMI_t. Finally, recall that convention dictates that we exclude the cash taxes saved from the tax deductibility of interest from C_t (instead, reflecting these cash flows in the form of a lower after tax cost of debt). Putting it all together. we have:

$$C_t = D_t + I_t - \Delta L + PD_t - \Delta PS_t + MIE_t - \Delta MI_t - tx_t I_t$$

If you suffer from insomnia and enjoy the finger exercises that only algebra can provide, you can show that this expression for C_t equals the previous one.[3]

Armed with the free cash flow to all investors C_t, we can now compute the *entity value*—the value of the operations to all investors before distinguishing between claimants. Denoting the weighted-average cost of capital as r_w and the entity value as P_f, we have

$$P_f = \sum_{t=1}^{\infty} \frac{C_t}{(1 + r_w)^t}$$

and, yes, this version of P_f is exactly equal to the P_f computed using the residual income to all investors model shown in the previous section. To compute the value of the common equity claim, we subtract from P_f the value of the debt P_d, the preferred stock claim P_{ps} and the minority interest claim P_{mi}. In the spirit of discounting cash flows, each of these non-common-equity claims is itself valued based on the cash flows it receives. Denoting the pre-tax cost of debt as r_d, the cost of preferred stock as r_{ps}, and the cost of minority interests as r_{mi}, we have

$$P_d = \sum_{t=1}^{\infty} \frac{(I_t - \Delta L_t)}{(1 + r_d)^t}$$

$$P_{ps} = \sum_{t=1}^{\infty} \frac{(PD_t - \Delta PS_t)}{(1 + r_{ps})^t}$$

[3]Here is the proof. By definition $NOI_t = NI_t + I_t(1 - tx_t) + PD_t + MIE_t$ and $\Delta NOA_t = \Delta CE_t + \Delta L_t + \Delta PS_t + \Delta MI_t$. Substitute these expressions for NOI_t and $(NOA_t - NOA_{t-1})$ in the first C_t expression. Next, note that by the clean surplus relation $NI_t = D_t + \Delta CE_t$. Substitute this in for NI_t, cancel the plus and minus ΔCE_t and you have the second expression for C_t.

and

$$P_{mi} = \sum_{t=1}^{\infty} \frac{(MIE_t - \Delta MI_t)}{(1 + r_{mi})^t}.$$

The values of P_d, P_{ps}, and P_{mi} computed based on their respective future cash flows are exactly the same as their values computed in the previous section based on residual income flows. Putting it all together, we compute the value of the common equity as:

$$P_e = P_f - P_d - P_{ps} - P_{mi},$$

just as in the previous section. Finally, we can mix and match between the residual income model and the discounted cash flow model. For instance, it is not uncommon to compute the value of the debt P_d or the value of the preferred stock using a residual income model, with the added assumption that all future residual flows to these claimants are zero. In other words, the value of the debt and the value of the preferred stock are simply assumed to equal their current book values, L_0 and PS_0, respectively.

Figure 10.4 illustrates the DCF valuation to all investors for Kohl's as of January 31, 2010 using the default *eVal* forecasts. To see this in *eVal*, go to the DCF Valuations sheet and scroll down (and set the valuation date to

FIGURE 10.4 Discounted Cash Flows to All Investors for Kohl's
Valuation based on *eVal* defaults as of January 31, 2010.

Fiscal Year of Forecast	11-01-31	12-01-31
Valuation All Investors		
Cost of Net Debt	8.00%	
Cost of Preferred Stock	9.00%	
Cost of Minority Interest	10.00%	
After Tax Weighted Average Cost of Capital	9.37%	
Free Cash Flow to Debt	40,902	46,257
Present Value of FCF to Debt	37,872	39,658
Value of Debt	1,438,346	
Free Cash Flow to Preferred Stock	0	0
Present Value of FCF to Preferred Stock	0	0
Value of Preferred Stock	0	
Free Cash Flow to Minority Interest	0	0
Present Value of FCF to Minority Interest	0	0
Value of Minority Interest	0	
Free Cash Flows to Investors	671,158	717,314
Present Value of FCF to Investors	613,646	599,647
Entity Value	13,072,809	
Less Value of Net Debt	(1,438,346)	
Less Value of Preferred Stock	0	
Less Value of Minority Interest	0	
Forecast Equity Value Before Time Adj.	11,634,463	

= Int. Expense – increase in Debt = 137,049 – 96,147

= 40,902/(1+.08)^1

= 46,257/(1+.08)^2

= *NOI* – increase in *NOA* = 1,132,413 – 461,255 taken from Cash Flow Analysis sheet

= 717,314/(1+.0937)^2

sum of present values of FCF to Investors

January 31, 2010 on the Valuation Parameters sheet). The figure shows the free cash flows each period to debt and then the free cash flows to all investors (preferred stock and minority interests are zero at Kohl's). Note that the value of debt, the value of preferred stock, and the entity value are each computed using a different discount rate. In particular, the entity value is computed using the weighted average cost of capital of 9.372157 percent. Recall that this rate was derived by *eVal* (with your help) by equating the directly-computed equity value with its indirectly computed counterpart. Note also that the result of $11,634,463 thousand, labeled as the Forecast Equity Value Before Time Adjustment, is exactly the same result as for the other three valuation models.

Tax Shield on Interest

Just as in the residual income to all investors model, the DCF to all investors reflects the cash tax savings from the tax deductibility of interest through a lower cost of debt. Free cash flow to all investors, C_t, is computed as:

$$C_t = D_t + I_t - \Delta L + PD_t - \Delta PS_t + MIE_t - \Delta MI_t - tx_t I_t.$$

Notice that $tx_t I_t$, *the tax shield on interest*, is explicitly backed out of C_t. Figure 10.5 shows the cash flows that are being discounted to estimate P_e, P_{ps}, P_{mi}, and P_d. How, then, can the sum of P_e, P_{ps}, P_{mi}, and P_d equal the entity value P_f, which excludes the tax shield? The answer is that the value of the tax shield is incorporated into the entity value through the lower discount rate r_w. Recall from Chapter 9 that the weighted-average cost of capital is a mix of the cost of equity r_e, the cost of preferred stock r_{ps}, the cost of minority interests r_{mi}, and the *after-tax* cost of debt $(1 - tx)r_d$. Using the after-tax cost of debt lowers the weighted-average cost of capital, which raises the present value of the C_t flows in the P_f formula. For more information, see the associated discussion on the tax shield on interest in section 10.2.

Figure 10.6 summarizes all four of the valuation models. To fit everything on one page, we have assumed there is no minority interest. As you may have noticed by now, minority interests get treated exactly like preferred stock in

FIGURE 10.5 The Variables in Each DCF Valuation Equation

entity value		common equity value		preferred stock value		minority interest		debt value		tax shield
P_f	=	P_e	+	P_{ps}	+	P_{mi}	+	P_d		
cash flows		cash flows		cash flows		cash flows		cash flows		cash flows
C_t	=	D_t	+	$PD_t - \Delta PS_t$	+	$MIE_t - \Delta MI_t$	+	$I_t - \Delta L_t$	−	$tx_t I_t$
discounted using										
r_w		r_e		r_{ps}		r_{mi}		r_d		
weighted average of r_e, r_{ps}, r_{mi}, and $(1 - tx)r_d$										

value of $tx_t I_t$ is incorporated into entity value by using $(1 - tx)r_d$ in r_w computation.