18

Taxes and Capital Structure

Corporate and Personal Income Tax

Now that you understand how financing works in a perfect world, it is time to move on to the real and imperfect world. The presence of income taxes, both corporate and personal, is an important violation of the M&M perfect-market assumptions in the real world. This chapter shows how you can create some value through an intelligent capital structure policy that reduces these taxes. There are even formulas that help you compute the explicit tax-value consequences for different leverage structures. The most popular are the adjusted present value (APV) formula and the tax-adjusted weighted average cost of capital (WACC) formula. These techniques are in such wide use that they deserve a lot of airtime. The next chapter will explain capital structure in the presence of market imperfections other than taxes (such as agency problems).

18.1 Relative Taxation of Debt and Equity

Let's assume you are running a simple firm with the following parameters:

A basic corporate example with equal taxation.

Investment Cost in Year 0	\$200
Before-Tax Gross Return in Year 1	\$280
Before-Tax Net Return from Year 0 to Year 1	\$80
Corporate Income Tax Rate (τ)	30%
Appropriate Cost of Capital from 0 to 1	12%

(If you find it easier, think of your project as having 1-year depreciation, the before-tax gross return as EBITDA, and your before-tax net return as EBIT.) Your goal is to understand the value of your firm under different tax regimes. Until Section 18.6, just assume that all your investors are tax-exempt.

Hypothetical Equal Taxation and Capital Budgeting

This short section's unrealistic tax code.

If the firm faces the same tax rate on debt and equity, no matter how it is financed, what is its value? In the real world, this assumption is entirely unrealistic. (Instead, only interest payments are tax-deductible). This scenario is useful only to show that investors care about "after-corporate-income-tax" returns, not about "before-corporate-income-tax" returns.

Taxes mean that the after-tax rate of return is lower than the before-tax rate of return.

Under this tax regime, consider financing your firm entirely with equity. With \$280 in before-tax earnings on the \$200 investment, you have a before-tax internal rate of return of (\$280–\$200)/\$200 = 40%. But, with taxes to the tune of 30% on the net return of \$80, Uncle Sam collects \$24. Your firm's after-tax net rate of return is therefore only (\$256 – \$200)/\$200 = 28%.

Investors receive an after-corporate-income-tax rate of return from the "black-box" firm.

Now hold your investors' other opportunities in the economy constant. What is the influence of a change in the corporate income tax that is applicable only to your firm? From the perspective of your firm, you are a "price-taker" when it comes to raising capital. This means that you are too small to make a difference. After all, you are competing with many other firms for the capital of many competitive investors. Ultimately, these investors care only about the cash that you will return to them. Let us assume that firms of your risk class (market beta) must offer an after-corporate-income-tax rate of return of $\mathsf{E}(r_{\text{Firm}}) = 12\%$ to attract investors. This 12% is the equivalent of a 17.14% before-tax rate of return, because $17.14\% \cdot (1 - 30\%) = 12\%$. Put differently, you can invest \$100 in equally risky projects elsewhere, expect to receive back \$117.14, pay Uncle Sam \$5.14 in taxes on \$17.14 in earnings, and keep \$12. (In this chapter, we again omit time subscripts if there is little risk of confusion.) How exactly do taxes matter to the rate of return that your projects must generate?

Projects with more tax liability must create more value before taxes to be on equal footing after taxes.

Your investor-owners really do not care what happens inside the firm, only what your firm can pay them in the end. It is all the same to them if:

- your projects earn 12% before tax and you manage to avoid all corporate income taxes;
- your projects earn 24% but you have to pay half of it in corporate income taxes;
- your projects earn 600%, of which 98% is confiscated by the government (600%·(1–98%) = 12%); or
- your projects face a 30% corporate tax rate, and your own projects earn 17.14% in before-tax rate of return in order to generate for your investors 12% in actual rate of return. Of course, this is the same calculation we already made. Your investment of \$200 turns into \$234.28, you pay Uncle Sam 30% in taxes on income of \$34.28 for a total income tax of \$10.28, and you are left with \$224 to return to your investors after the corporate income tax is paid.

Investors demand a proper (risk-adjusted) rate of return, regardless of how the firm gets there.

The NPV formula is well-equipped to handle corporate income taxes. However, as already explained in Chapter 11, you must calculate the present value using after-tax quantities in both the numerator and denominator. For example, the "\$280-before-corporate-income-tax" firm, with its 12% required after-corporate-income-tax cost of capital, has a PV of:

$$\text{PV} = \frac{\mathsf{E}(C_{\text{after-corp-tax}})}{1 + \mathsf{E}(r_{\text{after-corp-tax}})} = \frac{\$280 - \$80 \cdot 30\%}{1 + 12\%} = \frac{\$256}{1 + 12\%} \approx \$228.57$$

➤ Taxes in NPV, Sect. 11.4, Pg.260.

There are some simple mistakes you must avoid here. You cannot usually find the same result if you work with before-tax expected cash flows and before-tax required rates of return. And you would definitely get a very wrong result if you used after-tax expected cash flows and then compared them to a cost of capital obtained from investments that have not yet been taxed at the corporate level.

Q 18.1. Assume a 30% corporate income tax. Show that a project that returns 17% before-tax would have a negative NPV if it cost \$100 today and if the appropriate after-tax cost of capital is 12%.

Realistic Differential Taxation of Debt and Equity

Let's move on to a model of a tax code that reflects reality better. In many countries—the United States included—individuals and corporations face similar tax treatments, tax schedules, and tax rates. Although tax code details vary from year to year, country to country, state to state, county to county, and even city to city, most tax codes are pretty similar in spirit. Thus, the tax concepts in this book apply relatively universally.

Tax codes worldwide violate the M&M no-tax assumption.

Section 11.4 described how the form of payout matters. Firms pay taxes on their earnings *net of interest payments*. That is, unlike dividend distributions or money used to repurchase shares or money reinvested, the IRS considers interest payments to be a cost of your operations. Therefore, it allows the payment of interest to be treated as a before-tax expense rather than as an after-tax distribution of earnings. The result is that a corporation saves on taxes when it distributes its earnings in the form of interest payments. For example, if Intel's operations really produced $100, and if $100 in interest was owed to creditors, then Uncle Sam would get nothing and the creditors would get the entire $100. However, if not paid out in interest, Uncle Sam would first collect corporate income taxes, say, 30%. Intel could only keep (or distribute) the $70 that would be left over. The point of this chapter is to show how an astute CFO can best exploit this difference in relative tax treatment.

Tax codes subsidize borrowing: Firms pay interest from before-tax income but pay dividends from after-tax income.

➤ Introduction to taxes, Sect. 11.4, Pg.257.

You may be wondering why you would not always finance your firm with as much debt as possible. The short preview answer is that if you were in a world in which corporate income taxes were the only distortion, then having as much debt as possible would indeed be ideal. However, there is more going on. If you take on too much debt, eventually other forces raise the firm's cost of capital to the point where further increases in debt are no longer value-increasing. These forces are the subject of the next chapter. But you must first understand how managers should go about capital budgeting if there are only corporate income taxes, and no other taxes or perfect-market distortions.

Preview: With too much debt, other not-yet-explained forces may increase the cost of capital.

Q 18.2. A debt-equity hybrid security would like to pay out $500 to its holders. The firm is in the 33% corporate income tax bracket. How much would the firm have to earn if the IRS designates the payment an interest payment? How much would the firm have to earn if the IRS designates the payment a dividend distribution?

18.2 Firm Value Under Different Capital Structures

In a perfect world, firms are indifferent between debt and equity. In the real world, Uncle Sam subsidizes firms that pay interest, relative to firms that retain earnings, pay dividends, or repurchase shares. Therefore, *on corporate tax grounds*, firms should have a preference for debt. What is the exact value of the firm in the presence of this tax subsidy for debt interest payments?

Introducing an interest tax subsidy leads to a corporate preference for debt.

To answer this question, begin with Exhibit 18.1. It works out the value of one hypothetical firm in two financing scenarios.

Debt can reduce money to the IRS.

An equity-financing (EF) scenario: In the all-equity scenario, the firm does not exploit the help of the IRS. It earns $280 on an investment of $200. At a 30% corporate income tax rate, it will pay corporate income taxes of $30\% \cdot \$80 = \$24$. It can then pay out the remaining $56 in dividends.

A debt-financing (DF) scenario: In the debt-financing scenario, the firm borrows $200 today at an interest rate of 11% for interest payments next year of $22. Therefore, its corporate profits will be $\$80 - \$22 = \$58$, on which it would have to pay Uncle Sam $17.40. This permits owners (creditors and shareholders—and a person may be both) to receive $62.60, the sum of $22 for its creditors and $40.60 for its equity holders.

Both scenarios assume:		
Investment Cost in Year 0		$200.00
Before-Tax Gross Return in Year 1		$280.00
Before-Tax Net Return from Year 0 to Year 1		$80.00
Corporate Income Tax Rate (τ)		30%
Appropriate Average Cost of Capital from 0 to 1[a]		12%
Scenario EF: 100% equity financing.		
Taxable Profits Next Year		$80.00
Corporate Income Taxes Next Year (30% of $80)		$24.00
Owners Will Keep *Next Year*		$56.00
Scenario DF: $200 debt financing at 11%. The rest is levered equity.		
Interest Payments		$22.00
Taxable Profits Next Year		$58.00
Corporate Income Taxes Next Year (30% of $58)		$17.40
Equity Owners Will Keep Next Year		$40.60
(Equity and Debt) Owners Will Keep *Next Year*	$22.00 + $40.60 =	$62.60

Exhibit 18.1: *Two Financing Scenarios for a Safe 1-Year Firm.* Table note [a]: In order to clear its cost-of-capital hurdle rate of 12%, the firm's projects must earn a rate of return of 17.14% before the firm pays out corporate income tax. With a 30% corporate income tax rate, Uncle Sam would confiscate $30\% \cdot 17.14\% \approx 5.14\%$ from the firm itself, and corporate investors would receive a rate of return of 12%.

Relative to the 100% equity-financed case (in which owners keep $56.00), the debt-financed case (in which owners keep $62.60) increases the firm's after-tax cash flow by $6.60. A quicker way to compute the tax savings is to multiply the tax rate by the interest payments: If the IRS allows the firm to deduct $22 in interest payments, the firm will save $\$22 \cdot 30\% = \$6.60$ in corporate income taxes. This $6.60 in tax savings will occur next year, and it will therefore have to be discounted back. It is common (but not necessarily unique or even correct) to use the firm's cost of capital to discount the tax shelter for a growing firm. This chapter's appendix explains the appropriate discount rate in greater detail, but just realize that whether you discount the much smaller tax shelter of $6.60 by the low cost of capital on debt (11%) or by a higher one, say, 15% (the firm's cost of capital), it would only make a difference of $\$5.95 - \$5.74 = \$0.21$. On a $280 expected cash flow, this is not big, especially compared to our other uncertainties in our cash flow estimate, our CAPM model use, our rate of return model estimate, and so on. We are done: Relative to the EF capital structure, the DF capital structure created just under $6 in present value.

The RJR Buyout Tax Loophole

In a **leveraged buyout** (**LBO**), the firm's indebtedness can increase dramatically—and this can significantly reduce corporate income taxes. In 1988, First Boston's plan to take over RJR Nabisco relied on an esoteric tax loophole just about to be closed. By "monetizing" its food operations (a fancy way to increase indebtedness), the deferring of taxes would have saved an estimated $3–$4 billion of RJR's corporate income taxes—which would have increased the annual federal U.S. deficit by 2%! Ultimately, First Boston lost its bid, and this scenario did not materialize. *Barbarians at the Gate*

Q 18.3. A $1 million construction project is expected to return $1.2 million in one year. Your company is in a 45% combined federal and state marginal income tax bracket.

1. If you finance the project with cash, how much will you pay in taxes?
2. If you finance the project with an $800,000 mortgage at an interest rate of 5%, how much will you pay in taxes?
3. If the appropriate project interest rate is 8%, what is the present value of the tax savings from financing the project with a mortgage?

18.3 Formulaic Valuation Methods: APV and WACC

We need formulas that work for any intermediate debt ratios.

Are there formulas that allow you to compute the firm value today not only for the current financing arrangement but also for other debt ratios that you might contemplate? Yes. There are essentially three methods. This section explains two of them, the APV and WACC:

1. You can compute an **adjusted present value** (**APV**), which adds back the tax subsidy. (This is basically the calculation from the previous section.)
2. You can generalize the *weighted average cost of capital* (*WACC*) formula to reflect the preferential treatment of debt by suitably lowering the cost of debt capital. It then becomes a **tax-adjusted WACC**.

➤ WACC, Sect. 17.3, Pg.456.

Method #3 is called "flow-to-equity."

➤ Valuing after-tax cash flows, Sect. 14.3, Pg.371.

The next section explains a third method to value the tax benefits. This "flow-to-equity" method constructs the financials for the firm in the new hypothetical capital structure and then values the after-tax cash flows directly. (Without describing it as such, you have actually already done this in Chapter 14, and you will do it again in Chapter 21, where you will have to create a pro forma.) Properly applied, all three methods should provide similar—though not necessarily exactly the same—answers.

Keep our simplifications in perspective.

Before you get into the nitty-gritty, it is important for you to realize that the tax model is just that—a model. You are working out the debt-related tax savings for a company that faces a fixed marginal income tax rate. The model further ignores many other possibly important tax issues, such as delayed income tax payments, tax-loss carryforwards, recapture of past tax payments, different marginal corporate income tax rates at different income levels, the possibility of default on income tax payments, state taxes, foreign taxes, special tax incentives, transfer pricing, or even outright tax evasion and fraud. Most of the time, our model works fairly well, but do not get carried away with excessive accuracy after the decimal point.

Adjusted Present Value (APV): Theory

The main idea of APV: Value an all-equity firm, then add the tax subsidy.

APV decomposes the value of the firm into two components:

1. The value of the firm as if it were *all equity-financed and fully taxed*
2. An additional tax subsidy for each dollar that can be named "interest" rather than "dividend"

In our example from Exhibit 18.1, the expected cash flow of the firm if it is 100% equity-financed is \$280 return minus \$24 in corporate taxes for a net of \$256. The APV method then adds the tax subsidy depending on the firm's debt ratio. For example:

Zero interest payments: If the firm is all equity-financed, the tax subsidy is zero.

High interest payments: If the firm has interest payments of \$80, the IRS would believe that the firm had not earned a penny. Therefore, the owners could keep an extra \$24 above the \$256 all-equity scenario *next year*.

Normal interest payments: If the firm has interest payments of, say, \$19, the IRS would see \$280 – \$19 = \$261 in return minus \$200 investment cost for a net return of \$61. The IRS would therefore collect 30% · \$61 = \$18.30, which is \$5.70 less than the \$24 that the IRS would have collected if the firm had been 100% equity-financed. Alternatively, you could have directly calculated the expected tax savings as $\tau \cdot (\mathsf{E}(r_{\text{Debt}}) \cdot \text{Debt}) = 30\% \cdot (\$19) = \$5.70$. This \$5.70 is the APV tax subsidy next year.

Tax savings are the product of the tax rate and the interest paid (debt level times interest rate).

We only need to make a formula out of this method. Your first step to a more general valuation formula in the presence of corporate income taxes is to relate the amount of debt today to the interest payments next year. Let's return to our example, in which you borrow \$200 at an interest rate of 11%. The expected interest payment is now

$$\text{Expected Interest Payment} = 11\% \cdot \$200 = \$22$$

$$\text{Expected Interest Payment} = \mathsf{E}(r_{\text{Debt}}) \cdot \text{Debt}$$

One important error to avoid is that you must use the *expected* debt interest rate (11%), not the *quoted* bank interest rate (which could be considerably higher than 11%). (This would not matter for large firms with little debt, but it could matter for smaller or more highly indebted firms.) Continuing, the future tax savings *relative to an all-equity-financed firm* is the amount of corporate income tax that the firm will *not* have to pay on the interest.

$$\text{Expected Tax Savings} = 30\% \cdot [11\% \cdot \$200] = \$6.60$$

$$\text{Expected Tax Savings} = \tau \cdot [\mathsf{E}(r_{\text{Debt}}) \cdot \text{Debt}]$$

In words, Uncle Sam would expect to receive \$6.60 less from the owners of the project, because \$22 in profit repatriation is designated as "interest."

APV discounts these tax savings and adds them to an "all-equity type" hypothetical firm.

The \$6.60 in tax savings still has to be discounted, because it will occur next year. The APV formula computes the discounted value of an all-equity-financed firm (with after-tax cash flows of \$256 next year) and then adds back the *discounted* tax savings:

($200 debt at 11% interest, i.e., \$22 interest payment discounted at 11%)

$$\text{APV} = \frac{\$256}{1+12\%} + \frac{30\% \cdot \$22}{1+11\%} \approx \$234.52$$

$$\text{APV} = \frac{\mathsf{E}(C)}{1+\mathsf{E}(r_{\text{Firm}})} + \frac{\tau \cdot [\mathsf{E}(r_{\text{Debt}}) \cdot \text{Debt}]}{1+\mathsf{E}(r_{\text{Debt}})}$$

$$\text{APV} = \text{Value as if 100\% Equity-Financed} + \text{Tax Subsidy from Interest Payments}$$

As described at length in the chapter appendix, you could also reasonably use the firm's cost of capital to discount the tax savings:

($200 debt at 11% interest, i.e., $22 interest payment discounted at 12%)

$$\text{APV} = \frac{\$256}{1+12\%} + \frac{30\% \cdot \$22}{1+12\%} \approx \$234.46$$

$$\text{APV} = \frac{\mathsf{E}(\text{C})}{1+\mathsf{E}(\text{r}_{\text{Firm}})} + \frac{\tau \cdot [\mathsf{E}(\text{r}_{\text{Debt}}) \cdot \text{Debt}]}{1+\mathsf{E}(\text{r}_{\text{Firm}})}$$

$$\text{APV} = \begin{array}{c}\text{Value as}\\ \text{if 100\% Equity-}\\ \text{Financed}\end{array} + \begin{array}{c}\text{Tax Subsidy}\\ \text{from Interest}\\ \text{Payments}\end{array}$$

The difference of 6 cents is obviously trivial in any real-world application.

APV generalizes easily to multiple years: Just compute the tax savings for each year and add them up in the same way that you would add up present values. You will work such a multiperiod example in the next section.

APV is easily generalized to more periods.

IMPORTANT

The adjusted present value (APV) formula computes an "as-if-all-equity-financed" PV (i.e., after corporate income tax) and then adds back the tax subsidy:

$$\text{APV} = \begin{array}{c}\text{Value as if Firm is 100\%}\\ \text{Equity-Financed and Fully}\\ \text{Taxed}\end{array} + \begin{array}{c}\text{Tax Subsidies}\\ \text{from Interest}\\ \text{Payments}\end{array}$$

If the project lasts for only one period (and omitting tedious and obvious time subscripts), this translates into

$$\text{APV Today} = \frac{\mathsf{E}(\text{FutureC})}{1+\mathsf{E}(\text{r}_{\text{Firm}})} + \frac{\mathsf{E}(\overbrace{\tau \cdot \overbrace{\text{r}_{\text{Debt}} \cdot \text{Debt}}^{\text{Interest Payment}}}^{\text{Tax Shield}})}{1+\mathsf{E}(\text{r}_{\text{Debt}})} \tag{18.1}$$

The $1+\mathsf{E}(\text{r}_{\text{Debt}})$ cost of capital in the second term may or may not be correct. However, because the second term is small, it rarely makes much difference whether you discount with $\mathsf{E}(\text{r}_{\text{Firm}})$ or $\mathsf{E}(\text{r}_{\text{Debt}})$.

APV: Application to a 60/40 Debt-Financing Case

An APV example: Value a firm financed with 60% debt.

In the example, the firm with $200 debt is worth $234.46 today. This comes to a debt ratio of $200/$234.46 ≈ 85%. Now assume that the firm instead considers a new capital structure in which it would borrow only $139.16. The firm has determined that this lower-debt capital structure would reduce its debt cost of capital to 9% per annum—after all, at such low levels, the debt is risk-free, so risk-averse investors would be willing to accept a lower *expected* rate of return. What would the firm's value then become?

Problem solved.

According to the APV formula, you begin with the value of a 100%-equity firm, which is $256/1.12, and add back the tax subsidy. Interest payments on $139.16 of debt will be 9%·$139.16 ≈ $12.52 *next year*. Taxes saved will be 30%·$12.52 ≈ $3.76 *next year*. Discounted at 9%, this is worth $3.45 *today*. Therefore,

$$\begin{aligned} \text{APV} &= \frac{\$256.00}{1+12\%} + \frac{30\% \cdot 9\% \cdot \$139.16}{1+9\%} \\ &\approx \$228.57 + \$3.45 = \$232.02 \end{aligned}$$

$$\begin{aligned} \text{APV} &= \frac{\mathsf{E}(\mathrm{C})}{1+\mathsf{E}(\mathrm{r}_{\text{Firm}})} + \frac{\tau \cdot \mathsf{E}(\mathrm{r}_{\text{Debt}}) \cdot \text{Debt}}{1+\mathsf{E}(\mathrm{r}_{\text{Debt}})} \\ &= \text{“As-if-All-Equity-Financed” Firm} + \text{Tax Subsidy} \end{aligned}$$

If you prefer discounting the expected tax shelter with the firm's cost of capital, use

$$\begin{aligned} \text{APV} &= \frac{\$256.00}{1+12\%} + \frac{30\% \cdot 9\% \cdot \$139.16}{1+12\%} \\ &\approx \$228.57 + \$3.36 = \$231.93 \end{aligned} \tag{18.2}$$

$$\begin{aligned} \text{APV} &= \frac{\mathsf{E}(\mathrm{C})}{1+\mathsf{E}(\mathrm{r}_{\text{Firm}})} + \frac{\tau \cdot \mathsf{E}(\mathrm{r}_{\text{Debt}}) \cdot \text{Debt}}{1+\mathsf{E}(\mathrm{r}_{\text{Firm}})} \\ &= \text{“As if All-Equity-Financed” Firm} + \text{Tax Subsidy} \end{aligned}$$

(Again, the cost of capital on the tax shelter makes little difference, here only $\$3.45 - \$3.36 = \$0.09$.) This is the APV answer: In the presence of corporate income taxes, a firm financed with $139.16 in debt would be worth about $232.

Tax-Adjusted Weighted Average Cost of Capital (WACC) Valuation: Theory

To show that WACC and APV are similar, we derive the tax-adjusted WACC formula from the APV formula.

The second method for computing the value of the firm uses a tax-adjusted weighted average cost of capital formula. If you start with the APV formula and manipulate it, it will be apparent that the two methods can yield the same value, at least if you start from Formula 18.2. Therefore, stick with the same parameters: 60/40 debt-equity financing, a 30% corporate income tax rate, a 9% cost of debt capital, and $280 before-tax return ($256 after-tax return in the all-equity case). As before, the firm borrows $139.16 at a 9% interest rate for net interest payments of $12.52. The corporate income tax shield is 30% of $12.52, or $3.76. The APV formula (Formula 18.2) values the firm at

$$\text{PV} = \frac{\$256}{1+12\%} + \overbrace{\frac{30\% \cdot \overbrace{(9\% \cdot \$139.16)}^{\approx \$12.52}}{1+12\%}}^{\approx \$3.76} \approx \$231.93$$

$$\text{PV} = \frac{\mathsf{E}(\mathrm{C})}{1+\mathsf{E}(\mathrm{r}_{\text{Firm}})} + \frac{\tau \cdot [\mathsf{E}(\mathrm{r}_{\text{Debt}}) \cdot \text{Debt}]}{1+\mathsf{E}(\mathrm{r}_{\text{Firm}})}$$

The main difference between APV and WACC is that whereas APV works with dollar values of debt and interest payments, the WACC method expresses debt as a ratio of firm value,

$$60\% \approx \$139.16/\$231.93 \qquad \$139.16 \approx 60\% \cdot \$231.93$$

$$\mathrm{w}_{\text{Debt}} = \text{Debt/PV} \implies \text{Debt} = \mathrm{w}_{\text{Debt}} \cdot \text{PV}$$

Substitute the debt expression into the APV formula,

$$\text{PV} = \frac{\$256}{1+12\%} + \frac{30\% \cdot [9\% \cdot (60\% \cdot \$231.93)]}{1+12\%} \approx \$231.93$$

$$\text{PV} = \frac{\mathsf{E}(\text{C})}{1+\mathsf{E}(\text{r}_{\text{Firm}})} + \frac{\tau \cdot [\mathsf{E}(\text{r}_{\text{Debt}}) \cdot (\text{w}_{\text{Debt}} \cdot \text{PV})]}{1+\mathsf{E}(\text{r}_{\text{Firm}})}$$

You now have PV on both sides of the equation, so you want to solve for PV. This requires a few algebraic steps.

1. Multiply both sides by $[1+\mathsf{E}(\text{r}_{\text{Firm}})] = (1+12\%) = 1.12$ to make the denominator disappear:

$$(1+12\%) \cdot \$231.93 \approx \$256 + 30\% \cdot [9\% \cdot (60\% \cdot \$231.93)]$$
$$[1+\mathsf{E}(\text{r}_{\text{Firm}})] \cdot \text{PV} = \mathsf{E}(\text{C}) + \tau \cdot [\mathsf{E}(\text{r}_{\text{Debt}}) \cdot (\text{w}_{\text{Debt}} \cdot \text{PV})]$$

2. Move the second term on the right side over to the left side:

$$(1+12\%) \cdot \$231.93 - 30\% \cdot [9\% \cdot (60\% \cdot \$231.93)] \approx \$256$$
$$[1+\mathsf{E}(\text{r}_{\text{Firm}})] \cdot \text{PV} - \tau \cdot [\mathsf{E}(\text{r}_{\text{Debt}}) \cdot (\text{w}_{\text{Debt}} \cdot \text{PV})] = \mathsf{E}(\text{C})$$

3. Pull out the PV:

$$\$231.93 \cdot [1+12\% - 30\% \cdot 9\% \cdot 60\%] \approx \$256$$
$$\text{PV} \cdot [1+\mathsf{E}(\text{r}_{\text{Firm}}) - \tau \cdot \mathsf{E}(\text{r}_{\text{Debt}}) \cdot \text{w}_{\text{Debt}}] = \mathsf{E}(\text{C})$$

4. Divide both sides by the PV multiplier:

$$\$231.93 \approx \frac{\$256}{1+12\%-30\% \cdot 9\% \cdot 60\%} \approx \frac{\$256}{1+10.38\%}$$
$$\text{PV} = \frac{\mathsf{E}(\text{C})}{1+\mathsf{E}(\text{r}_{\text{Firm}}) - \tau \cdot [\mathsf{E}(\text{r}_{\text{Debt}}) \cdot \text{w}_{\text{Debt}}]} = \frac{\mathsf{E}(\text{C})}{1+\text{WACC}} \quad (18.3)$$

This is the tax-adjusted WACC valuation formula. Its big idea is to discount the "as-if-100%-equity-financed and fully taxed" cash flows (of $\mathsf{E}(\text{C}) = \$256$), not with the plain cost of capital $\mathsf{E}(\text{r}_{\text{Firm}}) = 12\%$, but with a reduced interest rate that comes from the corporate income tax subsidy on interest payments. The term that does this—relative to our earlier no-tax WACC formula (Formula 17.2)—is $\tau \cdot \text{w}_{\text{Debt}} \cdot \mathsf{E}(\text{r}_{\text{Debt}}) = 30\% \cdot 60\% \cdot 9\% = 1.62\%$. Therefore, your revised discount rate is $1+12\%-30\% \cdot 9\% \cdot 60\% = 1+10.38\%$. The 10.38% is the (tax-adjusted) WACC —lower than your all-equity cost of capital of 12%.

My intuition for the WACC formula.

➤ Perfect-markets WACC, Formula 17.2, Pg.461.

The WACC formula is often slightly rearranged. Split $\mathsf{E}(\text{r}_{\text{Firm}})$ into its cost of equity and cost of debt components, $\mathsf{E}(\text{r}_{\text{Firm}}) = \text{w}_{\text{Debt}} \cdot \mathsf{E}(\text{r}_{\text{Debt}}) + \text{w}_{\text{Equity}} \cdot \mathsf{E}(\text{r}_{\text{Equity}})$. In our example, to keep the weighted-average firm cost of capital at the constant $\mathsf{E}(\text{r}_{\text{Firm}}) = 12\%$, solve $\mathsf{E}(\text{r}_{\text{Firm}}) = \text{w}_{\text{Debt}} \cdot \mathsf{E}(\text{r}_{\text{Debt}}) + \text{w}_{\text{Equity}} \cdot \mathsf{E}(\text{r}_{\text{Equity}}) = 60\% \cdot 9\% + 40\% \cdot \mathsf{E}(\text{r}_{\text{Equity}}) = 12\%$, and find $\mathsf{E}(\text{r}_{\text{Equity}}) = 16.5\%$. Substitute this into Formula 18.3, and you get the more common version of the WACC formula,

The more common form of WACC breaks out the equity cost of capital.

$$\text{PV} = \frac{\$256}{1+10.38\%} = \frac{\$256}{1+40\% \cdot 16.5\% + (1-30\%) \cdot 60\% \cdot 9\%}$$
$$\text{PV} = \frac{\mathsf{E}(\text{C})}{1+\text{WACC}} = \frac{\mathsf{E}(\text{C})}{1+\text{w}_{\text{Equity}} \cdot \mathsf{E}(\text{r}_{\text{Equity}}) + (1-\tau) \cdot \text{w}_{\text{Debt}} \cdot \mathsf{E}(\text{r}_{\text{Debt}})}$$

The tax-adjusted WACC generalizes the perfect-market WACC from the previous chapter.

➤ WACC in a perfect world, Formula 17.2, Pg.461.

Your new WACC formula generalizes the old M&M WACC formula from the previous chapter. If the corporate tax rate τ is zero, the tax subsidy is useless, and the tax-adjusted WACC formula simplifies to your older and simpler WACC formula. This works for about half of all publicly-traded firms in the United States, which indeed have a marginal tax rate of zero (e.g., due to tax-loss carryforwards or due to clever tax shelters). For these companies, the use of debt does not provide a useful tax shelter. They can use the simplified M&M version of the WACC formula, which ignores the tax subsidy of interest. But for highly taxed firms, you don't have a choice. You need the new WACC formula, which can also handle firms with positive corporate income tax rates.

Alas, in practical use—though convenient and intuitive—WACC is often difficult to apply.

Unfortunately, you can only use the WACC formula in a multiperiod setting *if* the cost of capital, the firm's debt ratio, and the firm's tax rate all stay constant. In this case, a present value formula would look something like

$$\text{PV} = \frac{\mathsf{E}(\text{C}_{\text{Time 1}})}{\{1+[\text{w}_{\text{Equity}}\cdot\mathsf{E}(\text{r}_{\text{Equity,Time 1}})+\text{w}_{\text{Debt}}\cdot\mathsf{E}(\text{r}_{\text{Debt,Time 1}})\cdot(1-\tau)]\}^{1}} + \frac{\mathsf{E}(\text{C}_{\text{Time 2}})}{\{1+[\text{w}_{\text{Equity}}\cdot\mathsf{E}(\text{r}_{\text{Equity,Time 2}})+\text{w}_{\text{Debt}}\cdot\mathsf{E}(\text{r}_{\text{Debt,Time 2}})\cdot(1-\tau)]\}^{2}} + \cdots \quad (18.4)$$

If these quantities are not all constant, no one knows how to compute a proper WACC. It is not unusual for firms to plan on high debt financing upfront that they pay back later on. Unfortunately, this is a situation that the WACC formula cannot handle. Moreover, WACC is difficult to use if there are nonfinancial liabilities with marginal costs of capital that are different from those on financial liabilities. In general, the WACC formula is best applied in real life as a quick and useful approximation. The APV method is often more flexible than the WACC method.

➤ WACC with nonfinancial liabilities, Sect. 17.5, Pg.468.

IMPORTANT

- The (tax-adjusted) weighted average cost of capital (WACC) formula discounts future cash flows with a lower cost of capital that reflects the advantage of the corporate tax shelter for interest payments:

$$\text{PV} = \frac{\mathsf{E}(\text{C})}{1+\text{WACC}} \quad (18.5)$$

$$\text{where}\quad \text{WACC} = \mathsf{E}(\text{r}_{\text{Firm}}) - \tau\cdot\mathsf{E}(\text{r}_{\text{Debt}})\cdot\text{w}_{\text{Debt}}$$

$$= \text{w}_{\text{Equity}}\cdot\mathsf{E}(\text{r}_{\text{Equity}}) + \text{w}_{\text{Debt}}\cdot\mathsf{E}(\text{r}_{\text{Debt}})\cdot(1-\tau)$$

  The expected cash flows must be the cash flows "as if the firm were all-equity-financed and fully taxed."
- This formula is a generalization of the WACC formula from the perfect M&M world. Therefore, it is this formula that is usually called the WACC formula.
- It is not clear how to use the WACC formula in a multiperiod setting.

The WACC formula is so common that it is worth memorizing.

The optimal capital structure without other forces is 100% debt.

➤ Cost of Capital, Exhibit 17.2, Pg.464.

Now recall Exhibit 17.2 from the previous chapter. It showed that the cost of capital remains the same 10%, regardless of the firm's capital structure. Is this still the case in the presence of corporate income taxes? No! Exhibit 18.2 shows that the tax subsidy pushes the firm's cost of capital down for high debt ratios. Indeed, if there were no other capital structure complications to consider, the optimal capital structure would be for the firm to take on as much debt as possible, a full 100%.

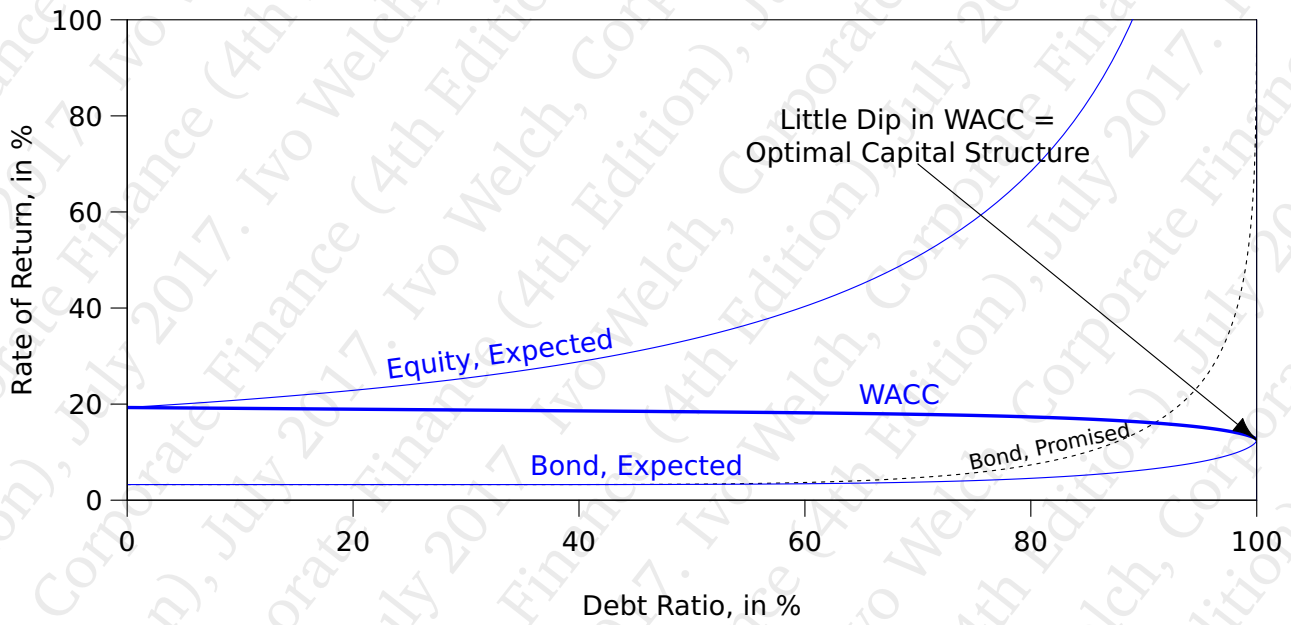

Exhibit 18.2: *The Cost of Capital in a World With Corporate Taxes.* This figure is the equivalent of Exhibit 17.2, except that debt now has a corporate income tax advantage. This means that the firm's overall cost of capital declines with the firm's debt ratio.

Comparing Flow To Equity, APV, WACC, and Avoiding Bad Mistakes

The three methods have thus worked as follows:

Perfect-Market No-Tax Unattainable Value	\$280/1.12
Flow To Equity	(\$280 – \$20.24)/1.12
APV	\$256/1.12 + \$3.76/1.12
WACC	\$256/1.1038
⇒ Attainable Value With Taxes and Leverage	\$231.93

Unfortunately, both WACC and APV are often used incorrectly.

1. The first common error is to forget that the correct expected cash flow in the present-value numerator is the "as-if-fully-equity-financed and fully taxed" cash flow (\$256 in our example). It is neither the before-tax project cash flow (\$280 in our example), nor the after-tax cash flow under the current financing scheme (e.g., $\$280 - 9\% \cdot \$139.16 \approx \$267.48$). If you have worked through the examples in this chapter, you should understand why this would provide the wrong answer. Unlike errors in the discount rate applied to the tax shelter—which is a modest error—using the wrong cash flow is a big error.

Sidenote: You may sometimes wish to adjust a firm's beta to reflect debt and corporate income taxes. This is done by the so-called Hamada Equation, $\beta_{\text{With Debt}} = \beta_{\text{Unlevered}} \cdot [1 + (1-\tau) \cdot (\text{Debt/Equity})]$. We shall not use this formula any further.

2. The second common error is to forget that you also have to use the proper costs of capital—and the E(R) inputs change with debt, too. The formulas only give you the benefit of debt explicitly. It is *you* who is supposed to realize that when you increase the debt, there will also be other economic imperfect-market forces at work that can push up the cost of debt and/or the cost of equity (i.e., the expected rate of return that you have to promise). If you apply APV or WACC mechanically without such adjustments, you would conclude that more debt is always better than less debt.

IMPORTANT

WACC and APV operate with expected "as-if-100%-equity-financed and after-corporate-income-tax" cash flows, not with the firm's *current* cash flows (which already depend on the *current* debt-equity financing).

PS: Do not forget that debt changes may also have other costs and benefits that change their costs of capital. We have not yet covered everything.

Q 18.4. Consider a 25/75 debt-equity financing case for your firm. As in the scenario in Exhibit 18.1 on page 478, your firm will produce a before-tax return of \$280, the investment costs \$200, the tax rate is 30%, the overall opportunity cost of capital (in other taxable projects) is 12%, and when the firm is 25% debt-financed, debt must offer an expected rate of return of 8%. (If you think of your opportunity cost of capital as the best your firm can achieve elsewhere, then these cost-of-capital numbers are your before-tax costs of capital from other projects before they would be taxed, too. If you think of your opportunity cost of capital as provided by your investors, who [like you] are also taxed, then it is the rate of return before their personal income taxes. The cost of capital for your personal investors is the subject of the next chapter.) First compute the WACC, then compute the debt as 25% of the WACC value, and show how the APV yields the same result.

Q 18.5. Consider financing your firm with \$100 debt: The before-tax return is \$280, the investment cost is \$200, the tax rate is 30%, the overall cost of capital is 12%, and this debt must offer an expected rate of return of 8.7%. (These are again before-tax opportunity rates of return.) First compute the APV, then compute the capital structure in ratios, and finally show that the WACC yields the same result.

Q 18.6. If you are thinking of debt in terms of a (constant) fraction of firm value, would you prefer WACC or APV? If you are thinking of debt in terms of a (constant) dollar amount, would you prefer WACC or APV?

Q 18.7. From memory, draw the WACC of the firm as a function of its debt ratio if the only market imperfection is the corporate income taxes.

Q 18.8. A firm in the 20% marginal tax bracket is currently financed with \$500 debt and \$1,000 equity. The debt carries an interest rate of 6%; the equity's cost of capital is 12%. The risk-free rate is 4%; the equity premium is 3%. What is the firm's beta? The firm is pondering a recapitalization to \$1,000 debt, which would increase the debt's interest rate to 8%. The firm will exist for only 1 more year. What would the new equity be worth?

Q 18.9. A firm in the 40% income tax bracket has an investment that costs \$300 in year 0, and offers a before-tax return (cash flow) in year 1 of \$500. Assume that the firm's before-tax opportunity cost of capital, as provided by the external capital markets, is approximately 20%. Its debt cost of capital is $\mathsf{E}\left(\mathrm{r}_{\mathrm{Debt}}\right) = 15\% + \mathrm{w}_{\mathrm{Debt}} \cdot 5\%$. Compute the APV, WACC, and a WACC-based value if the firm borrows \$50 to finance it. Repeat if the firm borrows \$100.

18.4 Sample Applications of Tax-Adjusted Valuation

Let's value a pro forma firm.

Let's move on to a more realistic example. You are actually already familiar with it: It is the hypothetical machine from Chapter 14, Exhibit 14.5. To make the example more useful, add the following parameters:

➤ Machine, Exhibit 14.5, Pg.364.

- The appropriate debt interest rate is 20%, so a loan of $25 must offer an expected $5 in interest per annum.
- The appropriate overall cost of capital for the firm is 30%.
- The corporate income tax rate is 40%.

Exhibit 18.3 shows all you need to know. Shareholders invest $26 and receive a total of $137 in dividends. Bondholders invest $25 and receive $25 in total interest payments. (Your firm follows an odd capital distribution policy, but so be it.) What is it worth?

The Flow-to-Equity Direct Valuation from the Pro Forma Financials

The third valuation method is flow-to-equity.

The main point of the more involved example is to show you the third method to handle the tax subsidy. This **flow-to-equity** method works directly with a "pro forma." For now, think of a pro forma simply as a forward projection of the financial statements. (Pro formas will be discussed in detail in Chapter 21.) We will demonstrate all three methods now: flow-to-equity, APV, and WACC.

Method #1: Direct cash flows, already after-tax, from the financials.

The project cash flow formula (Formula 14.1) tells you that the project cash flows for your NPV valuation are:

➤ Project cash flows, Formula 14.1, Pg.379.

Computing Project Cash Flows, $25 Debt Financing

		Y1	Y2	Y3	Y4	Y5	Y6
	Total Operating Activity	$46	$53	$53	$43	$33	$33
+	Total Investing Activity	–$75	–$75				
+	Interest Expense		$5	$5	$5	$5	$5
=	**Project Cash Flows**	–$29	–$17	+$58	+$48	+$38	+$38

What is the discount rate for after-tax cash flows?

We need a discount factor for these after-tax cash flows. (This is very difficult to assess accurately, but fortunately the precise discount rate here does not matter too much. The chapter appendix explains this better.) We will be using the same 30% cost of capital for the firm. Now discount these cash flows on the overall firm:

$$\text{NPV} = \frac{-\$29}{1.30} + \frac{-\$17}{1.30^2} + \frac{+\$58}{1.30^3} + \frac{+\$48}{1.30^4} + \frac{+\$38}{1.30^5} + \frac{+\$38}{1.30^6} \approx \$28.95 \qquad (18.6)$$

So, you would be willing to pay $28.95 *today* for the right to buy (and finance) the firm, which will initiate *next year* with this exact capital structure. But wait: Did you forget about the tax shelter that came with the debt? No, you did not! The pro forma itself had already incorporated the correct interest expense. The interest payments had already reduced the corporate income tax and thereby appropriately increased your project's cash flows.

	The Income Statement	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**
	Gross Sales (Revenues)	$70	$70	$70	$70	$70	$70
–	Cost of Goods Sold (COGS)	$5	$5	$5	$5	$5	$5
–	Selling, General & Administrative Expenses (SG&A)	$5	$5	$5	$5	$5	$5
=	EBITDA (Net Sales)	$60	$60	$60	$60	$60	$60
–	Depreciation	$25	$50	$50	$25	$0	$0
=	EBIT (Operating Income)	$35	$10	$10	$35	$60	$60
–	Interest Expense	$0	$5	$5	$5	$5	$5
=	EAIBT (or EBT)	$35	$5	$5	$30	$55	$55
–	Corporate Income Tax (at 40%)	$14	$2	$2	$12	$22	$22
=	**Net Income**	$21	$3	$3	$18	$33	$33

	Excerpts from the Cash Flow Statement	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**
	Net Income	$21	$3	$3	$18	$33	$33
+	Depreciation	$25	$50	$50	$25	$0	$0
=	**Total Operating Activity**	$46	$53	$53	$43	$33	$33
	Capital Expenditures	–$75	–$75				
=	**Total Investing Activity**	–$75	–$75				
+	Net Equity Issue	$26					
+	Dividends			–$53	–$43	–$33	–$8
+	Net Debt Issue	$25					–$25
=	**Total Financing Activity**	$51		–$53	–$43	–$33	–$33
	Net Change in Cash	+$22	–$22	$0	$0	$0	$0

Exhibit 18.3: *Financial Statements of Hypothetical Machine.*

The APV Valuation

The second method to value this firm is APV. But be careful: The cash flows in Formula 18.6 are *not* the cash flows that you need for the APV analysis, because these are not the cash flows *as-if-100%-equity-financed*. APV states that you can only add back the tax shield to the *as-if-100%-equity-financed* cash flows. If you used the cash flows in Formula 18.6 and then added the tax shield (due to the interest payment designation), you would mistakenly count the tax shield twice. You must therefore start over to find the correct expected cash flows as if the firm were fully equity-financed, in which case the tax obligation would be higher. By how much? You can intuit this figure even before you write down the full financials. In years 2-6, the taxable net income would be \$5 more, so at your 40% corporate income tax rate you would have to pay not \$2, but \$4 in taxes. This means that you would have to pay an extra \$2 in taxes each year.

Method #2, APV, demands a detour: You must construct as-if-100%-equity-financed financials.

Check that this intuition is correct. The financials of an all-equity-financed firm are:

Here are the 100%-equity-financed cash flows.

Abbreviated Income Statement, 100% Equity-Financed							
		Y1	Y2	Y3	Y4	Y5	Y6
=	EBIT (Operating Income)	\$35	\$10	\$10	\$35	\$60	\$60
–	Interest Expense	\$0	\$0	\$0	\$0	\$0	\$0
=	EAIBT (or EBT)	\$35	\$10	\$10	\$35	\$60	\$60
–	Corporate Income Tax (at 40%)	\$14	\$4	\$4	\$14	\$24	\$24
=	**Net Income**	\$21	\$6	\$6	\$21	\$36	\$36

(Note how the tax obligations are higher than they were when the firm had some debt financing.)

Abbreviated Cash Flow Statement, 100% Equity-Financed							
		Y1	Y2	Y3	Y4	Y5	Y6
	Net Income	\$21	\$6	\$6	\$21	\$36	\$36
+	Depreciation	\$25	\$50	\$50	\$25	\$0	\$0
=	**Total Operating Activity**	\$46	\$56	\$56	\$46	\$36	\$36
	Capital Expenditures	–\$75	–\$75				
=	**Total Investing Activity**	–\$75	–\$75				

You can now reuse our present value cash flow formula on the 100%-equity-financed version of our firm:

Computing Project Cash Flows, 100% Equity-Financed							
		Y1	Y2	Y3	Y4	Y5	Y6
	Total Operating Activity	\$46	\$56	\$56	\$46	\$36	\$36
+	Total Investing Activity	–\$75	–\$75				
+	Interest Expense	\$0	\$0	\$0	\$0	\$0	\$0
=	**Project Cash Flows**	–\$29	–\$19	+\$56	+\$46	+\$36	+\$36

Comparing this to the equivalent table on Page 487, you can see that the project cash flows in your 100%-equity-financed firm have indeed lost the tax shelter of \$2 in each of years 2-6. The intuition was correct!

Return to the main task: APV valuation.

Now discount these "as-if-100%-equity-financed" total project cash flows with the firm's appropriate cost of capital, which is assumed to be 30%. Standing at time 0, this gives you

$$\text{NPV}_{\substack{\text{Project, 100\%}\\ \text{Equity- Financed}}} = \frac{-\$29}{1.30} + \frac{-\$19}{1.30^2} + \frac{+\$56}{1.30^3} + \frac{+\$46}{1.30^4} + \frac{+\$36}{1.30^5} + \frac{+\$36}{1.30^6} \approx \$25.20$$

The APV formula states that you now need to add back the expected tax shield from the debt. The interest tax shields in years 2-6 are the interest payments ($5 per year) multiplied by the corporate tax rate (40%), or $2 per year. What is the value of this tax shelter?

$$\text{NPV}_{\text{Tax Shelter}} = \frac{\$0}{1.30} + \frac{+\$2}{1.30^2} + \frac{+\$2}{1.30^3} + \frac{+\$2}{1.30^4} + \frac{+\$2}{1.30^5} + \frac{+\$2}{1.30^6} \approx \$3.75$$

Therefore, the APV method tells you that the firm value is

$$\text{APV} \approx \$25.20 + \$3.75 = \$28.95$$

This is the same answer that you found in Formula 18.6.

The WACC Valuation

Method #3: WACC. The debt is about 35% of the firm's financing.

The third method to value the firm is WACC. Start again with the firm's cash flows, as if 100% equity-financed.

Computing Project Cash Flows, 100% Equity-Financed

	Y1	Y2	Y3	Y4	Y5	Y6
Project Cash Flows	–$29	–$19	+$56	+$46	+$36	+$36

The idea now is to use an appropriate tax-adjusted WACC to discount these cash flows. But there is another tricky issue: What is the firm's debt ratio? That is, WACC requires $w_{\text{Debt}} = (1 - w_{\text{Equity}})$ as an input. In the real world, you could just look up the current firm values. In our example, I am sparing you the details of working out that the debt is about 35% of the firm's value today. You know the other two remaining inputs that you need to compute WACC, which are the overall corporate cost of capital at 30%, and the debt cost of capital at 20%.

Return to the main task: WACC valuation.

You can now compute the firm's weighted average cost of capital as

$$\text{WACC} = 30\% - 40\% \cdot 35\% \cdot 20\% = 27.2\%$$

$$\text{WACC} = \mathsf{E}(r_{\text{Firm}}) - \tau \cdot w_{\text{Debt}} \cdot \mathsf{E}(r_{\text{Debt}})$$

Under the incorrect but hopefully reasonable assumption that the debt ratio remains at 35%,

$$\text{NPV} = \frac{-\$29}{1.272} + \frac{-\$19}{1.272\%^2} + \frac{+\$56}{1.272\%^3} + \frac{+\$46}{1.272\%^4} + \frac{+\$36}{1.272\%^5} + \frac{+\$36}{1.272\%^6} \approx \$29.55$$

This is a (modest) 60 cents off the value of the APV formula. Most of the difference comes from the fact that the fraction of debt in the capital structure is 35% in the first year but a different proportion of the value in subsequent years. As noted on Page 484, the WACC method really does not apply in this case. However, in the real world, this error would be dwarfed by errors in what you have assumed about the tax code and by your uncertainty about the expected cash flows and costs of capital that such projects would carry.

Q 18.10. Construct a pro forma for the following firm: A 3-year project costs $150 in year 1 (not year 0) and produces $70 in year 1, $60 in year 2, and $55 in year 3. (All numbers are year-end.) Depreciation, both real and financial, is straight line over three years. Projects of this riskiness (and with this term structure of project payoffs) have an 18% before-tax opportunity cost of capital. The marginal corporate income tax rate is 40%.

1. Assume that the firm is 100% equity-financed. Construct the pro forma and compute expected project cash flows.
2. Compute the project IRR.
3. Compute the project NPV.
4. Assume that this firm expects to receive an extra tax-exempt bonus of $2 in years 2 and 3 from a benevolent donor. What would be the project's cash flows and IRR now?

For the remaining questions, assume that the firm instead has a capital structure financing $50 with debt raised in year 1 at a 10% (expected) interest rate. There is no interest paid in year 1, just in years 2 and 3. The principal is repaid in year 3.

5. Construct the pro forma now. What is the IRR of this project?
6. From the pro forma, what is the NPV of the debt-financed project?
7. Compute the NPV via the APV method.
8. Via the APV method, how much would firm value be if the firm would have taken on not $50, but $40, in debt (assuming the same debt interest rate of 10%)?
9. Does the debt ratio of the firm stay constant over time? Is this firm a good candidate for the WACC method?

The Tax Shelter on Intel's Financial Statement

The application is easy.

Can you apply your newfound theoretical knowledge of how to handle corporate income taxes to a real-world firm—in fact, to the Intel example from Chapter 14? Of course, you can. What is the tax subsidy in Intel's income statement in Exhibit 14.2?

Leverage is a less effective tax shield than country shifting

In recent decades, profitable multinational U.S. companies have become more aggressive in shifting their operations overseas. Apple is famous for holding about $200 billion overseas in order to avoid U.S. taxes—all the while merrily issuing more U.S. debt to finance its operations. But Apple is not alone. Deep inside its financial statements, Intel reports that it paid about a 20% tax rate (down from 26% in 2014). It is not eager to advertise why this is so much lower than the U.S. statutory rate of 35%, but its financial statement footnotes mention that it has to do with shifting to lower-tax jurisdictions and U.S. R&D tax credits. You can also see this reflected on the net income statement, where $2,792 is the provision for taxes on $14,212 of income before taxes (i.e., under 20%). Suffice it to say that although leverage is a good tax-shelter, there are much better ones for many large companies.

Marginal debt shelter

Morningstar's website has nice charts of prevailing YTMs for individual firms' corporate bonds. In June 2016, the quoted (not expected) YTM on Intel 1-year debt was about 1% per annum (50bp above the Treasury), 2% (50bp above) for 5-year debt, and 4% (150bp above) for 30-year debt. For economists, it is the marginal cost of debt that matters, not the average cost of debt. Compared with its (intrinsically) long-term equity, Intel saves about 20% × 4% on every dollar of long-term debt that it would now issue. Thus, an extra $10 billion in debt would save about $100 million in taxes. This is not a small amount, but with interest rates so low, it's not a major dent. If it is risk-averse, it could try to have its U.S. operations borrow money from foreign low-income-tax-country subsidiaries at high interest rates in order to reduce its taxable U.S. income. (It would have to disguise this maneuver in somewhat strange and complex securities, so that the IRS could not easily contest the interest rate.)

Not enough debt, but also too much cash?!

This poses an interesting quasi-dilemma for Intel. On the one hand, Intel has too much equity and too little debt. It could reduce its taxes by issuing more debt, most likely without further harming its credit rating. Intel did just that in 2015. On the other hand, Intel is keeping a lot of money on the balance sheet and by earning interest has to pay taxes on this money's interest again. It should consider repurchasing more shares from its investors to return the money to investors without triggering more tax obligations. This is, after all, the point of a corporation—returning money to shareholders if they can invest it better and with fewer tax obligations than you can.

Source shifting tends to be more important than leverage as a tax strategy for MNCs.

Independent of these debt-related strategies, other tax-avoidance strategies—like shifting even more operations to lower-tax host countries—could reduce the tax burden even more. But those have relatively less to do with the debt-equity ratio and more to do with how operations and cash flows should be structured. The next question covers a case in which a corporation has a clear tax shelter, because it has large net leverage.

Q 18.11. From 2013 to 2015, GE had the following income statement:

Sales	$347.8
EBITDA	$36.6
Interest	$9.1
Income Bef Tax	$27.6
Tax	$8.4
Minority Interest	–$0.7
Net Income	$19.1

Assess the tax shield due to its $145 long-term debt.

18.5 Contemplating Corporate Taxes and Leverage

You now understand how managers can use capital structure to adjust to the presence of corporate income taxes.

Which Tax-Adjusted Valuation Method is Best?

None of the three methods always dominates.

Which of the three valuation methods is best: flow-to-equity, APV, or WACC? In the real world, they are all in use because each has its advantages and disadvantages.

Estimated values should be similar.

Of course, the three methods should come out with similar results. As the hypothetical machine example in Section 18.4 showed, if suitably applied, the differences are usually modest. This is especially true if you compare valuation-method differences to the errors that you will inevitably introduce in your assessments of future expected cash flows, your estimate for the appropriate costs of capital, and the necessary simplification of the tax code.

Here is how I see the three methods:

Compare the advantages and disadvantages of the methods.

Flow-to-equity: The advantage of the flow-to-equity method is that it is lucid and makes it less likely that you will use an incorrect expected cash flow. The disadvantage of the flow-to-equity method is that it requires a lot more effort (you have to construct full financials!), and that it does not break out the tax advantage of debt explicitly. This makes it more difficult to think about the tax-induced consequences of contemplated capital structure changes.

APV: The APV formula makes it relatively easy to determine how an extra dollar of debt increases firm value. When thinking of a specific addition or project with a specific cost, this may be the easiest formula to use.

WACC: The WACC formula makes it relatively easy to determine how an extra percentage in debt increases firm value. When thinking of a target ratio change in capital structure policy, this may be the easiest formula to use.

My advice: APV is often simplest.

In many common cases, APV is easier to work with than WACC. For example, APV makes it much easier to think about projects that add debt capacity only at some stage in their lives. What drives project debt capacity? The simple answer is that more tangible (collateralizable) projects tend to add more debt capacity, because your bank will find it easier to repossess and resell tangible assets. A research and development (R&D) project may require an equity investment upfront, followed by the construction of a laboratory that can be debt-financed. The laboratory adds debt capacity, the R&D does not. APV makes it easy to add in the debt capacity only in later stages. APV also makes it easier to assign different discount factors to the firm's projects and tax shields.

WACC is often most difficult for multiyear projects.

WACC is probably the most difficult method. No one knows how to do multiyear compounding with time-varying WACCs. Therefore, the method can only be applied if the firm's debt ratio remains roughly constant in future years. Of course, if you know that this is the case, WACC may be easier to use than APV. However, in all other cases, WACC usage errors could become important. The empirical evidence suggests that publicly traded corporations rarely keep constant debt ratios, often rendering WACC a less preferable method. On a more technical note, WACC also leans more heavily on the assumption that borrowing rates are competitive and thus zero NPV. Therefore, WACC works only in "normal" situations in which creditors are paid the appropriate cost of capital on the debt. WACC cannot deal with "below-market" or "above-market" unfairly priced loans—much as the plain version of the CAPM cannot. (You already know that you need to use a certainty equivalent form of the CAPM in this case, explained in the companion. Of course, the CAPM itself is dubious.)

Repeat: The Important Mistakes to Avoid

Same warning again: Please don't ever adjust current non-100% equity cash flows via APV or WACC.

The first big mistake you should never commit is to use the wrong expected cash flows for APV or WACC. Using the wrong discount rate on the tax shelter or tax liability is forgivable (within bounds); using the wrong expected cash flows is not. Let's reemphasize what you must do. In the flow-to-equity method, you already have both the projected debt cash flows and the projected equity cash flows, so your life is simple. You can just use these pro forma cash flows, which already take the debt tax shield into account. In contrast, in both the APV and WACC methods, you must not use the expected cash flows of the firm under the current capital structure (much less the expected cash flows of the current equity), but the cash flows that would accrue if the firm were fully equity-financed.

Same warning again: Don't let the formulas teach you to think that more debt is always better than less.

The second big mistake you should never commit is to believe that just because it is not explicitly in the formula, debt has no drawbacks. In most real-life situations, raising your debt level can increase both your cost of debt capital and your cost of equity capital.

A Quick-and-Dirty Heuristic Tax-Savings Rule

Why bother with such small 1-year tax savings?

Do not confuse the question of whether tax savings are important with whether the right discount factor for the tax savings is important. The former is much bigger than the latter. But aren't the tax savings too small to bother with altogether? Before you draw this conclusion, realize that the firm need not invent anything new or work extra hard to obtain the tax savings. In addition, tax savings materialize year after year after year. In fact, this constancy provides a nice back-of-the-envelope heuristic of what the firm can gain in value from one dollar extra in debt.

The tax savings will repeat. Rule of thumb: Each perpetual dollar of debt gives tau benefit.

Start with the APV formula. If a large firm today takes on and maintains an extra \$1 billion in debt rather than an extra \$1 billion in equity, the interest is on the order of about 6%, or \$60 million per year. The tax rate for many corporations is about 40%, leading to a savings of \$24 million—this can pay for a nice executive bonus. But this is only the first year. The \$24 million per year savings is a perpetuity. If the cost of capital on the tax shelter is the cost of capital on the debt (6%), then you can compute the total value increase to the firm today to be \$24/6% = \$400 million.

$$\text{Value Increase} \approx \frac{40\% \cdot 6\% \cdot \$1\text{billion}}{6\%} = \$400 \text{ million}$$

$$\text{Value Increase} \approx \frac{\tau \cdot \mathsf{E}(r_{\text{Debt}}) \cdot \text{Debt}}{\mathsf{E}(r_{\text{Debt}})} \approx \tau \cdot \text{Debt}$$

This is a nice shortcut: For every dollar extra in eternal debt, the value of the firm increases by the tax rate of the firm. This formula is so easy that you can often compute it in your head. For example, compare financing a \$1 million project with 50% debt rather than with all-equity, in which a firm in the 40% marginal tax bracket plans not to repay any of the debt principal or to take on new debt. The tax savings would be $40\% \cdot \$500{,}000 = \$200{,}000$.

Two small problems with this heuristic are the discount rate and the perpetuity assumptions.

It is important that you recognize that the $\tau \cdot \text{Debt}$ formula for the tax savings is not an exact calculation. It is only a heuristic—that is, a rule that gives you a good but not a perfect estimate very quickly. For example, it has made at least two assumptions that are never perfectly satisfied. The first is that the appropriate discount rate on the tax shelter is exactly the same as the cost of capital on debt. The second is that the debt and its tax shelter are truly perpetual, with constant cash flows and discount rates. Still, the formula is very useful to quickly get a handle on the long-term benefits of additional debt.

Are Investment and Financing Decisions Separate Now?

If the world is not perfect, projects with different financing options can offer different values. Thus, financing and investment decisions must be considered together, not separately.

In the perfect M&M world, investment and financing decisions can be made independently: Managers can focus on production choices and leave the financing to the nerds in the finance department. Unfortunately, if debt is tax-advantaged, or if there are other market imperfections, this is no longer the case.

For example, consider two projects with equal costs, equal payoffs, and equal costs of capital. (Alternatively, just consider their NPVs to be the same.) The first project is a research and development project; the second is a building. In the real world, it is difficult to find a bank to lend money for R&D: After all, if the firm fails to pay its interest payments, there is often little that the bank can collect and resell. Buildings, on the other hand, are easy to repossess. Therefore, the building offers more **debt capacity** (and income tax shelters) than the R&D project. Such debt capacity can make it more valuable than the otherwise equally promising R&D project. Managers cannot choose among projects without taking into consideration how each project aids the debt capacity of the firm.

Real estate has more debt capacity, which may add value if debt has value.

➤ Debt Capacity, Pg.493.

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In an imperfect world, unlike the M&M world, managers cannot ignore or delay financing decisions when making real investment decisions. The two decisions are intertwined.

A second complication derives from the fact that the value of the debt capacity can depend on who the owner is. Although most profitable and older firms are in the same highest tax bracket, some younger, growing, and unprofitable firms are in lower tax brackets. To these younger firms, the debt capacity is worth a lot less than it is to a large and profitable firm like Intel PepsiCo (which can immediately use the tax deduction).

The same complication you saw in Chapter 11 is at work here, too: The value depends on the owner's identity.

The Average and Marginal Cost of Capital

In Section 17.5, you already encountered the distinction between the average and the marginal costs of capital. Beware that in our current chapter, we have been computing only the *average* cost of capital. Unfortunately, as manager, you are often more interested in your *marginal* cost of capital on the next dollar of financing, because you want to compare it to the marginal rate of return on your next project. When the world is imperfect, the average cost of capital is usually lower than the marginal cost of capital. For example, your firm may have been able to finance its existing plants with tax-preferred debt, but lenders may not want to provide debt for the R&D that it wants to undertake now. Nevertheless, to help you estimate your marginal cost of capital, it is often still quite useful to learn your average cost of capital. If nothing else, it gives you a lower bound.

Different projects can have different financing.

➤ Marginal versus average cost of capital, Sect. 17.5, Pg.468.

Of course, the distinction between the two costs of capital does not change any of the calculations in this chapter. Our chapter is concerned with valuing the firm's tax shelter if you keep the same projects and have the ability to take on different levels of debt. The income tax shelter has an influence on the marginal cost of capital, just as it has on the average cost of capital.

Lesser Evils: Combining Tax-Adjusted WACC with the CAPM

Let me tie up one final loose end. Formally speaking, the CAPM is a perfect-market model and does not hold in an imperfect world. But the theoretical advice not to use it does not help you much in the real world. What can you use in the real world if your boss decides you need to use the CAPM, anyway?

Formally, it is wrong to use the CAPM in a world of taxes.

Informally, you often have no better alternative for the cost of equity capital.

One answer is that you can be a pragmatist and just use the CAPM anyway. You could combine the tax-adjusted WACC formula with a cost of equity capital estimated from the CAPM:

$$\begin{aligned} \mathsf{E}(r_{\text{Firm}}) &= w_{\text{Equity}} \cdot \mathsf{E}(r_{\text{Equity}}) + (1-\tau) \cdot w_{\text{Debt}} \cdot \mathsf{E}(r_{\text{Debt}}) \\ &\approx w_{\text{Equity}} \cdot \{r_F + [\mathsf{E}(r_M) - r_F] \cdot \beta_{\text{Equity}}\} + (1-\tau) \cdot w_{\text{Debt}} \cdot \mathsf{E}(r_{\text{Debt}}) \end{aligned}$$

This use of the CAPM to estimate a cost of equity capital, $\mathsf{E}(r_{\text{Equity}})$, is widespread. After all, we do not have a much better model. The quality of this approximation depends on how good the CAPM is in our real and imperfect world—and it is imperfect not only with respect to corporate income taxes but also with respect to other distortions explained in the next chapter (such as personal income taxes). Users generally hope that the CAPM cost of capital reasonably reflects all these other market imperfections. For example, if Treasuries must also offer relatively higher rates of return to compensate investors for higher personal income taxes on interest receipts—say, 5% taxable instead of 3.5% tax-exempt—your firm and your CAPM risk-free parameter should use the 5%, too. Thus, the personal income tax has made it into the historical parameter estimates of your CAPM model. As a corporation, this extra compensation payable to investors is part of your cost of capital that you have to pay to your investors, too. After all, your investors also suffer this tax imperfection.

Debt cost of capital: Maybe you can use historical average excess rates of return for bonds in the same rating category.

➤ Components of expected rates of return on corporate bonds, Exhibit 11.1, Pg.266.

For the term on the right, the cost of debt capital, $\mathsf{E}(r_{\text{Debt}})$, practice is more varied. Again, you want to estimate your *expected* interest rate (cost of capital). Unfortunately, the CAPM may not be a good model for bond pricing. The risk premium that is the main subject of the CAPM is often modest for bonds. Instead, it is liquidity and other imperfect market premiums (also elaborated on in the next chapter) that can be quite important. You may have to be more pragmatic here. One common practice is to estimate the historical average realized spread over Treasury that was earned by bonds of similar credit ratings, and use it to adjust the interest rate that you are quoted by your bank.

Do not forget about the difference between expected and promised returns!

➤ Expected versus promised yields, Sect. 6.2, Pg.113.

Of course, you should never rely on such a *quoted* interest rate on corporate debt, either your own debt or for bonds of similar credit ratings—because doing so would ignore the default premium—even if some analysts mistakenly do so. Fortunately, if you commit this error for very large, publicly traded corporations, you are only making a modest error. They rarely default. Unfortunately, for small firms, this may not be the case.

Q 18.12. A firm has expected before-tax earnings of $20 per year forever, starting next year. The firm is in the 25% tax bracket.

1. If the firm is financed with half debt (risk-free, at 5% per year) and half equity (at 10% per year), and this is eternally maintained, then what is its NPV?
2. If this firm took on $50 in debt and maintained its debt load at $50 forever (i.e., not the 50/50 debt-equity ratio), then what would this firm's value be?

18.6 Personal Income Taxes and Clientele Effects

Firms can reduce their costs of capital if they can reduce their investors' taxable personal incomes.

So far, you could just assume that all your investors are tax-exempt. Now we need to make it more realistic. Uncle Sam also collects his share from investors' income. As a corporate manager, does this mean that you need to think about your investors' personal income taxes? Yes! In effect, your corporate owners pay both your corporate income tax and their own personal income taxes. Take an extreme hypothetical example in which personal taxes on interest are 99%, personal taxes on dividends are 0%, and corporate income taxes are 40%. As the corporate CFO, should you pay out earnings as interest or as dividends?

- You can pay out $100 in interest payments. This means that your company can avoid all corporate taxes and pay out the full $100 from before-tax earnings as interest. As the CFO, you have sheltered *all* corporate income from taxes. Congratulations!? No—you have failed your clients. Your investors would have to pay $99 in taxes and therefore be left with only $1 to consume.
- You can dedicate $100 to dividend payments. This means that your company first has to pay $40 in corporate taxes, leaving only $60 for the actual dividends. Does this mean that you have failed in your job as CFO? No! Your investors would receive the dividends tax-free and therefore get to consume a full $60.

You would have done well by your investors in choosing the equity-based capital structure, in which payments become dividends, relative to the debt-based capital structure, in which payments become interest. Even though financing with debt would have saved your firm on corporate income taxes, it would have been a terrible overall financial strategy. (As you will learn later, your investors would demand a very high cost of debt capital under this tax code, which would make you, as the manager, determine that debt is not as good a method of financing as equity.)

As a CFO, you therefore need to understand how your investors' personal income taxes can influence the optimal corporate capital structure. There is a subtle interplay between personal and corporate taxes, which creates both investor and firm clienteles, each with different tax profiles and different strategies, all evolved to reduce the overall tax payment to Uncle Sam. In the real world, we should see the following:

Investor clienteles and firm clienteles play important roles.

Firm clienteles: Small-growth or firms with large past losses should have more equity in their capital structures than large, cash-rich firms.

Investor clienteles: Highly taxed individual investors should invest more in equity-financed firms, and tax-exempt investors should invest more in bonds.

Let me show you how this works.

Q 18.13. Why should a CFO be concerned with taxes that the firm itself is not paying?

Background: The Tax Code for Security Owners

➤ Introduction to taxes, Sect. 11.4, Pg.257.

First, let's review our investors' tax situations. Recall that investors care about the type of income they receive:

The type of income matters: Capital gains income is better than interest income for taxable investors.

Ordinary income is taxed at relatively high ordinary income tax rates (up to 39% Federal, plus 3.8% net investment income tax, plus state income tax), and it is very difficult to shelter from taxes.

Interest income is basically taxed like ordinary income.

Dividend income is taxed at a lower rate. If a domestic corporation has already paid taxes on its earnings, its dividends are considered "qualified," which reduces the personal tax rate imposed on the dividend recipients. Individuals in lower ordinary income tax brackets pay a 15% dividend tax, while those in higher tax brackets pay 20%+3.8%. Giving investors credit for dividends paid from already-taxed earnings is similar to how the United Kingdom and many other countries have taxed dividends for a long time.

Capital gains income is generally the most tax-advantaged form of income. Although short-term capital gains are taxed at the (high) ordinary income tax rate (where short-term usually means one year or less), long-term capital gains on financial securities are taxed at the same statutory rate as qualifying dividends (i.e., up to 24%). The tax advantage of

capital gains is not limited only to its relatively low statutory tax rate, however. There are more advantages: Capital gains are not incurred on an annual basis, but only when they are realized. When they are inherited, the recipients' cost bases are **stepped up**, meaning that the price at which the asset is received becomes the cost basis for the future. Capital gains can also escape taxation when they are used for charitable donations. And, unlike interest or dividend income, capital gains can be offset by capital losses. Therefore, the best form of income for investors remains long-term capital gains.

We are ignoring tax code details.

This perspective is simplistic. For example, the U.S. tax code contains many special rules that can apply to certain forms of income depending on the exact payor and recipient. For example, unlike individuals, corporations as security holders still pay a 35% capital gains tax rate. Furthermore, there are some very intricate tax rules on how capital gains income and interest income on bonds must be computed. Generally, these regulations are designed to prevent firms from paying out cash in a form that counts as interest payments for them and as capital gains for their investors. In addition, there are hundreds of special clauses in the tax code—some pure corporate subsidies, some targeted at only one qualifying company, and others penalizing particular situations. The tax code is not static, either, but changes every year! And all this ignores state and sometimes local taxes, Social Security and Medicare contributions, and the like. Yet all of these complications are dwarfed by the complications in multinational companies.

You must understand the logic and principles, not the specifics.

The interplay between the tax treatment of financial securities and the reaction of corporations is an ongoing cat-and-mouse game. You must first learn how to think about taxes, before you learn how our specific tax code works at the moment. Any details will likely be outdated within 10 years—if not sooner. Tax rates have gone up steadily since the Reagan administration, and the Federal government (and the state of California where I reside) have made so many promises that it is hard to see how they cannot raise taxes in the future.

Q 18.14. What kinds of income do investors like and dislike from a tax perspective?

Q 18.15. Explain the (personal and corporate) tax treatments if a company pays out its operating cash flow through interest payments, repurchased shares, or dividend payments.

The Principle Should Be "Joint Tax Avoidance"

The owners do not care where taxes are paid (corporate or personal), just that as little as possible is paid in total.

The main point of this section is simple: If managers want to best represent their corporate owners, they should consider not only the corporate income taxes that they have to pay directly, but also other issues—specifically, the personal taxes—affecting their investors. To understand the logic, pretend that you are the sole owner of a corner shop ("the corporation") and you are also its manager. Do you care whether the IRS taxes you right at the cash register of your corporate business or taxes you personally when you move the cash from the corporate register into your own pocket? Or do you care instead about how much you can ultimately put into your pocket and use to buy goods? The finance premise is that you care only about the money in your pocket that you have left over *after* Uncle Sam has had his dip from both. You want to reduce the net tax obligation both at the cash register (the corporate tax) and in your own pocket (the personal tax). Corporate investors are no different from your corner shop. They really should not care about the earnings of the corporation. They should only care about spendable after-tax personal income that these earnings ultimately translate into. It should not matter whether the corporation or they themselves paid taxes.

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- Corporate and personal taxes that can be avoided provide cash that the owners can keep.
- Reducing the total taxes ultimately collected by Uncle Sam (now and in the future) at *either* the corporate *or* the personal level can increase the value of the firm to its owners.

Tax Clienteles

Your Problem: How Can You Minimize Total IRS Receipts?

Distributions in interest help the paying firm, but not (taxable) recipient investors. Distributions in capital gains save investors tax money, but not firms.

As a manager acting on behalf of your corporate owners, your corporate goal should be to minimize overall taxes paid, not just corporate taxes paid. You can shift tax burdens from your company to your investors (and vice-versa) through your corporate financing and payout policies. Recall that your investors cannot shelter interest income, can modestly shelter dividend income, and can easily shelter capital gains income. So you face a trade-off:

- If you plan to pay out cash as interest income, you can save on your own corporate income tax—but your investors will receive cash as interest payments and thus face the full brunt of Uncle Sam. Thus, your bond investors should demand a relatively higher expected rate of return.
- If you plan to reinvest retained earnings, which means that your earnings will become capital gains for your investors, you pay more in corporate income taxes—but your investors will receive lower-taxed capital gains instead of taxable interest. This allows them to avoid some personal income taxes. Thus, relative to the appropriate perfect-market rate of return, your equity investors should demand a relatively lower expected rate of return than your equivalent bond investors.

An important complication is that different investors face different personal tax rates.

To make matters even more interesting, corporate managers have to be concerned that, in real life, not every investor faces the same tax rate. There are low-tax investors, like tax-exempt charities and endowments, pension and foreign funds, or even individual investors' 401-K plans, that pay lower or zero personal income taxes. And there are high-tax investors, like most domestic investors with retail brokerage accounts, that pay high taxes on interest income, medium taxes on dividends, and low taxes on capital gains. What should corporate managers (and their investor) do?

SimCity Live: Let's arrange firms and investors to minimize tax liabilities.

The best way to understand your choices is to imagine that you are a puppeteer, controlling the private economy. Your opponent is the IRS. You can work with the following game pieces:

High-tax *firms* (HTF): Mostly mature value firms with high earnings that cannot avoid paying taxes, sometimes dubbed "cash cow" firms. (For example, in this decade, Intel, Microsoft, and Apple have been bulging with earnings and thus tax liabilities.) For illustration (in Exhibit 18.4 below), assume they pay corporate income tax of 40% on earnings, and 20% if they reinvest them.

Low-tax firms (LTF): Although these used to be mostly smaller, high-growth firms, these days even some large firms qualify. For example, when the U.S. government sold its shares in AIG, these shares came with over $60 billion in tax-loss carryforwards. With $3 billion in annual income before tax, AIG will not have to pay corporate income tax for decades. For illustration, assume LTFs pay one-tenth the effective corporate income tax as high-tax corporations (i.e., 4% on earnings and 2% on reinvested earnings). This reflects the fact that they may face positive tax rates in the distant future, after they have exhausted all their tax-loss carryforwards. That is, using up tax-loss carryforwards is not "free."

High-tax *investors* (HTI): Mostly retail investors earning over $100,000 per year. For illustration, assume they pay 40% on interest income, 20% on dividend income, and 10% on capital gains.

Low-tax investors (LTI): Low-tax or tax-exempt investors—like pension funds. For illustration, assume they pay one-tenth of the taxes of high-tax investors (4%, 2%, and 1%, respectively.)

The rates are not exact, and this is not a perfect classification, either. Even many low-tax investors or 401-Ks must often eventually pay some taxes. (Endowments do not.) And even low-tax corporations may run out of tax shelters (or they can immediately use up all their tax credits and thereby become high-tax companies!). But it will serve you well in thinking about the problem. How would you arrange your pieces? Would you have the high-tax corporation finance itself with debt or equity? Would you have the low-tax investor own the high-tax corporation or the low-tax corporation?

Limited Low-Tax Availability

Who should own what is only interesting if tax-exempt investors are not in practically unlimited supply—or else they would own everything.

Clearly, you would not face a difficult problem if 99.9% of your investors were tax-exempt—you could make almost all taxed corporations issue lots of debt (and thereby avoid corporate income taxes). In this case, neither corporations nor the almost entirely tax-exempt investor sector would end up owing much in taxes. Corporations would worry little about (or compensate) their investors for these investors' (nonexistent) personal income taxes. Corporations could offer bonds with the same yield as equivalently risky but tax-exempt entities.

However, the empirical evidence suggests that low-tax investors are not in ample supply. The NYSE's *Factbook* reports that there was $11 trillion in total equities outstanding in 2002, of which 49.8% was held by all institutional investors, 36% by retail investors, and 11% by foreign investors. Almost half of the institutional money—a total 21.5% of the equities market—were tax-exempt pension funds. Another large part were individual tax-exempt accounts. It is likely that these economy-wide ratios have remained steady since 2002. Thus, tax-exempt investors are indeed a force, but a limited one.

Firms cannot easily become low-tax, either.

With limited low-tax firms and low-tax investors, let's work out what firms and investors should do. Using the illustrative tax assumption, and making our lives simpler by assuming that expected rates of return are the same for debt and equity (i.e., risk-neutrality), Exhibit 18.4 shows the choices. When the firm pays interest, it can reduce its taxable earnings one to one. (Remember that interest is paid from pre-tax earnings.) When the firm reinvests, it first pays corporate income tax, but often receives an "investment tax credit" break (or it can try to classify new investment as required maintenance and expense it as a tax cost). Otherwise, it has to pay its full tax rate. It can then use the post-tax net income to repurchase shares or pay dividends.

Your Solution: Arrange Clienteles

"Clientele effects": different firms attract different investors. This reduces Uncle Sam's take.

What is your best strategy? As master puppeteer with a limited number of tax-exempt investors, and with the task of minimizing Uncle Sam's take and maximizing your private sector take, you should sort your pieces into the following clienteles:

High-tax, profitable firms should pay out via interest (thus, have debt).

High-tax, profitable firms: Make your "cash-cow" value firms in the highest tax bracket issue debt, so that their cash flows can be paid out as interest, thereby avoiding the high corporate income tax.

Low-tax investors should hold this debt.

Low-tax investors: Make your tax-exempt investors hold this corporate debt, so that the interest receipts remain untaxed at the recipient level. (If you instead made your high-tax investors hold this debt, Uncle Sam would be better off, and you and your investors would be worse off.)

Uncle Sam therefore sees little cash from either of these two. You still have low-tax firms and high-tax investors to allocate. What can you do with them?

		Low-Tax Investor (LTI) (e.g. 401-K, Pension Fund)	High-Tax Investor (HTI) (e.g., retail investor)
High-Tax Firm (HTF)	Debt & Pay Interest	HTF Pays Interest on \$100 at 0% Rate τ =\$0 LTI Pays 4% Interest Tax ..... τ =\$4 IRS: \$4 You: \$96	HTF Pays Interest on \$100 at 0% Rate τ =\$0 HTI Pays 40% Interest Tax ..... τ =\$40 IRS: \$40 You: \$60
	Equity & Reinvest	HTF Reinvests \$80 at 1–0.2 Rate ..... τ =\$20 LTI Pays 1% CapGains Tax ..... τ =\$0.80 IRS: \$21 You: \$79.20	HTF Reinvests \$80 at 1–0.2 Rate ..... τ =\$20 HTI Pays 10% CapGains Tax ..... τ =\$8 IRS: \$28 You: \$72
	Equity & Repurchase Stock	HTF Repurchases \$60 at 1–0.4 Rate .. τ =\$40 LTI Owns Bigger Share ..... τ =\$0 IRS: \$40 You: \$60	HTF Repurchases \$60 at 1–0.4 Rate .. τ =\$40 HTI Owns Bigger Share ..... τ =\$0 IRS: \$40 You: \$60
	Equity & Pay Dividends	HTF Pays \$60 Divs at 1–0.4 Rate ..... τ =\$40 LTI Pays 2% Div Tax ..... τ =\$1.20 IRS: \$41.20 You: \$58.80	HTF Pays \$60 Divs at 1–0.4 Rate ..... τ =\$40 HTI Pays 20% Div Tax ..... τ =\$12.00 IRS: \$48.00 You: \$48
Low-Tax Firm (LTF)	Debt & Pay Interest	LTF Pays Interest on \$100 at 0% Rate . τ =\$0 LTI Pays 4% Interest Tax ..... τ =\$4 IRS: \$4 You: \$96	LTF Pays Interest on \$100 at 0% Rate . τ =\$0 HTI Pays 40% Interest Tax ..... τ =\$40 IRS: \$40 You: \$60
	Equity & Reinvest	LTF Reinvests \$98 at 1–0.02 Rate ..... τ =\$2 LTI Pays 1% CapGains Tax ..... τ =\$0.98 IRS: \$2.98 You: \$97.02	LTF Reinvests \$98 at 1–0.02 Rate ..... τ =\$2 HTI Pays 10% CapGains Tax ..... τ =\$9.80 IRS: \$11.80 You: \$88.20
	Equity & Repurchase Stock	LTF Repurchases \$60 at 1–0.04 Rate .. τ =\$4 LTI Bigger Share ..... τ =\$0 IRS: \$4.96 You: \$95.04	LTF Repurchases \$60 at 1–0.04 Rate .. τ =\$4 HTI Owns Bigger Share ..... τ =\$0 IRS: \$13.60 You: \$86.40
	Equity & Pay Dividends	LTF Pays Dividends \$60 at 1–0.04 Rate τ =\$4 LTI Pays 2% Div Tax ..... τ =\$1.92 IRS: \$5.92 You: \$94.08	LTF Pays Dividends \$60 at 1–0.04 Rate τ =\$4 HTI Pays 20% Div Tax ..... τ =\$19.20 IRS: \$23.20 You: \$76.80

Exhibit 18.4: *Tax Clienteles.* The economy consists of two firms both about to earn \$100 in profit. One firm has a corporate income tax rate of 40% (HTF), the other of 4% (LTF). However, reinvested profits suffer only half the tax rate (20% and 2%, respectively). The economy also consists of two types of investors. The LTI investor suffers no taxes (e.g., your 401-K, or a pension or foreign fund). The HTI investor pays 40% tax on interest income, 10% tax on capital gains, and 20% tax on dividend income. The tax rates were chosen primarily for clarity of illustration.

Because LTI are in limited supply, you need to choose one box on each column. Because LTF are in limited supply, you need to choose one box from the upper half.

High-tax investors should hold equity.

High-tax investors: Make your high-tax individual investors hold stocks instead of bonds. They will then either receive capital gains (taxed very little) or dividends (taxed just a little more). This way, your high-tax investors will suffer only fairly low tax penalties, too.

Low-tax, unprofitable firms should pay out via share repurchases or dividends (thus, have equity).

Low-tax firms: Make your low-tax firms finance themselves with equity, not with debt. You need this arrangement to satisfy the demand for equity by your high-tax investors. You can make your low-tax firms use their cash flows to reinvest in the corporation, repurchase their shares, or pay dividends. In any case, it would allow these firms' predominantly high-tax investors not to suffer much in taxes. (If you instead made your low-tax firms finance themselves with debt, the firms would have little use for the corporate income tax shelter provided by debt, at least compared to high corporate tax firms—and your high-tax investors would have no equities to buy.)

Again, Uncle Sam therefore sees relatively little cash from his taxable minions.

Can you do better? No.

Now put the two figures together. Our proposed solution leaves Uncle Sam with $\$4+\$11.80 = \$15.80$ in receipts and the rest of the economy with $\$200-\$15.80 = \$184.20$. Can you find a combination that is better? No! This is the best puppeteering that you can do! In the net configuration in the economy, the non-Uncle Sam economy gets to keep $\$96+\$88.20 = \$184.20$, for a net taxation of only 8%.

Market Prices as Puppeteers

Extreme tax avoidance is interesting. But there is no puppeteer. Or is there?

But you are not a puppeteer, so why does any of the above matter? Is there a puppeteer in real life? Actually, there is. The puppeteer is the financial market! This is what capitalist markets are really good at—they allocate resources to their best uses, and the best use of capital here is where capital avoids paying taxes. The puppeteer's strings are the required costs of capital on debt and equity. They induce investors and firms to sort themselves to where the (tax-loss) frictions are the lowest. (If the market did not sort everything well, arbitrageurs could find a way to make money from rearranging firms and investors better to save on aggregate taxes.)

The puppeteer is the set of market prices that induces firms and investors to do the right thing.

Let me show you an example of how this might work. Let's work with the same example as before, in which \$100 in before-tax cash is all that either type of firm has to decide on. However, to make it really simple, assume further that there is no uncertainty. What would happen if the financial market demanded a 10% interest rate as appropriate compensation for debt holders and a 7% capital gains rate as appropriate compensation for equity holders?

The high-tax (cash-cow) firm with \$100 of income would realize that it had two options:

1. **Finance with equity:** After paying \$40 in corporate income taxes, it would offer its investors a capital gain of \$60, which would be worth $\$60/(1+7\%) \approx \$56.07$.
2. **Finance with debt:** Paying nothing in corporate income taxes, it would be worth $\$100/(1+10\%) \approx \$90.91$.

Value-maximizing managers of high-tax firms would therefore prefer to finance with debt.

The low-tax (growth) firm would realize that it had two options:

1. **Finance with equity:** After paying \$2 in corporate income taxes, it would offer its investors a capital gain of \$98, which would be worth $\$98/(1+7\%) \approx \$91.59$.
2. **Finance with debt:** Paying nothing in corporate income taxes, it would be worth $\$100/(1+10\%) \approx \$90.91$.

Value-maximizing managers of low-tax firms would therefore prefer to finance with equity.

High-tax (retail) investors could earn 7% in capital gains. After 10% in capital gains taxes, this would leave them with $7\% \cdot (1-10\%) = 6.3\%$ in after-personal-income-tax returns. Or they could earn 10% in interest income. After 40% in interest taxes, this would leave them with 6% in after-personal-income-tax returns. They will therefore prefer to invest in the equity of low-tax firms and not in the debt of high-tax firms.

Low-tax (pension fund) investors could also earn 7% in capital gains. This would leave them with a little under 7% in after-personal-income-tax returns. Or they could earn 10% in interest income. After 4% in interest taxes, this leaves them with $10\% \cdot (1-4\%) = 9.6\%$ in after-personal-income-tax returns. They will therefore prefer to invest in the debt of high-tax firms and not in the equity of low-tax firms.

As you can see, every party gravitated toward the choice that was most tax-efficient—just as I claimed they would. It happened because I set the before-tax yields on interest above their perfect-market equivalents, and the before-tax yields on equity below their perfect-market equivalents. If there was uncertainty, then these required yields would, of course, also be affected by risk premiums.

Clienteles mitigate tax effects.

You should now understand the tax rationale for how expected rates of return will sort firms and investors to minimize taxes. From your perspective as a corporate manager, the presence of personal income taxes has magically worked to increase your debt cost of capital relative to your equity cost of capital. However, relative to a nonclientele situation, clientele self-sorting has reduced the effective personal income tax penalty on debt. Clienteles mitigate your debt cost of capital.

The real world resembles this model sketch.

There is good empirical evidence that such tax-clientele ownership effects are important. For example, corporate bonds are overwhelmingly owned by tax-exempt institutions. Of course, in the real world, tax avoidance is just one (important) force at work, so the world is not as neat as our model. For instance, tax-exempt investors may want to diversify across many different companies, and not just hold exclusively the debt of high-tax, cash-cow corporations. The clientele net income tax reduction is not the only force at work.

Q 18.16. Would Uncle Sam be better off if our puppeteer forced the low-tax firm to be financed with debt and the high-tax firm with (share-repurchasing) equity? Refer back to Exhibit 18.4.

Q 18.17. Would Uncle Sam be better off if our puppeteer forced low-tax investors to hold equity and high-tax investors to hold debt? Refer back to Exhibit 18.4.

Q 18.18. From a tax perspective, would you expect large, stable firms to be predominantly held by pension funds or by high-tax individuals? Would you expect young, growing firms to be predominantly held by pension funds or by high-tax individuals?

Q 18.19. Is it more critical for the high-tax firm or the low-tax firm to finance itself correctly?

Q 18.20. In a risk-neutral world, would a high-tax investor be satisfied with a lower rate of return on capital gains?

Q 18.21. If investor tax rates on dividends would rise, how do you think the prices and expected rates of firms will respond in equilibrium?

Q 18.22. If Congress made 401-K and other investors taxable, how do you think the prices and expected rates of firms will respond in equilibrium?

From the firm's perspective, tax-exempt investors (in the United States) reduce the cost of capital on debt.

WACC and APV With Personal Taxes

More formulas, e.g., to handle personal income taxes? Fortunately, no. WACC and APV won't change. I will soon explain why. In brief, from a corporate CFO's perspective, the input figures for the expected costs of capital will change with the personal taxes that are imposed on your investors, but the formula will not. To the extent that retail investors have to pay more in taxes, they will demand higher expected rates of return. From your CFO perspective, you can take the expected rates of return that they demand as given. (In contrast, you had to break out your own corporate income taxes in the APV and WACC formulas only because it was you yourself who had to pay corporate taxes on your net income.)

➤ WACC, Formula 18.5, Pg.484.

➤ APV, Formula 18.1, Pg.481.

➤ Another APV or WACC Formula?, Sect. 19.9, Pg.544.

18.7 The U.S. Tax System (Mess)

Some Other Corporate Tax Avoidance Schemes

There are too many tax avoidance schemes in existence to list in just one book. They are also changing all the time. Here are some examples.

Wall Street and Main Street employ armies of lobbyists and tax accountants and lawyers to help themselves and their clients avoid taxes, but this is really an arms race between the IRS (Congress) and investors. Investors and companies keep looking for or are actively lobbying Congress for new tax avoidance schemes; and the IRS (when it can) tries to close these new loopholes. There are a large number of both past (now closed) and current tax avoidance schemes. Some of the more noteworthy remaining tax reduction schemes are as follows:

- Sometimes, high-tax firms may be able to buy low-tax firms, and thereby immediately use the acquired firm's existing **net operating losses** (**NOLs**).

  For example, the *Financial Times* reported on February 10, 1994, that the £2.5B GKN Corporation made a hostile bid for the £300M Westland Corporation, solely because GKN needed Westland's NOLs to reduce its own corporate taxes due.

- Compared to buying on credit, **leasing** can be a tax-advantageous arrangement. If the borrower does not have enough income to use the interest deduction efficiently, someone else should be the official owner of the asset and "lease" it to the borrower, thereby capturing the full benefit of the interest deductibility.

- Multinational corporations can shift difficult-to-value profitable assets from a high-tax to a low-tax country. For example, corporate income taxes in Switzerland (federal and canton) can be as low as 7.8% (for holding companies) and as high as 25%. This contrasts with state and federal corporate income tax rates as high as 45% in the United States. Now consider a company that has just developed a patent worth \$10 million per year. If the U.S. branch owns the patent, the firm will retain only $(1-45\%)\cdot\$10 = \$5.5$ million per year. If the Swiss branch owns the patent, the firm will retain up to $(1-7.8\%)\cdot\$10 \approx \$9.2$ million per year. Why stop at \$10 million? If the Swiss branch charges the U.S. branch \$20 million per year, the firm's U.S. tax obligations (resulting from profits from other businesses) will decrease by \$9 million per year ($45\%\cdot\$20$ million), but Swiss tax obligations will increase by \$1.56 million per year ($7.8\%\cdot\$20$ million). Still, this is a healthy \$7.4 million net gain per year (relative to a situation in which the Swiss branch will change nothing).

  This tax-efficient capital transfer can also be accomplished with capital structure. For example, if the Swiss branch lent funds to the U.S. branch at an interest rate of 36% per year, rather than 6% per year, the effect would be a reduction of the firm's tax liabilities. For every \$1,000 in excess interest paid (at the 36% instead of the 6% rate), the company would retain an extra $(45\%-7.8\%=37.2\%)$ \$372 in profits. Companies can play similar, but less drastic, tax games by choosing the U.S. state and municipality in which they are headquartered.

  The IRS is very much aware of these issues, but it is Congress that makes the rules, not the IRS. Even the U.S. Senate has reported on its own "subpart F" tax loophole, which allows

companies to "sell" their intellectual property rights to a foreign, controlled company in a tax shelter. This explains why our tech giants' patents and inventions are now all owned by their Irish subsidiaries, even though they were invented in the United States. Estimates are that about $2 trillion of undistributed earnings are now held abroad.

- Many firms have moved their headquarters to lower-income-tax states or negotiated special rates with their home states. Many other firms have or have tried to move to other countries (to avoid most U.S. taxes on their worldwide income altogether). The Treasury Department has issued new guidelines to try to slow down this trend. As of 2016, it is, however, primarily the negative publicity that has managed to stop some of these mergers.
- There are a variety of flow-through vehicles that allow businesses and individuals to funnel income untaxed to another firm in a chain, where they are "presumably" to be taxed. However, tax lawyers have devised very complex arrangements in which these corporations are then owned by lower-tax individuals often in foreign tax dominions. There is an entire off-shore industry that has developed to legally own and administer these foreign entities, with an implicit but not explicit understanding that they belong to unnamed parties that would otherwise be taxed. (If it were explicit, it would be illegal.) This industry is lucrative for all its participants but socially detrimental. It wastes a lot of brainpower and fees on unproductive activities and leaves the economy with where it could have been without this effort—almost no tax collections.

A Saner Tax Code?

How good is the U.S. tax system? It's terrible. In fact, it can only be described as insane.

It's insane.

First, it costs a lot to administer, yet the United States collects very little in corporate income taxes. As of 2016, under 2% of GDP is collected by corporate income taxes, down from about 4% in 1965. (In Germany, it is similar. In Canada, it is about 3-5%.)

The U.S. collects very little in corporate taxes.

Among the reasons for this low tax take are the so-called *special income tax provisions* that Congress has enacted. These often apply to only one single company, usually a large political contributor and employer in a Congressional district or state. Together, the special income tax provisions amount to more than $1 trillion dollars a year. (For perspective, this is more than the total amount of federal discretionary spending.) The non-partisan GAO found that 72% of foreign corporations and 57% of U.S. corporations did not pay any taxes in at least one year between 1998 and 2005. More than 50% and 42% did not pay taxes for two or more years. Picking just the final year of the survey, 2005, about 25% of the largest U.S. companies paid no federal income taxes. It continues. In 2009, Exxon made $19 billion in profits, yet it *received* $156 million from the IRS. Bank of America made $4.4 billion in profits (having been bailed out by taxpayer funds), yet paid nothing. John Graham (from Duke University) reported that a large number of firms—but not all—are fully aware of how to manage their taxes effectively. In fiscal year 2001, about 6,000 firms had effective tax rates of 5% or less! Between 1,500 and 2,000 firms had tax rates between 5% and 30%. And about 4,000 firms had tax rates between 30% and 40%. As I write this in 2016, more than 160 high-powered corporate lobbyists are pressing for a "tax holiday" for more than $1.4 trillion in offshore profits, which their employers would then repatriate. The lobbyists include former chiefs of staff of the most important U.S. House and Senate members, both Democrat and Republican. Legal corruption should not surprise you: after all, the U.S. tax stream is the biggest river of money in the history of mankind.

Why so little? What does this mean for companies?

Before such corporate tax avoidance schemes outrage you too much, you should realize that you may even benefit when tax lawyers and Congress help many U.S. companies succeed in escaping some of their tax burdens. First, corporations are just vehicles owned by investors. Corporate income taxes are ultimately paid by the investors—often small dispersed investors like you, perhaps in your pension fund. Second, the United States has no monopoly on corporate locations. If U.S. taxes are too high, some corporations may just leave the United States; others

Should the government prevent corporate tax avoidance?

may never come. Question: Where do you think Dell Computer is located? If you answered "Texas," you are wrong. Dell moved its worldwide headquarters to Singapore in January 2007. Question: Are Google world-wide sales primarily occurring in Silicon Valley? Nope. They occur mostly in Ireland, where Google pays a grand rate of 2.4%. Many financial services firms have already left, too. U.S. disclosure and tax laws and regulations have built strong financial service centers in places like the Bermudas, the Cayman Islands, and Switzerland. Some European countries have even stronger regulations than those in the United States, and many are in fact experiencing similar capital and corporate flight as the United States. (I do not have statistics, but I would guess that the tiny *Isle of Man* may have as many corporations today as the entire *United Kingdom* proper.)

Intra-U.S. State competition.

Tax reduction through relocation does not just apply to countries, but also to U.S. states. Question: From what location does Microsoft sell its software from? If you answered "Seattle, Washington," you are wrong. Corporate software sales are located in Nevada, where there is no corporate income tax. This saves Microsoft over $50 million per year. Greenwich, Connecticut is the financial services center that the New York tax code built. These days, most hedge funds that remain in the United States (and all have foreign subsidiaries!) have located themselves not in New York City, but in Greenwich, CT, a small town just across the border from New York that was formerly a place for vacation homes. They did so to avoid N.Y. state and city taxes. (And, in a twist of irony, all these hedge fund managers now own vacation homes in New York City.)

But we get the worst of all worlds.

So, why am I upset? It is not because many corporations are paying low taxes. It is because of how this happens and its consequences. It would be wonderful if our low tax rate encouraged corporations to settle and operate in the United States. Unfortunately, it does not. The U.S. tax code actively does the opposite. The actual U.S. tax rates for established corporations with armies of good lobbyists, smart tax lawyers, and a global structure may be low, but the statutory tax rates for corporations that just want to come and operate in the United States are high. In fact, the whole situation is full of irony. It is not even greed, but the legal fiduciary duty of U.S. executives to reduce their corporate taxes as much as they legally can. More often than not, this means that their fiduciary duty forces them to locate their most valuable assets, their operations, and sometimes even their headquarters, offshore. This is because foreign domiciles collect even less in incomes taxes when a corporation headquartered offshore then does business in the United States.

Botox

In November 2015, $200 billion Pfizer, maker of Viagra, announced a tax-inversion purchase of $4 billion Allergan, maker of Botox. The resulting company would be headquartered in Dublin. This was so large and egregious that the press noticed. Thus, in April 2016, the Treasury issued new rules to curb such "inversions." Although the Treasury did not name Pfizer, one of the new provisions targeted a specific feature of their merger (Allergan's previous history as a major acquirer of other companies). A few days later, Pfizer abandoned the "merger." Can you imagine the combination Viagra-Botox drug the world will never see?

Various

Don't blame individuals. It's the system.

In sum, the United States has a system that not only offers incentives for companies to move out of the United States, but also collects very low corporate income tax receipts. So, why is Congress not fixing the matter? Simple—Congressmen depend on the financial contributions of corporate lobbyists, plus more than half become lobbyists after they retire. If Congress simply eliminated all corporate taxes and subsidies, there would be little reason for corporations to hire lobbyists and donate to reelection campaigns. It's not individuals that are corrupt; it's the system. It's all of us.

And don't think we like entrepreneurs! It's only lip service.

Then there is the "small entrepreneur's tax." A corporation that loses money can use the losses to offset income in other years. But a small entrepreneur who has staked all her savings

and failed, and then has to return to work and earn ordinary income elsewhere, cannot use more than her $3,000 of losses a year. This is an asymmetry: if the venture does well, the gains are taxable. If it does not, the losses are in effect not tax-deductible.

Does this sound depressing? I hope it does not. Keep life in perspective. Life is not perfect. Like life, our tax system is not so much "designed" as it is "evolved." Unlike life, the competitive pressure to correct bad choices is low. Yes, we have corruption, crony capitalism, incompetent government, and stupidity in the United States. But it's worse almost everywhere else. If anything, the United States easily ranks among the most desirable countries in the world. There are millions of foreigners who would love to live and pay taxes here. So, don't let it depress you. Just be successful, enjoy life—and, when you are old enough and if you are put in charge, improve the system.

Non Design

Summary

This chapter covered the following major points:

- In the imperfect real world, the U.S. tax code favors debt over equity. Managers should take this corporate income tax advantage into account.
- The calculation of the income tax advantage can be done through the APV method, the tax-adjusted WACC method, or the flow-to-equity method (a full pro forma employing a financing scenario that subtracts the interest and thereafter corrects for the reduced tax burden).
- Both the APV and the WACC method begin with cash flows *as if fully equity-financed and fully taxed*, which is why they need to put back the tax advantage derived from the presence of debt.
  - APV does so by adding back the tax benefit:

$$\text{APV} = \frac{\mathsf{E}(\text{C})}{1+\mathsf{E}(\text{r}_{\text{Firm}})} + \frac{\overbrace{\tau \cdot \overbrace{\mathsf{E}(\text{r}_{\text{Debt}})}^{\text{Interest Payment}} \cdot \text{Debt}}^{\text{Tax Shield}}}{1+\mathsf{E}(\text{r})}$$

    For the discount rate $\mathsf{E}(\text{r})$ applicable to the right term (the expected tax shelter), the following guidelines (explained in the companion appendix) may help: If the firm's debt ratio will decline over time, use the debt cost of capital. If it will remain constant, use the firm's overall cost of capital. If it will increase, use the equity cost of capital.
  - WACC does so by lowering the cost of debt capital:

$$\begin{aligned}\text{PV} &= \frac{\mathsf{E}(\text{C})}{1+\text{WACC}}\\ \text{WACC} &= \mathsf{E}(\text{r}_{\text{Firm}}) - \tau \cdot \mathsf{E}(\text{r}_{\text{Debt}}) \cdot \text{w}_{\text{Debt}}\end{aligned}$$

    WACC can also be written as $\text{w}_{\text{Equity}} \cdot \mathsf{E}(\text{r}_{\text{Equity}}) + \text{w}_{\text{Debt}} \cdot \mathsf{E}(\text{r}_{\text{Debt}}) \cdot (1-\tau)$.
- These methods usually arrive at similar but not exactly identical valuations. We are rarely sure about the appropriate discount rate that should be applied to the future tax benefits in the APV formula. The WACC formula cannot deal with changing costs of capital or debt ratios over time at all. However, the errors that an incorrect discount rate on the tax shield would cause are usually dwarfed by other simplifications and uncertainty in expected cash flows and discount rates.
- The first error you should never commit is to use the wrong expected cash flows. That is, never add the APV tax subsidy or lower tax-adjusted WACC cost of capital when the cash flows are not "as if fully equity-financed and after having been fully taxed."
- The second error you should never commit is to think that just because the formulas only give you the benefit of having more debt in explicit terms, there are no costs. The costs of more debt influence your net cost of capital because they influence the two cost-of-capital terms in the formula.
- The following heuristic is often convenient: A constant extra dollar of debt *forever* increases the value of the firm by the firm's marginal income tax rate. For example, a $100 eternal debt increase will create $30 in value for a firm in the 30% marginal income tax bracket. (This is *only* the tax benefit, not the cost of debt!)
- In the imperfect real world, financing and investment decisions can no longer be separated: Projects that add more debt capacity may add value through the financing channel.

- In the imperfect real world, the WACC is not the marginal cost of capital.
- It is common and reasonable to combine the WACC formula or APV formula with the CAPM formula, even if this is not entirely correct.
- One managerial objective should be to minimize the overall tax burden—the sum of taxes paid by the corporation and its investors.
- Investor clientele effects arise because they reduce overall tax payments. These effects are illustrated below.

Choice	Low-Tax Investors (e.g., pension funds)
Good	Hold bonds (or very-high-dividend stocks)
Bad	Hold (low-dividend) stocks with high capital gains

Choice	High-Tax Investors (e.g., high-income individuals)
Good	Hold (low-dividend) stocks with high capital gains
Bad	Hold bonds (or very-high-dividend stocks)

Choice	High-Tax Corporations (e.g., "cash cows")
Good	Finance with bonds
Bad	Finance with stocks

Choice	Low-Tax Corporations (e.g., "growth firms")
Good	Finance with stocks (and pay out via share repurchases instead of via dividends)
Bad	Finance with bonds

It is the market prices for the cost of capital that incentivize smart firms and smart investors to arrange themselves in this clientele fashion to reduce overall taxes.

- There are numerous other tax-reduction schemes that firms can undertake—way too numerous to enumerate.
- The existing U.S. tax system can only be described as illogical to insane.

Preview of the Chapter Appendix in the Companion

The companion appendix to this chapter explains how you should think of and select a good discount rate for the APV tax shelter. (If the debt ratio is likely to decline in future years, use the cost of capital on debt. If it is likely to remain stable, use the expected rate of return on the firm. If it is likely to increase, use the cost of capital on equity.)

Keywords

APV, 479. Adjusted present value, 479. Debt capacity, 495. Flow-to-equity, 487. LBO, 479. Leasing, 504. Leveraged buyout, 479. NOL, 504. Net operating losses, 504. Stepped up, 498. Tax-adjusted WACC, 479.

Answers

Q 18.1 This 17% and 12% scenario is the example in the text, slightly amplified: NPV = –\$100 + (\$117.00 – \$17.00 · 30%)/1.12 ≈ –\$0.09 < 0.

Q 18.2 For this debt-equity hybrid, the firm has to earn \$500 if the security is designated as debt with an interest payment. But if the security is designated as equity with a dividend distribution, then it would have to earn \$500/(1 – 0.33) ≈ \$746, because only \$500 of the \$746 will be left after the firm has paid its corporate income taxes.

Q 18.3 For the \$1 million construction project:

1. With a \$200,000 return, Uncle Sam would receive \$200,000 · 45% = \$90,000 if you pay out cash.
2. If you finance with 80% debt, you will have \$800,000 · 5% = \$40,000 in interest to deduct from the \$200,000 return. Thus, you would pay taxes only on \$160,000. This lowers your tax bill to \$160,000 · 45% = \$72,000. (*Side advice:* If you borrow \$800,000, you may have to invest your \$800,000 elsewhere. If you do not choose tax-exempts, Uncle Sam may receive more taxes from your additional income on the \$800,000.)
3. The net subsidy is \$90,000 – \$72,000 = \$18,000 next year. At an appropriate cost of capital of 8%, this is a PV of \$18,000/1.08 ≈ \$16,667.

Q 18.4 For the 25/75 debt-equity financing, the WACC valuation is

$$\text{PV} = \frac{\$256}{1 + 12\% - 25\% \cdot 30\% \cdot 8\%} \approx \$229.80$$

$$\frac{\mathsf{E}(\text{C})}{1 + \mathsf{E}(r_{\text{Firm}}) - w_{\text{Debt}} \cdot \tau \cdot \mathsf{E}(r_{\text{Debt}})}$$

The firm has \$229.80 · 25% = \$57.45 of debt (and \$172.35 in equity value today). Its APV is

$$\text{APV} = \frac{\$256}{1 + 12\%} + \frac{30\% \cdot 8\% \cdot \$57.45}{1 + 12\%} \approx \$229.80$$

$$\text{APV} = \frac{\mathsf{E}(\text{C})}{1 + \mathsf{E}(r_{\text{Firm}})} + \frac{\tau \cdot \mathsf{E}(r_{\text{Debt}}) \cdot \text{Debt}}{1 + \mathsf{E}(r_{\text{Firm}})}$$

Q 18.5 For the \$100 debt financing, the APV valuation is

$$\text{APV} = \frac{\$256}{1 + 12\%} + \frac{30\% \cdot 8.7\% \cdot \$100}{1 + 12\%} \approx \$230.90$$

$$\text{APV} = \frac{\mathsf{E}(\text{C})}{1 + \mathsf{E}(r_{\text{Firm}})} + \frac{\tau \cdot \mathsf{E}(r_{\text{Debt}}) \cdot \text{Debt}}{1 + \mathsf{E}(r_{\text{Firm}})}$$

Therefore, the \$100 debt is 43.3% of the firm's value today. The WACC-based valuation is

$$\text{PV} \approx \frac{\$256}{1 + 12\% - 43.3\% \cdot 30\% \cdot 8.7\%} \approx \$230.90$$

Q 18.6 You would prefer to use WACC if you follow a constant ratio-based debt target, and APV if you follow a dollar-based debt target. Look at the previous two questions. You cannot figure out the APV in the first question before you determine the WACC, and the opposite is true in the second question.

Q 18.7 Exhibit 18.2 draws the WACC as a function of the debt ratio with only corporate income tax distortions. The plot has its lowest cost of capital where the debt ratio is 100%.

Q 18.8 The firm's overall cost of capital today is $6\% \cdot {}^{1}/_{3} + 12\% \cdot {}^{2}/_{3} = 10\%$. Because $4\% + 3\% \cdot \beta = 10\%$, the beta is 2. The easy way is to recognize that the firm is sheltering \$500 · 6% = \$30 through interest payments. If it refinanced with \$1,000, it could now shelter \$1,000 · 8% = \$80. Uncle Sam would see an additional \$50 less in income, which means that the firm would pay \$50 · 20% = \$10 less in income tax *next year*. Now you need to determine the appropriate discount rate for \$10 in tax savings. For convenience, use the debt cost of capital: 8%. This means that our recapitalization increases firm value by \$10/1.08 ≈ \$9.26. (If you prefer to use the overall firm cost of capital, you would obtain \$9.09.) The question intentionally gave additional irrelevant information about the firm's future existence.

Q 18.9 Let's do this in steps:

- This project will offer \$200 before-tax profit in year 1. Discounted back at the firm's cost of capital (don't worry if this is exact), the NPV without taxes is –\$300 + \$500/1.2 ≈ \$116.67. But, if equity-financed, the IRS will declare taxes due on \$200 of profit, or \$80. Therefore, the NPV with taxes and all equity-financed is –\$300 + \$420/1.2 = \$50.
- Now, right after the investment, the firm has a value of \$420/1.2 = \$350. With debt of \$50 (\$100), the firm carries a debt load of around \$50/\$350 ≈ 14.3% (28.6%). Let's round this to 15% (30%). The cost of debt capital formula given in the question suggests that $\mathsf{E}(r_{\text{Debt}}) = 15\% + 15\% \cdot 5\% = 15.75\%$ (16.5%). (Note: The question is a bit ambiguous in that it does not tell you what to use as firm value. The 15% and 30% debt ratios are reasonable values, though.)
- Interest payments on \$50 (\$100) at a cost of capital of 15.75% (16.5%) are \$7.88 (\$16.50) *next year*. Facing a tax rate of 40%, Uncle Sam would thereby subsidize the project to the tune of 40% · \$7.88 ≈ \$3.15 (\$6.60), which in today's value would be worth around \$3.15/1.2 ≈ \$2.63 (\$5.50). Therefore, under APV, if financed with \$50 in debt, the project is worth \$50 + \$2.63 = \$52.63. (With \$100 in debt, the APV is \$50 + \$5.50 = \$55.50).
- The equity cost of capital, if 15% of the firm is financed by debt at a rate of 15.75%, is the solution to $15\% \cdot 15.75\% + 85\% \cdot \mathsf{E}(r_{\text{Equity}}) = 20\% \Rightarrow \mathsf{E}(r_{\text{Equity}}) = 20.75\%$. Therefore,

the WACC is given by the formula, $w_{Equity} \cdot E(r_{Equity}) + w_{Debt} \cdot E(r_{Debt}) \cdot (1-\tau) = 85\% \cdot 20.75\% + 15\% \cdot 15.75\% \cdot (1-40\%) \approx 19.06\%$. Similarly, if \$100 is borrowed, $E(r_{Equity}) = 21.5\%$, and WACC $= w_{Equity} \cdot E(r_{Equity}) + w_{Debt} \cdot E(r_{Debt}) \cdot (1-\tau) = 70\% \cdot 21.5\% + 30\% \cdot 16.5\% \cdot (1-40\%) \approx 18.02\%$. The WACC -based value with \$50 in debt is thus $-\$300 + \$420/1.1906 \approx \$52.76$. (With \$100 in debt, it is $-\$300 + \$420/1.1802 \approx \$55.87$.) Note that you have made a few assumptions and approximations, so that it would really make little sense to worry now about being off by a little in the APV and WACC computations (\$52.76 and \$52.63).

Q 18.10 For our 3-year project firm:

1. The pro forma for a 100% equity-financed firm is shown below.

	Income Statement	**Y1**	**Y2**	**Y3**
	EBITDA (= Net Sales)	\$70	\$60	\$55
–	Depreciation	\$50	\$50	\$50
=	EBIT	\$20	\$10	\$5
–	Interest Expense	\$0	\$0	\$0
–	Income Tax (at 40%)	\$8	\$4	\$2
=	**Net Income**	\$12	\$6	\$3

	Limited Cash Flow Statement	**Y1**	**Y2**	**Y3**
	Net Income	\$12	\$6	\$3
+	Depreciation	\$50	\$50	\$50
=	**Operating Cash Flow**	**\$62**	**\$56**	**\$53**
	Capital Expenditures	–\$150	\$0	\$0
=	**Investing Cash Flow**	**–\$150**	**0**	**0**

Economic Project Cash Flows = (Operating CF + Investing CF + Interest)	**Y1**	**Y2**	**Y3**
Project Cash Flows	**–\$88**	**+\$56**	**+\$53**

2. The IRR of our project solves

$$\frac{-\$88}{1+\text{IRR}} + \frac{+\$56}{(1+\text{IRR})^2} + \frac{+\$53}{(1+\text{IRR})^3} = 0$$

Thus, the IRR of a purely equity-financed project is 15.69%.

3. The NPV of the purely equity-financed project is

$$\text{NPV} = \frac{-\$88}{1.18} + \frac{+\$56}{1.18^2} + \frac{+\$53}{1.18^3} \approx -\$2.10$$

This is in line with the fact that the project IRR of 15.69% is less than the 18% cost of capital.

4. The cash flows would increase to –\$88, +\$58, and +\$55. The IRR would increase to 18.61%.

5. The debt-financed pro forma would now be as follows:

	Income Statement	**Y1**	**Y2**	**Y3**
	EBITDA	\$70	\$60	\$55
–	Depreciation	\$50	\$50	\$50
=	EBIT	\$20	\$10	\$5
–	Interest Expense	**\$0**	**\$5**	**\$5**
–	Income Tax (40%)	\$8	\$2	\$0
=	**Net Income**	\$12	\$3	\$0

	(Limited) Cash Flow Statement	**Y1**	**Y2**	**Y3**
	Net Income	\$12	\$3	\$0
+	Depreciation	\$50	\$50	\$50
=	**Operating CF**	**\$62**	**\$53**	**\$50**
	Capital Exp.	–\$150	\$0	\$0
=	**Investing CF**	**–\$150**	**0**	**0**

Economic Project Cash Flows =(Operating CF + Investing CF + Interest)	**Y1**	**Y2**	**Y3**
Project CF	–\$150 + \$62	\$53 + \$5	\$50 + \$5
=	**–\$88**	**+\$58**	**+\$55**

The Economics of Financing	**Y1**	**Y2**	**Y3**
Debt Flow	+\$50	–\$5	–\$55
Equity Flow	+\$38	–\$53	\$0

Not surprisingly, these are the same as the aforementioned cash flows, with a \$2 income tax subsidy in years 2 and 3. The IRR is again 18.61%.

6. The NPV of the debt-financed firm is

$$\text{NPV} = \frac{-\$88}{1.18} + \frac{+\$58}{1.18^2} + \frac{+\$55}{1.18^3} \approx +\$0.55$$

With the tax subsidy, this project becomes worthwhile.

7. The APV of this project would start with the as-if-100%-equity-financed value. This was computed above as

$$\frac{-\$88}{1.18} + \frac{+\$56}{1.18^2} + \frac{+\$53}{1.18^3} = -\$2.10$$

For APV, now add the discounted tax subsidies in years 2 and 3. These have a value of

$$\text{Tax Subsidy} = \frac{\$2}{1.18^2} + \frac{\$2}{1.18^3} \approx \$2.65$$

Therefore, the APV would be –\$2.10 + \$2.65 = \$0.55.

8. By APV, the expected tax subsidy would shrink from $\tau \cdot \mathsf{E}(\text{Interest Payment}) = 40\% \cdot \$5 = \$2$ per year to $\tau \cdot \mathsf{E}(\text{Interest Payment}) = 40\% \cdot \$4 = \$1.60$ per year. The expected value of the tax subsidy would therefore be

$$\text{Tax Subsidy} = \frac{\$1.60}{1.18^2} + \frac{\$1.60}{1.18^3} \approx \$2.12$$

The net project value would be about \$0.02.

9. You can see that after year 2 and before year 3, the debt is expected to be 100% of the capital structure. However, in year 1, with debt contributing \$50, it is obviously not 0% of the firm. Thus, its weight in the capital structure is drastically changing. This firm is not at all a good candidate for using WACC.
P.S.: Please do not try to compute a weighted average cost of capital from the debt and equity internal rates of return (10% and 40%, respectively). If the debt would be at 57% of the firm's capital structure, then the appropriate rate of return of equity would have to be around 30% so that the weighted cost of capital would come out to $\mathsf{E}(r_{\text{Firm}}) = w_{\text{Debt}} \cdot \mathsf{E}(r_{\text{Debt}}) + w_{\text{Equity}} \cdot \mathsf{E}(r_{\text{Equity}}) = 18.6\%$. This is much lower than the equity IRR of 40% (which is the same as its expected rate of return from year 1 to year 2), because from year 2 to year 3, the equity becomes a much smaller part of the firm. What bites you in this case is the fact that you have a strong term structure of investment weights.

Q 18.11 With \$8.4 billion in tax payments on pre-tax income of \$27.6 billion, GE had a tax rate of about 30%. Assuming that the tax rate would be the same on each extra dollar earned, the \$9.1 billion in interest therefore saved GE (and cost Uncle Sam) $\$9 \cdot 30\% \approx \$3$ billion in tax revenue: \$8.4 billion paid vs. the \$11+ billion it would have been if the full \$36.6 billion had been taxed at 30%.

Q 18.12 For the \$20 earnings firm in the 25% tax bracket:

1. The weighted average cost of capital is

$$\text{WACC} = 50\% \cdot 5\% \cdot (1 - 25\%) + 50\% \cdot 10\% = 6.875\%$$
$$\text{WACC} = w_{\text{Dbt}} \cdot \mathsf{E}(r_{\text{Dbt}}) \cdot (1 - \tau) + w_{\text{Eqty}} \cdot \mathsf{E}(r_{\text{Eqty}})$$

The numerator of the NPV calculation has to be after corporate income tax; therefore, it is $(1 - 25\%) \cdot \$20 = \$15$. This is an annuity, therefore the NPV is PV = \$15/6.875% ≈ \$218.18.

2. The cost of capital for a fully equity-financed firm without a tax subsidy would be 7.5%, because it had 50% debt at 5% and 50% equity at 10%. Therefore, the as-if-fully-equity-financed value is PV = \$15/7.5% = \$200.00. Now, you need to add back the tax subsidy. With \$50 in risk-free debt and therefore with an interest rate of 5%, the interest payments would be $\mathsf{E}(r_{\text{Debt}}) \cdot \text{Debt} = \$2.50$ per year. The tax savings would be $\tau \cdot \$2.50 = \$0.625$, which is an eternal cash flow. At the interest rate of 5%, the value of the tax subsidy today is \$0.625/0.05 = \$12.50. Therefore, the value of this firm is \$200 + \$12.50 = \$212.50.

Q 18.13 A CFO should be concerned with the taxes that his investors are paying because he is supposed to act on behalf of the owners of the firm. This includes the task of minimizing any taxes that these owners are paying.

Q 18.14 Investors like capital gains best, then dividend income, then (equally) ordinary income and interest income.

Q 18.15 The firm must pay corporate income tax on cash used for repurchases and dividends, but it can use before-tax cash to pay interest. When the firm repurchases shares, investors receive the gains as capital gains (or, equivalently, an increase in the percentage of the firm that they own). Investors can easily shelter most of these payouts because they are capital gains, which face a lower statutory tax rate and can be delayed until opportune. In contrast, investors face the full brunt of Uncle Sam on cash that comes to them in the form of interest payments. Dividend payments receive a treatment that is in between the two (impossible to delay, but subject to a lower statutory tax rate).

Q 18.16 If the puppeteer forced low-tax firms to finance with debt, and high-tax firms to finance with equity:

- The IRS would collect no corporate income tax from the low-tax firm. Low-tax investors who do not mind interest receipts would preferentially sort themselves toward the low-tax firms. With a 4% tax on \$100 interest receipts, the IRS would collect \$4 from them.
- The IRS would collect a full \$40 from the high-tax firm. High-tax investors who like equity gains would preferentially hold their shares. The \$60 paid out to investors would face a 10% capital gains tax rate, for another IRS take of \$6. In sum, Uncle Sam ends up with \$46.

The total tax payment would therefore be \$4 + \$40 + \$6 = \$50. This is much higher than the \$15.80 tax in our proposed best solution. So the answer to our original question is yes—Uncle Sam would be better off if he could eliminate the tax deduction of interest for high-tax firms.

Q 18.17 Assuming that the high-tax firm still borrows and pays out \$100, and the low-tax firm still finances with equity and pays out \$98 (the answer is qualitatively the same if you assume that they pay out \$96), if the puppeteer forced low-tax investors to hold equity and high-tax investors to hold debt:

- The high-tax investors would receive \$100 (from high-tax firms) but pay \$40 for interest receipts to the IRS.
- The low-tax investors would receive \$98 (from low-tax firms) and pay 1% (\$0.98) in capital gains tax.

The net payment of \$40 + \$2 + \$0.98 = \$42.98 is higher than the \$15.80 in our proposed solution. So the answer to our original question is yes—Uncle Sam would be better off if he could force interest receipts on high-tax investors.

Q 18.18 Old, stable firms typically have large profits and would issue debt to minimize their tax liabilities. Because pension funds are largely tax-exempt, they like the interest receipts that they receive from bonds. Young, growing firms should use a lot of equity financing. The tax deductibility of interest payouts would be of little use to them. Thus, their investors would gain primarily from capital gains. This is of value primarily to high-tax individuals who want to avoid highly taxed inflows.

Q 18.19 It is usually more critical for the high-tax firm to do the right thing, because it has to try to avoid its own corporate income taxes.

Q 18.20 Yes—a high-tax investor would be willing to accept a lower rate of return on capital gains in a risk-neutral world. The alternative is to receive interest income, which would be too heavily taxed.

Q 18.21 Dividend-paying equity will become relatively more expensive for investors. Thus, their demand for dividend-paying equity will decline. Thus, the expected rate of return for such equity has to increase to compensate (put differently, their share price will be lower). This will induce firms to issue relatively more debt and less equity.

Q 18.22 Formerly tax-exempt investors preferentially held debt to gain interest receipts and dividend-paying stocks to gain dividend receipts. This advantage would disappear. The pension funds would tilt more towards reinvesting and repurchasing stocks. The prices of debt and dividend-paying stocks would fall, in effect increasing their required expected rates of return. In the aggregate, firms should reduce their debt and dividends. (Note: the individual marginal firm could be indifferent. This was the point of a famous Merton Miller Presidential Address.)

End of Chapter Problems

Q 18.23. Assume a 20% corporate income tax. Does a project that returns 16% before-tax have a negative NPV if it costs \$100 today and if the appropriate after-tax cost of capital is 11%?

Q 18.24. A firm will have before-tax cash flows of \$3 million. It can invest in equally risky cash flows that earn a before-tax expected rate of return of 14%. What assumption do you have to make to allow yourself to work with before-tax present values?

Q 18.25. If there are no market imperfections except for corporate income taxes, what should the firm's optimal capital structure be?

Q 18.26. Your firm is in a 40% combined federal and state marginal income tax bracket. Your annual income is \$500,000 per year for two years. If you finance some project with a \$1,300,000 mortgage at an interest rate of 8%, how much will Uncle Sam receive? If you finance the project with cash, how much will Uncle Sam receive? If other equivalent firms are offering investors expected rates of return of 10%, what is the PV of the tax savings from financing the project with a mortgage?

Q 18.27. You can take a \$1 million project. However, this kind of project is ordinary income for you, and it will produce either nothing or \$3 million next year, both with equal probabilities. Assume that your taxable opportunity cost of capital is 10% and your combined tax rate is 35%. Your after-tax cost of capital is thus 6.5%.

1. What is the project worth? Assume that you could fully use tax losses to offset other income taxed at 35%, too.
2. How would your answer change if you could not use the tax losses elsewhere?

Q 18.28. A firm will earn a taxable net return of \$500 million next year. If it took on debt today, it would have to pay creditors $\mathsf{E}(r_{\text{Debt}}) = 5\% + 10\% \cdot w^2_{\text{Debt}}$. (The increasing cost of interest may be the case for different reasons, covered in the next chapter.) Thus, if the firm has 100% debt, the financial markets would demand 15% expected rate of return. Further, assume that the financial markets will lend the firm capital at this overall net cost of 15%, regardless of how the firm is financed. The firm is in the 25% marginal tax bracket.

1. If the firm is fully equity-financed, what is its value?
2. If the firm is financed with equal amounts of debt and equity today, what is its value according to the APV method?
3. If the firm is financed with equal amounts of debt and equity today, what is its value according to the WACC method?

4. Does this firm have an optimal capital structure? If so, what is its APV and WACC?

Q 18.29. Go to the IRS website. Look up the highest Federal marginal income tax rates for investors and corporations today on the different types of income that they might earn. How would your state income tax further raise your tax rate?

Q 18.30. What does a corporate manager have to do to assign high-tax investors to his equity securities and low tax investors to his debt securities?

Q 18.31. In Nirvana, all investors are tax-exempt. Only firms pay income taxes. How should firms be financed? How would the WACC formula work?

Q 18.32. From a joint income tax perspective, how should a high-tax value firm be financed? How should a low-tax growth firm be financed?

Q 18.33. From an income tax perspective, what kind of investments should a high-net-income investor hold? What should a tax-exempt pension fund hold?

Q 18.34. Can you use the CAPM with the tax-adjusted WACC formula?

Q 18.35. A multibillion-dollar corporation is undertaking an R&D project. It costs $1 million in R&D. Because it is risky, the appropriate cost of capital for R&D is 15%. Next year, if it succeeds (probability of 80%), the firm can build a factory for $10 million that can be financed with an $8 million mortgage, and it will earn $20 million the following year. It will have no risk, so the cost of capital will be only 6%.

1. Assume taxes in the economy do not exist. What is the value of this firm?
2. Assume there are taxes now. The firm is in the 33% tax bracket. The after-tax opportunity costs of capital are therefore 10% and 4%, respectively. The cash outflows of $1 million and $10 million are not tax-deductible when they are incurred, but capital losses are fully tax-deductible at the same corporate income rate. (Hint: What is the income that Uncle Sam works with in either case? What kind of effective tax credits does this mean from the perspective of the firm?) If the firm is fully equity-financed, what is the value of this project in the presence of taxes?
3. Using APV, what is the value of this project if the factory is fully financed with risk-free debt?

Q 18.36. Construct a pro forma for the following firm: A 4-year project costs $150 in year 1 (not year 0) and produces $70 in year 1, $60 in year 2, $50 in year 3, and $40 in year 4. (All numbers are year-end.) Depreciation, both real and financial, is straight line over 4 years. Projects of this riskiness (and with this term structure of project payoffs) have a 15% taxable cost of capital. The marginal corporate income tax rate is 33%.

1. Assume that the firm is 100% equity-financed. Construct the pro forma and compute expected project cash flows.
2. Compute the project IRR.
3. Compute the project NPV.

For the remaining questions, assume that the firm instead has a capital structure financing $100 with debt raised in year 1 at a 10% (expected) interest rate. Interest is paid out in each year. Principal and interest are paid out in the final year. Money in excess of interest payments is paid out as dividends.

4. Construct the pro forma now. What is the IRR of this project?
5. From the pro forma, what is the NPV of the debt-financed project?
6. Compute the NPV via the APV method.
7. Via the APV method, how much would firm value be if the firm would have taken on $40 (not $100) in debt (assuming the same interest rate of 10%)?
8. Does the debt ratio of the firm stay constant over time? Is this firm a good candidate for the WACC method?

Q 18.37. Medtronic is a medical device company headquartered in Dublin, with operational headquarters in Minnesota and $35 billion in financial debt. In April 2015, it reported $4.1 billion in income before taxes, 0.7 billion in interest expense, $3.5 billion in taxable income, and $0.8 billion in taxes. What was its debt-related tax shield?

Q 18.38. Estimate how Intel's value would have changed (in 2016) if it had announced that it planned to take on and maintain an additional $10 billion in debt and use it all to repurchase equity? Assume that corporate income taxes are the only market imperfection and that its marginal tax rate would not be affected.

Q 18.39. Compute the tax shield for JP Morgan in the most recent fiscal year, using information from YAHOO! FINANCE.

Q 18.40. A firm has a current debt-equity ratio of 2/3. It is worth $10 billion, of which $4 billion is debt. The firm's overall cost of capital is 12%, and its debt currently pays an (expected) interest rate of 5%. The firm estimates that its debt rating would deteriorate if it were to refinance to a 1/1 debt-equity ratio through a debt-for-equity exchange, so it would have to pay an expected interest rate of 5.5%. The firm is solidly in a 35% corporate income tax bracket. The firm reported net income of $500 million. On a corporate income tax basis only, ignoring all other capital structure-related effects, what would you estimate the value consequences for this firm to be? When would equity holders reap this benefit? That is, calculate the value the instant before it is known and the instant after it is known, and compute the percentage change in value.

Q 18.41. Is the negative effect of debt on the price/ earnings ratio a force that pushes firms toward equity?

Q 18.42. Let's work a problem that shows how investors and firms sort themselves. Assume that taxable and tax-exempt firms each earn $1 of income. Assume that the financial markets offer 8% for tax-exempt income and 10% for taxable income. Assume that taxable firms and taxable investors are both taxed at 33.3%. Show what each type of firm and investor would do. Assume that capital gains are entirely untaxed. How would the arrangement change if the financial markets offered 9% for tax-exempt income?