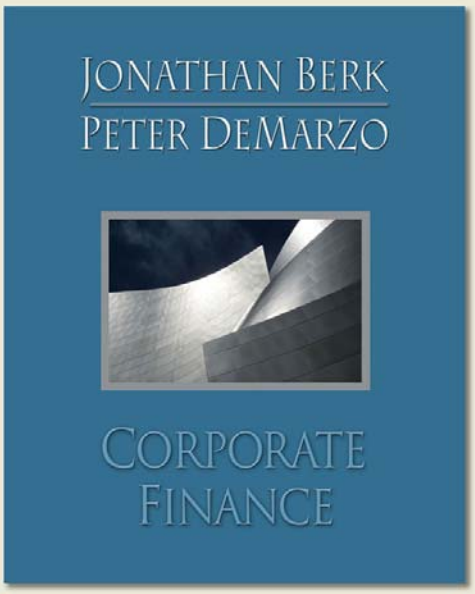


第 二讲

资本预算与有杠杆估值

本章提纲

本章提纲（续）

18.7 融资的其他效应

18.8 资本预算高级专题

18.1 本章概述

- 本章的基本假设
  - 项目承担平均风险。
  - 公司的债务股权比率（D/E）保持不变。
  - 公司税是唯一要考虑的市场摩擦。

18.2 加权平均资本成本法

- 在此，我们假设公司保持固定不变的债务股权比率，因此公司的加权资本成本（WACC）不随时间改变。

18.2加权平均资本成本法（续）

$$r_{wacc} = \frac{E}{E + D} r_E + \frac{D}{E + D} r_D (1 - \tau_c)$$

- WACC包含了债务的抵税收益，由WACC对未来自由现金流折现可以计算投资的有杠杆价值，即在给定公司的杠杆政策时包含利息税盾收益的价值。

$$V_0^L = \frac{FCF_1}{1 + r_{wacc}} + \frac{FCF_2}{(1 + r_{wacc})^2} + \frac{FCF_3}{(1 + r_{wacc})^3} + \text{L}$$

应用WACC法对项目估值

- 假设阿弗科公司(Avco)正在考虑引进一条新的包装生产线，RFX系列。
  - Avco预计此项用于包装生产的技术4年后将会过时。营销部门预计在未来的4年间，这一生产线的年销售额会达到6000万美元。
  - 预期每年的制造成本和营业费用分别为2500万美元和900万美元。

应用WACC法对项目估值(续)

- 产品开发需要前期投入研发费用和营销费用667万美元，需要为生产设备投资2400万美元。
  - 设备将于4年后报废，按直线法记提折旧。
- Avco预计项目不需要净营运资本。
- 公司税率为40%。

Table 18.1

TABLE 18.1 SPREADSHEET **Expected Free Cash Flow from Avco's RFX Project**

	Year	0	1	2	3	4
Incremental Earnings Forecast ($ million)						
1	Sales	–	60.00	60.00	60.00	60.00
2	Cost of Goods Sold	–	(25.00)	(25.00)	(25.00)	(25.00)
3	Gross Profit	–	35.00	35.00	35.00	35.00
4	Operating Expenses	(6.67)	(9.00)	(9.00)	(9.00)	(9.00)
5	Depreciation	–	(6.00)	(6.00)	(6.00)	(6.00)
6	EBIT	(6.67)	20.00	20.00	20.00	20.00
7	Income Tax at 40%	2.67	(8.00)	(8.00)	(8.00)	(8.00)
8	Unlevered Net Income	(4.00)	12.00	12.00	12.00	12.00
Free Cash Flow						
9	Plus: Depreciation	–	6.00	6.00	6.00	6.00
10	Less: Capital Expenditures	(24.00)	–	–	–	–
11	Less: Increases in NWC	–	–	–	–	–
12	Free Cash Flow	(28.00)	18.00	18.00	18.00	18.00

Table 18.2

TABLE 18.2 **Avco's Current Market Value Balance Sheet ($ million) and Cost of Capital Without the RFX Project**

Assets		Liabilities		Cost of Capital	
Cash	20	Debt	320	Debt	6%
Existing Assets	600	Equity	300	Equity	10%
Total Assets	620	Total Liabilities and Equity	620		

应用WACC法对项目估值(续)

- Avco计划在可预见的未来保持与当前的(净)债务股权比率一致的债务水平，包括对RFX项目的融资。因此，Avco的WACC为，

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D(1-\tau_c) = \frac{300}{600}(10\%) + \frac{300}{600}(6\%)(1-0.40)$$
$$= 6.8\%$$

应用WACC法对项目估值(续)

- 用WACC折现项目的未来自由现金流，计算出包含债务税盾的项目价值。

$$V_0^L = \frac{1800}{1.068} + \frac{1800}{1.068^2} + \frac{1800}{1.068^3} + \frac{1800}{1.068^4} = 6125\text{万美元}$$

  - 项目的净现值为3325万美元
    - 6125万美元 – 2800万美元 = 3325万美元

WACC法小结

1. 确定投资的自由现金流。
2. 计算加权平均资本成本。
3. 使用WACC对投资的自由现金流折现，计算包含杠杆纳税收益的投资价值。

WACC法小结(续)

- WACC可作为全公司范围内新投资的资本成本，前提是新投资与公司所有其他投资具有类似的风险，并且不改变公司的债务股权比率。

Example 18.1

Valuing an Acquisition Using the WACC Method

Problem

Suppose Avco is considering the acquisition of another firm in its industry that specializes in custom packaging. The acquisition is expected to increase Avco's free cash flow by $3.8 million the first year, and this contribution is expected to grow at a rate of 3% per year from then on. Avco has negotiated a purchase price of $80 million. After the transaction, Avco will adjust its capital structure to maintain its current debt-equity ratio. If the acquisition has similar risk to the rest of Avco, what is the value of this deal?

Example 18.1 (cont'd)

Solution

The free cash flows of the acquisition can be valued as a growing perpetuity. Because its risk matches the risk for the rest of Avco, and because Avco will maintain the same debt-equity ratio going forward, we can discount these cash flows using the WACC of 6.8%. Thus the value of the acquisition is

$$V^L = \frac{3.8}{6.8\% - 3\%} = \$100 \text{ million}$$

Given the purchase price of $80 million, the acquisition has an NPV of $20 million.

维持不变的债务股权比率

- 通过投资与RFX项目，Avco增加了初始市场价值为6125万美元的新资产。
  - 为保持债务股权比率不变，Avco需要增加3062.5万美元的新债务。
    - 50% × 6125 = 3062.5万美元

维持不变的债务股权比率(续)

- Avco可以通过减少现金持有或借债的方式来达到上述债务水平。
  - 假设Avco决定支出2000万美元的现金，同时额外借入1062 .5万美元。
    - 项目初始只需要投入2800万美元, Avco可将剩余的262.5万美元作为股利(获通过回购股票)发放给股东。
      - 3062.5万美元 − 2800万美元 = 262.5万美元

Table 18.3

TABLE 18.3 Avco's Current Market Value Balance Sheet ($ million) with the RFX Project

Assets		Liabilities	
Cash	—	Debt	330.625
Existing Assets	600.00		
RFX Project	61.25	Equity	330.625
Total Assets	661.25	Total Liabilities and Equity	661.25

维持不变的债务股权比率(续)

- Avco的股权市值增加了3062.5万美元。
  - 3306.25 − 3000 = 3062.5万美元
- 加上262.5万美元的股利，股东的总收益为3325万美元。
  - 3062.5 + 262.5 = 3325万美元
  - 恰好为RFX项目的净现值。

维持不变的债务股权比率(续)

- 借债能力
  - 为维持公司的目标“债务与价值比率”而需要的债务融资额
  - 项目在t期的借债能力为:

$$D_t = d \times V_t^L$$

    - d是公司的目标“债务与价值比率”，V^L_t 表示项目在t期的有杠杆持续价值。

维持不变的债务股权比率(续)

- 计算借债能力
  - V^L_t 可由以下公式计算:

$$V_t^L = \frac{FCF_{t+1} + \overbrace{V_{t+1}^L}^{t+2\text{期及至后自由现金流的价值}}}{1 + r_{wacc}}$$

Table 18.4

TABLE 18.4 SPREADSHEET **Continuation Value and Debt Capacity of the RFX Project over Time**

	Year	0	1	2	3	4
Project Debt Capacity ($ million)						
1 Free Cash Flow		(28.00)	18.00	18.00	18.00	18.00
2 Levered Value, V^L (at $r_{wacc} = 6.8\%$)		61.25	47.41	32.63	16.85	–
3 Debt Capacity (at $d = 50\%$)		30.62	23.71	16.32	8.43	–

Example 18.2

Debt Capacity for an Acquisition

Problem

Suppose Avco proceeds with the acquisition described in Example 18.1. How much debt must Avco use to finance the acquisition and still maintain its debt-to-value ratio? How much of the acquisition cost must be financed with equity?

Example 18.2 (cont'd)

Solution

From the solution to Example 18.1, the market value of the assets acquired in the acquisition, V^L, is \$100 million. Thus, to maintain a 50% debt-to-value ratio, Avco must increase its debt by \$50 million. The remaining \$30 million of the \$80 million acquisition cost will be financed with new equity. In addition to the \$30 million in new equity, the value of Avco's existing shares will increase in value by the \$20 million NPV of the acquisition, so in total the market value of Avco's equity will rise by \$50 million.

18.3 调整现值法

- 调整现值 (APV)
  - 确定投资的有杠杆价值的另一种方法：首先计算投资的无杠杆价值，既不考虑杠杆时的价值，然后加上利息税盾的价值，再减去由其他市场摩擦引起的成本。

$$V^L = APV = V^U + PV(\text{利息税盾}) - PV(\text{财务困境成本，代理成本和发行成本})$$

项目的无杠杆价值

- APV法的第一步为，运用项目无杠杆融资的资本成本计算自由现金留的价值。

项目的无杠杆价值(续)

- 无杠杆资本成本
  - 公司无杠杆时的资本成本：
    对于保持目标杠杆比率的公司，可以用不考虑税收影响的加权资本成本(税前加权资本成本)来估计它的无杠杆资本成本。

$$r_U = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D = \text{税前WACC}$$

    - *对于调整债务水平以保持目标杠杆比率的公司而言，以上等式是成立的。*

项目的无杠杆价值(续)

- 目标杠杆比率
  - 公司根据项目的价值或现金流成比例的调整债务水平(这一比例不必恒定不变)。
  - 固定的债务股权比率是目标杠杆比率的一种特殊形式。

项目的无杠杆价值(续)

- Avco的无杠杆资本成本，就是其股权和债务资本成本的加权平均:

$$r_U = 0.50 \times 10.0\% + 0.50 \times 6.0\% = 8.0\%$$

- 不考虑杠杆时的项目价值为:

$$V^U = \frac{1800}{1.08} + \frac{1800}{1.08^2} + \frac{1800}{1.08^3} + \frac{1800}{1.08^4} = 5962\text{万美元}$$

利息税盾估值

- 不考虑杠杆时的项目价值，5962万美元，没有包含债务的利息支付产生的税盾的价值。

$$\text{第t年的利息支付} = r_D \times D_{t-1}$$

  - 利息税盾等于利息支付与公司税率的乘积。

Table 18.5

TABLE 18.5 SPREADSHEET

Expected Debt Capacity, Interest Payments, and Interest Tax Shield for Avco's RFX Project

	Year	0	1	2	3	4
Interest Tax Shield ($ million)						
1	Debt Capacity, D_t	30.62	23.71	16.32	8.43	–
2	Interest Paid (at $r_D = 6\%$)	–	1.84	1.42	0.98	0.51
3	Interest Tax Shield (at $\tau_c = 40\%$)	–	0.73	0.57	0.39	0.20

利息税盾估值(续)

- 下一步是确定利息税盾的现值。
  - *当公司保持目标杠杆比率，它的未来利息税盾与项目的现金流具有相同的风险，因此，利息税盾应以项目的无杠杆资本成本来折现。对于RXF项目，其利息税盾的价值计算如下，*

$$PV(\text{利息税盾}) = \frac{73}{1.08} + \frac{57}{1.08^2} + \frac{39}{1.08^3} + \frac{20}{1.08^4} = 163\text{万美元}$$

利息税盾估值(续)

- 为了确定有杠杆时的项目价值，我们在无杠杆项目价值的基础上加上利息税盾的价值。

$$V^L = V^U + PV(\text{利息税盾}) = 5962 + 163 = 6125\text{万美元}$$

  - 项目的净现值为3325万美元
    - 6125万美元 – 2800万美元 = 3325 万美元
      - 这与使用WACC法计算出的价值完全一样。

APV法小结

1. 确定投资的无杠杆价值。
2. 确定利息税盾的现值。
   a. 确定预期的利息税盾。
   b. 对利息税盾折现。
3. 将利息税盾的现值加到投资的无杠杆价值上以确定投资的有杠杆价值。

APV法小结(续)

- APV法的优点。
  - 如果公司不能保持固定不变的债务股权比率，APV法就比WACC法更易于应用。
  - APV法可以明确地对市场摩擦估值，使得管理者能够衡量这些市场摩擦对价值的影响。

Example 18.3

Using the APV Method to Value an Acquisition

Problem

Consider again Avco's acquisition from Examples 18.1 and 18.2. The acquisition will contribute $3.8 million in free cash flows the first year, which will grow by 3% per year thereafter. The acquisition cost of $80 million will be financed with $50 million in new debt initially. Compute the value of the acquisition using the APV method, assuming Avco will maintain a constant debt-equity ratio for the acquisiton.

Example 18.3 (cont'd)

Solution

First, we compute the value without leverage. Given Avco's unlevered cost of capital of r_U = 8%, we get

$$V^U = 3.8 / (8\% - 3\%) = \$76 \text{ million}$$

Avco will add new debt of $50 million initially to fund the acquisition. At a 6% interest rate, the interest expense the first year is 6% × 50 = $3 million, which provides an interest tax shield of 40% × 3 = $1.2 million. Because the value of the acquisition is expected to grow by 3% per year, the amount of debt the acquisition supports—and, therefore, the interest tax shield—is expected to grow at the same rate. The present value of the interest tax shield is

$$PV(\text{interest tax shield}) = 1.2 / (8\% - 3\%) = \$24 \text{ million}$$

The value of the acquisition with leverage is given by the APV:

$$V^L = V^U + PV(\text{interest tax shield}) = 76 + 24 = \$100 \text{ million}$$

This value is identical to the value computed in Example 18.1 and implies an NPV of 100 − 80 = $20 million for the acquisition. Without the benefit of the interest tax shield, the NPV would be 76 − 80 = −$4 million.

18.4 股权现金流法

- 股权现金流法(FTE)
  - 此方法明确计算了股东得到的自由现金流，并同时考虑了公司与债权人之间往来的各种支付。
  - 流向股东的现金流要用股权资本成本折现。

计算股权自由现金流

- 股权自由现金流(FCFE)
  - 调整利息支付、借债以及债务偿还之后剩余的自由现金流。
- 股权自由现金流法(FTE)的第一步是要确定项目为股东带来的自由现金流。

TABLE 18.6 SPREADSHEET Expected Free Cash Flows to Equity from Avco's RFX Project

	Year	0	1	2	3	4
Incremental Earnings Forecast ($ million)						
1	Sales	–	60.00	60.00	60.00	60.00
2	Cost of Goods Sold	–	(25.00)	(25.00)	(25.00)	(25.00)
3	Gross Profit	–	35.00	35.00	35.00	35.00
4	Operating Expenses	(6.67)	(9.00)	(9.00)	(9.00)	(9.00)
5	Depreciation	–	(6.00)	(6.00)	(6.00)	(6.00)
6	EBIT	(6.67)	20.00	20.00	20.00	20.00
7	Interest Expense	–	(1.84)	(1.42)	(0.98)	(0.51)
8	Pretax Income	(6.67)	18.16	18.58	19.02	19.49
9	Income Tax at 40%	2.67	(7.27)	(7.43)	(7.61)	(7.80)
10	Net Income	(4.00)	10.90	11.15	11.41	11.70
Free Cash Flow to Equity						
11	Plus: Depreciation	–	6.00	6.00	6.00	6.00
12	Less: Capital Expenditures	(24.00)	–	–	–	–
13	Less: Increases in NWC	–	–	–	–	–
14	Plus: Net Borrowing	30.62	(6.92)	(7.39)	(7.89)	(8.43)
15	Free Cash Flow to Equity	2.62	9.98	9.76	9.52	9.27

计算股权自由现金流(续)

- 注意在计算现金流中的两个变化。
  - 在税前减去利息费用。
  - 加上公司净借债行为的进款。
    - 公司借债时这一进款额为正，而当公司偿还本金减少债务时，该项为负。

$$t\text{期的净借债} = D_t - D_{t-1}$$

计算股权自由现金流(续)

- 另外，根据项目的自由现金流可直接计算股权自由现金流(FCFE)，

$$FCFE = FCF - (1-\tau_c) \times (\text{利息支付}) + (\text{净借款})$$

Table 18.7

TABLE 18.7 SPREADSHEET **Computing FCFE from FCF for Avco's RFX Project**

	Year	0	1	2	3	4
Free Cash Flow to Equity ($ million)						
1	Free Cash Flow	(28.00)	18.00	18.00	18.00	18.00
2	After-tax Interest Expense	–	(1.10)	(0.85)	(0.59)	(0.30)
3	Net Borrowing	30.62	(6.92)	(7.39)	(7.89)	(8.43)
4	Free Cash Flow to Equity	2.62	9.98	9.76	9.52	9.27

股权现金流估值

- 股权自由现金流(FCFE)代表了对股东的支付，故应以项目的股权资本成本折现。
  - 给定RFX项目的风险和杠杆与Avco整体的风险和杠杆相同，因此可以用Avco的股权资本成本10.0%对项目的FCFE折现。

$$NPV(FCFE) = 262 + \frac{998}{1.10} + \frac{976}{1.10^2} + \frac{952}{1.10^3} + \frac{927}{1.10^4} = 3325\text{万美元}$$

股权现金流估值(续)

- The value of the project's FCFE represents the gain to shareholders from the project and it is identical to the NPV computed using the WACC and APV methods.

股权现金流法小结

1. 确定投资的股权自由现金流。
2. 确定股权资本成本。
3. 用股权资本成本对股权自由现金流折现，计算股权价值。

股权现金流法小结(续)

- 股权现金流法的优点。
  - 如果公司的资本结构复杂，并且资本结构中其他证券的市场价值未知，此时要计算公司的股权价值，应用FET法可以可以直接计算股权的价值。
  - FTE法强调了项目对股权的影响，从管理层的视角它可以被视为探讨项目为股东带来收益的更明了的方法。
- 股权现金流法的缺点。
  - 在最终作出资本预算决策之前，需要计算项目的借债能力，以确定利息和净借债。

Example 18.4

Using the FTE Method to Value an Acquisition

Problem

Consider again Avco's acquisition from Examples 18.1 through 18.3. The acquisition will contribute $3.8 million in free cash flows the first year, growing by 3% per year thereafter. The acquisition cost of $80 million will be financed with $50 million in new debt initially. What is the value of this acquisition using the FTE method?

Example 18.4 (cont'd)

Solution

Because the acquisition is being financed with $50 million in new debt, the remaining $30 million of the acquisition cost must come from equity:

$$FCFE_0 = -80 + 50 = -\$30 \text{ million}$$

In one year, the interest on the debt will be $6\% \times 50 = \$3$ million. Because Avco maintains a constant debt-equity ratio, the debt associated with the acquisition is also expected to grow at a 3% rate: $50 \times 1.03 = \$51.5$ million. Therefore, Avco will borrow an additional $51.5 - 50 = \$1.5$ million in one year.

$$FCFE_1 = +3.8 - (1 - 0.40) \times 3 + 1.5 = \$3.5 \text{ million}$$

After year 1, FCFE will also grow at a 3% rate. Using the cost of equity $r_E = 10\%$, we compute the NPV:

$$NPV(FCFE) = -30 + 3.5 / (10\% - 3\%) = \$20 \text{ million}$$

This NPV matches the result we obtained with the WACC and APV methods.

18.5 基于项目的资本成本

- 在现实中，公司特定项目的风险往往不同于公司平均项目的风险。
- 另外，项目的杠杆融资水平也会有所不同。

估计无杠杆资本成本

- 假设Avco要开办一个新的塑胶生产部门，塑胶生产业务与公司主营的包装业务面临不同的市场风险。
  - 可以将塑胶生产部门与其它具有相似经营风险且只单纯经营塑胶生产业务的公司进行对比，来估计这一项目的无杠杆资本成本。

估计无杠杆资本成本(续)

- 假设有两家塑胶生产公司与Avco的塑胶生产部门具有可比性，并具有下列特征:

Firm	Equity Cost of Capital	Debt Cost of Capital	Debt-to-Value Ratio, $D/(E+D)$
Comparable #1	12.0%	6.0%	40%
Comparable #2	10.7%	5.5%	25%

估计无杠杆资本成本(续)

- 假设两家公司都保持目标杠杆比率，可通过税前加权平均资本成本来估计每家竞争者的无杠杆资本成本。

Competitor 1: $r_U = 0.60 \times 12.0\% + 0.40 \times 6.0\% = 9.6\%$

Competitor 2: $r_U = 0.75 \times 10.7\% + 0.25 \times 5.5\% = 9.4\%$

估计无杠杆资本成本(续)

- 基于这两家可比公司的数据，估计塑胶生产部门的无杠杆资本成本为9.5%。

项目杠杆和股权资本成本

- 如果一个项目的目标杠杆比率与公司的目标杠杆比率不同，项目的股权资本成本也不同于公司的股权资本成本. 项目的股权资本成本可计算为:

$$r_E = r_U + \frac{D}{E}(r_U - r_D)$$

项目杠杆和股权资本成本(续)

- 架设Avco计划塑胶生产项目的债务融资与股权融资额相等，预期借债成本仍为6%.
  - 给定项目的无杠杆资本成本为9.5%，则项目的股权资本成本为:

$$r_E = 9.5\% + \frac{0.50}{0.50}(9.5\% - 6\%) = 13.0\%$$

项目杠杆和股权资本成本(续)

- 塑胶生产部门的加权平均资本成本为:

$$r_{WACC} = 0.50 \times 13.0\% + 0.50 \times 6.0\% \times (1 - 0.40) = 8.3\%$$

- 另一种计算加权平均资本成本的方法为:

$$r_{wacc} = r_{wacc} - d\tau_c r_D$$

$$r_{wacc} = 9.5\% - 0.50 \times 0.40 \times 6\% = 8.3\%$$

Example 18.5

Computing Divisional Costs of Capital

Problem

Hasco Corporation is a multinational provider of lumber and milling equipment. Currently, Hasco's equity cost of capital is 12.7%, and its borrowing cost is 6%. Hasco has traditionally maintained a 40% debt-to-value ratio. Hasco engineers have developed a GPS-based inventory control tracking system, which the company is considering developing commercially as a separate division. Management views the risk of this investment as similar to that of other technology companies' investments, with comparable firms typically having an unlevered cost of capital of 15%. Suppose Hasco plans to finance the new division using 10% debt financing (a constant debt-to-value ratio of 10%) with a borrowing rate of 6%, and its corporate tax rate is 35%. Estimate the unlevered, equity, and weighted average costs of capital for each division.

Example 18.5 (cont'd)

Solution

For the lumber and milling division, we can use the firm's current equity cost of capital $r_E = 12.7\%$ and debt-to-value ratio of 40%. Then

$$r_{wacc} = 0.60 \times 12.7\% + 0.40 \times 6\% \times (1 - 0.35) = 9.2\%$$
$$r_U = 0.60 \times 12.7\% + 0.40 \times 6\% = 10.0\%$$

For the technology division, we estimate its unlevered cost of capital using comparable firms: $r_U = 15\%$. Because Hasco's technology division will support 10% debt financing,

$$r_E = 15\% + \frac{0.10}{0.90}(15\% - 6\%) = 16\%$$
$$r_{wacc} = 15\% - 0.10 \times 0.35 \times 6\% = 14.8\%$$

Note that the cost of capital is quite different across the two divisions.

确定项目的增量杠杆

- 为了确定项目的股权资本成本或加权资本成本，需要计算公司投资项目以后的增量融资额(公司接受项目所增加的融资额)。

确定项目的增量杠杆(续)

- 换句话说，也就是项目投资前后总债务(扣除现金后)的变化量 。
  - 注意: 项目的增量融资不必对应于直接为该项目筹措的资金。

确定项目的增量杠杆(续)

- 下面给出了确定项目增量融资时要牢记的一些重要概念。
  - 现金为负的债务
  - 固定的股利政策意味着100%的债务融资
  - 最有杠杆取决于项目和公司特征
  - 具有安全现金流的项目可100%的由债务融资。

Example 18.6

Debt Financing at Cisco Systems

Problem

In mid-2005, Cisco Systems held more than $16 billion in cash and securities and no debt. Consider a project with an unlevered cost of capital of $r_U = 12\%$. Suppose Cisco's payout policy is fixed during the life of this project, so that the free cash flow from the project will affect only Cisco's cash balance. If Cisco earns 4% interest on its cash holdings and pays a 35% corporate tax rate, what cost of capital should Cisco use to evaluate the project?

Example 18.6 (cont'd)

Solution

Because the inflows and outflows of the project change Cisco's cash balance, the project is financed by 100% debt; that is, $d = 1$. The appropriate cost of capital for the project is

$$r_{wacc} = r_U - \tau_c r_D = 12\% - 0.35 \times 4\% = 10.6\%$$

Note that the project is effectively 100% debt financed, even though Cisco itself had no debt.

18.6 其他杠杆政策与APV法

- 至此，我们一直假设，公司希望保持固定不变的债务股权比率。
  - 本节将考虑两种其他可供选择的杠杆政策。
    - 不变的利息保障比率（Constant interest coverage）
    - 预先设定的债务水平（Predetermined debt levels）

不变的利息保障比率

- 不变的利息保障比率
  - 公司保持利息支付为自由现金流的一个目标比例
    - 如果目标比例为*k*，那么：

$$t\text{年的利息支付} = k \times FCF_t$$

不变的利息保障比率（续）

- 为应用APV法，必须计算这一政策下的税盾现值：

$$PV(\text{利息税盾}) = PV(\tau_c k \times FCF) = \tau_c k \times PV(FCF)$$
$$= \tau_c k \times V^U$$

  - 保持固定的利息保障比率时，利息税盾的价值与项目的无杠杆价值成比例。

不变的利息保障比率(续)

- 用APV法，有杠杆项目的价值由下式给出:
  - 固定利息保障比率下，项目的有杠杆价值

$$V^L = V^U + PV(\text{利息税盾}) = V^U + \tau_c k \times V^U$$
$$= (1 + \tau_c k)V^U$$

Example 18.7

Valuing an Acquisition with Target Interest Coverage

Problem

Consider again Avco's acquisition from Examples 18.1 and 18.2. The acquisition will contribute $3.8 million in free cash flows the first year, growing by 3% per year thereafter. The acquisition cost of $80 million will be financed with $50 million in new debt initially. Compute the value of the acquisition using the APV method assuming Avco will maintain a constant interest coverage ratio for the acquisition.

Example 18.7 (cont'd)

Solution

Given Avco's unlevered cost of capital of $r_U = 8\%$, the acquisition has an unlevered value of

$$V^U = 3.8 / (8\% - 3\%) = \$76 \text{ million}$$

With $50 million in new debt and a 6% interest rate, the interest expense the first year is 6% × 50 = $3 million, or k = Interest/FCF = 3 / 3.8 = 78.95%. Because Avco will maintain this interest coverage, we can use Eq. 18.14 to compute the levered value:

$$V^L = (1 + \tau_c\, k)\, V^U = [1 + 0.4\,(78.95\%)]\, 76 = \$100 \text{ million}$$

This value is identical to the value computed using the WACC method in Example 18.1, where we assumed a constant debt-equity ratio.

预先设定债务水平

- 公司可能根据事先知道的固定计划来调整债务水平，而不是基于目标债务股权比率或利息保障比率来确定债务水平。

预先设定债务水平(续)

- 假设Avco计划借债3062万美元，然后以固定的进程减少债务。
  - 在1年后将债务减少到2000万美元，两年后减少到1000万美元3年后将为零
- 不论RFX项目成功与否，都不会对Avco的杠杆造成其他影响。

Table 18.8

TABLE 18.8 SPREADSHEET

Interest Payments and Interest Tax Shield Given a Fixed Debt Schedule for Avco's RFX Project

	Year	0	1	2	3	4
Interest Tax Shield ($ million)						
1	Debt Capacity, D_t	30.62	20.00	10.00	–	–
2	Interest Paid (at r_D = 6%)	–	1.84	1.20	0.60	–
3	Interest Tax Shield (at τ_c = 40%)	–	0.73	0.48	0.24	–

预先设定债务水平(续)

- *若根据固定的计划来设定债务水平，可使用债务资本成本折现预先确定的利息税盾。*
  - 在Avco的例子中:

$$PV(\text{利息税盾}) = \frac{73}{1.06} + \frac{48}{1.06^2} + \frac{24}{1.06^3} = 132\text{万美元}$$

预先设定债务水平(续)

- Avco项目的有杠杆价值为:

$$V^L = V^U + PV(\text{利息税盾}) = 5962 + 132 = 6094\text{万美元}$$

预先设定债务水平(续)

- 预先设定债务水平的一个简单的情形就是，公司将永久保持不变债务水平，这时项目的有杠杆价值为：
  - 永久性固定债务水平下项目的有杠杆价值

$$V^L = V^U + \tau_c \times D$$

  - 谨记：
    - 如果债务水平被预先设定，公司不根据现金流或公司价值的变化而调整债务水平，公司就不再维持目标杠杆比率，于是在目标杠杆比率下使用的公式就不再适用了。

不同估值方法的比较

- 一般来讲，如果公司在投资的整个寿命期内都保持固定的债务与价值比率，则WACC法最为简便易行。
- 在其他杠杆政策下，APV法通常是最简单的方法。
- 一般只有在复杂情形下，比如公司资本结构中其他证券的价值或利息税盾难以确定时，才应用FTE法。

18.7 融资的其他效应

- 发行成本及其他融资成本
  - 公司通过借贷或发行证券筹集资本时，提供贷款或承担证券销售的银行要收取费用。
  - 这些费用应该包括在投资成本中，从而减少项目的净限值。

Table 18.9

TABLE 18.9 **Typical Issuance Costs for Different Securities, as a Percentage of Proceeds**

Financing Type	Underwriting Fees
Bank loans	< 2%
Corporate bonds	
Investment grade	1–2%
Non-investment grade	2–3%
Equity issues	
Initial public offering	8–9%
Seasoned equity offering	5–6%

Source: Data based on typical underwriting, legal, and accounting fees for $50 million transaction. See, e.g., I. Lee, S. Lochhead, J. Ritter, and Q. Zhao, "The Cost of Raising Capital," *Journal of Financial Research* 19(1) (1996): 59–74.

证券的错误定价

- 如果管理层认为所发行证券的价格低于(或高于)其真实价值，那么证券发行交易的净现值，应该包含在项目的价值中。
  - 证券发行交易的净现值是实际筹集的资金与出售证券的真实价值之间的差额。

证券的错误定价(续)

- *证券发行正的净现值会使现有股东受益，而负的净现值会使现有股东遭受损失。*

Example 18.8

Valuing a Loan

Problem

Gap, Inc., is considering borrowing $100 million to fund an expansion of its stores. Given investors' uncertainty regarding its prospects, Gap will pay a 6% interest rate on this loan. The firm's management knows, however, that the actual risk of the loan is extremely low and that the appropriate rate on the loan is 5%. Suppose the loan is for five years, with all principal being repaid in the fifth year. If Gap's marginal corporate tax rate is 40%, what is the net effect of the loan on the value of the expansion?

Example 18.8 (cont'd)

Solution

Shown below are the cash flows (in $ millions) and interest tax shields of a fair loan, at a 5% interest rate, and of the above-market rate loan Gap will receive, with a 6% interest rate. For each loan, we compute both the NPV of the loan cash flows and the present value of the interest tax shields, using the correct rate $r_D = 5\%$.

	Year	0	1	2	3	4	5
1	Fair Loan	100.00	(5.00)	(5.00)	(5.00)	(5.00)	(105.00)
2	Interest Tax Shield		2.00	2.00	2.00	2.00	2.00
3	At $r_D = 5\%$:						
4	*NPV*(Loan Cash Flows)	0.00					
5	*PV*(Interest Tax Shield)	8.66					
6	Actual Loan	100.00	(6.00)	(6.00)	(6.00)	(6.00)	(106.00)
7	Interest Tax Shield		2.40	2.40	2.40	2.40	2.40
8	At $r_D = 5\%$:						
9	*NPV*(Loan Cash Flows)	(4.33)					
10	*PV*(Interest Tax Shield)	10.39					

For the fair loan, note that the NPV of the loan cash flows is zero. Thus the benefit of the loan on the project's value is the present value of the interest tax shield of $8.66 million. For the actual loan, the higher interest rate increases the value of the interest tax shield but implies a negative NPV for the loan cash flows. The combined effect of the loan on the project's value is

$$NPV(\text{Loan Cash Flows}) + PV(\text{Interest Tax Shield}) = -4.33 + 10.39 = \$6.06 \text{ million}$$

While leverage is still valuable due to the tax shields, paying the higher interest rate reduces its benefit to the firm by $8.66 - 6.06 = \$2.60$ million.

财务困境成本和代理成本

- 财务困境成本和代理成本也会影响资本成本。
  - 例如，财务困境成本趋于加大公司价值对市场风险的敏感性，提高了高杠杆公司的无杠杆（税前）资本成本。

财务困境成本和代理成本

- 自有现金流的估计必须将财物困境成本和代理成本包含进来。
- 此外，由于这些成本也影响现金流的系统风险，所以无杠杆资本成本将不再独立与公司的杠杆。

Example 18.9

Valuing Distress Costs

Problem

Your firm currently has no leverage, and it expects to generate free cash flows of $10 million per year in perpetuity. The firm's current (unlevered) cost of capital is 10%, and its marginal corporate tax rate is 35%. You would like to determine whether adding leverage would increase the firm's value. Simulating the firm's future cash flows, you have estimated the likelihood and cost of financial distress with different levels of permanent debt and have produced the following estimates:

Debt Level, D	0	20	40	60	80
$E(FCF)$	10.0	9.9	9.8	9.5	9.0
r_U	10.0%	10.5%	11.0%	11.8%	13.0%

Based on this information, which level of permanent debt is optimal for the firm?

Example 18.9 (cont'd)

Solution

Because the debt level is known, the simplest course of action is to apply the APV method. The unlevered value of the firm can be computed as a perpetuity, $V^U = E(FCF) / r_U$. With permanent debt, the value of the tax shield is $\tau_c D$. Adding these together yields the estimate of the firm's levered value:

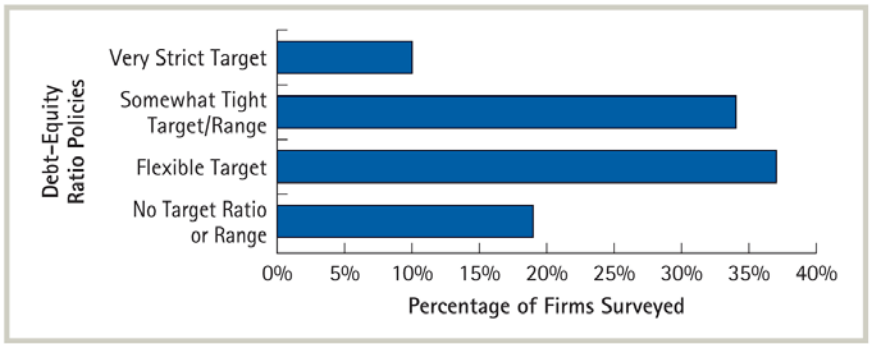
Debt Level, D	0	20	40	60	80
$V^U = E(FCF) / r_U$	100.0	94.3	89.1	80.5	69.2
$PV(ITS) = \tau_c D$	0.0	7.0	14.0	21.0	28.0
$V^L = V^U + \tau_c D$	100.0	101.3	103.1	101.5	97.2

Of the debt levels shown here, the value of the firm is maximized with $D =$ $40 million. This debt level provides the best tradeoff of tax benefits versus financial distress and agency costs.

18.8 资本预算高级专题

- 定期调整债务水平
  - 现实中，大多数公司允许债务股权比率偏离目标水平，并定期调整杠杆使其恢复到与目标比率一致。

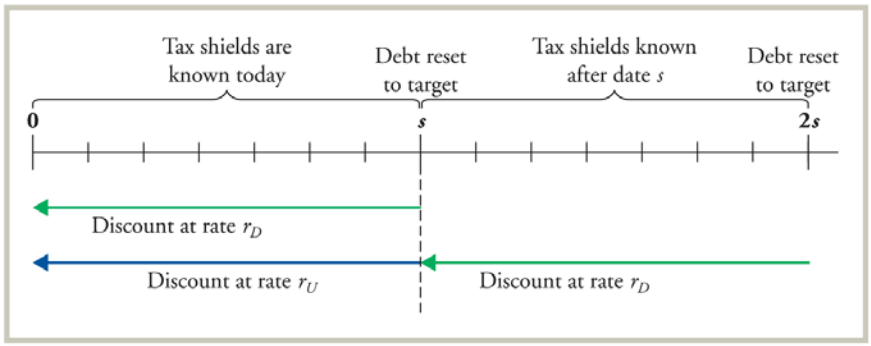
图 18.1 公司的杠杆政策



18.8资本预算高级专题(续)

- 定期调整债务水平
  - 假设公司每s期就调整它的杠杆。那么至日期s的利息税盾就可以预先确定(如下页所示)，所以应该以债务的资本成本折现。

图 18.2 定期调整债务水平时对税盾的折现



18.8资本预算高级专题(续)

- 定期调整债务水平
  - 日期s之后的利息税盾取决于公司在未来的债务水平的调整，所以它是有风险的。
    - 如果公司根据目标债务股权比率或利息保障比率调整债务水平，对于未来的利息税盾，在利息税盾为已知的时间内应以债务的资本成本折现，但在利息税盾仍有风险的早期则应以无杠杆的资本成本折现。

18.8资本预算高级专题(续)

- 定期调整债务水平
  - 一个重要的特例是公司每年都调整债务水平

$$PV(\tau_c \times Int_t) = \frac{\tau_c \times Int_t}{(1 + r_U)^{t-1}(1 + r_D)} = \frac{\tau_c \times Int_t}{(1 + r_U)^t} \times \left(\frac{1 + r_U}{1 + r_D}\right)$$

$$r_{WACC} = r_U - d\tau_c r_D \frac{1 + r_U}{1 + r_D}$$

$$V^L = \left(1 + \tau_c k \frac{1 + r_U}{1 + r_D}\right) V^U$$

Example 18.10

Annual Debt Ratio Targeting

Problem

Celmax Corporation expects free cash flows this year of $7.36 million and a future growth rate of 4% per year. The firm currently has $30 million in debt outstanding. This leverage will remain fixed during the year, but at the end of each year Celmax will increase or decrease its debt to maintain a constant debt-equity ratio. Celmax pays 5% interest on its debt, pays a corporate tax rate of 40%, and has an unlevered cost of capital of 12%. Estimate Celmax's value with this leverage policy.

Example 18.10 (cont'd)

Solution

Using the APV approach, the unlevered value is $V^U = 7.36 / (12\% - 4\%) = \$92.0$ million. In the first year, Celmax will have an interest tax shield of $\tau_c\, r_D\, D = 0.40 \times 5\% \times \$30$ million $= \$0.6$ million. Because Celmax will adjust its debt after one year, the tax shields are expected to grow by 4% per year with the firm. The present value of the interest tax shield is therefore

$$PV(\text{Interest Tax Shield}) = \underbrace{\frac{0.6}{(12\% - 4\%)}}_{PV \text{ at rate } r_U} \times \underbrace{\left(\frac{1.12}{1.05}\right)}_{\text{Debt is set 1 year in advance}} = \$8.0 \text{ million}$$

Therefore, $V^L = V^U + PV(\text{Interest Tax Shield}) = 92.0 + 8.0 = \$100.0$ million.

We can also apply the WACC method. From Eq. 18.17, Celmax's WACC is

$$r_{WACC} = r_U - d\tau_c r_D \frac{1 + r_U}{1 + r_D} = 12\% - \frac{30}{100}(0.40)(5\%)\frac{1.12}{1.05}$$
$$= 11.36\%$$

Therefore, $V^L = 7.36 / (11.36\% - 4\%) = \$100$ million.

Finally, the constant interest coverage model can be applied (in this setting with constant growth, a constant debt-equity ratio implies a constant interest coverage ratio). Given interest of $5\% \times \$30$ million $= \$1.50$ million this year, from Eq. 18.18

$$V^L = \left(1 + \tau_c k \frac{1 + r_U}{1 + r_D}\right) V^U$$
$$= \left(1 + 0.40 \times \frac{1.50}{7.36} \times \frac{1.12}{1.05}\right) 92.0 = \$100 \text{ million}$$

杠杆与资本成本

- 根据固定的计划设置某些时期内的债务水平，则预设债务的利息税盾就是已知的，是相对安全的现金流。
  - 这些安全现金流将会减少杠杆对公司股权风险的影响。
  - 在评估公司杠杆时，应从债务中减去这些“安全”的税盾价值，这与从债务中减去现金的方式一样。

杠杆与资本成本(续)

- 如果 T^S 表示预先设定的债务的利息税盾的现值，那么公司股权的风险将取决于扣除预先确定的税盾现值后的债务净额:

$$D^S = D - T^S$$

杠杆与资本成本(续)

- 资本成本可计算为:
  - 固定债务计划下的杠杆和资本成本

$$r_U = \frac{E}{E+D^s} r_E + \frac{D^s}{E+D^s} r_D \text{ 或, 等价地, } r_E = r_U + \frac{D^s}{E}(r_U - r_D)$$

- WACC可又下式计算:
  - 固定债务计划下的项目WACC

$$r_{wacc} = r_U - d\tau_c[r_D + \phi(r_U - r_D)]$$

    - D表示债务与价值比率，$\Phi = T^s/(\tau_c D)$衡量债务水平的持久性。

Example 18.11

APV and WACC with Permanent Debt

Problem

International Paper Company is considering the acquisition of additional forestland in the southeastern United States. The wood harvested from the land will generate free cash flows of $4.5 million per year, with an unlevered cost of capital of 7%. As a result of this acquisition, International Paper will permanently increase its debt by $30 million. If International Paper's tax rate is 35%, what is the value of this acquisition using the APV method? Verify this result using the WACC method.

Example 18.11 (cont'd)

Solution

Using the APV method, the unlevered value of the land is $V^U = FCF / r_U = 4.5 / 0.07 =$ \$64.29 million. Because the debt is permanent, the value of the tax shield is $\tau_c D = 0.35(30) = 10.50$. Therefore, $V^L = 64.29 + 10.50 =$ \$74.79 million.

To use the WACC method, we apply Eq. 18.21 with $\phi = T^s / (\tau_c D) = 1$ and $d = 30 / 74.79 = 40.1\%$. Therefore, the WACC for the investment is

$$r_{wacc} = r_U - d\tau_c r_U = 7\% - 0.401 \times 0.35 \times 7\% = 6.017\%$$

and $V^L = 4.5 / 0.06017 =$ \$74.79 million.

变动杠杆时的WACC法和FTE法

- 如果公司不能保持固定不变的债务股权比率，WACC法和FTE法则较难应用。因为在债务融资比例发生变化时，项目的股权资本成本和WACC不会保持不变。
  - 然而通过一些调整，这两种方法依然能够使用。

Table 18.10

TABLE 18.10 SPREADSHEET Adjusted Present Value and Cost of Capital for Avco's RFX Project with a Fixed Debt Schedule

	Year	0	1	2	3	4
Unlevered Value ($ million)						
1	Free Cash Flow	(28.00)	18.00	18.00	18.00	18.00
2	Unlevered Value, V^U (at $r_u = 8.0\%$)	59.62	46.39	32.10	16.67	–
Interest Tax Shield						
3	Debt Schedule, D_t	30.62	20.00	10.00	–	–
4	Interest Paid (at $r_d = 6\%$)	–	1.84	1.20	0.60	–
5	Interest Tax Shield (at $\tau_c = 40\%$)	–	0.73	0.48	0.24	–
6	Tax Shield Value, T^s (at $r_D = 6.0\%$)	1.32	0.67	0.23	–	–
Adjusted Present Value						
7	Levered Value, $V^L = V^U + T^s$	60.94	47.05	32.33	16.67	–
Effective Leverage and Cost of Capital						
8	Equity, $E = V^L - D$	30.32	27.05	22.33	16.67	–
9	Effective Debt, $D^s = D - T^s$	29.30	19.33	9.77	–	–
10	Effective Debt-Equity Ratio, D^s/E	0.966	0.715	0.438	0.000	
11	Equity Cost of Capital, r_E	9.93%	9.43%	8.88%	8.00%	
12	WACC, r_{wacc}	6.75%	6.95%	7.24%	8.00%	

变动杠杆时的WACC法和FTE法(续)

- 例如，在项目开始时，WACC可计算如下:

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1 - \tau_c)$$

$$= \frac{30.32}{60.94} 9.93\% + \frac{30.62}{60.94} 6\% (1 - 0.40) = 6.75\%$$

变动杠杆时的WACC法和FTE法(续)

- 每年的有杠杆价值计算如下:

$$V_t^L = \frac{FCF_{t+1} + V_{t+1}^L}{1 + r_{wacc}(t)}$$

Table 18.11

TABLE 18.11 SPREADSHEET

WACC Method for Avco's RFX Project with a Fixed Debt Schedule

	Year	0	1	2	3	4
WACC Method ($ millions)						
1	Free Cash Flow	(28.00)	18.00	18.00	18.00	18.00
2	WACC, r_{wacc}	6.75%	6.95%	7.24%	8.00%	
3	Levered Value V^L (at r_{wacc})	60.94	47.05	32.33	16.67	–

个人所得税

- 在有个人所得税的的情况下*WACC*法不需要进行调整。
  - 不过，在存在投资者纳税的情况下，APV法需要做一些修正，因为这一方法需要计算无杠杆资本成本。
    - 债务资本成本，r_D，应调整如下:

$$r_D^* \equiv r_D \frac{(1 - \tau_i)}{(1 - \tau_e)}$$

个人所得税(续)

- 无杠杆资本成本变为:

$$r_U = \frac{E}{E + D^s} r_E + \frac{D^s}{E + D^s} r_D^*$$

- 有效抵税税率:

$$\tau^* = 1 - \frac{(1 - \tau_c)(1 - \tau_e)}{(1 - \tau_i)}$$

个人所得税(续)

- 利息税盾计算如下:

$$\text{第}t\text{年的利息税盾} = \tau^* \times r_D^* \times D_{t-1}$$

  - 如果公司保持目标杠杆比率，就以r_U对利息税盾折现;如果债务水平是根据预先设定的计划确定的，则以r^*_D对利息税盾折现。

Example 18.12

Using the APV Method with Personal Taxes

Problem

Apex Corporation has an equity cost of capital of 14.4% and a debt cost of capital of 6%, and the firm maintains a debt-equity ratio of 1. Apex is considering an expansion that will contribute $4 million in free cash flows the first year, growing by 4% per year thereafter. The expansion will cost $60 million and will be financed with $40 million in new debt initially with a constant debt-equity ratio maintained thereafter. Apex's corporate tax rate is 40%; the tax rate on interest income is 40%; and the tax rate on equity income is 20%. Compute the value of the expansion using the APV method.

Example 18.12 (cont'd)

Solution

First, we compute the value without leverage. From Eq. 18.23, the debt cost of capital of 6% is equivalent to an equity rate of

$$r_D^* = r_D \frac{1-\tau_i}{1-\tau_e} = 6\% \times \frac{1-0.40}{1-0.20} = 4.5\%$$

Because Apex maintains a constant debt-equity ratio, $D' = D$ and Apex's unlevered cost of capital is, using Eqs. 18.23 and 18.24,

$$r_U = \frac{E}{E+D'} r_E + \frac{D'}{E+D'} r_D^* = 0.50 \times 14.4\% + 0.50 \times 4.5\% = 9.45\%$$

Therefore, $V^U = 4 / (9.45\% - 4\%) = \$73.39$ million.

From Eq. 18.25, the effective tax advantage of debt is

$$\tau^* = 1 - \frac{(1-\tau_c)(1-\tau_e)}{(1-\tau_i)} = 1 - \frac{(1-0.40)(1-0.20)}{(1-0.40)} = 20\%$$

Apex will add new debt of \$40 million initially, so from Eq. 18.26 the interest tax shield is $20\% \times 4.5\% \times 40 = \$0.36$ million the first year (note that we use r_D^* here). With a growth rate of 4%, the present value of the interest tax shield is

$$PV(\text{Interest Tax Shield}) = 0.36 / (9.45\% - 4\%) = \$6.61 \text{ million}$$

Therefore the value of the expansion with leverage is given by the APV:

$$V^L = V^U + PV(\text{Interest Tax Shield}) = 73.39 + 6.61 = \$80 \text{ million}$$

Given the cost of \$60 million, the expansion has an NPV of \$20 million.

Let's check this result using the WACC method. Note that the expansion has the same debt-to-value ratio of 40/80 = 50% as the firm overall. Thus its WACC is equal to the firm's WACC:

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1-\tau_c)$$
$$= 0.50 \times 14.4\% + 0.50 \times 6\% \times (1-0.40) = 9\%$$

Therefore, $V^L = 4 / (9\% - 4\%) = \$80$ million, as before.