Accounting and Finance

Class 5

Net Present Value and Investment Decisions

Class Outline

- **Topics**
  - 5.1) Net Present Value (NPV) Rule for Capital Budgeting
  - 5.2) Other Capital Budgeting Considerations
- **Readings**
  - Berk and DeMarzo: section 5.3, sections 7.1-7.4, and sections 8.1-8.4.
  - Case: none
- **Practice Problems**
  - Canvas: Graded Problem Set #2 (due at 11:59pm on March 25)
  - MyLab: Practice Problem Set #2 (not graded)
  - Download: Practice Problem Set #2 (not graded)

Section 5.1
Net Present Value (NPV) Rule for Capital Budgeting

What Is Capital Budgeting?

- *Capital budgeting* is a process used by companies for evaluating, ranking, and choosing amongst various potential investments.
- Examples of such investment decisions.
  - Purchasing a new machine.
  - Building a new factory.
  - Opening a new store.
  - Starting a new product line.
  - Starting a new company.
  - Buying another company.
- The techniques developed here can also be used to value an entire company (which can be viewed as a single large project).

Firm Value and Net Present Value

- You just inherited $12 million. You could invest it in a savings account paying 10% a year, or you could start your own firm.
  - The firm's only project would be to develop and sell a tPad, a transparent tablet.
  - The project requires an initial investment of $12 million.
  - It will generate cash flows of $5.5 million in year 1, and $12.1 million in year 2.

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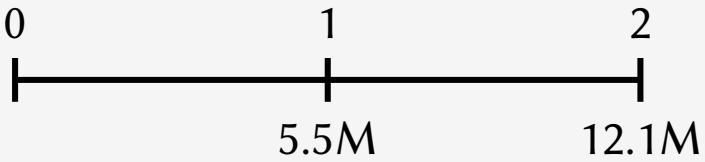
  - It will generate cash flows of $5.5 million in year 1, and $12.1 million in year 2.
- You decide to start the firm and invest in the project. As soon as you do, Google approaches you to buy your firm. What is the minimum you would sell it for?
  - Whether you sell or not, the initial investment has been made.
  - Thus, if Google buys the firm, it will receive the following cash flows (and you will be foregoing them).



  - To make you indifferent, Google would have to pay $PV = \frac{5.5M}{1.10} + \frac{12.1M}{(1.10)^2} = 15M$.

Firm Value and Net Present Value (cont'd)

- Notice that, by investing in the project, you increased the money that you have now by $3 million.
  - Before the project, your firm was worth $12 million (in cash).
  - After investing in the project, you can sell it for $15 million.

Firm Value and Net Present Value (cont'd)

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- This \$3 million is the net present value of the project:

$$NPV = -12M + \frac{5.5M}{1.10} + \frac{12.1M}{(1.10)^2} = 3M.$$

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  That is, the value of your firm went up by the project's NPV.
- This is always true.
  - $NPV > 0 \longrightarrow$ Firm value $\uparrow$ if project is undertaken.
  - $NPV < 0 \longrightarrow$ Firm value $\downarrow$ if project is undertaken.
- **Conclusion**: To maximize value, a firm should undertake a project if and only if its *NPV* is positive.

The Goal of the Firm and the Net Present Value Rule

- The goal of the firm should be to maximize its value.
  - Shareholders can use capital markets to choose portfolios that reflect their time preferences.
    - Old investors can sell their shares if the projects pay off in the long term.
    - Young investors can reinvest dividends if the projects pay off in the short term.
  - Thus, all shareholders agree on corporate policy: maximization of shareholder value makes all of them better off.
  - Importantly, this does not depend on the shareholders' preferences, e.g., whether they are retirees and need funds early or are saving for retirement and have a long horizon.

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  - Importantly, this does not depend on the shareholders' preferences, e.g., whether they are retirees and need funds early or are saving for retirement and have a long horizon.
- As seen on pages 5.5-5.6, a simple decision rule for the selection of projects will implement this objective: undertake all positive-NPV projects.
  - This is known as the *Net Present Value (NPV) rule*.
  - The simplicity of this decision rule allows managers to run firms without knowing the specific preferences of their (thousands of) investors.

The NPV Formula

- Managers act in the best interest of all shareholders by undertaking projects with positive NPV.
- For a one-period investment the NPV formula is

$$NPV = C_0 + \frac{C_1}{1+r}$$

where C_0 is the initial cash flow (which is generally negative), and
C_1 is the end-of-period cash flow (which is usually positive).

- The general formula for a T-period project is

$C_t < 0$: costs
$C_t > 0$: benefits

$$NPV = C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \cdots + \frac{C_T}{(1+r)^T} = \sum_{t=0}^{T} \frac{C_t}{(1+r)^t}$$

- In this module, we focus on how to find the cash flows, C_t.
(We will find the appropriate discount rate, r, later in the course)

Cash Flow Projections

- The cash flows (C_t) to be used in the NPV formula on page 5.8 measure the impact of the project on the firm's available cash.
  - If the project adds to the firm's cash in year t, then $C_t > 0$.
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- To estimate the project's cash flows, we proceed in two steps.
  1) Forecast Incremental Earnings
     - Forecast expected impact of project on firm's future income statements.
     - Incremental Earnings
       = Firm's Earnings With Project – Firm's Earnings Without Project.
     - What earnings do we use? See pages 5.10-5.12.

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       = Firm's Earnings With Project – Firm's Earnings Without Project.
     - What earnings do we use? See pages 5.10-5.12.
  2) Calculate Free Cash Flows from Earnings
     - Earnings are an accounting measure of the firm's performance; they do not represent actual cash flows.
     - To properly measure the project's cash flows, we must make some adjustments to earnings.

Quick Overview of the Income Statement

- The following table shows the income statement of Global Conglomerate Corporation for 2021 and 2022.

GLOBAL CONGLOMERATE CORPORATION

Income Statement
Year Ended December 31 (in $ million)

	2022	2021
Total sales	186.7	176.1
Cost of sales	(153.4)	(147.3)
Gross Profit	33.3	28.8
Selling, general, and administrative expenses	(13.5)	(13.0)
Research and development	(8.2)	(7.6)
Depreciation and amortization	(1.2)	(1.1)
Operating Income	10.4	7.1
Other income	—	—
Earnings Before Interest and Taxes (EBIT)	10.4	7.1
Interest income (expense)	(7.7)	(4.6)
Pretax Income	2.7	2.5
Taxes	(0.7)	(0.6)
Net Income	2.0	1.9
Earnings per share:	$0.556	$0.528
Diluted earnings per share:	$0.526	$0.500

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Debt Financing

Quick Overview of the Income Statement (cont'd)

- Let us denote the corporate tax rate by τ_c.
- *Unlevered Net Income* (*UNI*) is an accounting quantity that is useful for valuation purposes:

$$\text{Unlevered Net Income} = \text{EBIT} - \tau_c \times \text{EBIT} = \text{EBIT} \times (1 - \tau_c).$$

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  which subtracts the interest expense before accounting for taxes.
- In essence, the *Unlevered Net Income* is the *Net Income* that a firm without any debt financing would have.
- For Global Conglomerate, $\tau_c = 25\%$ and so we have
  - Unlevered Net Income $= 7.1 \times (1 - 0.25) = 5.3$ for 2021, and
  - Unlevered Net Income $= 10.4 \times (1 - 0.25) = 7.8$ for 2022.

Why Ignore the Debt Cash Flows?

- When valuing a firm or a project, we ignore the effect of debt on cash flows.
- Why?
  - We want to compute the value of the firm or project to all claimholders, independent of how the firm is financed.
  - Interest payments are payments to some of the claimholders that provided financing for the project; therefore, we do not want to subtract these payments.

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- Example.
  - Suppose that Apple requires $2 billion in order to design, create, and produce the next iPhone.
  - Question: Will Apple sell more/fewer iPhones if it borrows to finance this investment?
  - Answer: No, as the financing does not affect the demand for iPhones. Thus the value of the project is unaffected by financing.
- In the Corporate Finance course, we consider how debt can potentially affect the value of the firm.

Free Cash Flow

- In short, two steps to estimate C_t in the NPV formula.
  1) Estimate the project's impact on the firm's future Unlevered Net Income (UNI).
  2) To reach C_t, we must calculate how much cash physically flows into the firm and is available to investors.
     - This quantity is referred to as *Free Cash Flow* (FCF).
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- Adjustments to UNI to reach FCF.
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- We will see that a firm's Free Cash Flow (FCF) in any given year is

$$FCF = \overbrace{(\text{Revenues} - \text{Costs} - \text{Depreciation}) \times (1 - \tau_c)}^{\text{Unlevered Net Income (UNI)}} + \text{Depreciation} - \text{CapEx} - \Delta\text{NWC}$$

Coca-Cola's Energy Drink Project

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  - The project has a 5-year horizon.
  - It requires an initial cash investment of $5 million to acquire the equipment necessary to produce the new drink.

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  - The project has a 5-year horizon.
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- To estimate the cash flows from the project, Coca-Cola starts with a projection of the number of cans it anticipates selling (in 000's) and the price per unit.

	0	1	2	3	4	5
Units Sold	—	5,000	7,000	10,000	8,000	4,000
Avg. Price per Unit	—	1.60	1.60	1.75	1.75	1.75
Sales	—	8,000	11,200	17,500	14,000	7,000

Coca-Cola's Energy Drink Project

- In terms of costs, Coca-Cola makes the following estimates.
- The gross profit margin is estimated at 25%. In other words, it expects the cost of producing each can to be 75% of the price.
  - Example: The total cost of goods sold in year 1 is expected to be $8{,}000 \times 75\% = 6{,}000$.
  - Note that, in the Mary Washington Pediatrics case, they use

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- The operating expenses for marketing and support (listed as "Selling General, and Administrative") are estimated to be 6% of sales.
  - For example, this means that SG&A in year 1 is expected to be $8{,}000 \times 6\% = 480$.
  - Note that, in the Mary Washington Pediatrics case, they have two separate items for SG&A: Operating Expenses and Physician Salary.

Coca-Cola's Energy Drink Project (cont'd)

- The new equipment will be depreciated on a straight-line basis over 5 years (down to a book value of zero).
  - This means that the yearly depreciation expense will be $\frac{\$5{,}000}{5} = \$1{,}000$.
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- Capital expenditures vs. Depreciation.
  - Capital expenditures are the actual cash outflows when an asset is purchased.
  - Depreciation is a non-cash expense that matches the cost of an asset with its use over time.
  - In this case,
    - the *initial capital expenditure* is \$5,000 at time 0; outflow
    - the *annual depreciation expense* is \$1,000 at the end of years 1 through 5. not an outflow
  - Important: Coca-Cola pays \$5,000 at time 0, but the annual depreciation expense does not involve any cash outlay.

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- Finally, Coca-Cola's tax rate is 40% (including federal and state taxes), and its opportunity cost of capital (discount rate) is 10%.

Coca-Cola's Project: Unlevered Net Income

- From the information above, Coca-Cola estimates the following stream of Unlevered Net Income over the life of the project.

75% (8,000) =	0	1	2	3	4	5
Sales	—	8,000	11,200	17,500	14,000	7,000
Cost of Goods Sold	—	-6,000	-8,400	-13,125	-10,500	-5,250
Gross Profit	—	2,000	2,800	4,375	3,500	1,750
SG&A	—	-480	-672	-1,050	-840	-420
Depreciation	—	-1,000	-1,000	-1,000	-1,000	-1,000
EBIT	—	520	1,128	2,325	1,660	330
Taxes (@40%)	—	-208	-451	-930	-664	-132
Unlevered Net Income	—	312	677	1,395	996	198

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- These are *not* the project's free cash flows. We need to make some adjustments to UNI to obtain the free cash flows.
  - Depreciation is not a cash flow; we need to add it back.
  - Capital expenditures (and sales) have not been taken into account yet.
  - Changes in net working capital (to be estimated later) are cash flows, but they have not been accounted for yet.

Coca-Cola's Project: CapEx and Depreciation

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  - Solution: subtract from UNI.
    - For Coca-Cola's project, we simply need to subtract $5,000 from the UNI of zero at time 0.

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- Depreciation.
  - Accounting treatment of the capital expenditure that "spreads the cost" of an asset over its useful lifetime.
  - Problem: not a cash expense, but treated as such in UNI projections.
  - Solution: add to UNI (see next page).

Coca-Cola's Project: CapEx and Depreciation (cont'd)

- Using the table on page 5.17, let us summarize the cash that Coca-Cola receives and pays out in the project's first year.

	0	1	Cash In/Out
Sales	—	8,000	**Cash In**
Cost of Goods Sold	—	-6,000	**Cash Out**
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- Notice the following:
  - **Cash In** – **Cash Out** = 8,000 – 6,000 – 480 – 208 = 1,312.
  - **Unlevered Net Income** = 312.

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+1,000 = Depreciation

- Notice the following:
  - **Cash In** – **Cash Out** = 8,000 – 6,000 – 480 – 208 = 1,312.
  - **Unlevered Net Income** = 312.
  - Difference = 1,312 – 312 = 1,000, which is equal to Depreciation.
    - This is because Depreciation is treated like all the other cash expenses in UNI.
    - But it is not a cash expense, and so we need to add it back to UNI to get the right measure of Cash In – Cash Out.

Coca-Cola's Project: CapEx and Depreciation (cont'd)

- We cannot simply remove Depreciation from the table on page 5.17, as we will then misstate taxes.
  - Depreciation reduces taxable profits (i.e., EBIT) and taxes ⟶ must be included in operating expenses.
  - But it's not a cash expense ⟶ must be added back to UNI.

Coca-Cola's Project: Net Working Capital

- Net working capital represents the firm's net investment in short-term assets.

$$\begin{aligned}\text{Net Working Capital} &= \text{Current Assets} - \text{Current Liabilities} \\ &= \text{Cash} + \text{Receivables} + \text{Inventory} - \text{Payables}.\end{aligned}$$

- An increase in Net Working Capital (NWC) can be due to
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- An increase in Net Working Capital (NWC) can be due to
  - an increase in Cash, Receivables, or Inventory;
  - a decrease in Payables.
- Most projects require an investment in net working capital in the early stages/years.
  - The increase (also referred to as change) in net working capital in year t is defined as:

$$\Delta \text{NWC}_t = \text{NWC}_t - \text{NWC}_{t-1}.$$

Coca-Cola's Project: Net Working Capital

- Net working capital represents the firm's net investment in short-term assets.

$$\begin{aligned}\text{Net Working Capital} &= \text{Current Assets} - \text{Current Liabilities} \\ &= \text{Cash} + \text{Receivables} + \text{Inventory} - \text{Payables}.\end{aligned}$$

- An increase in Net Working Capital (NWC) can be due to
  - an increase in Cash, Receivables, or Inventory;
  - a decrease in Payables.
- Most projects require an investment in net working capital in the early stages/years.
  - The increase (also referred to as change) in net working capital in year t is defined as:

$$\Delta \text{NWC}_t = \text{NWC}_t - \text{NWC}_{t-1}.$$

  - An increase in the firm's NWC is effectively an extra cash outflow not properly accounted for in Unlevered Net Income.
  - Thus increases in NWC must be subtracted from UNI to measure the project's free cash flows.

Coca-Cola's Project: Inventory

- In the table on page 5.17, the COGS line represents the cost of the units that Coca-Cola expects to *sell* each year.
  - Companies often produce more than what they sell, and so accumulate an inventory from one year to the next.
  - Since the cost of building up this inventory is not reflected in UNI, we must subtract it.

From page 2.17:

	0	1
Sales	—	8,000
Cost of Goods Sold	—	-6,000
Gross Profit	—	2,000
SG&A	—	-480
Depreciation	—	-1,000
EBIT	—	520
Taxes (@40%)	—	-208
Unlevered Net Income	—	312

→ **Only cost of units sold.**
Misses units not sold (inventory increase).

Coca-Cola's Project: Inventory

- In the table on page 5.17, the COGS line represents the cost of the units that Coca-Cola expects to *sell* each year.
  - Companies often produce more than what they sell, and so accumulate an inventory from one year to the next.
  - Since the cost of building up this inventory is not reflected in UNI, we must subtract it.
- Suppose that Coca-Cola expects to keep its inventory at 3% of sales at all times.
  - Inventory will go up from 0 at time 0 to $3\% \times 8{,}000 = 240$ at the end of year 1.
  - This is an additional cost that must be subtracted from the UNI.

Coca-Cola's Project: Inventory

- In the table on page 5.17, the COGS line represents the cost of the units that Coca-Cola expects to *sell* each year.
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  - Inventory will go up from 0 at time 0 to $3\% \times 8{,}000 = 240$ at the end of year 1.
  - This is an additional cost that must be subtracted from the UNI.
- When Coca-Cola depletes its inventory (in later years), the opposite will happen.
  - Inventory goes down.
  - The net decrease must be added to UNI (as COGS then includes production costs that were incurred in previous years).

Coca-Cola's Project: Receivables

- Suppose that 15% of the sales in year 1 are on credit.
  - This means that Coca-Cola's receivables (for this project) will go up from zero at time 0 to 15% × 8,000 = 1,200 at time 1.
  - This also means that Coca-Cola received only 8,000 − 1,200 = 6,800 from customers in year 1.

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- Problem: The UNI estimated on page 5.17 assumes that the entire 8,000 was received as cash.

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  - This also means that Coca-Cola received only 8,000 – 1,200 = 6,800 from customers in year 1.
- Problem: The UNI estimated on page 5.17 assumes that the entire 8,000 was received as cash.

	0	1	In/Out	Actual Flow
Sales	—	8,000	**In**	**+6,800**
Cost of Goods Sold	—	-6,000	**Out**	**-6,000**
Gross Profit	—	2,000		
SG&A	—	-480	**Out**	**-480**
Depreciation	—	-1,000		
EBIT	—	520		
Taxes (@40%)	—	-208	**Out**	**-208**
Total	—	—	**1,312**	**112**

Coca-Cola's Project: Receivables (cont'd)

- Solution.
  - The difference of 1,312 – 112 = 1,200 is equal to the increase in Receivables.
  - We should subtract it from UNI to get the right measure of "Cash IN – Cash OUT."
- Could we have simply replaced 8,000 by 6,800 in the table on page 5.17?
  - No, as we would then have miscalculated the company's taxes (which are based on accounting sales, not cash sales).

Coca-Cola's Project: Payables

- Payables have a similar (but opposite) effect as Receivables.
- Suppose that 15% of the COGS in year 1 are on credit.
  - This means that Coca-Cola's payables (for this project) will go up from zero at time 0 to $15\% \times 6{,}000 = 900$.
  - This also means that Coca-Cola paid only $6{,}000 - 900 = 5{,}100$ to counterparties in year 1.

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- Problem: The UNI estimated on page 5.17 assumes that the entire 6,000 was paid in cash.

	0	1	In/Out	Actual Flow
Sales	—	8,000	**In**	**+8,000**
Cost of Goods Sold	—	-6,000	**Out**	**-5,100**
Gross Profit	—	2,000		
SG&A	—	-480	**Out**	**-480**
Depreciation	—	-1,000		
EBIT	—	520		
Taxes (@40%)	—	-208	**Out**	**-208**
Total	—	—	**1,312**	**2,212**

Coca-Cola's Project: Payables (cont'd)

- Solution.
  - The difference of 2,212 – 1,312 = 900 is equal to the increase in Payables.
  - We should add it to UNI to get the right measure of "Cash IN – Cash OUT."
- As in the case of Receivables, we couldn't have simply replaced 6,000 by 5,100 in the table on page 5.17.

Coca-Cola's Project: Cash

- The cash included in NWC is only the cash that is not invested to earn a market return. Only includes non-invested cash needed to run the business/project.
  - Cash held in the firm's checking account, in a company safe or cash box, and cash registers.
  - Cash set aside to quickly meet unexpected expenditures.

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  - Cash held in the firm's checking account, in a company safe or cash box, and cash registers.
  - Cash set aside to quickly meet unexpected expenditures.
- Intuition.
  - The cash that is set aside to run the project is not available to investors. It is not a free cash flow.
  - It must stay within the firm, and does not earn interest.
  - It becomes available to investors only when the project ends or is liquidated.

Coca-Cola's Project: Cash (cont'd)

- Suppose that Coca-Cola sets a minimum cash balance of 2% of sales in year 1, and that it will take the cash back from the project in year 5.
  - Although, the UNI in year 1 is 312, some of it (2% × 8,000 = 160), cannot be distributed to investors by Coca-Cola.
  - This is captured by the Cash account increasing by 160 in year 1.

- Thus, by subtracting Cash increases from UNI, we take both adjustments into account.
  - Year 1: Cash increase of 160 ⟶ subtract 160 from UNI.

Coca-Cola's Project: Cash (cont'd)

- Suppose that Coca-Cola sets a minimum cash balance of 2% of sales in year 1, and that it will take the cash back from the project in year 5.
  - Although, the UNI in year 1 is 312, some of it (2% × 8,000 = 160), cannot be distributed to investors by Coca-Cola.
  - This is captured by the Cash account increasing by 160 in year 1.
  - When Coca-Cola gets the cash back (from the project) in year 5, Cash decreases by 160 and this cash can be paid out to investors.
- Thus, by subtracting Cash increases from UNI, we take both adjustments into account.
  - Year 1: Cash increase of 160 $\longrightarrow$ subtract 160 from UNI.
  - Year 5: Cash increase of −160 $\longrightarrow$ subtract −160 from UNI.

Coca-Cola's Project: Cash (cont'd)

- Suppose that Coca-Cola sets a minimum cash balance of 2% of sales in year 1, and that it will take the cash back from the project in year 5.
  - Although, the UNI in year 1 is 312, some of it (2% × 8,000 = 160), cannot be distributed to investors by Coca-Cola.
  - This is captured by the Cash account increasing by 160 in year 1.
  - When Coca-Cola gets the cash back (from the project) in year 5, Cash decreases by 160 and this cash can be paid out to investors.
- Thus, by subtracting Cash increases from UNI, we take both adjustments into account.
  - Year 1: Cash increase of 160 $\longrightarrow$ subtract 160 from UNI.
  - Year 5: Cash increase of −160 $\longrightarrow$ subtract −160 from UNI.
- Question: Since the cash is eventually paid out, why do we care? That is, why don't we ignore cash since −160 + 160 = 0?
  - PV of increase in cash in year 1: $-\frac{160}{1.10} = -145.$
  - PV of decrease in cash in year 5: $+\frac{160}{(1.10)^5} = +99.$

  } Total = −46
  - In essence, the investors lose the interest on the cash tied to the project.

Coca-Cola's Project: Net Working Capital Projections

- We now have all the elements required to estimate Coca-Cola's NWC for the duration of the project.
- Summary of assumptions used for the projections.
  - Cash: 2% of Sales.
  - Receivables: 15% of Sales.
  - Inventory: 3% of Sales.
  - Payables: 15% of COGS.
  - Year 5: Assume that all four items go back to zero.

	0	1	2	3	4	5
Cash	—	160	224	350	280	0
Receivables	—	1,200	1,680	2,625	2,100	0
Inventory	—	240	336	525	420	0
Payables	—	-900	-1,260	-1,969	-1,575	0
Net Working Capital	—	700	980	1,531	1,225	0
Increase in NWC	—	700	280	551	-306	-1,225

- This last line must be subtracted from UNI.

= 1,531 – 980

= 980 – 700

Coca-Cola's Project: Free Cash Flows and NPV

- We can now estimate the project's Free Cash Flows.

	0	1	2	3	4	5
Sales	—	8,000	11,200	17,500	14,000	7,000
Cost of Goods Sold	—	-6,000	-8,400	-13,125	-10,500	-5,250
Gross Profit	—	2,000	2,800	4,375	3,500	1,750
SG&A	—	-480	-672	-1,050	-840	-420
Depreciation	—	-1,000	-1,000	-1,000	-1,000	-1,000
EBIT	—	520	1,128	2,325	1,660	330
Taxes (@40%)	—	-208	-451	-930	-664	-132
Unlevered Net Income	—	312	677	1,395	996	198

Coca-Cola's Project: Free Cash Flows and NPV

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Taxes (@40%)	—	-208	-451	-930	-664	-132
Unlevered Net Income	—	312	677	1,395	996	198
Plus: Depreciation	—	1,000	1,000	1,000	1,000	1,000
Less: Capital Expenditures	-5,000	—	—	—	—	—
Less: Increase in NWC	—	-700	-280	-551	306	1,225
Free Cash Flow	-5,000	612	1,397	1,844	2,302	2,423

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Plus: Depreciation	—	1,000	1,000	1,000	1,000	1,000
Less: Capital Expenditures	-5,000	—	—	—	—	—
Less: Increase in NWC	—	-700	-280	-551	306	1,225
Free Cash Flow	-5,000	612	1,397	1,844	2,302	2,423

- Finally, we can calculate the net present value (NPV) of the project:

$$NPV = -5{,}000 + \frac{612}{1.10} + \cdots + \frac{2{,}423}{(1.10)^5} = 1{,}173.$$

- Since the NPV is greater than zero, Coca-Cola should undertake the project.

Discounting Free Cash Flows Using Excel

- In Excel there are two ways to calculate the NPV of a project, once its Free Cash Flows have been estimated.
  1) Discount each cash flow by the appropriate number of years and use the SUM function.

- Here is what this looks like for Coca-Cola's project.

	A	B	C	D	E	F	G
1	**Discounting Free Cash Flows ($000s)**						
2		**0**	**1**	**2**	**3**	**4**	**5**
3	Free Cash Flow	(5,000)	612	1,397	1,844	2,302	2,423
4	Present Value (@ 10%)	(5,000)	556	1,154	1,385	1,572	1,504
5	**Net Present Value (using sum of DCFs)**	**1,173**	=SUM(B4:G4)				

Discounting Free Cash Flows Using Excel

- In Excel there are two ways to calculate the NPV of a project, once its Free Cash Flows have been estimated.
  1) Discount each cash flow by the appropriate number of years and use the SUM function.
  2) Use Excel's NPV(RATE, RANGE) function.
     - RANGE should *not* include the free cash flow at time 0.
     - The time-0 FCF should be added separately (it's usually negative).

- Here is what this looks like for Coca-Cola's project.

	A	B	C	D	E	F	G
1	**Discounting Free Cash Flows ($000s)**						
2		**0**	**1**	**2**	**3**	**4**	**5**
3	Free Cash Flow	(5,000)	612	1,397	1,844	2,302	2,423
4	Present Value (@ 10%)	(5,000)	556	1,154	1,385	1,572	1,504
5	**Net Present Value (using sum of DCFs)**	**1,173**	=SUM(B4:G4)				
6	**Net Present Value (using NPV function)**	**1,173**	=B3+NPV(10%,C3:G3)				

Calculating Free Cash Flow Directly

- To sum up, the firm's free cash flow in any given year is calculated as

$$FCF = \overbrace{(\text{Revenues} - \text{Costs} - \text{Depreciation}) \times (1 - \tau_c)}^{\text{Unlevered Net Income}} + \text{Depreciation} - \text{CapEx} - \Delta\text{NWC}$$

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- Notice that Depreciation appears twice in this expression.
  - 1st line: $-\text{Depreciation} \times (1 - \tau_c)$
  - 2nd line: $+\text{Depreciation}$
  - The sum is $\tau_c \times$ Depreciation, so we can rewrite FCF as

$$FCF = (\text{Revenues} - \text{Costs}) \times (1 - \tau_c) - \text{CapEx} - \Delta\text{NWC} + \tau_c \times \text{Depreciation}.$$

- This last term shows that the net effect of depreciation is to create a positive tax shield (usually referred to as the *depreciation tax shield*).

Section 5.2
Other Capital Budgeting Considerations

Tax Cuts and Jobs Act of 2017

- Starting in 2018, companies were allowed to fully deduct (i.e., expense) their investments in tangible assets in the year they are made, rather than have to depreciate them over time.
  - Equivalent to an extreme form of accelerated depreciation.
  - This provision is being phased out at 20% a year between 2023 and 2027.
- Given that depreciation has a positive effect on FCFs (see page 5.32), the Act increased the value of some projects.

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  - Equivalent to an extreme form of accelerated depreciation.
  - This provision is being phased out at 20% a year between 2023 and 2027.
- Given that depreciation has a positive effect on FCFs (see page 5.32), the Act increased the value of some projects.
- For the Coca-Cola project of the last section, this effectively means that the initial investment of $5 million in equipment is fully deductible from taxes in year 0.
  - See modified FCF calculations on page 5.35.
  - No need for depreciation.
  - Creates a negative tax in year 0 ⟶ See page 5.36 for reasoning.
  - Bottom line: increases project value by 1,657 – 1,173 = 484.

Tax Cuts and Jobs Act of 2017 (cont'd)

- The FCF spreadsheet from page 5.30 is modified as follows.

	0	1	2	3	4	5
Sales	—	8,000	11,200	17,500	14,000	7,000
Cost of Goods Sold	—	-6,000	-8,400	-13,125	-10,500	-5,250
Gross Profit	—	2,000	2,800	4,375	3,500	1,750
SG&A	—	-480	-672	-1,050	-840	-420
Capital Expenditures	**-5,000**	—	—	—	—	—
EBIT	-5,000	1,520	2,128	3,325	2,660	1,330
Taxes (@40%)	2,000	-608	-851	-1,330	-1,064	-532
Unlevered Net Income	-3,000	912	1,277	1,995	1,596	798
Plus: Depreciation	—	**0**	**0**	**0**	**0**	**0**
Less: Capital Expenditures	**0**	—	—	—	—	—
Less: Increase in NWC	—	-700	-280	-551	306	1,225
Free Cash Flow	-3,000	212	997	1,444	1,902	2,023

- The net present value (NPV) of the project is now

$$NPV = -3{,}000 + \frac{212}{1.10} + \cdots + \frac{2{,}023}{(1.10)^5} = 1{,}657 \text{ (vs. 1,173 on page 5.30).}$$

Tax Cuts and Jobs Act of 2017 (cont'd)

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Capital Expenditures	**-5,000**	—	—	—	—	—
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Unlevered Net Income	-3,000	912	1,277	1,995	1,596	798
Plus: Depreciation	—	**0**	**0**	**0**	**0**	**0**
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negative tax!

- The net present value (NPV) of the project is now

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Tax Cuts and Jobs Act of 2017 (cont'd)

- The tax for the project is negative in year 0.
  - Taken literally, this means that Coca-Cola receives $2 million from the IRS.
  - Of course, the IRS does not send money to companies that make losses.

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  - The negative profits simply serve to shield the profits from the company's other projects from taxes.
  - So, although the firm will not literally receive $2 million when the investment is made, the addition of this project will reduce its overall tax burden by $2 million.

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  - The negative profits simply serve to shield the profits from the company's other projects from taxes.
  - So, although the firm will not literally receive $2 million when the investment is made, the addition of this project will reduce its overall tax burden by $2 million.
- To see this, suppose that Coca-Cola expects to earn EBIT of $110 million from operations other than the new energy drink this year.
  - Note: To be exact, Coca-Cola's EBIT was $14.4 billion in 2023.

Tax Cuts and Jobs Act of 2017 (cont'd)

- Questions.
  - What does Coca-Cola owe in taxes without the new project?
  - What does it owe with the new project?

Tax Cuts and Jobs Act of 2017 (cont'd)

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  - What does Coca-Cola owe in taxes without the new project?
  - What does it owe with the new project?
- Solution.
  - Without the new project, Coca-Cola owe taxes in the amount of

$$\$110 \text{ million} \times 40\% = \$44 \text{ million}.$$

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  - With the new project, Coca-Cola's EBIT will be

$$\$110 \text{ million} - \$5 \text{ million} = \$105 \text{ million}.$$

    Thus it will owe taxes in the amount of

$$\$105 \text{ million} \times 40\% = \$42 \text{ million}.$$

Tax Cuts and Jobs Act of 2017 (cont'd)

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  - What does Coca-Cola owe in taxes without the new project?
  - What does it owe with the new project?
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$$\$110 \text{ million} - \$5 \text{ million} = \$105 \text{ million}.$$

    Thus it will owe taxes in the amount of

$$\$105 \text{ million} \times 40\% = \$42 \text{ million}.$$

  - Undertaking the new project reduces Coca-Cola' taxes by

$$\$44 \text{ million} - \$42 \text{ million} = \$2 \text{ million}.$$

- What happens if this is the company's only project or if its other projects are not profitable? We use loss carry-forwards ⟶ see Corporate Finance course.

Salvage Value

A good good example is airplanes (see www.airfleets.net)

- In the Coca-Cola example of the previous section, the equipment is fully depreciated and worthless at the end of 5 years.
- In many situations, firms resell their used equipment before it is fully depreciated.
  - The gain on such sales is taxed.
  - The after-tax cash flow from the asset sale must be added to the project's FCFs.

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  - The gain on such sales is taxed.
  - The after-tax cash flow from the asset sale must be added to the project's FCFs.
- Here is how this cash flow is calculated.
  - The gain on the sale is

$$\text{Gain on Sale} = \text{Sale Price} - \text{Book Value}$$

where the asset's book value is given by

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

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$$\text{Gain on Sale} = \text{Sale Price} - \text{Book Value}$$

where the asset's book value is given by

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

  - The cash flow to be added to the project's FCF is

$$\begin{aligned}\text{After-Tax CF from Asset Sale} &= \text{Sale Price} - \tau_c \times \text{Gain on Sale} \\ &= \text{Book Value} + (1 - \tau_c)(\text{Sale Price} - \text{Book Value})\end{aligned}$$

Salvage Value: Example

- Suppose the equipment that Coca-Cola purchases (for $5,000) actually has a useful life of 8 years, and that it will be depreciated straight-line over that time.
  - The annual depreciation expense is $\frac{\$5,000}{8} = \$625$.

Salvage Value: Example

- Suppose the equipment that Coca-Cola purchases (for $5,000) actually has a useful life of 8 years, and that it will be depreciated straight-line over that time.
  - The annual depreciation expense is $\frac{\$5{,}000}{8} = \$625$.
- The (new energy drink) project is still expected to last for only 5 years. At that time, the equipment's book value will be

$$\begin{aligned}(\text{Book Value})_5 &= \text{Purchase Price} - \text{Accumulated Depreciation} \\ &= 5{,}000 - 5 \times 625 = 1{,}875.\end{aligned}$$

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- Coca-Cola expects to resell the equipment for \$2,200 at that time.
  - The gain on the sale is

$$(\text{Gain on Sale})_5 = \text{Sale Price} - \text{Book Value} = 2{,}200 - 1{,}875 = 325.$$

  - The cash flow to be added in year 5 is

$$\begin{aligned}(\text{CF from Asset Sale})_5 &= \text{Sale Price} - \tau_c \times (\text{Gain on Sale})_5 \\ &= 2{,}200 - 40\% \times 325 = 2{,}070.\end{aligned}$$

Salvage Value: Example (cont'd)

- We can now adjust the project's FCFs (originally calculated on page 5.30).
- The asset sale is reflected in the Capital Expenditures line.

	0	1	2	3	4	5
Sales	—	8,000	11,200	17,500	14,000	7,000
Cost of Goods Sold	—	-6,000	-8,400	-13,125	-10,500	-5,250
Gross Profit	—	2,000	2,800	4,375	3,500	1,750
SG&A	—	-480	-672	-1,050	-840	-420
Depreciation	—	-625	-625	-625	-625	-625
EBIT	—	895	1,503	2,700	2,035	705
Taxes (@40%)	—	-358	-601	-1,080	-814	-282
Unlevered Net Income	—	537	902	1,620	1,221	423
Plus: Depreciation	—	625	625	625	625	625
Less: Capital Expenditures	-5,000	—	—	—	—	2,070
Less: Increase in NWC	—	-700	-280	-551	306	1,225
Free Cash Flow	-5,000	462	1,247	1,694	2,152	4,343
Net Present Value	1,890					

The Concept of Terminal Value

- Sometimes, the project is expected to last for a long time or even forever.
  - However, typically we have specific information about cash flow projections only for a few years.
- Solution.
  - Stop after a few years (usually 4 to 8 years), and assign a terminal value to the project at that time.
  - This value represents the market value of the free cash flows from the project at all subsequent dates.
  - For example, the terminal value at the end of year 5 represents the value at that date of all the cash flows in years 6, 7, 8, ...

Terminal Value: Example

- Let us go back to the Coca-Cola example of the previous section. Page 5.30 shows the projected free cash flows of the energy drink project.
  - It is unlikely that Coca-Cola would expect sales of a newly introduced drink to abruptly stop after five years.
  - At the same time, it is difficult for Coca-Cola to precisely estimate the demand for this product after five years.

Terminal Value: Example

- Let us go back to the Coca-Cola example of the previous section. Page 5.30 shows the projected free cash flows of the energy drink project.
  - It is unlikely that Coca-Cola would expect sales of a newly introduced drink to abruptly stop after five years.
  - At the same time, it is difficult for Coca-Cola to precisely estimate the demand for this product after five years.
- If the project goes past year 5,
  - Coca-Cola will not recover the Net Working Capital of the project in year 5, and
  - will instead calculate it the same way it was calculated for the first four years on page 5.29.

	0	1	2	3	4	5
Cash (2% × sales)	—	160	224	350	280	**140**
Receivables (15% × sales)	—	1,200	1,680	2,625	2,100	**1,050**
Inventory (3% × sales)	—	240	336	525	420	**210**
Payables (15% × COGS)	—	-900	-1,260	-1,969	-1,575	**-788**
Net Working Capital	—	700	980	1,531	1,225	**612**
Increase in NWC	—	700	280	551	-306	**-613**

Terminal Value: Example (cont'd)

- The project's Free Cash Flows for the first five years are then as follows.

	0	1	2	3	4	5
EBIT	—	520	1,128	2,325	1,660	330
Taxes (@40%)	—	-208	-451	-930	-664	-132
Unlevered Net Income	—	312	677	1,395	996	198
Plus: Depreciation	—	1,000	1,000	1,000	1,000	1,000
Less: Capital Expenditures	-5,000	—	—	—	—	—
Less: Increase in NWC	—	-700	-280	-551	306	**613**
Free Cash Flow	-5,000	612	1,397	1,844	2,302	**1,811**

Terminal Value: Example (cont'd)

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Less: Capital Expenditures	-5,000	—	—	—	—	—
Less: Increase in NWC	—	-700	-280	-551	306	**613**
Free Cash Flow	-5,000	612	1,397	1,844	2,302	**1,811**

- Let us assume that Coca-Cola expects the free cash flows of the project to increase at an annual rate of 1% after year 5.

	0	1	2	3	4	5	6	7	…
FCF	-5,000	612	1,397	1,844	2,302	1,811	$1{,}811 \times 1.01$	$1{,}811 \times (1.01)^2$	…

- What terminal value in year 5 captures the value of future free cash flows in year 6 and beyond? What is the NPV of the project?

Terminal Value: Example (cont'd)

- Since the future free cash flows beyond year 5 are expected to grow at 1% per year, they are a growing perpetuity.
  - The first cash flow (in year 6) is $FCF_6 = 1{,}811 \times 1.01 = 1{,}829$.

Terminal Value: Example (cont'd)

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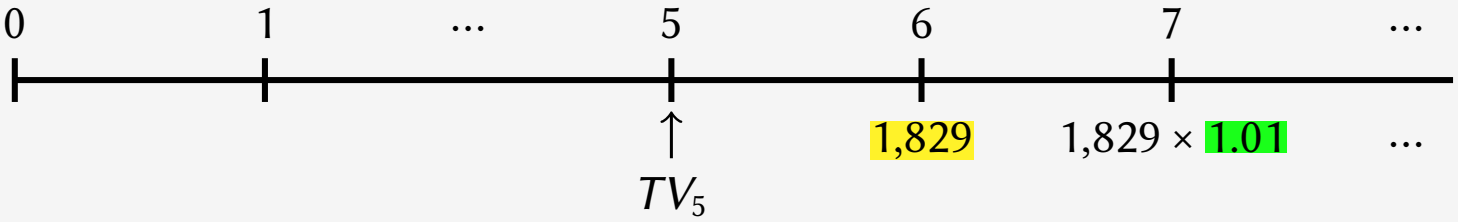
  - The first cash flow (in year 6) is $FCF_6 = 1{,}811 \times 1.01 = 1{,}829$. This leads to the following time line for the cash flows after year 5.



Terminal Value: Example (cont'd)

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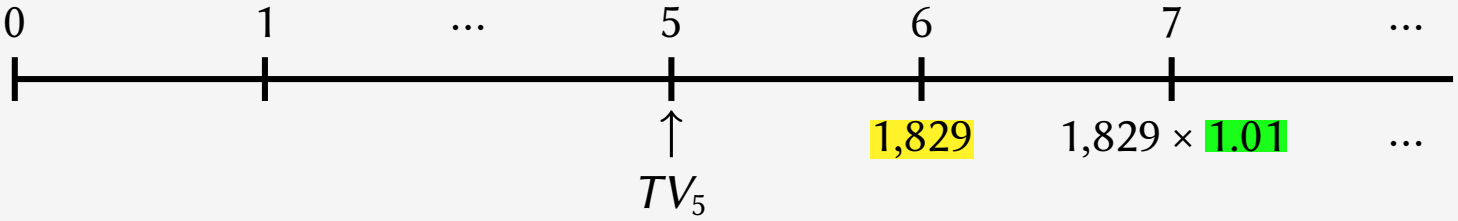

  - Using the growing perpetuity formula, the terminal value (at the end of year 5) is

$$TV_5 = \frac{FCF_6}{r - g} = \frac{1{,}829}{0.10 - 0.01} = 20{,}322.$$

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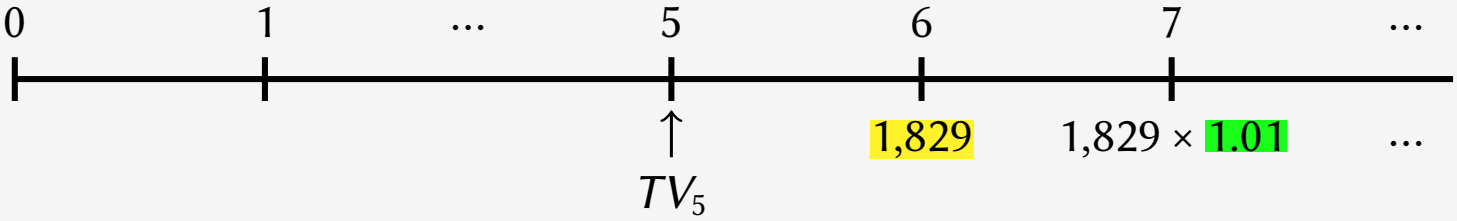

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$$TV_5 = \frac{FCF_6}{r - g} = \frac{1{,}829}{0.10 - 0.01} = 20{,}322.$$

- We can restate the project's free cash flows as follows.

	0	1	2	3	4	5
FCF (years 0-5)	-5,000	612	1,397	1,844	2,302	1,811
Terminal Value						20,322
Total FCF	-5,000	612	1,397	1,844	2,302	22,133

- The project's NPV (at 10%) is 13,411.

Net Present Value and Investment Decisions: Main Takeaways

- To evaluate investment decisions and value projects, we need to determine Free Cash Flows.
- To compute Free Cash Flows, Unlevered Net Income needs to be adjusted for Depreciation, Capital Expenditures, and changes in Net Working Capital.
- The NPV rule always leads to investment decisions which are in the shareholders' best interest.

Net Present Value and Investment Decisions: Formulas

- Net Present Value: $NPV = C_0 + \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$
- Unlevered Net Income: $UNI = \underbrace{(\text{Revenues} - \text{Costs} - \text{Depreciation})}_{EBIT} \times (1 - \tau_c)$
- Net Working Capital: $NWC = \text{Current Assets} - \text{Current Liabilities}$
  $= \text{Cash} + \text{Receivables} + \text{Inventory} - \text{Payables}$
- Free Cash Flow: $FCF = UNI + \text{Depreciation} - \text{CapEx} - \Delta NWC$
- After-Tax CF from Asset Sale: $\text{Sale Price} - \tau_c \times (\text{Sale Price} - \text{Book Value})$