

Capital structure with Taxes: WACC vs APV

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Tax benefit of debt

	Unlevered Firm	Levered Firm
Earnings before interest and taxes.	EBIT	EBIT
Interest Expense	-0	-r*FV
Taxable Income	EBIT	EBIT - r*FV
Tax	-τ*EBIT	-τ*(EBIT - r*FV)
After Tax Income	(1 - τ)*EBIT	(1 - τ)*EBIT - r*FV + τ*r*FV
Total free cash flow	(1 - τ)*EBIT	(1 - τ)*EBIT + τ*r*FV

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Tax benefit of debt

- Tax benefits: Interest on debt is tax deductible whereas cashflows on equity (like dividends) are not
 - Tax benefit each year = $\tau r D$ (note D is the face value of debt)
 - After tax interest on debt = $(1 - \tau)r$

- Violation of MM 1: Other things being equal, the higher the marginal tax rate of a corporation, the more debt it will have in its capital structure.

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How do you value interest tax shields?

$$\tau_1 r_1 D_1 \quad \tau_2 r_2 D_2 \quad \tau_3 r_3 D_3 \quad \tau_4 r_4 D_4 \quad \dots$$

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- Make simplifying assumptions on $\tau_i r_i D_i$
 - For example, assume debt is constant $D_i = D$, interest rate is constant $r_i = r_c$, corporate tax rate is constant $\tau_i = \tau$, then
 - $$\text{NPV}(\text{Tax shields}) = \sum_{t=1}^{\infty} [(\tau r_c D) / (1 + r_{\text{tax-shield}})^t] = (\tau r_c D) / r_{\text{tax-shield}}$$
 - What is $r_{\text{tax-shield}}$?
 - What is r_c ?

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If debt is issued in perpetuity: $NPV(\text{tax shields}) = \tau D$
(this is the upper bound estimate)

- Riskfree debt issued at perpetuity at face value:

$$r = r_C = r_f = r_p \Rightarrow NPV(\text{tax shield}) = (\tau D)$$

E.g.: $\tau = .34$ $D = 1,000$

- Risky debt issued at perpetuity (risk is idiosyncratic) at face value:

$$r = r_f + \beta (r_m - r_f) \Rightarrow NPV(\text{tax shield}) = (\tau D)$$

You should take into account the probability of default

Example: the junk bond problem in Hw1:

$r_C = r_p = 10\%$ probability of default (only interest) = 20%, face value of the bond = 1000. The bond is sold at par. One year bond.

What is the expected return?

Calculate:

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Interest tax shields: different types of debt

- Suppose the bond in the previous example is issued in perpetuity. Calculate the value of the perpetuity of tax shields in the previous example assuming a 34% corporate tax rate:
- Debt with a finite maturity:
 - The value of the tax shield is lower if debt maturity is shorter.

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What is the appropriate τ
to compute NPV of tax shields?

- Expected marginal tax rate, i.e. the present value of the firm's tax liability when its taxable income increases by one dollar. Remember to take into account that the value of the debt tax shields declines at the rate of interest if they cannot be used this year.
 - Expected tax rate
 - Tax loss carry-backs. Losses can be carried back against past taxes (up to 3 years)
 - Tax loss carry forwards. Losses can also be carried forward (uncertainty) (up to 15 years).

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Firms with high tax shields
(should have high debt):

- Low cashflow volatility. Firms with low variable taxable income will place a higher value on tax shields, so they should have higher leverage (other things being equal).
- Low Non-debt tax shields (Depreciation, investment tax credit, pensions contributions). Firms with low NDTS will place a higher value on tax shields

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Bottom line: If interest on debt is tax deductible the capital structure is relevant; with corporate taxes, debt is preferred to equity.

- Questions:
 - What is the impact of taxes on debt level and valuation of the project (or firm)?
 - APV vs. WACC
 - Should firms be all debt financed?

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What is the impact of taxes on debt level and valuation of the project (or firm)?

- Under capital structure irrelevance, financing is a zero NPV transaction: $NPV(\text{financing}) = NPV(\text{Bond issue})$
- Under capital structure relevance, financing is not a zero NPV transaction:
 - the value of the firm (project) = $NPV[\text{all equity firm (project)}] + NPV[\text{financing}]$ (APV-adjusted PV)
 - if the only reason for capital structure relevance is taxes:
 - $NPV[\text{financing}] = NPV(\text{tax shields})$
 - please note that usually $NPV(\text{tax shields}) > 0$
 - financing can turn negative NPV projects into positive (and vice versa)

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APV vs. WACC

- Alternatively to APV, WACC (weighted average cost of capital) is often used to compute the discount value of a project (firm).
- Definition:
 - $WACC = [E/(D+E)] r_E + [D/(D+E)] (1 - \tau) r_D$

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APV vs. WACC

- Often APV and WACC are alternative techniques. However when used inappropriately WACC may be misleading.
- WACC and APV: an example
 - Corporate valuation: Invisible Reactive INC.
 - Total free cashflow=\$220K in perpetuity
 - $r_D=10\%$, $r_A=20\%$, $r_E=23.8\%$,
 - $D=\$400K$, $E=\$800K$
 - $\tau_c=25\%$

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Value of the firm with APV

$$\begin{aligned} V_{\text{Firm}} &= \sum_{t=1}^{\text{infinity}} \frac{220}{(1+.2)^t} + \sum_{t=1}^{\text{infinity}} \frac{.25(.10)400}{(1+.10)^t} \\ &= \frac{220}{.2} + 0.25(400) = 1200 \end{aligned}$$

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Value of the firm with WACC

$$\text{WACC} = [E/(D+E)] r_E + [D/(D+E)] (1-\tau) r_D$$

$$\text{WACC} = .238 \frac{800}{1200} + 0.1(1-.25) \frac{400}{1200} = .183$$

$$V_{\text{Firm}} = \frac{220}{.183} = 1200$$

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Bottom line :

- Value of the firm with WACC and APV is identical

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Assumptions of WACC:

- **Constant capital structure.** Estimates of r_E and r_D are based on the firm's past capital structure
- **Same Risks.** When historical estimates are used to calculate r_E and r_D (e.g. CAPM using firm-level data) we are implicitly making the assumption that project risks equal historical firm risks.
- **Other costs and benefits of debt.** WACC assumes the only violation of MM is the no tax assumptions. In practice when WACC is used, these other factors are ignored.
- **Source of value is hidden.** With APV we can tell whether a positive NPV comes from the project or the financing.

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What have we learned?

- If there are tax deduction on interests, capital structure is no longer irrelevant: you need to make capital allocation decisions together with capital structure decisions.
- Based on the benefits of tax shields, some firms are more likely to issue more debt
- Learned how to value the NPV of financing
- APV vs. WACC