L5: Taxes

Adam Hal Spencer

The University of Nottingham

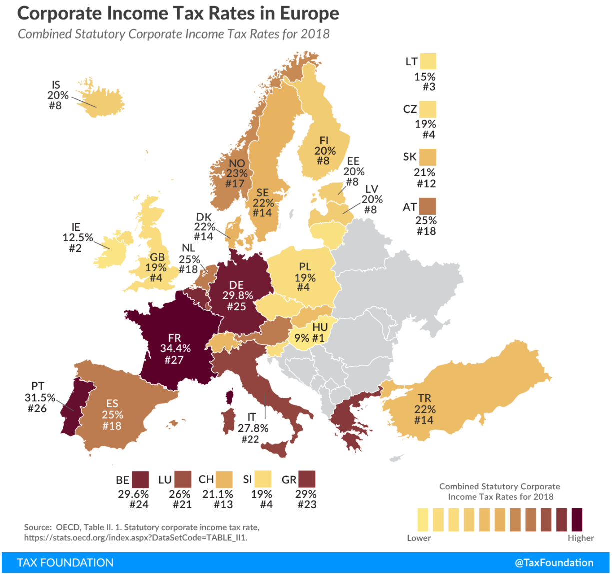
Essentials of Financial Economics 2020
Financial Decision-Making (1^{st} Quarter)

Roadmap

Motivation

- *The only things that are certain in life are death and taxes*.
- Nobody likes them.
- A surprising twist: taxes actually make borrowing look *more attractive*.

Corporate tax rates across Europe



Roadmap

Tax deductibility of interest (1)

- Interest payments are tax deductible in the United Kingdom.
  - There are some caps to the amount you can claim.
- Paid out of **before** tax earnings.
- Holding all else equal, a higher level of interest payments reduces the firm's taxable income.
- Debt financing has an **additional benefit** over equity financing along this channel.

Tax deductibility of interest (2)

- Consider two firms — Firm Unlevered and Firm Levered.
- Firm Unlevered is 100% equity while Firm Levered borrowed $1,000 worth of debt at 8% interest.
- Assume that capital expenditures, depreciation and the change in net working capital are zero.

	Firm Unlevered	**Firm Levered**
EBIT	500	500
Interest	0	80
Pretax income	500	420
Tax (35%)	175	147
Net income to shareholders	325	273
Total income to D and E	$325 + 0 = 325$	$273 + 80 = 353$
Tax shield from debt	0	28

- Total cash flow from Firm Levered is 28 higher — known as the **debt tax shield (DTS)**.

Tax deductibility of interest (3)

- Firm Unlevered is 100% equity while Firm Levered borrowed \$D worth of debt at r_D% interest.

	Firm Unlevered	**Firm Levered**
EBIT	C	C
Interest	0	$r_D D$
Pretax income	C	$C - r_D D$
Tax (35%)	$\tau^C C$	$\tau^C (C - r_D D)$
Net income to shareholders	$(1 - \tau^C) C$	$(1 - \tau^C)(C - r_D D)$
Total income to D and E	$(1 - \tau^C) C$	$(1 - \tau^C) C + \tau^C r_D D$
Tax shield from debt	0	$\tau^C r_D D$

- Value from having debt of D at interest rate of r_D is $\tau^C r_D D$.

Roadmap

Valuation of tax shields

- If a firm takes-out some debt worth D at an interest rate of r_D for T periods

$$PV(DTS) = \sum_{t=1}^{T} \frac{\tau^C r_D D}{(1 + r^*)^t}. \tag{1}$$

- If the debt is assumed to be held in perpetuity, then

$$PV(DTS) = \frac{\tau^C r_D D}{r^*}. \tag{2}$$

- What discount rate should we use for r^* in (5) and (4)?

Discount rate for tax shields

- What discount rate should we use for r^* in the tax shields formula?
- The rate should reflect the riskiness of the tax shield payments.

  (1) r_D: reflects the risk of the debt that generates the tax shields.

  (2) r_A: reflects the risk of the corporate profits, which we need to generate tax shields.

  (3) r_E: gives a conservative estimate of the risk.

- When we set $r^* = r_D$ then the formula for (4) simplifies

$$PV(DTS) = \tau^C D$$

Adjusted present value method (APV) (1)

- A method for evaluating firms and projects.
- Say that a project is to be financed using debt **and** equity.
- APV method looks at a **counterfactual** where the project is 100% equity-financed then adds-in the tax benefits of debt.
- Explicitly separates the project's cash flows that are associated with **real** operations and **financing**.

Adjusted present value method (APV) (2)

- Refer back to slide (6) with Firm Unlevered and Firm Levered.
- Let's assume that their cash flows are perpetual.
  - I.e. each firm has project cash flows of C each period while Firm Levered has debt of D maintained in perpetuity.
- Denote the value of Firm Unlevered and Firm Levered by V_U and V_L respectively.

$$V_U = PV[(1-\tau^C)C]$$
$$V_L = PV[(1-\tau^C)C + \tau^C r_D D],$$

which can be combined to get

$$V_L = V_U + PV(DTS), \tag{3}$$

which is known as the **APV formula**.

- We'll make some more adjustments to equation (3) in future lectures.

Some notes on APV

- When calculating the APV of a new project, always use the **incremental** debt.
- τ^C is the **marginal** tax rate; not the average.
  - Need to look at the tax that you'll be charged on **marginal** debt.
- When we have positive taxes, we can create value by purely changing firm's capital structure, (see example later).

Personal taxes (1)

- Investors in the firm need to pay additional taxes, (e.g. capital gains and dividends).
- The cash flow to individual investors **net of all taxes** is what's important.

Time Period	C-Corporation: Ordinary Income (τ_c)	C-Corporation: Capital Gains ($\tau_{c,cg}$)	Individual: Ordinary Income (τ_p)	Individual: Dividends ($\tau_{p,div}$)	Individual: Capital Gains ($\tau_{p,cg}$)
Pre-1981	46.0%	28.0%	70.0%	70.0%	28.0%
1982-1986	46.0%	20.0%	50.0%	50.0%	20.0%
1987	40.0%	28.0%	39.0%	39.0%	28.0%
1988-1990	34.0%	34.0%	28.0%	28.0%	28.0%
1991-1992	34.0%	34.0%	31.0%	31.0%	28.0%
1993-1996	35.0%	35.0%	39.6%	39.6%	28.0%
1997-2000	35.0%	35.0%	39.6%	39.6%	20.0%
2001-2002	35.0%	35.0%	38.6%	38.6%	20.0%
2003-	35.0%	35.0%	35.0%	15.0%	15.0%

Source: Scholes et al. (2005), Taxes and Business Strategy (3rd ed), Table 1.1, p. 12

Personal taxes (2)

- Denote τ^i the personal tax rate paid on **interest/ordinary income**.
- Denote τ^e the personal tax rate on **dividends**.

	Flow to debtholders	**Flow to equityholders**
Amount to distribute	1	1
Corporate taxes	0	τ^C
Income after corporate tax	1	$1-\tau^C$
Personal taxes	τ^i	$(1-\tau^C)(1-\tau^e)$
Investor flow after tax	$(1-\tau^i)$	$(1-\tau^C)(1-\tau^e)$

- See that there is no corporate tax liability for interest paid to debtholders.
- Tax benefit to debt if $(1-\tau^i) > (1-\tau^C)(1-\tau^e)$.
  - Has been the case historically.

Personal taxes (3)

- When debt is held in **perpetuity** then

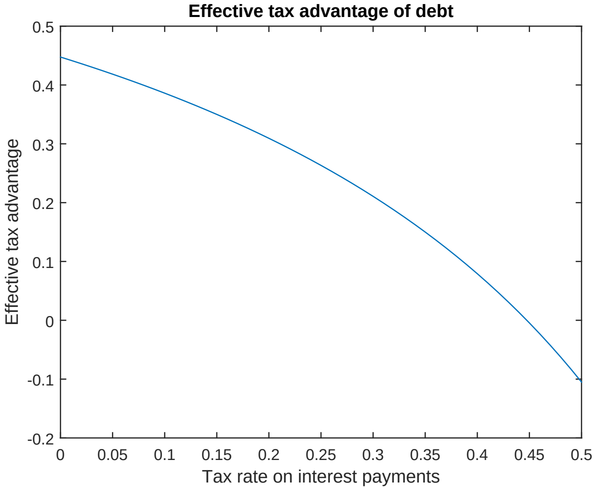
$$PV(DTS) = D\tau^*$$
$$\tau^* = \frac{(1-\tau^i) - (1-\tau^C)(1-\tau^e)}{1-\tau^i},$$

which is expressed as a **percentage**. Derivation from Miller (1977).

- When τ^i is high, the tax advantage of debt is smaller.
- When $\tau^e = \tau^i$ then $PV(DTS) = \tau^C D$ as before.

Personal taxes (4)

- How does τ^* vary with τ^i?
- Fix $\tau^C = 0.35$ and $\tau^e = 0.15$ and vary τ^i from 0 to 0.5 (below).



What about negative earnings before tax (EBT)?

- EBT defined as EBIT less interest expenses.
- If this measure is negative, then things get complicated...
- Need to take account of carryforwards and carrybacks for the operating losses.
  - Do we deduct the losses against previous or future losses?
- We won't worry about this case in the course.

Example 1: leveraged recapitalisation

- Firm Pure has 1b shares outstanding, which are trading at \$640 per share.
- The firm is currently 100% equity.
- Assume that $\tau^C = 0.35$ and $r_D = 0.03$ while all personal tax rates are zero.
- Say that the firm issues \$100b in perpetual debt and uses the proceeds to **repurchase shares**.
  - **(a)** What happens to the share price? What is the value of the debt tax shield?
  - **(b)** What is the firm's value after the recap?
  - **(c)** How many shares are repurchased and at what price?
  - **(d)** Who gains and loses from the recap?
  - **(e)** What happens to the price at announcement?

Example 1 solution (1)

- The firm was originally 100% equity so $V_U = \$640 \times 1b = \$640b$.
- With the new debt, we can use APV to get

$$\begin{aligned} V_L &= V_U + PV(DTS) \\ &= \$640b + \$100(0.35)b \\ &= \$675b \end{aligned}$$

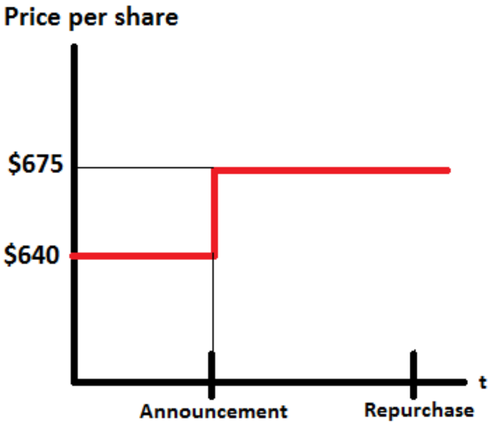
where I just assumed that the debt was perpetual and r_D was the appropriate discount rate.

- Use the two equations and two unknowns approach to find the new share price and the number of shares repurchased.

$$\begin{aligned} S \times P_{new} &= \$100b \\ P_{new} &= \frac{\$675b - \$100b}{1b - S} \end{aligned}$$

which can be solved to get $P_{new} = \$675$ and $S = \frac{100}{675}b$.

Example 1 solution (2)



- Price response at time of announcement due to forward-looking investors.

Example 1 [part 2]

- Now assume that there are personal tax rates of $\tau^e = 0.15$ and $\tau^i = 0.35$. Repeat the previous exercise!
- Give an intuition for the different price that the shares rise to on announcement relative to part 1.

Example 1 [part 2] solution (1)

- The effective tax benefit of debt is given by

$$\tau^* = 1 - \frac{(1-\tau^C)(1-\tau^e)}{1-\tau^i}$$
$$= 0.15$$

- Then the present value of the DTS is $PV(DTS) = \$15b$.
- $V_L = \$640b + \$15b = \$655b$.

$$SP_{new} = \$100b$$
$$P_{new} = \frac{655-100}{1-S}$$

which can be solved for $S = \frac{100}{655}$ and $P_{new} = \$655$.

- The price rise is now **smaller** given that there is less of a tax benefit of debt due to $\tau^i > 0$.

Roadmap

Motivation

- We've 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)

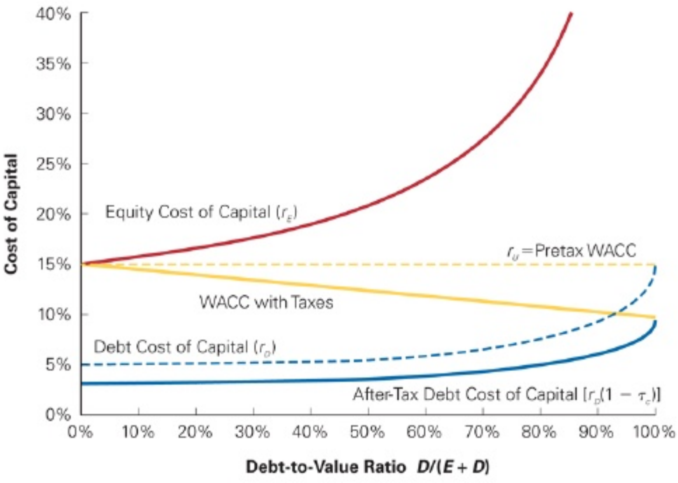
- How do we use the WACC estimate?
- If the cash flows from the **real** operations of the project are given by C_t for $t \in \{0, 1, 2, ...\}$ then discount as follows

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

- 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.

Equivalence of APV and WACC (2)

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

$$V_L = \frac{C}{WACC} = \frac{C}{r_A - r_D \frac{D}{V_L} \tau^C} \tag{4}$$

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

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

$$V_L = V_U + PV(DTS) = \frac{C}{r_A} + \frac{r_D D \tau^C}{r_A} \tag{5}$$

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 (5)).

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

which is the same as using the WACC approach in equation (4)!

- **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)(\$100m) = \$40m.
- 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.

Roadmap

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.