Chapter 17 Homework Problem Solutions
ISyE 4311

Problem 17.1
For Mortimer’s group: the after-tax interest expense is 31,500, the net income is $120,000 - 31,500 = 88,500$, and so the ROE $= 88,500/500,000 = 17.7\%$.
For Joanne’s group: the net income is 120,000, and so the ROE $= 120,000/1,000,000 = 12\%$.

Problem 17.2
After-tax interest expense is 37,800, the net income is $120,000 - 37,800 = 82,200$, and so the ROE $= 82,200/600,000 = 13.7\%$.

Problem 17.3
a. $50,000/350,000 = 14.29\%$ = ROE with no debt.
b. $ROE = \frac{50,000-0.6(0.08(0.25)(350,000))}{0.75(350,000)} = 17.45\%$.
c. $ROE = \frac{50,000-0.6(0.08(0.50)(350,000))}{0.50(350,000)} = 23.77\%$.
d. $ROE = \frac{50,000-0.6(0.08(0.80)(350,000))}{0.20(350,000)} = 52.23\%$.

Problem 17.4
a. Shareholders receive 50,000, debt holders receive 0, total = 50,000.
b. Shareholders receive 45,800, debt holders receive 7,000, total = 52,800.
c. Shareholders receive 41,600, debt holders receive 14,000, total = 55,600.
d. Shareholders receive 36,560, debt holders receive 22,4000, total = 58,960.

Problem 17.5
Note: Solution assumes 80,000 is after-tax.
With a personal loan: shareholders receive 53,000 and debt holders receive 27,000.
With a corporate loan: shareholders receive 63,800 and debt holders receive 27,000.

Problem 17.6
Incremental cash flow $= T_C r_D D = 10,800$. PV @ 9\% = 120,000 and so $V^L = 720,000$.
Alternatively, $V^L = V^U + T_C D = 600,000 + 0.4(300,000) = 720,000$.

Problem 17.7
a. $V^U = 900,000$. $V^L = V^U + T_C D = 900,000 + 0.3(450,000) = 1,035,000$.
b. See book solution spreadsheet.

NOTE: Can use this “secret” calculation for a conventional fixed-rate loan only:
STEP 1. Calculate the period payment

$$Y = \frac{0.08(450,000)}{1 - (1.08)^{-20}} = 45,833.49.$$
STEP 2. Calculate the first period’s principal payment

\[ PP(1) = Y - iLB(0) = 45,833.49 - 0.08(450,000) = 9,833.49. \]

STEP 3. Calculate value of interest tax shield as

\[ T_C[LB(0) - \frac{PP(1) + N}{1 + i}] = 0.3[450,000 - 20(9,833.49)/1.08] = 80,369.48! \]

Problem 17.8
a. \( V^L = V^U + T_CD = 720,000 \) and \( D = 300,000 \), and so the new \( E = 420,000 \). Annual equity cash flow = 63,800. \( r_E = 63,800/420,000 = 15.19\% \).
\( r_U = 80,000/600,000 = 13.3\% \). \( r_E = 13.3 + (13.3 - 9)(0.6)(300/420) = 15.19\% \).
b. \( V^L = V^U + T_CD = 1.15M \) and \( D = 0.5M \), and so the new \( E = 0.65M \). Annual equity cash flow = 88,500. \( r_E = 88,500/650,000 = 13.62\% \).
\( r_U = 120,000/1,000,000 = 12\% \). \( r_E = 12 + (12 - 9)(0.7)(500/650) = 13.62\% \).
c. \( V^L = V^U + T_CD = 1.035M \) and \( D = 0.45M \), and so the new \( E = 0.585M \). Annual equity cash flow = 94,800. \( r_E = 94,800/585,000 = 16.21\% \).
\( r_U = 120,000/900,000 = 13.3\% \). \( r_E = 13.3 + (13.3 - 8)(0.7)(450/585) = 16.21\% \).

Problem 17.9
a. \( r_{WACC} = \frac{80,000}{720,000} = 11.1\% = 15.19 \frac{120}{720} + 5.4 \frac{300}{720} \).
Note \( r_{WACC} = r_U(1 - T_C(D/V^L)) = 13.3(1 - 0.4(300/720)). \)
b. \( r_{WACC} = \frac{120,000}{1,150,000} = 10.43\% = 13.62 \frac{650}{1,150} + 6.3 \frac{500}{1,150}. \)
Note \( r_{WACC} = r_U(1 - T_C(D/V^L)) = 12(1 - 0.3(500/1,150)). \)
c. \( r_{WACC} = \frac{120,000}{1,035,000} = 11.59\% = 16.21 \frac{585}{1,035} + 5.6 \frac{450}{1,035}. \)
Note \( r_{WACC} = r_U(1 - T_C(D/V^L)) = 13.3(1 - 0.3(450/1,035)). \)

Problem 17.10
a. \( V^U = 300K/0.12 = 2.5M. \)
b. \( V^L = V^U + T_CD = 2.5M + 0.36(1.2M) = 2.932M. \ E = 1.732M. \)
c. With no debt: \( r_E = r_U = 12\%. \)
With debt:
\[ r_E = 12 + (12 - 9)(0.64)(1.2/1.732) = (300,000 - 69,120)/1,732,000 = 13.33\%. \]
d. With no debt: \( r_{WACC} = r_U = 12\%. \)
With debt:
\[ r_{WACC} = 13.33 \frac{1.732}{2.932} + 5.76 \frac{1.2}{2.932} = 10.23\% = 12(1 - 0.36 \frac{1.2}{2.932}) = \frac{300,000 - 69,120}{1,732,000}. \]

Problem 17.11
a. \( V^U = E = 50(30,000) = 1.5M. \)
b. \( V^L = V^U + T_C D = 1.68M. \)
c. \( 1.68M/30 = 56 \) per share.
d. Repurchase \( 600,000/56 = 10,714 \) shares.
e. \( D = 600,000 \) and \( V^L = 1.68M. \) \( E = 1.08M. \) Check: \( 1.08M = (30,000 - 10,714)56. \)
f. \( r_U = 150K/1.5M = 10\%. \) \( r_E = 10 + (10 - 6)90.7)(600/1,080) = 11.56\%. \) Check: \( r_E = (150,000 - 25,000)/1,080,000. \)
g. \( r_{WACC} = 11.56(1,080/1,680) + 4.2(600/1,080) = 8.93\%. \) Check: \( r_{WACC} = 10(1 - 0.3(600/1,680)). \)

**Problem 17.12**

Interest payment in first year = 8,000, after-tax interest shield = 3,200. Since the principal payment each year = 12,500, the after-tax interest shield declines by 1/8 or 400 each year, i.e., the second year’s after-tax interest shield = 2,800, the third year’s after-tax interest shield = 2,400, and so on. The PV of this cash flow stream @ 8\% is 11,266.81.

NOTE: Can use this “secret” calculation for this type of loan only:

**STEP 1.** Calculate the constant principal payment \( PP = LB(0)/N = 100,000/8 = 12,500. \)

**STEP 2.** Calculate the annuity factor \( (1 - (1+i)^{-N})/i = (1 - (1.08)^{-8})/0.08 = 5.74664. \)

**STEP 3.** Calculate the value of the interest tax shield as

\[
T_C[LB(0) - \frac{LB(0) 1 - (1+i)^{-N}}{N}] = 0.4[100,000 - 12,500(5.74664)] = 11,266.81!
\]

**Problem 17.13**

See book solution spreadsheet.

NOTE: Can use this “secret” calculation for a conventional fixed-rate loan only:

**STEP 1.** Calculate the period payment

\[
Y = \frac{0.08(50,000)}{1 - (1.08)^{-10}} = 7,451.47.
\]

**STEP 2.** Calculate the first period’s principal payment

\[
PP(1) = Y - iLB(0) = 7,451.47 - 0.08(50,000) = 3,451.47.
\]

**STEP 3.** Calculate value of interest tax shield as

\[
T_C[LB(0) - \frac{PP(1) * N}{1 + i}] = 0.4[50,000 - 10(3,451.47)/1.08] = 7,216.78!
\]

Here, the new NPV = -4,643 + 7,217 = 2,574.