Fundamentals of Capital Budgeting

Required Reading

- **Chapter 9,** "*Fundamentals of Capital Budgeting*"" from J. Berk et al., Fundamentals of Corporate Finance, Second Canadian Edition.

Recommended Reading

- **Chapter 2**, "*Introduction to Financial Statement Analysis*" from J. Berk et al., Fundamentals of Corporate Finance, Second Canadian Edition.

The Net Present Value (NPV) Rule

0	1	2	3	4	……	Time
FCF_0	FCF_1	FCF_2	FCF_3	FCF_4	…	Free Cash Flows

Consider an investment that generates the above stream of free cash-flows. The net present value (NPV) of this investment is :

$$NPV = \sum_{t=0}^{\infty} \frac{FCF_t}{(1+r)^t}$$

where $\boldsymbol{FCF_t}$ is the free cash-flow that arrives at date $\boldsymbol{t}$ and $\boldsymbol{r}$ is the cost of capital associated to the project (which is determined by the market return of other projects of similar risk).

Income Statement

Revenues	(1)
- Cost of Good Sold	(2)
- Other Costs	(3)
- Depreciation	(4)
EBIT	(5)=(1)-(2)-(3)-(4)
- Interest Paid	(6)
Taxable Income	(7)=(5)-(6)
- Taxes	(8)
Net Income	**(9)=(7)-(8)**

Net Income: Problems for Finance

1. We are interested in all the cash that a project generates and that the firm is free to distribute to *both* debt-holders and equity-holders:

Revenues	(1)
- Costs	(2)
- Depreciation	(3)
EBIT	(4) = (1)-(2)-(3)
- EBIT x T_C	(5) = (4) x T_C
Unlevered Net Income	**(6) = (4)- (5)**

Note: *Tc is the corporation's tax rate.*

Notice the following:

1) The relation between *Net Income* (or Earnings) and *Unlevered Net Income* (or Unlevered Earnings) is:

Unlevered Net Income = Net Income + Interest Paid (1-T_C)

2) To calculate the *Unlevered Net Income* we exclude the interest payments *and* the interest tax shield.

3) The ***Unlevered*** *Net Income* is the net income that the firm would have if it were to have no debt (and hence, no interest payments).

Net Income: Problems for Finance

2. Income statements include **non-cash items** such as **depreciation** that only affect cash flows because of taxes.

Revenues	(1)
- Costs	(2)
- Depreciation	(3)
EBIT	(4) = (1)-(2)-(3)
- EBIT x T_C	(5) = (4) x T_C
Unlevered Net Income	(6) = (4) - (5)
+ Depreciation	(3)
Unlevered Net Income + Depreciation	(7) =(6)+ (3)

Notice the following:

- Notice that depreciation is not a cash item in itself but it does have cash implications because depreciation is deductible for tax purposes (and hence reduces the taxes that the corporation pays to the government):

Unlevered Net Income + Depreciation =
= (Revenues – Costs) (1 – T_C) + Depreciation x T_C

- **"Depreciation x T_C"** is called the ***depreciation tax shield*** that is the tax savings that results from the ability to deduct the depreciation.

Net Income: Problems for Finance

3. The firms need to invest in long-term assets (**Capital Expenditures**) and in current assets (**Change in Net Working Capital**) hence not all operating cash-flows can be distributed to debt-holders and equity-holders):

Unlevered Net Income	(1)
+ Depreciation	(2)
- CAPX	(3)
- Change in NWC	(4)
Free Cash-Flow (*FCF*)	**(5) =(1)+(2)–(3)–(4)**

Notice that there are many ***equivalent*** expressions for FCF, just use the most convenient one in each occasion:

***FCF* = Unlevered Net Income + Depreciation – CAPX – Change in NWC**

- ***FCF*** = (Revenues – Costs – Depreciation) x (1 – T_C) + Depreciation –CAPX – Change in NWC
- ***FCF*** = EBIT x (1 – T_C) + Depreciation –CAPX – Change in NWC (Note: **EBIT** = Revenues – Costs – Depreciation)
- ***FCF*** = (Revenues – Costs) x (1 – T_C) + T_C x Depreciation –CAPX – Change in NWC
- ***FCF*** = EBITDA x (1 – T_C) + T_C x Depreciation –CAPX – Change in NWC (Note: **EBITDA** = Revenues – Costs)
- ***FCF*** = Net Income + (1–T_C) x Interest Paid + Depreciation – CAPX – Change in NWC

Change in Net Working Capital (NWC)

- Many projects need some capital to be tied up (working capital):

NWC = Current Assets – Current Liabilities =
= Cash + Inventory + Receivables – Payables

- The net investment in current assets during each period is the change NWC:

$$\textbf{Change in } NWC_t = NWC_t - NWC_{t-1}$$

Change in Net Working Capital (NWC)

- Under "Generally Accepted Accounting Principles" (GAAP), the income statement shows revenue and expenses when they accrue. However in *Finance* we are interested in **actual cash flow** in a given period.
- For instance, revenues and expenses are reported when a sale is declared. Therefore:

  → COGS in 2015 includes the costs of items sold in 2015 even if the cost was incurred in 2014 or hasn't been incurred yet.

  → Sales in 2015 include the income from items sold in 2015 even if the payment has not been received yet.

- Including the Changes in NWC in our FCF calculation allows to correct this problem.

Example

Consider a firm that buys 2 cars at t=0 for $10K each and sells one car at t=1 for $20K and the other at t=2 for $40K. Assuming that the corporate tax rate is zero and that all purchases and sales are paid immediately, calculate the FCF in year 0, 1 , and 2.

Year	***0***	***1***	***2***
Sales	0	20K	40K
COGS	0	10K	10K
Inventory (i.e., NWC)	20K	10K	0
Change in NWC	20K	-10K	-10K
FCF =*Sales-COGS-Change in NWC*	**-20K**	**20K**	**40K**

Notice that in the above example the COGS is not an actual cost during the year but it "compensated" with the change in inventories (i.e., Change in NWC). At the end the FCF are: -20K in year 0 (which reflects the cots of purchasing of the cars); and 20K and 40K in year 1 and 2, respectively, (which reflects the revenues from selling the cars).

Calculate the FCF for 2015

Note: The corporate tax rate is 38%.

	2014	**2015**
Sales	1,000	1,200
Cost of Goods Sold	700	850
Depreciation	30	35
Interest Expense	59	78
Capital Expenditures	40	40
Accounts Receivable	50	60
Inventories	50	60
Accounts Payable	20	25

Answer

NWC (14) = Cash + Receivables + Inventory – Payables =
= 50 + 50 – 20 = $80

NWC (15) = 60 + 60 – 25 = $95

Change in NWC (15) = 95 – 80 = $15

FCF (15) = (Sales – Costs) x (1 – T_C) + T_C x Depreciation
–CAPX – Change in NWC =
= (1-0.38) (1,200 – 850) + 0.38 x 35 – 40 – 15 = **$175.3**

Free Cash Flows from a Project

- **Incremental free cash flows:** All *<u>changes</u>* in the firm's present and future FCF that are direct consequence of taking the project.

INCREMENTAL FREE CASH FLOWS ARE THE ONLY RELEVANT FCF IN CALCULATING THE NPV OF A PROFECT

- Compare the firm's value, **V**, with and without the project:

Value (Project) = **V** (Firm with Project) – **V** (Firm without Project)

Calculating Incremental FCF
Important Points to Remember

1. Do not include sunk costs

Q. *Why?* Sunk costs have already been spent (and hence, do not depend on whether the firm takes the project or not).

2. Include opportunity costs

Definition: *Opportunity Cost* is the most valuable alternative use of an asset if the project is not undertaken.

Q. In opening a department store, does it matter whether the firm already owns the building?

Calculating Incremental FCF
Important Points to Remember

3. Consider spillover effects

- *Example*: If a firm is deciding whether to launch a new product (e.g., Zero Coke) it must take into account how the new product will affect the sales of the firm's existing products (e.g., Diet Coke).

4. Avoid accounting illusions

- *Example*: The project might be "charged" for a fraction of expenses that would be incurred anyway. Allocated costs should be only included if they are truly incremental costs.

5. **Remember to include the recovery of the NWC at the *end* of the project.**

6. **Consider grants, subsidized credits and other forms of government intervention that affect the FCF.**

Example

Toys-for-Kids Inc., which has a cost of capital of 10% and a corporate tax rate of 34%, is considering the introduction of a new product, Turbo-Widgets (***TW***), which has been developed at an R&D cost of $1M over the past 3 years.

- The new machine to produce *TW* would cost $2M and last 15 years with a salvage value at the end of $0. The new machine can be depreciated linearly to $0 over 10 years.
- Annual sales of TW are expected to be $400,000, but cannibalization would lead existing sales of Regular Widgets to decrease by $20,000.
- Operating cost would amount to $40,000 per year. In addition, *TW* would need to be painted using the painting machine, that currently runs at a cost of $30,000 per year regardless of how much it is used.
- $250,000 of NWC would be need over the life of the project.

Should Toys-for-Kids Inc. launch Turbo-Widgets?

Solution

Year	***FCF*** (000's)
0	-2000-250 = -$2250
1-10	(400-40-20)(1-.34) + 0.34 x 200 = $292.4
11-14	(400-40-20)(1-.34) = $224.4
15	(400-40-20)(1-.34) + 250 = $474.4

$$\text{NPV} = -2250 + \frac{292.4}{0.1}\left(1-\frac{1}{(1.1)^{10}}\right) +$$

$$+\frac{224.4}{0.1\cdot(1.1)^{10}}\left(1-\frac{1}{(1.1)^{4}}\right)+\frac{474.4}{(1.1)^{15}} = -\$65.517\,\text{K}$$

"The project should be rejected since it has a negative NPV"

Notice the following:

- R&D is a sunk cost so it is not an incremental FCF.
- Project should not be charged for the painting-machine time since it is not an incremental FCF.
- Depreciation is $2 M /10 = $200 K for the first 10 years and it generates a depreciation tax shield of (0.34 x 200) per year.
- FCF at *t=0* includes the initial investment and initial NWC.
- FCF at *t=15* includes recovery of NWC. [Note: In this problem the salvage value of the asset and the book value of the asset is zero.]

Straight Line Depreciation vs. CCA

- In the previous example we have assumed that "*new machine to produce TW would cost $2M and last 15 years*" and "*can be depreciated linearly to $0 over 10 years*".
- This meant that the machine was depreciated at a rate of $200K per year, which generated a depreciation tax shield of $200K x 0.34% = $68K each year during the first 10 years.
- This is called the **Straight Line Depreciation** method. However in Canada, the Canada Revenue Agency uses the **Capital Cost Allowance (CCA)** method.

Straight Line Depreciation vs. CCA

Next we examine each of these two depreciation methods:

1- Straight Line Depreciation

2- Capital Cost Allowance (CCA)

(1) Straight Line Depreciation

1. **Every year the depreciation is a constant percentage of the initial capital investment, and we use this depreciation to calculate the depreciation tax shield.** [In this method we assume that depreciation for tax purposes is the same as the depreciation under GAAP.]

   For example, if a machine costs $1,200 and it is depreciated to $200 linearly over 5 years and the tax rate is 40%, then:

   →The depreciation is $200 [i.e. (1,200-200)/5=$200] per year.

   →The depreciation tax shield is $200 x 0.4 = $80 per year.

(1) Straight Line Depreciation

2. **Under the straight line depreciation method, when an asset is liquidated the corporation pays taxes on the capital gain** (*or receives a tax credit on the capital loss*). The capital gain is the difference between the sale price of the asset and its book value:

where

$$\boxed{\text{Taxes Paid on Asset Sales} = T_c \times \underbrace{(\text{Sale Price - Book Value})}_{\text{Capital Gain}}}$$

$$\text{Book Value} = \text{Purchase Price - Accumulated Depreciation}$$

Example (Straight Line Depreciation)

Dot.com purchased a machine 10 years ago for $1 million. The machine, which has been *depreciated in straight line* at the rate of $60,000 per year, has just been resold for $300,000. Calculate the taxes that Dot.com must pay on the resale assuming that its marginal corporate tax rate is 35%.

Solution

Book Value = 1,000K – 60K x 10 years = $400K

Capital Gain = 300K – 400K = –$100K

Taxes Paid = 0.35 x (-100) = –$35K

Note: *Taxes Paid < 0 means that the firm gets a tax credit.*

Example (Straight Line Depreciation)

Dot.com is considering replacing its existing machine.

- The new machine costs \$260,000 and would replace the existing machine. The new machine would be sold for \$30,000 after 10 years. During those 10 years, the new machine would <u>depreciate in straight line</u> from \$260,000 to \$20,000 at the rate of \$24,000 per year.
- The new machine would increase before-tax sales by \$80,000 per year. and before-tax operating costs by \$30,000 per year. These changes in sales and costs would occur at year-end during the 10 years that the new machine would be operating. Both the new and the old machine require \$14,000 in working capital.
- The old machine was acquired 5 years ago for \$90,000 and it has a current market value of \$40,000. The old machine could last for another 10 years, and after 10 years would be worth \$20,000. During those 10 years, the old machine would <u>depreciate in straight line</u> from \$40,000 to \$20,000 at the rate of \$2,000 per year.
- If Dot.com's cost of capital is 20% and its marginal corporate tax rate is 40%, ***should Dot.com replace the machine*?**

Solution

First calculate the <u>incremental</u> FCF of the new machine:

FCF (Year 0) = –260K + 40K = –\$220K

FCF (Years 1-9) = (1–0.4) (80K–30K) + 0.4 (24K–2K) = \$38.8K

FCF (Year 10) = (1–0.4) (80K–30K) + 0.4 (24K–2K) +

+30K – 0.4 (30K-20K) – 20K = \$44.8K

Second calculate the NPV of replacing the machine:

$$\text{NPV} = -220K + \frac{38.8K}{0.2}\left(1 - \frac{1}{1.2^9}\right) + \frac{44.8K}{1.2^{10}} = -\$54.92K < 0$$

Hence Dot.com should not replace the existing machine.

Comments

- *FCF in year 0:*

  The \$40K comes from selling the old machine. [Notice that since the sale price of \$40K equals the book value there is no capital gain or loss.]

  The NWC is not an incremental FCF (both machines need the same amount of NWC).

- *FCF years 1 to 9:*

  The incremental depreciation tax shield is 0.4 x (24K-2K), that is, the depreciation tax shield of the new machine minus the depreciation tax shield given up from the old machine (if the project is taken).

- *FCF year 10:*

  Dot.com must pay 0.4 x (30K-20K) in taxes because of the capital gain when selling the new machine.

  The -\$20K is the amount that Dot.com gives up in year 10 from replacing the machine and selling the old machine in year 0. [Notice that since the sale price of \$20K equals the book value there is no capital gain or loss.]

(2) Capital Cost Allowance (CCA)

- **Capital Cost Allowance (*CCA*):** The Canada Revenue Agency method of depreciation for income tax purposes. Hence, under the CCA method the depreciation for tax purposes is not the same as depreciation under GAAP.

- ***CCA* rate:** The proportion of undepreciated capital cost that can be claimed as *CCA* in a given tax year.

- **Undepreciated Capital Cost (UCC):** The balance, at a point in time, calculated by deducting an asset's current and prior *CCA* amounts from the original cost of the asset.

(2) Capital Cost Allowance (CCA)

CCA Rules

1. CCA assigns every capital asset to a particular **asset class**.

2. Each asset class has a maximum **CCA rate** for tax purposes.

3. Asset classes follow the **Declining Balance Method.** In the declining balance method, every year the depreciation is calculated by multiplying the undepreciated capital cost **(UCC)** by the CAA rate (***d***):

$$CCA_t = UCC_t \times d$$

(2) Capital Cost Allowance (CCA)

CCA Rules (Cont.)

4. T**he Half-year Rule**: In the first year of the asset, the CCA is calculated on only one-half of the installed value of the asset. Assume that an asset is purchase for $*CapEx* at the end of year 0 (i.e., beginning of year 1) then:

$$\boldsymbol{t} = 1 \qquad \boldsymbol{UCC}_1 = 0.5 \times \boldsymbol{CapEx}$$

$$\boldsymbol{t} \geq 2 \qquad \boldsymbol{UCC}_{\boldsymbol{t}} = \boldsymbol{CapEx} \times (1 - \frac{\boldsymbol{d}}{2}) \times (1 - \boldsymbol{d})^{\boldsymbol{t}-2}$$

Example (CCA Method)

Bombardier is buying a machine that costs $4,000. The new machine has a CCA rate of 10%. Assuming that the corporate tax rate is 40%, what will the yearly CCA and depreciation tax shield for 4 years?

Year	CAPX	UCC	CCA	Deprec. Tax Shield
0	4000			
1		2000 (= 4000/2)	200 (=2000 x 0.1)	80 (= 200 x 0.4)
2		3800 (=2000+2000-200)	380 (=3800 x 0.1)	152 (=380 x 0.4)
3		3420 (=3800-380)	342 (=3420 x 0.1)	136.8 (=342 x 0.4)
4		3078 (=3420-342)	307.8 (=3078x 0.1)	123.1 (=307.8 x 0.4)

(2) Capital Cost Allowance (CCA)

Rules (cont.)

5. When an **asset is liquidated** (i.e., sold) after a number of years, if its sale price (or salvage value) is smaller than its original purchase price, then

→ The corporate pays *no* taxes on the asset sale.

→ The asset pool's UCC is reduced by the asset sale price.

→ There will be tax shields beyond the life of the asset as long as the asset pool remains positive.

(2) Capital Cost Allowance (CCA)

Rules (cont.)

Based on these rules, **the Present Value of the CCA Tax Shields** associated to an asset assuming that its sale price (or savage value) is smaller than its purchase price is:

$$\boldsymbol{PVTS_{CCA}} = \frac{\boldsymbol{CapEx \times d \times T_c}}{\boldsymbol{r + d}} \times \frac{\left(1 + \frac{\boldsymbol{r}}{2}\right)}{(1 + \boldsymbol{r})} - \frac{\text{Sale Price}_{\boldsymbol{t}} \times \boldsymbol{d} \times \boldsymbol{T_c}}{\boldsymbol{r + d}} \times \frac{1}{(1 + \boldsymbol{r})^{\boldsymbol{t}}}$$

where, (i) ***CapEx*** is the cost of buying the asset; (ii) ***d*** is the CCA depreciation rate; (iii) $\boldsymbol{T_C}$ is the company's marginal tax rate; (iv) ***r*** is the discount rate; (v) ***t*** is the asset life or time when the asset is sold; and (vi) $\boldsymbol{Sale\ Price_t}$ is the salvage value or sale price of the asset at time t.

(2) Capital Cost Allowance (CCA)

Rules (cont.)

- Where does the previous formula of the Present Value of the CCA Tax Shields come from?

$$PVTS_{CCA} = \underbrace{\underbrace{\frac{(CapEx/2)\cdot d \cdot T_C}{r-(-d)}}_{\substack{\text{PV of Tax Shield of the} \\ \text{Half that Starts in Year 1}}} + \underbrace{\frac{(CapEX/2)\cdot d \cdot T_C}{r-(-d)} \frac{1}{1+r}}_{\substack{\text{PV of Tax Shields of the} \\ \text{Half that Starts in Year 2}}}} - \underbrace{\underbrace{\frac{Sale_t \cdot d \cdot T_C}{r-(-d)} \frac{1}{(1+r)^t}}_{\substack{\text{PV of Tax Shield Implications} \\ \text{of the Savage Value}}}}$$

$$PVTS_{CCA} = \overbrace{\frac{CapEx \times d \times T_c}{r+d} \times \frac{\left(1+\frac{r}{2}\right)}{(1+r)}} - \overbrace{\frac{\text{Sale Price}_t \times d \times T_c}{r+d} \times \frac{1}{(1+r)^t}}$$

(See the Appendix for more details.)

Example (CCA Method)

A new truck costs $30,000. The truck will be depreciated at a CCA rate of 30% rate. The truck will be worthless after 10 years. The new truck will generate pre-tax revenues of $10,000 per year during its 10 years of life. If the required rate of return is 10% and the tax rate is 40%, what is the NPV of buying the truck?

Solution

- FCF_0 = -30,000
- *FCF (years 1 through 10)* without tax shield of depreciation:

  FCF_t *(w/o tax shield)*=10,000 (1-.4)=$6,000 for t=1,2,…,10

- Present value of depreciation tax shields:

$$PVTS_{CCA} = \frac{30{,}000 \times 0.4 \times 0.3}{0.1 + 0.3} \times \frac{1 + \frac{0.1}{2}}{1 + 0.1} = \$8{,}591$$

- NPV:

$$NPV = -30{,}000 + \frac{6{,}000}{0.1}\left(1 - \frac{1}{(1.1)^{10}}\right) + 8{,}591 = \$15{,}458$$

Example (CCA Method)

Mary is considering buying a new ice cream machine to replace the old one. Should the purchase be made according to the following information?

- Machine's CCA rate is 30%
- The new machine costs $7,000, it has a useful life of three years and a salvage value of $600.
- The old machine, which originally costs $3,000, could be sold for $200 now and for $150 in three years.
- EBITDA *after tax* (i.e., EBITDA x (1-T_C)) will increase by $5,000 per year.
- The tax rate is 40% and the cost of capital is 20%.

Solution

- $\Delta\ FCF_0$ = -7,000+200= -6,800
- $\Delta\ FCF_1$ *(w/o depreciation tax shield)*=Δ EBITDA x $(1\text{-}T_C)_1$ = 5,000
- $\Delta\ FCF_2$ *(w/o depreciation tax shield)*=Δ EBITDA x $(1\text{-}T_C)_2$ = 5,000
- $\Delta\ FCF_3$ *(w/o dep. tax shield)*=Δ EBITDA x $(1\text{-}T_C)_3$ + Δ *Salvage Value*$_3$

  = 5,000 + (600-150) = 5,450
- .
$$PVDTS_{CCA} = \frac{(7000-200)\times 0.3\times 0.4}{0.2+0.3}\times\frac{1+\frac{0.2}{2}}{1+0.2} - \frac{(600-150)\times 0.3\times 0.4}{0.2+0.3}\times\frac{1}{(1+0.2)^3} = 1{,}433$$
- .
$$NPV = -6800 + \frac{5000}{1.2} + \frac{5000}{1.2^2} + \frac{5450}{1.2^3} + 1433 = \$5{,}426 \Rightarrow Take-the-project$$