FIN 325 Corporate Finance

L7 (Theory): Tax Benefits of Debt under WACC Method

Instructor: Adam Hal Spencer[1]

Summer 2016

[1]Departments of Economics and Finance, UW–Madison.

Motivation

- Last time we explored the implications of taxes in the context of the APV method.
- APV is a versatile method of valuation, the further benefits of which we will explore in future lectures.
- But in industry, most firms will use a method called **weighted average cost of capital** (WACC) to account for tax benefits.
- APV method adjusted the **cash flows** associated with the project.
- WACC method instead adjusts the **discount rate**.

WACC definition (1)

- The APV method told us that we could **increase** firm value by assuming debt.
- When the corporate tax rate is positive, we define WACC as

$$\begin{aligned} WACC &= \frac{E}{D+E} r_E + \frac{D}{D+E}(1-\tau^C) r_D \\ &= r_A - r_D \frac{D}{V} \tau^C \end{aligned}$$

- How does this compare with r_A?

$$\begin{aligned} r_A &= \frac{E}{D+E} r_E + \frac{D}{D+E} r_D \\ &> \frac{E}{D+E} r_E + \frac{D}{D+E}(1-\tau^C) r_D \\ &= WACC \end{aligned}$$

where the inequality relies on $\tau^C > 0$.

WACC definition (2)

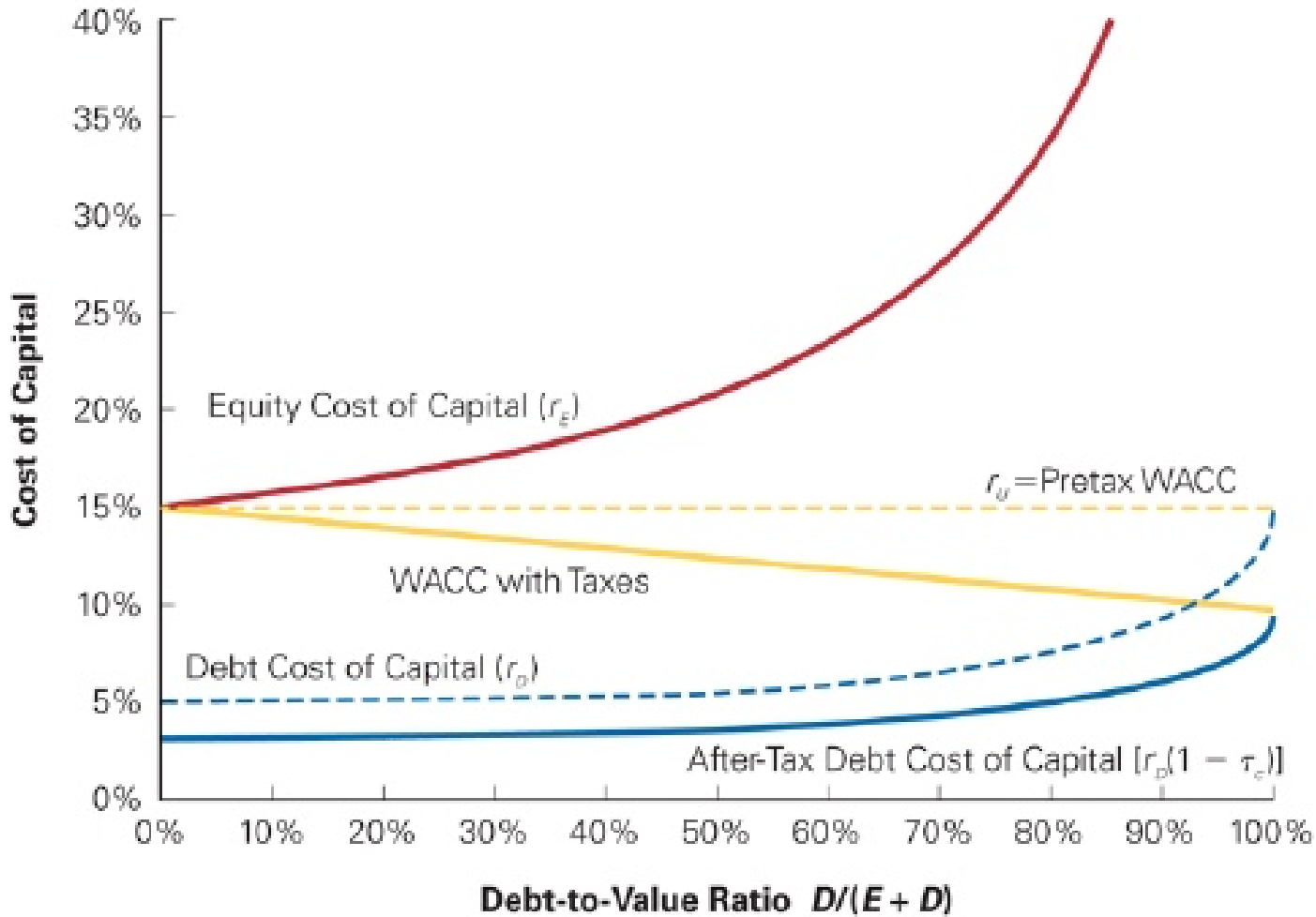
- How do we use the WACC estimate?
- If the cash flows from the **real** operations of the project are given by C_t for $t \in \{0, 1, 2, ...\}$ then discount as follows

$$V_L = \sum_{t=0}^{\infty} \frac{C_t}{(1 + WACC)^t}$$

- Given that $WACC < r_A$, see that each of the cash flows C_t after discounting will be higher than using r_A.
- This incorporates the tax shields you'll be receiving from the Government!
- To use WACC though, we **must assume a constant leverage ratio**! I.e. $\frac{D}{E}$ is constant!

WACC intuition

- A project must generate sufficient returns to compensate investors for risk.
- Interest payments reduce taxes and thus the required rate of return from the assets.



Equivalence of APV and WACC (1)

- Firm valuation under the two methods can be shown to be the same under certain conditions.
- Let's start by assuming that we have a firm that has the following characteristics:
  - Perpetual cash flow of C (after-tax) in each period.
  - Has a **constant** $\frac{D}{V_L}$ ratio.
  - Discounts its **tax shields** with r_A.
- This proof will be **non-examinable**, so don't stress if you get lost. Just try your best to follow it.

Equivalence of APV and WACC (2)

- Using the **WACC** method, the firm value V_L is given by

$$\begin{aligned} V_L &= \frac{C}{WACC} \\ &= \frac{C}{r_A - r_D \frac{D}{V_L} \tau^C} \end{aligned} \tag{1}$$

where I've just substituted the WACC formula into the perpetuity formula.

- Using the **APV** method the firm value is given by

$$\begin{aligned} V_L &= V_U + PV(DTS) \\ &= \frac{C}{r_A} + \frac{r_D D \tau^C}{r_A} \end{aligned} \tag{2}$$

where recall I said on the previous slide that we'd discount the tax shields with r_A here!

Equivalence of APV and WACC (3)

- Now it's clear that $D = \frac{D}{V_L} V_L$ (just multiplied D by one).
- Substitute this expression for D into the APV formula for V_L (equation (2)).

$$
\begin{aligned}
V_L &= \frac{C}{r_A} + \frac{r_D \tau^C \frac{D}{V_L}}{r_A} V_L \\
\Rightarrow V_L \left[1 - \frac{r_D \tau^C \frac{D}{V_L}}{r_A} \right] &= \frac{C}{r_A} \\
\Rightarrow V_L &= \frac{C}{r_A \left[1 - \frac{r_D \tau^C \frac{D}{V_L}}{r_A} \right]} \\
&= \frac{C}{r_A - r_D \tau^C \frac{D}{V_L}},
\end{aligned}
$$

  which is the same as using the WACC approach in equation (1)!

- **In general** the valuation will differ between the WACC and APV methods though!

Example A [for Aston] (1)

- Aston Martin produces the Vanquish (Bond car).

- Assume the following
  - $r_D = 0.060$.
  - $r_E = 0.124$.
  - $\tau^C = 0.350$.
  - $D/A = 0.400$.

Example A [for Aston] (2)

- Assume that Aston Martin considers investing £12.5b in a new factory to be built in Cornwall, United Kingdom.
- Will generate perpetual cash flows of £1.731b before tax each period. (I.e. £1.125b after tax).
- Project has same risk as their current operations and will be financed with same debt and equity ratios.

  (a) What is the project's WACC?

  (b) What is the value of the project under the WACC method?

  Suppose now instead that rather than financing the project using a fixed debt to equity ratio policy, that the firm will instead use fixed perpetual debt of £5b.

  (c) What is the value of the project under the APV method?

Example A [for Aston] solution (1)

(a) The project WACC is found as

$$\begin{aligned} WACC &= 0.124 \times 0.6 + 0.06 \times (1 - 0.35) \times 0.4 \\ &= 9\%. \end{aligned}$$

(b) The NPV using the WACC approach is then

$$\begin{aligned} NPV &= -12.5b + \frac{1.125b}{9\%} \\ &= 0. \end{aligned}$$

(c) Find the value of the unlevered firm as

$$\begin{aligned} r_A &= 12.4\% * 0.6 + 6\% * 0.4 \\ &= 9.84\% \\ \Rightarrow V_U &= -12.5 + \frac{1.125}{9.84\%} \\ &= -1.067b \end{aligned}$$

Example A [for Aston] solution (2)

- Then find the present value of the debt tax shields as

$$PV(DTS) = \frac{5b \times 0.06 \times 0.35}{r}$$
$$= \frac{0.105b}{r}$$

  which will vary depending on which r we choose.

(i) Use $r_D = 0.06 \Rightarrow V_L = -1.067 + 1.75 = 0.685$.

(ii) Use $r_A = 0.984 \Rightarrow V_L = -1.067 + 1.067 = 0$.

(iii) Use $r_E = 0.124 \Rightarrow V_L = -0.218$.

Maintaining a constant leverage ratio (1)

- What does it mean to maintain a constant leverage ratio? What are the mechanics behind it?
- To illustrate one possible method for keeping leverage constant, consider a simple two period model.
- The firm needs to invest \$50m today ($t = 0$) to generate a cash flow of \$100m (after discounting by WACC) next period ($t = 1$).
- The firm has a policy of maintaining $D/A = 0.4$ at all times.
- The firm's balance sheet currently, (before accepting the project), is as follows:

Assets	**Liabilities**
Current projects \$400m	Debt \$160m
	Equity \$240m

Maintaining a constant leverage ratio (2)

- Firm needs to issue some new securities to finance the upfront investment of \$50m.
- Issue debt worth 40% of the positive cash flow $\Rightarrow (0.4)(\$100\text{m}) = \$40\text{m}$.
- This will fund part of the upfront investment.
  - Still \$10m remaining though.
- Issue the remaining \$10m as equity.
- Also get a rise in equity due to the positive NPV of the project.

Assets	**Liabilities**
Current projects \$400m	Old debt \$160m
New project \$100m	New debt \$40m
	Old equity \$240m
	New equity \$60m

Maintaining a constant leverage ratio (3)

- Why does the value of the firm's assets increase by the \$100m and **not the NPV of the project** — \$50m?
- Because we issued more securities in the company.
- New debt and equity holders gave us the \$50m upfront cost in cash.
- We handed the cash over to whoever had to be paid for the upfront cost
- Rise in asset value is then just the value of positive discounted cash flow from next period.

Takeaways

- Taxes and capital structure: interest payments are a tax writeoff and so we generate **extra value** through tax shields.
- Two methods for evaluating — APV and WACC.
- WACC is the primary method of use in the real world.
- APV though, as we shall see soon, allows us to incorporate other effects on firm value induced by financial decisions.