Effects of Leverage on Price and Returns

- How leverage (debt funding) amplifies returns on equity.
- Assets as a portfolio of debt and equity, and the weighted average cost of capital (WACC) as the required return on assets.
- The interest tax shield benefit of debt funding.
- Valuation of levered assets with interest tax shields.
- Costs of financial distress.
- Miller and Modigliani capital structure irrelevance in a perfect world.
- WACC and the capital asset pricing model (CAPM).

Leverage Using Debt

Debt liabilities allow firms or investors to 'lever up' or 'amplify' returns on equity. This is because debt holders are only paid the coupon and principal payments that they're promised, not more.

Equity holders have a residual claim on the firm's assets and own everything that's left after the debt holders are paid. If the firm has a good year, equity holders share in the high profits but debt holders do not. Debt holders are only paid what they're owed. Equity holders are paid the rest.

This is a double-edged sword because on the one hand, during good times having debt makes equity returns very high. But during bad times, debt makes equity returns very negative.

Calculation Example: Personal Finance and Leverage

Question 1: Bob has a:

- $600,000 house.
- $400,000 mortgage loan on the house.
- $1,000 in his deposit account at the bank.
- $6,000 in credit card debt.

Question 1a: What is Bob's net wealth?

Answer: Looking at Bob as if he is a business with assets (V), equity (E) and debt (D), then net wealth is the same as equity. Note that in this case equity does not mean shares, it means net wealth. Bob's net wealth (E) can be calculated:

$$V = D + E$$

$$(600k + 1k) = (400k + 6k) + E$$

$$E = (600k + 1k) - (400k + 6k)$$

$$= 195k$$

So if Bob sold his house and paid all of his debts then he would have $195k left. Note that the $1k deposit, which is lending to the bank, can be seen as a positive asset or as a negative liability, it doesn't matter for the calculation of net wealth.

Question 1b: What is the weight of the asset class real estate in Bob's net wealth?

Answer: $x_{Real\ Estate} = \frac{600k}{195k} = 3.0769 = 308\%$

Question 1c: What is the weight of the asset class debt in Bob's net wealth?

Answer: The asset class debt is not just the liability D as in V=D+E. In that equation, D is the debt used to fund the assets V. But the assets might contain debt assets (lending), such as in Bob's case since he has a deposit account which is lending to the bank.

The asset class debt is all types of borrowing and lending which have the characteristics of debt. This includes the:

- mortgage loan owed (borrowing, writing debt, drawing down debt, debt sold, short debt),
- bank deposit lent (lending, investing in debt, debt bought or long debt) and
- credit card debt which is borrowing.

Therefore the weight in debt is:

$$x_{Debt} = \frac{-400k + 1K - 6k}{195k} = -2.076923077 = -208\%$$

This is a negative weight so we're net sellers of debt (borrowers).

To remember that lending is buying and borrowing is selling debt, think about what happens to the cash at the start.

Lenders: Buy debt, Long debt, Invest in debt.

Lending is buying debt since you give cash at the start and receive the debt contract which contains the promise to pay you back. This is investing in debt since the investor pays money at the start in exchange for the contract.

Borrowers: Sell debt, Short debt, Issue debt.

Borrowing is selling debt since you receive cash at the start and give the debt contract to the buyer which contains your promise to pay her back. This is also where the term 'writing' or 'drawing' debt comes from. The borrower writes the debt contract and exchanges it for cash at the start of the loan.

Question 1d: If house prices fall by 25% this year, what will be Bob's **dollar** and **percentage** change in net wealth?

Answer: If house prices fall, the bank will not cut the amount owing on the mortgage loan, it will remain the same.

Therefore Bob's new net wealth (E_1) will be:

$$V_1 = D_1 + E_1$$

$$(600k \times (1 - 0.25) + 1k) = (400k + 6k) + E_1$$

$$E_1 = 45k$$

Bob's Balance Sheet
Now (t=0) and later (t=1), in $k

Time	V	D	E
0	601	406	195
1	451	406	45

Bob's net wealth is only 45k, \$150k less than \$195k. This is because the house is worth \$150k less.

As a percentage, his change in net worth or equity is:

$$r_E = \frac{E_1 - E_0}{E_0} = \frac{45k - 195k}{195k} = -0.769230769 \approx -77\%$$

So a 25% fall in house prices leads to a 77% fall in net wealth. This shows the power (and danger) of leverage from debt liabilities and how it amplifies the returns to equity.

Notice that the fall in net wealth is 3.0769 times the fall in the house price since the weight of net wealth in the house is 3.0769.

Questions: Leverage and portfolio returns

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Assets as a Portfolio of Debt and Equity

Assets (V) can be viewed as a portfolio of the debt (D) and equity (E) that fund the assets. Of course this is just the balance sheet:

$$V = D + E$$

If you own all of the debt (bonds and loans) and equity (shares), you own the assets. Therefore the return on assets (r_V) are a weighted average of the returns on the debt (r_D) and equity (r_E) that fund them. This is also called the weighted average cost of capital (WACC) before tax:

$$r_V = r_D . \frac{D}{V} + r_E . \frac{E}{V} = WACC_{before\ tax}$$

Weighted Average Cost of Capital (WACC)

$$WACC_{before-tax} = r_D.\frac{D}{V} + r_E.\frac{E}{V}$$

$$WACC_{after-tax} = r_D.(1 - t_c).\frac{D}{V} + r_E.\frac{E}{V}$$

The weighted average cost of capital, the WACC, is the:

- Required total return of debt, r_D, also called the cost of debt, weighted by the proportion of debt (D); and the
- Required total return of equity, r_E, also called cost of equity, weighted by the proportion of equity (E) used to finance the firm's assets (V).

Note that V, D and E are all supposed to be *market* values not *book* values.

Valuation using Cash Flows and WACC

Now that we know how to calculate cash flows, present values and the costs of debt and equity, the last step to valuing a whole business or project is to calculate the discount rate applicable to the cash flows. One method is to use the WACC.

The value of a firm (V) is equal to its Firm Free Cash Flows (FFCF) discounted its WACC. If FFCF are a perpetuity, then:

$$V_0 = PV[FFCF\ discounted\ by\ WACC] = \frac{FFCF_1}{WACC - g}$$

Taxes are a complicating factor.

The Benefit of Debt: Interest Tax Shields

Interest expense is looked upon by the tax office as a cost of doing business, so it is tax-deductible. That's why it is subtracted from Net Income (NI) before tax is paid:

$$NI = (Rev - COGS - FC - Depr - \boldsymbol{IntExp}).(1 - t_c)$$

However, we know that interest expense is an accountants' attempt to quantify the income payable to debt holders, just as dividends are income to equity holders (note that interest expense is not a cash flow). In a perfect world with no taxes or transaction costs we wouldn't care if we financed our project with debt or equity. But since interest expense is tax-deductible and dividends aren't, debt is tax-advantaged.

Advantage of Debt versus Equity Funding

$$\mathrm{NI} = \underbrace{(\mathrm{Rev} - \mathrm{COGS} - \mathrm{FC} - \mathrm{Depr} - \mathbf{IntExp})}_{\text{Pretax profit}}.(1 - \mathrm{t_c})$$

The effect of more debt funding (D as in V=D+E):

↑D, ↑IntExp, ↓Pretax profit, ↓Tax.

The effect of more equity funding (E):

↑E, ↑Dividends, <u>Same</u> Pretax profit, <u>Same</u> Tax.

Debt is tax advantaged over equity because **interest expense** is tax deductible but **dividends** are not. This is the 'interest tax shield' benefit of funding your assets with debt.

Quantifying the Interest Tax Shield

$$NI = (Rev - COGS - FC - Depr - \boldsymbol{IntExp}).(1 - t_c)$$

$$FFCF = NI + Depr - CapEx - \Delta NOWC + \boldsymbol{IntExp}$$

After substituting the NI equation into FFCF, and then expanding and collecting like terms, the following can be shown:

$$FFCF = (Rev - COGS - FC - Depr).(1 - t_c) + Depr - CapEx - \Delta NOWC + \boldsymbol{IntExp}.\boldsymbol{t_c}$$

That last term, $\boldsymbol{IntExp}.\boldsymbol{t_c}$, is the tax shield per year. It is the tax saving from paying interest on debt. Note that:

$\boldsymbol{IntExp} = \boldsymbol{D}.\boldsymbol{r_d}$, where D is the value of the firm's debt.

Calculation Example: Interest Tax Shield

Just Jeans Group Income Statement for period ending 26 July 2008	
Net sales	822
COGS	717
Depreciation	24
EBIT	81
Interest expense	11
Taxable income	70
Taxes	21
Net income	49

Just Jeans Group Balance Sheet as at 26 July	2008	2007
Current A	92	105
Non-current A	195	178
Total A	287	259
Current L	208	72
Non-current L	22	134
Owners Equity	57	53
Total L and OE	287	259

Note: all figures are given in millions of dollars ($m).

Question: Find the yearly interest tax shield assuming a corporate tax rate (t_c) of 30%.

Answer: The easy way is to use the formula:

Interest tax shield per year $= IntExp.t_c$

$$= 11m \times 0.3 = \$3.3m$$

So \$3.3m is the annual tax saving from paying interest on debt. If the firm didn't have this debt then it would have a lower FFCF and the value of the firm's assets is less.

Question: Find the present value of the interest tax shields (V_{ITS}). Assume that the interest tax shield will be constant forever and that the discount rate of the interest tax shield (r_{ITS}) is 10%.

Answer: Since the tax shield cash flow will be the same forever, we can value it using the perpetuity formula $V_0 = \frac{C_1}{r}$:

$$V_{ITS} = \frac{r_D . D . t_c}{r_{ITS}} = \frac{IntExp . t_c}{r_{ITS}} = \frac{11m \times 0.3}{0.1} = 33m$$

This is the increase in the value of the firm from having debt, incurring interest expense and therefore paying less tax.

Valuation with Debt

If a firm has no debt, we say it is 'unlevered' or 'all-equity'. Let:

V_U be the **un**levered asset value;

V_L the levered asset value;

E_U the **un**levered equity value;

E_{LwITS} the levered equity value with interest tax shields;

E_{LxITS} the levered equity value excluding interest tax shields;

V_{ITS} the present value of interest tax shields.

Some formulas that must hold:

$V_U = E_U$, since debt is zero in an unlevered firm.

$V_L = V_U + V_{ITS}$, since the value of the levered firm is equal to that of the unlevered firm, plus the interest tax shields.

$$E_{LwITS} = E_{LxITS} + V_{ITS}$$

$$V_L = D + E_{LwITS}$$

$$V_L = D + E_{LxITS} + V_{ITS}$$

Define profits and cash flows as:

$$NI = (Rev - COGS - FC - Depr - \boldsymbol{IntExp}).(1 - t_c) = NPAT$$

$$FFCF = NI + Depr - CapEx - \Delta NOWC + \boldsymbol{IntExp} = CFFA$$

$$NOPAT = (Rev - COGS - FC - Depr - \mathbf{0}).(1 - t_c)$$

$$OFCF = NOPAT + Depr - CapEx - \Delta NOWC + \mathbf{0}$$

These equations give us three different methods to find the value of a levered firm (V_L).

Valuation with Interest Tax Shields in the Discount Rate: 'Textbook Method'

The most commonly used method to value a levered project (find V_L) is to calculate its cash flows as if it is all-equity financed, so there is no debt and no interest expense. That is, find the operating free cash flows $OFCF$s.

Then discount the OFCFs using the firm's after tax weighted average cost of capital, $WACC_{after-tax}$.

This will give the correct value of the firm including the present value of the interest tax shields.

This method takes the interest tax shield into account in the **discount rate** rather than the **cash flow**.

There are two key assumptions:

- the firm has a target debt-to-assets ratio (D/V) or debt-to-equity ratio (D/E) that it sticks to, and
- the project is of similar risk to the rest of the business.

It might seem curious that the tax shield benefit is included in the project's value when we used the OFCF which pretends debt there's no interest expense on debt.

But the interest tax shield benefit is included in the discount rate (the after-tax WACC) rather than the cash flow (the OFCF). The cost of debt in the after-tax WACC, r_D, is being multiplied by $(1 - t_c)$ which reduces the cost of debt by the amount of the tax shield. The lower discount rate (WACC) makes for a higher value (V), and this increase in value is due to the interest tax shields.

Calculation Example: Firm Valuation

Question 1: A firm has a target debt-to-assets ratio $\left(\frac{D}{V_L}\right)$ of 25%.

The cost of levered equity (with the interest tax shield) is 10%. The cost of debt is 5%.

The tax rate is 30%.

The firm's operating free cash flows (OFCFs) are \$10m each year which is expected to be earned at the end of every year forever.

Find the value of the levered firm (V_L).

Answer: We are already given the OFCF, so the next step is to find the after-tax WACC:

$$WACC_{after-tax} = r_d.(1 - t_c).\frac{D}{V} + r_e.\frac{E}{V}$$

$$= 0.05 \times (1 - 0.3) \times 0.25 + 0.1 \times 0.75$$

$$= 0.08375$$

Since the positive cash flows go on forever, we will use the perpetuity formula ($V_0 = \frac{C_1}{r-g}$) to find the value of the levered firm:

$$V_L = PV[OFCF, discounted\ by\ WACC_{after-tax}]$$

$$V_L = \frac{10m}{0.08375} = \$119.403m$$

Valuation with Interest Tax Shields in the Cash Flow

The second (harder) way to value a project is to calculate its firm free cash flows (FFCF, also known as cash flow from assets CFFA), and then to discount these using the WACC before tax.

This method takes the interest tax shield into account in the cash flow rather than the discount rate. This method also assumes that:

- the firm has a target debt-to-assets ratio (D/V) or debt-to-equity ratio (D/E) that it sticks to, and
- the project is of similar risk to the rest of the business.

Calculation Example: Firm Valuation

In the previous question the firm had a levered value (V_L) of \$119.403m.

Question 2: Show that the levered value of the firm using the harder method gives the same result.

Answer:

$$WACC_{before-tax} = r_D.\frac{D}{V} + r_E.\frac{E}{V}$$

$$= 0.05 \times 0.25 + 0.1 \times 0.75$$

$$= 0.0875$$

We need to find the FFCF. This depends on the yearly interest tax shield which depends the amount of debt D. Since the debt-to-assets ratio is 25%:

$$\frac{D}{V_L} = 0.25$$

$$D = 0.25 \times V_L$$

Let's substitute this into the below equation,

$$\begin{aligned} FCFF &= OFCF + IntExp \times t_c \\ &= OFCF + D \times r_d \times t_c \\ &= OFCF + 0.25 \times V_L \times r_d \times t_c \\ &= 10m + 0.25 \times V_L \times 0.05 \times 0.3 \end{aligned}$$

Since the positive cash flows go on forever, we will use the perpetuity formula ($V_0 = \frac{C_1}{r-g}$) to find the value of the levered firm:

$$V_L = PV[FFCF, discounted\ by\ WACC_{before-tax}]$$

$$V_L = \frac{10m + 0.25 \times V_L \times 0.05 \times 0.3}{0.0875}$$

$$V_L \times 0.0875 - 0.25 \times V_L \times 0.05 \times 0.3 = 10m$$

$$V_L \times (0.0875 - 0.25 \times 0.05 \times 0.3) = 10m$$

$$V_L = \frac{10m}{(0.0875 - 0.25 \times 0.05 \times 0.3)}$$

$= \$119.4030m$ Which is the same as before!

Valuation with Interest Tax Shields Added Separately: APV Method

The Adjusted Present Value (APV) method is to discount the OFCF by the before-tax WACC (which is the same as the unlevered cost of equity) to get the unlevered value of assets (V_U, which is equal to E_U), and then add the present value of interest tax shields on separately (V_{ITS}), so

$$V_L = V_U + V_{ITS}$$

Where:

$$V_U = PV[OFCF, discounted\ by\ WACC_{before-tax}]$$

Firm and Project Valuation

The main problems to avoid are:

- Double-counting the interest tax shield in both the discount rate and the cash flow. It should only be included in one of them. Double-counting will lead to valuations that are too high.
- Not including the tax shield at all, in the discount rate or in the cash flow. This will lead to valuations that are too low.

Theory Examples: Valuation

Question 1: A levered project's FFCF is calculated. It is discounted using the after-tax WACC. Is this correct?

Answer: No, this will double-count the interest tax shield. Interest is included in the cash flow (FFCF that includes interest expense), so the tax shield per year will be $\boldsymbol{IntExp.t_c}$.

The discount rate is the after-tax WACC which also accounts for the tax shield since it reduced the cost of debt by $(1 - t_c)$. So the tax shield will be included in the cash flow and the discount rate which is wrong.

The asset value price will be too big.

Question 2: A levered project's OFCF is discounted using the after-tax WACC. Is this correct?

Answer: Yes, this is the textbook method. The tax shield is only included in the discount rate. So long as the project has the same risk as the firm, and the firm keeps to its debt to equity ratio, then the project will be correctly valued.

Question 3: A levered project's OFCF is discounted using the pre-tax WACC. Is this correct?

Answer: No, tax shields are not included at all. This calculation will give the unlevered value of the project V_U which will be too low compared to the correct value of the project's assets V_L.

Question 4: A levered project's FFCF is discounted using the pre-tax WACC. Is this correct?

Answer: Yes, this is the harder method. The tax shield is included in the cash flow, and not the discount rate so this will give the correct, levered value of the project.

Another difficulty is that the WACC assumes a constant debt-to-equity ratio. This means that when the value of the firm changes, for example, after a dividend is paid, then the amount of debt and also the interest tax shield needs to be re-calculated. This can be very laborious.

Question 5: A levered project's FFCF is discounted using the pre-tax WACC to find the value of the unlevered firm. Then the present value of tax shields are added separately. Is this correct?

Answer: No, this double-counts the tax shields since the value of the firm is calculated using the 'harder method', and then the tax shields are added again.

Question 6: A levered project's OFCF is discounted using the pre-tax WACC to find the value of the unlevered project. Then the present value of tax shields are added separately. Is this correct?

Answer: Yes, this is the APV method of calculating the unlevered value of the firm and adding on the present value of tax shields separately.

Questions: Interest tax shield cash flows and levered business valuation

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Calculation Example: Levered Investment Property

Question: Value an investment property with:

- $50,000 gross rent revenue this year, expected to be paid at the end of the year (in arrears);
- $10,000 maintenance costs also paid annually in arrears;
- The building is fully depreciated for tax purposes and there is no capital expenditure required in the foreseeable future;
- 3% pa perpetual growth rate in rent revenue and costs.
- 5% pa mortgage rate;
- 80% loan-to-valuation ratio (LVR or debt-to-assets ratio);
- 9.8% pa required total return on property (WACC **before** tax);
- 30% tax rate.

Answer using textbook method: With the data given, it will be easier to find the OFCF compared to the FFCF, but the WACC after tax will be a little harder to calculate.

First find the net operating profit after tax (NOPAT) in the first year. Use 'k' for thousands (kilo).

$$NOPAT_1 = (Rev_1 - COGS_1 - FC_1 - Depr_1 - \mathbf{0}).(1 - t_c)$$

$$= (50k - 0 - 10k - 0 - 0).(1 - 0.3) = 28k$$

Then find the operating free cash flow (OFCF) in the first year:

$$OFCF_1 = NOPAT_1 + Depr_1 - CapEx_1 - \Delta NOWC_1 + \mathbf{0}$$

$$= 28k + 0 - 0 - 0 + 0 = 28k$$

To find the WACC after tax, we first need to find the cost of equity (r_E) based on the WACC before tax provided:

$$WACC_{before-tax} = r_D.\frac{D}{V_L} + r_E.\frac{E}{V_L}$$

$$0.098 = 0.05 \times 0.8 + r_E \times (1 - 0.8)$$

$$r_E = \frac{0.098 - 0.05 \times 0.8}{1 - 0.8} = 0.29$$

Now find the WACC after tax based on the cost of equity:

$$WACC_{after-tax} = r_D.(1 - t_c).\frac{D}{V_L} + r_E.\frac{E}{V_L}$$

$$= 0.05 \times (1 - 0.3) \times 0.8 + 0.29 \times (1 - 0.8)$$

$$= 0.086$$

$$V_L = PV[OFCF, discounted\ by\ WACC_{after-tax}]$$

$$V_{L0} = \frac{OFCF_1}{WACC_{after\ tax} - g}$$

$$= \frac{28000}{0.086 - 0.03}$$

$$= 500{,}000$$

Answer using 'harder' method: With the data given, it will be harder to find the FFCF but the WACC before tax is already known!

First find the net income (NI, also called earnings or profit) in the first year, remembering that:

$$\boldsymbol{IntExp_1 = D_0 . r_D = D_0 \times 0.05}$$

Where $\boldsymbol{D_0}$ is the debt value now and $\boldsymbol{r_D}$ is the expected yield to maturity. Use 'k' for thousands (kilo).

$$NI_1 = (Rev_1 - COGS_1 - FC_1 - Depr_1 - \boldsymbol{IntExp_1}).(1 - t_c)$$

$$= (50k - 0 - 10k - 0 - \boldsymbol{D_0} \times \boldsymbol{0.05}).(1 - 0.3)$$

$$= (40k - \boldsymbol{D_0} \times \boldsymbol{0.05}).(1 - 0.3)$$

Then find the firm free cash flow (FFCF) in the first year:

$$FFCF_1 = NI_1 + Depr_1 - CapEx_1 \; - \; \Delta NOWC_1 + \boldsymbol{IntExp_1}$$

$$= (40k - \boldsymbol{D_0} \times \mathbf{0.05}\,).(1 - 0.3) + 0 - 0 - 0 + \boldsymbol{D_0} \times \mathbf{0.05}$$

$$= (40k - \boldsymbol{D_0} \times \mathbf{0.05}\,) \times 0.7 + \boldsymbol{D_0} \times \mathbf{0.05}$$

$$= 28k - \boldsymbol{D_0} \times \mathbf{0.05} \times 0.7 + \boldsymbol{D_0} \times \mathbf{0.05}$$

$$= 28k + \boldsymbol{D_0} \times \mathbf{0.05} \times 0.3$$

$$= 28k + D_0 \times 0.015$$

This formula is familiar since the FFCF is just OFCF plus the interest tax shield per annum ($IntExp_1.t_c = D_0.r_{D\ 0\to1}.t_c$):

$$FFCF = OFCF + IntExp.t_c$$

$$= OFCF + D.r_D.t_c$$

$$= 28k + D_0 \times 0.05 \times 0.3$$

Now we can find the value of the levered investment property:

$$V_L = PV[FFCF, discounted\ by\ WACC_{before-tax}]$$

$$V_{L0} = \frac{FFCF_1}{WACC_{before\ tax} - g}$$

$$= \frac{28k + D_0 \times 0.015}{0.098 - 0.03}$$

Re-arranging the debt-to-assets ratio, $\frac{D}{V_L} = 0.8$, we know that the debt $D_0 = V_{L0} \times 0.8$, so:

$$V_{L0} = \frac{28k + V_{L0} \times 0.8 \times 0.015}{0.098 - 0.03}$$

$$V_{L0} = \frac{28k + 0.012 \times V_{L0}}{0.068}$$

$$0.068 \times V_{L0} = 28k + 0.012 \times V_{L0}$$

$$0.068 \times V_{L0} - 0.012 \times V_{L0} = 28k$$

$$0.056 \times V_{L0} = 28k$$

$$V_{L0} = \frac{28k}{0.056}$$

$$= 500{,}000$$

Same as the textbook method!

The Costs of Financial Distress

While debt brings the benefits of lower tax payments in the form of interest tax shields, it also brings the costs of financial distress.

For example, take a car dealing business with a very high level of leverage. Say it has a debt-to-equity ratio of 10 to 1 (1,000%), then its debt-to-assets ratio is 10 to 11 which means that 91.91% of its assets are funded by debt and only 9.09% of its assets are funded by equity.

The car dealing firm will have a high interest expense which is a fixed cost. If the firm has a bad year with low sales, it will

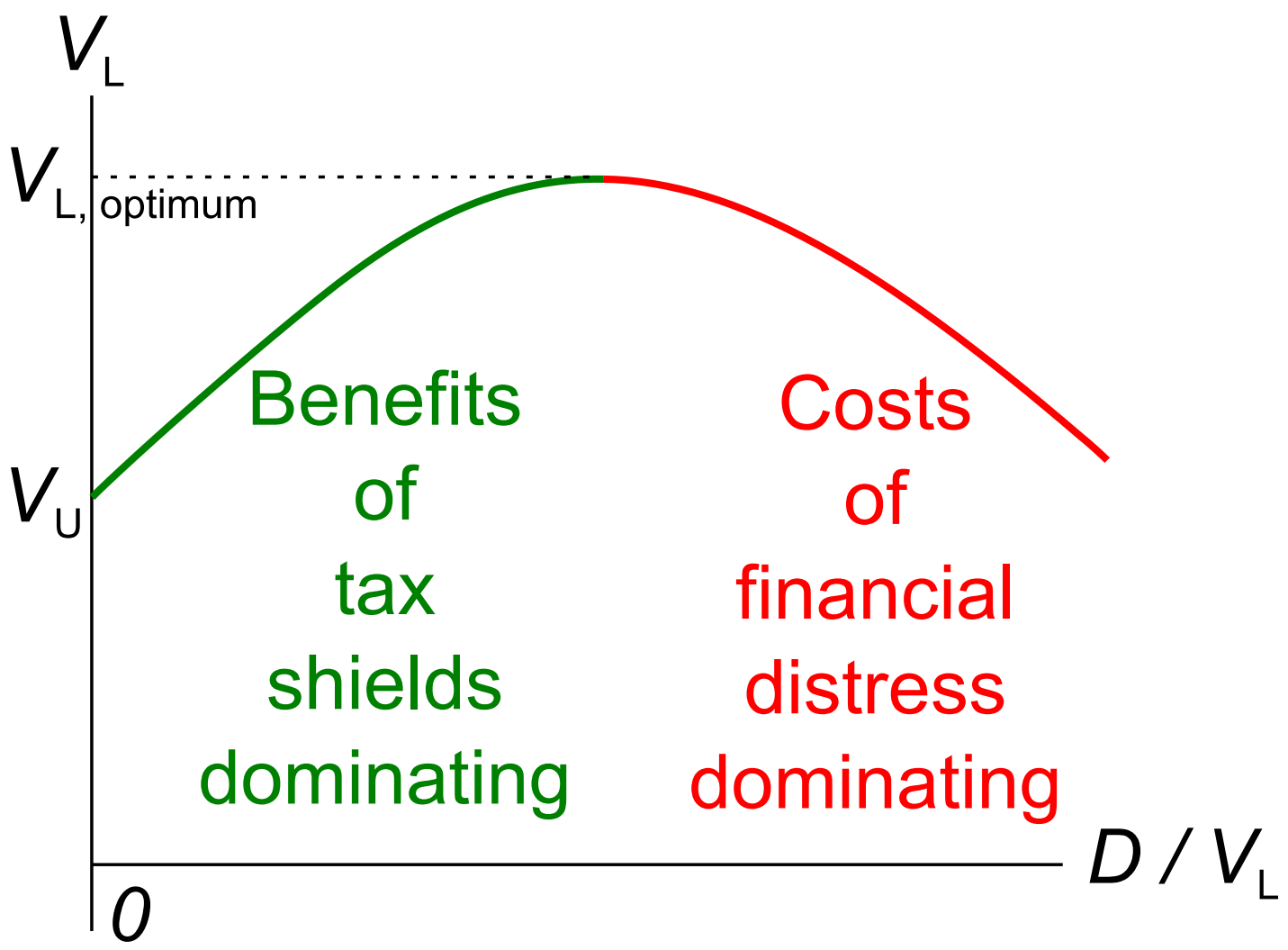
make a loss larger than its small amount of book equity, leading to bankruptcy.

- The danger of bankruptcy will make the firm's employees afraid of losing their job when the firm goes bankrupt, so they will leave.
- Customers will be wary of buying cars since the warranty will be worthless if the firm goes bankrupt.
- Suppliers will be wary of selling cars to the dealer on credit because if the dealer goes bankrupt then they may not be able to pay back the loan. So the supplier will demand cash on delivery and will not extend more generous credit terms.

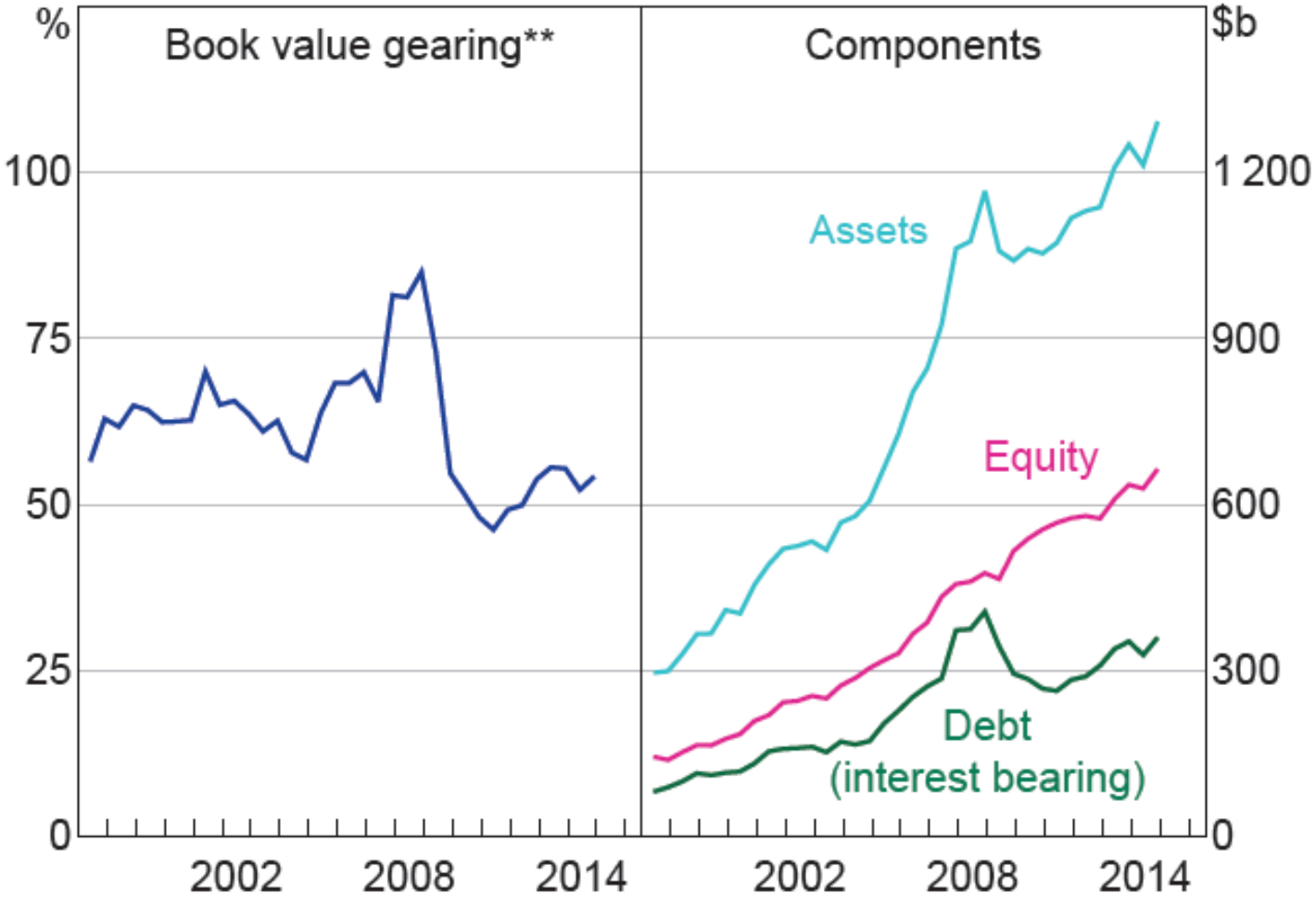
All of these are real business costs of financial distress which become worse as the proportion of debt grows.

The costs of financial distress moderate the benefits of interest tax shields.

Firms try to achieve a gearing (or leverage) ratio that balances these costs and benefits. This is $V_{L,optimum}$ in the graph below.


V_L
$V_{L,\text{ optimum}}$
V_U
Benefits of tax shields dominating
Costs of financial distress dominating
D / V_L
0

Listed Corporations' Gearing Ratio*



* The gross gearing ratio is defined as the ratio of the book value of gross debt to the book value of equity; excludes foreign-domiciled companies

** Data from 1997 includes real estate companies

Sources: Morningstar; RBA; Statex

Miller and Modigliani (M&M) - Capital Structure Irrelevance

In the 1950's Miller and Modigliani (M&M) described the conditions under which a firm's capital structure is irrelevant.

Their key argument was **'home-made' leverage.** The idea is that a firm's shareholders can borrow themselves, therefore they can create their own tax-shields. This means that a firm's capital structure is irrelevant.

If a company has no leverage, but a shareholder wants leverage, he can borrow (sell debt) himself and use the borrowed cash to buy more of the company's stock. His interest payments will be tax deductible from the income he

receives from the company in the form of dividends and capital gains, therefore he creates his own tax shields.

If a company is highly levered, but a shareholder wants no leverage, she can lend some of her own cash (buy debt) herself and invest the remainder in the company's stock. Her interest income will be taxed together with the income she receives from the company in the form of dividends and capital gains, and in this case she will not be receiving the full benefit of the tax shields, just as she would if the company had no leverage.

Other Applications of the 'Home-made' Principal

M&M's idea of 'home-made' leverage is a powerful concept that is applied to many other areas of finance.

Diversification

There is no point for a firm to diversify into lots of different businesses since an investor can do it themselves by buying lots of shares. In fact firms that diversify are believed to be at a disadvantage since they lose focus on their 'core competency', they suffer the 'conglomerate discount'.

Payout Policy

There is no point in a firm paying dividends if it has positive NPV projects available, it should invest in those projects, making a capital gain, and any shareholders who need dividends can pay themselves 'home-made' dividends by selling some stock.

Vice-versa for firms that pay high dividends, but a shareholder wants capital gains. The shareholder can simply invest the dividends in more stock, replicating a capital gain.

Why Capital Structure and Payout Policy is Relevant

M&M's theory of capital structure irrelevance only applies in a world without taxes and transaction costs.

But in the real world there are taxes and transaction costs. Therefore capital structure is relevant.

Similarly for payout policy. Real world tax rates on dividends (personal income) and capital gains are different, so investors will usually have a preference of one over the other. Therefore payout policy is also relevant.

Common Misperceptions

The theories of debt, tax shields and the WACC seem quite simple, but they are not! Take the following example.

Question: An all-equity financed firm is valued at V_U.

Management is thinking of increasing the proportion of debt in the firm's capital structure by selling debt (borrowing) and buying back shares (share repurchase). The assets of the firm will not be changed.

Management's argument for increasing the proportion of debt in the firm's capital structure is:

1. The firm's WACC is simply a weighted average of the cost of equity and the after-tax cost of debt.

$$WACC_{after-tax} = r_d.(1 - t_c).\frac{D}{V} + r_e.\frac{E}{V}$$

2. The cost of debt is always less than the cost of equity.

   $r_d < r_e$

3. Therefore by increasing the proportion of debt in the firm's capital structure, its WACC will be lower and so the levered value of the firm (V_L) will be higher.

Describe the **flaw** in their reasoning.

Consider the statements in a world with corporate taxes only, without transaction costs and without information asymmetries or any other market frictions. Also assume that the firm's shareholders can borrow at the same rate as the firm (r_d).

Answer: Management's first two statements are correct, but the third is not.

The managers are correct when they assert that V_L increases when more debt is issued. But it's not because the cost of debt is *cheaper* than equity. Of course debt has a lower required return than equity, that's because it has less risk. The real reason why the value of the firm increases is because of the higher present value of interest tax shields.

The cost of debt is always less than the cost of equity. That's because debt-holders have less risk since they have first claim on the firm's assets if it goes bankrupt. But as the proportion of debt increases (higher leverage, so $\uparrow \frac{D}{V_L}$), the risk of equity increases and so does its required return ($\uparrow r_e$). This balances

out the higher weight in the cheaper cost of debt in such a way that the before-tax WACC doesn't change.

However, the after-tax WACC will decrease due to the higher interest tax shields from having more debt.

Another reason why the value of the firm's assets shouldn't change (except for the tax shield benefit) is that the before tax WACC is the required return on the firm's assets. Since the firm's assets are unchanged, the before-tax WACC should be unchanged because the risk of the firm's assets is still the same therefore the discount rate that applies to those assets (the before tax WACC) should be the same.

Finally, even though it is true that the levered value of the firm increases, there is not necessarily any increase in shareholder

wealth. This is because, according to M&M's theory of home-made leverage, if shareholders valued the higher benefits of tax shields above the costs of financial distress, they would have already borrowed themselves using their own holding company to create those interest tax-shields on their own account.

Therefore managers' efforts to adjust the level of leverage to maximise the levered value of the firm might be in vain.

Theory Examples: M&M

Question: An all-equity financed firm has constant expected net income (NI), full payout, and therefore no expected growth in NI or dividends.

The firm decides to issue debt to buy back equity ($\uparrow \frac{D}{V}$).

There are no transaction costs, no information asymmetry, and the cost of debt (r_D) remains constant. The firm's assets are unchanged.

What will happen to the firm's $WACC_{before\ tax}$, $WACC_{after\ tax}$, $CFFA_{unlevered}$, $CFFA_{levered}$, V_{TS}, V_U, V_L, r_{EL} and shareholder wealth?

Assume that individuals and firms can borrow and lend at the same rates, there is corporate tax only, there are no transaction costs of arranging debt, no signaling effects and no costs of financial distress.

Answer part 1: $WACC_{before\ tax}$ remains unchanged.

Since the firm's assets are unchanged, the $WACC_{before\ tax}$ must remain constant. That's because it's the discount rate appropriate to the level of risk of the firm's assets, and since the assets are unchanged then the risk of the assets must be unchanged so the required return ($WACC_{before\ tax}$) of those assets must also remain unchanged.

Answer part 2: $WACC_{after\ tax}$ falls.

Since the after-tax WACC takes tax shields into account, it will fall to reflect the benefit of the larger amount of tax shields which occurs when the proportion of debt increases.

Answer part 3: $CFFA_{unlevered}$ remains the same since it ignores interest expense.

Answer part 4: $CFFA_{levered}$ will increase by the amount of the increase in yearly tax shields ($IntExp \times t_c$).

Answer part 5: V_{ITS} will increase by the present value of the increase in yearly interest tax shields ($IntExp \times t_c$).

If the discount rate of tax shields is the same as the cost of debt, the present value of this increase will be $D \times t_c$.

Answer part 6: V_U will be unchanged since it ignores the present value of tax shields.

Answer part 7: V_L will increase by the present value of tax shields (V_{ITS}).

Answer part 8: r_{EL}, the required return on levered equity will increase since there is proportionally more debt (higher leverage) and therefore the equity risk is higher so the required return on equity will rise. Note that:

$$r_{WACC\ before-tax} = r_D . \frac{D}{V_L} + r_{EL} . \frac{E_L}{V_L}$$

Answer part 9: Since the corporation is worth more, shareholder wealth will also increase.

However, Miller and Modigliani's theory can be applied in the real world with taxes. If shareholders would have benefited from the higher leverage, they could have levered up themselves using personal borrowing (home leverage) and bought more shares until their preferred risk-return trade off was reached and they were happy. So if the firm increases its corporate leverage, it may lead shareholders to reduce their own home-made personal leverage until they are back to their preferred overall level of leverage again.

However, in the US, corporate interest tax shields are generally better than personal tax shields since corporate interest tax shields save corporate and personal tax while personal interest tax shields just save personal tax.

In Australia, the imputation system may make corporate interest tax shields worthless since corporate tax is refunded at the personal level when franked dividends are paid. This makes personal interest tax shields are more valuable compared with corporate interest tax shields. This is complicated by the fact that only domestic tax residents can use franking credits, foreigners can't. Yet foreigners own around 50% of Australian listed equity! It's a difficult but interesting topic.

Questions: Miller and Modigliani's theory of home made leverage

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WACC before tax

The WACC before tax is also called the opportunity cost of capital or the required return on assets (r_V).

There are two ways of finding the WACC before tax: using the ordinary weighted cost of capital formula, or using the CAPM.

$$r_{WACC\ before-tax} = r_D.\frac{D}{V} + r_E.\frac{E}{V} \quad = \quad r_V = r_f + B_V\left(r_m - r_f\right)$$

The CAPM equation is very useful since it says that the WACC before tax will increase when the beta (systematic risk measure, B_V) of the firm's assets increases.

WACC after tax

The WACC after tax is very similar to the WACC before tax, but it takes tax shields into account as well.

$$r_{WACC\ \boldsymbol{after-tax}} = r_D.(1 - t_c).\frac{D}{V} + r_E.\frac{E}{V}$$

$$= r_D.\frac{D}{V} + r_E.\frac{E}{V} \qquad - r_D.t_c.\frac{D}{V}$$

$$= r_{WACC\ \boldsymbol{before-tax}} - r_D.t_c.\frac{D}{V}$$

$$= r_f + B_V\left(r_m - r_f\right) - r_D.t_c.\frac{D}{V}$$

The WACC after tax increases when the beta (systematic risk measure) of the firm's assets increases, B_V, or when interest tax shields decrease, $\left(r_D . t_c . \frac{D}{V}\right)$.

WACC Issues: Project versus Business Systematic Risk

Discounting a project's cash flows by the firm's WACC only works if the project is of similar systematic risk to the firm's other projects.

Example question: A low-systematic-risk supermarket chain is evaluating a project to make computers which is a high-systematic-risk industry. What WACC should it use?

Answer: The supermarket should not use its own WACC to discount the computer project cash flows, otherwise the project value will be overstated. Instead, the WACC of a 'pure-play' computer company should be used. Alternatively, the

CAPM should be used to estimate the beta of a computer firm's assets which will also equal the weighted average beta of its equity and debt.

WACC Issues: Funding Source is Irrelevant

The choice of funding for the project is irrelevant to calculating the WACC. The WACC (also called the required return on assets) is supposed to reflect the systematic risk of the project's or business's assets, not the source of funding.

Since the cost of debt is always cheaper than the cost of equity, managers are tempted to trick themselves into thinking that if a project is funded with debt then the discount rate will be lower which makes their project appear to have a higher NPV. But this is false. The financing decision (D + E) is independent of the investing decision (V). The choice of funding should have no effect on value.

WACC Issues: Debt-to-Assets Ratios and the WACC after tax

Whenever the firm's debt-to-assets ratio (D/V) changes, the WACC **after** tax needs to be recalculated since the amount of interest tax shields has changed. Of course, this depends on what is assumed about Miller and Modigliani's theory of 'home-made leverage'.

On the other hand, the WACC **before** tax will not change and doesn’t need recalculation since it doesn't take tax shields into account. It only accounts for the time value of money and systematic risk of the assets which is independent of leverage (how the assets are funded, debt versus equity).

WACC Issues: Weights Should Use <u>Market</u> Values, Not <u>Book</u> Values

The WACC is supposed to use market values rather than book values. This is particularly problematic when using pro-forma balance sheets since the book value of equity (retained profits plus contributed equity plus reserves) is usually much smaller than the market value of equity (number of shares times share price) if the firm has performed well since it first listed.

Pro-forma balance sheets and income statements are commonly used to find FFCF and the WACC. These can be used to find the market share price. But the WACC depends on the market share price which in turn depends on the WACC,

creating a circularity problem. This can be resolved algebraically or by setting up a circular reference in the spreadsheet with iterative calculation. But practitioners rarely do this. They tend to:

- Use the current market stock price to calculate the weights in the WACC, if the firm is listed;
- Use the WACC of similar companies operating in the same industry, if it is known;
- Estimate the WACC to be approximately equal to the expected return on the market portfolio. Remember that the average firm has a beta equal to the market's (one);
- Assume that book equity approximates market equity (which is usually not the case).

WACC Issues: Expected Future WACC over Past Historical WACC

The WACC is used to find the current price which equals the discounted **future** cash flows, not past cash flows. Therefore the WACC that is expected to apply in the future is more important than the WACC that applied in the past. The problem of course is that the future is unknown, so usually the best guide to the future is the past. So in most cases, using the past WACC is usually best practice.

When using historical betas to proxy for future expected betas, be careful that they are within a reasonable range. For example, some stocks with short histories of returns less

than one business cycle will show extreme historical betas that are very large (more than 4) or very low (less than zero). These are unreasonable and would not be expected to occur in the future so they should be made closer to one.

Practitioners commonly assume that firms should become more 'average' or similar to the market portfolio in the future. They calculate the future expected beta of returns as 1/3 plus 2/3 multiplied by the historical beta. This makes the beta closer to one, the beta of the market portfolio. Note that the weighting of 2/3 and 1/3 is completely arbitrary, but commonly used.

$$\beta_{\text{estimated future}} = \frac{2}{3} \cdot \beta_{\text{past}} + \frac{1}{3}$$

This adjustment makes sense if the firm had a high level of systematic risk (beta > 1) in the past but is likely to have less systematic risk in the future. Or conversely, if the firm had a low level of systematic risk (beta < 1) in the past but will increase in the future.

Cash Flows and Discount Rates

Low cash flows and high discount rates reduce valuations.

Sensitivity analysis is commonly used to visualise how changes in discount rates and cash flows (for example revenue growth or COGS as % of sales) affect the valuation. Sensitivity analysis is best done in a spreadsheet program, for example in MS Excel using data tables.

Practitioners often devote more time to correctly forecast cash flows than discount rates because cash flows are usually the more important determinant of value.