Example 10-1: Perfect markets benchmark NPV

A project that costs $7 million returns $1.45 million after-tax cash flow per year for 10 years. Its beta is 1.5, the risk-free rate is 6% and the expected return on the market is 12%. The firm’s tax rate is 34%.

What is the project’s base-case NPV?

Using CAPM: \( r = 0.06 + (0.12 - 0.06) \times 1.5 = 0.15 \)

Base-Case NPV =

\[
-7 + \frac{1.45}{0.15} \left( 1 - \frac{1}{(1.15)^{10}} \right) = \$277,214
\]

Suppose the firm must issue equity to raise cash to fund this project, and suppose investment bankers charge 6% of the gross proceeds. There are no other costs or benefits associated with the financing.

What is the project’s APV?

Note that to raise $7 million requires the firm to raise $X where

\[
X(1 - .06) = $7 million, \text{ or } X = $7,446,809
\]

so the gross issue costs are $446,809; issue costs net of taxes are \((1-.34)\cdot446,809 = \$294,894\).
Example 10-2: Corporate Taxes Only

Modify the original project. Ignore the issuing costs and assume that the project costs $7 million and has inflows of $1.45 million after taxes in perpetuity. Assume the project’s debt capacity is 40% of its present value (not its NPV). The company plans to maintain this debt capacity indefinitely. The firm’s tax rate is 34%. Calculate the project’s APV.

Base-Case NPV = -7 + 1.45/0.15 = $2.666667 million

Project’s Value = 1.45/0.15 = $9.66667 million =>

Debt Capacity = 0.40(9.66667) = $3.8666667 million

PV of Debt Capacity Tax Shield = $3.866667 million

APV = $2.66667 million + $1.314 million = $3.98 million.

Example 10-3: Personal and Corporate Taxes

Same as above, only now $\tau_{pe} = .14$ and $\tau_{pd} = .28$. Then

$T^*, the relative tax advantage of debt, is reduced to

$T^* = \frac{1 - (1 - \tau_p)(1 - \tau_{pe})}{(1 - \tau_{pd})}$

so $T^*D = .21(3.867m) = $.812m.$

and $APV = -$7m + $9.667m + $.812m = $3.48m.$

copyright Janice Eberly, 2002
Example 10-4: Finite-lived Project

Suppose everything is the same as above, but the project has only a two-year life with after-corporate-tax cash inflows of $5 million at the end of each year (i.e., at times 1 and 2); and that the project’s debt capacity is 40% of its value at any point in time. The debt is riskless; i.e., \( r_D = 6\% \).

Base-Case NPV \( = -7 + 5/(1.15) + 5/(1.15)^2 = $1.12854 \) million

Project Value during year 1 \( = 5/(1.15) + 5/(1.15)^2 = $8.12854 \) million

Project Value during year 2 \( = 5/(1.15) = $4.3478 \) million

Debt Capacity during year 1 \( = 0.40(8.12854) = $3.2514 \) million

Debt Capacity during year 2 \( = 0.40(4.3478) = $1.7391 \) million

Tax Shield during year \( t = r_D D_t \tau_c \)

Value of Debt Tax Shield in year 1 \( = 0.06(3.2514)(0.34) = $0.06633 \) million

Value Debt Tax Shield in year 2 \( = 0.06(1.7391)(0.34) = $0.03548 \) million

PV of Debt Capacity Tax Shield \( = 0.06633/(1.06) + 0.03548/(1.06)^2 = $0.09415 \) million

APV \( = $1.12854 \) million + $0.09415 million \( = $1.22269 \) million
Example 10-5: WACC

A firm has 100,000 shares outstanding, a price per share of $50 and $1 million in riskless debt. The expected return on their equity is 11%, and the riskless rate is 4%. The corporate tax rate is 34% and there are no personal taxes.

(a) What is the firm's WACC?

\[
WACC = 0.04(1-0.34)(1/6) + 0.11(5/6) = 0.0961
\]

The firm has access to a new project that requires an investment of $200,000 and has an expected before-tax cash flow of $60,000 per year, forever. The new project has the same business risk as the current projects in the firm. However, it cannot support as high a proportion of debt. Suppose that if the project is adopted it will be financed with $180,000 in new equity and $20,000 in new perpetual debt.

What will the share price be?

To find the project value, we cannot use WACC because the capital structure of the project differs from that of the firm.

The right approach is to find \( r_A \), and then use an APV approach to evaluating the project.
To find the return on assets, use

\[ \text{WACC} = .0961 = r_A(1 - .34(1/6)), \text{ which implies } r_A = .1019 \]

The APV of the project is:

\[ -200,000 + 60,000(1-.34)/.1019 + 20,000(.34) = 195,416. \]

On a per share basis this is 195,416/100,000 = 1.95, so the share price will increase to $51.95.

Example 10-6

A project costs $700 and produces perpetual before-tax cash flows of $200. The project’s beta-risk-adjusted expected return is \( r_a = 20\% \). The project provides the firm with $500 perpetual debt capacity; the firm’s tax rate is 35%. Ignore personal taxes. Compute the project’s NPV using the APV approach.

\[
\text{APV} = \text{Base-Case NPV} + \text{PV(financing effects)} \\
= \{-700 + (1-0.35)200 / 0.20\} + (0.35)500 = \$125.
\]
Alternatively, suppose you did not know the project’s beta, but instead know of a firm whose assets and capital structure are the same as the project’s. The firm’s capital structure consists of 39.4% equity and 60.6% debt. If the firm’s debt is riskless, then its $r_D = 10\%$. Using historical data on equity returns or the firm’s equity beta and the CAPM, you could estimate that $r_{EL} = 29.97\%$.

[I know what this value has to be since I know that $r_a = 20\%$ for this firm (see equation (7) in the appendix to the notes); in practice, the 29.97\% would have to be estimated because $r_a$ is not known. If $r_a$ were known, you would simply use the APV approach.]

**Compute the project’s NPV using the WACC approach.**

With the information just given, we can compute the firm’s WACC:

\[
WACC = \left(\frac{E_L}{V_L}\right) r_{EL} + \left(\frac{D}{V_L}\right) (1-\tau_c) r_D
\]

\[
= (0.394)(0.2997) + (0.606)(1-0.35) 0.10 = 15.75\%
\]

and discount the project’s after-tax cash flows using this rate and ignoring financing-related cash flows:

\[
NPV = -700 + (1-0.35)200 / (0.1575) = $125.
\]

*This is the same as our APV calculation - WHY?*
Example 10-7: Too much debt can be a tax disadvantage!

Taxes and Unused Tax Shields

Consider a small new company with:

operating income = $100/yr (EBIT)

depreciation = $20/yr

outstanding debt = $900

Tax rates:

\[ \tau_c = .34; \quad \tau_{pd} = .28; \quad \tau_{pe} = .10 \]

Assume both debt and equity require 7.2% after tax.

(All cashflows are riskfree.)

\[ r_{pd}(1-.28) = 7.2\% \text{ implies } r_{pd} = 10\% \]

\[ r_{pe}(1-.1) = 7.2\% \text{ implies } r_{pe} = 8\% \]

\[ a. \text{ What is the required before personal tax return on debt? on equity?} \]

Annual interest paid = .1(900) = $90, leaving $10 for the equity holders.

Value of the equity = $10/.08 = $125.

Value of the debt = $90/.1 = $900.

So total value = $1,025.