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QUANTIFYING THE FUTURE

Bridging the Gap Between Capital Investment Valuations in the Public & Private Sectors

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Agenda

Contents

- Introduction
- What is Capital Investment Valuation?
- Capital Investment Culture
  - Public Sector Acquisition Management
  - Private Sector Business Development
- Capital Investment Valuation
  - Depreciation Tax Shields
  - Accelerated Depreciation
- Cost of Capital
- Nominal vs. Real Values for Discounting
- DCF Valuation
- Conclusion

Introduction

- B.S. in Finance from the University of Florida
- MBA in Corporate Finance from The University of Texas at Austin
- Over 17 years of Finance experience in capital investment valuation, forecasting & budgeting, cost estimation, benefits quantification, and business case development
- 6 years of Energy Finance experience in Investment Appraisal
- Developed discounted cash flow models for major Power Generation capital investments at ConocoPhillips
- Created buy vs. lease analyses for deep-water drilling rig projects
- Evaluated major capital investments/acquisitions in the Business Case Group of Investment Planning & Analysis at the FAA
- Project manager for 2 FAA programs in the PMO
- Project Management Institute (PMI) Project Management Professional (PMP)
- Currently lead investment analysis consultant teams developing costs, benefits, and business cases for FAA acquisitions

What is Capital Investment Valuation

- **Capital investment**[1] – money invested in a business venture with an expectation of income, and recovered through earnings generated by the business over several years. It is generally understood to be used for capital expenditure rather than for day-to-day operations (working capital) or other expenses.
- When companies evaluate capital investments, they often use a discounted cash flow (DCF) valuation approach, where the company calculates free cash flow (FCF) and discounts these cash flows by the company's cost of capital to calculate NPV and other valuation metrics.

[1] http://www.businesdictionary.com

Valuation Culture

Public Sector

- Purpose of Capital Investments
  - Value to the agency
  - Agency, industry, or infrastructure sustainment
  - Complying with government Executive or Congressional Order
  - Efficiency within Government
  - Reacting to a concern in the public's best interest (safety, security, hazard avoidance)
  - Strategic initiative

Private Sector

- Purpose of Capital Investments
  - A means of growth
- Organic Growth
  - Expand existing operations
  - Increase market share
  - Invest in new projects

Cultural Distinctions

Public Sector

- Government acquisition process well-defined and developed
- Longer investment decision process
  - Sunk costs by time of investment decision
- Review of Metrics
  - Different operational groups within the agency are tasked with developing new investment ideas, creating alternative solutions to infrastructure problems, and converting new technology programs into business cases
- Public Sector managers not rewarded with financial incentives
- Public sector program managers are not rewarded with financial incentives based on the outcome of their programs.

Private Sector

- Streamlined Investment Analysis process
- Emphasis on Return on Investment (ROI) to return cash flow to reinvest in future capital investments

Capital Investment Valuation

- Both public and private sectors devoted to development, analysis, and interpretation of business cases
- Not just financial analysts (economists)
  - Also includes lawyers, engineers, developers, project managers, accountants, and technical experts
- **Primary Metrics of Capital Investment Valuation**
  - **Net Present Value (NPV)**
    - Discounted cash flow value of project/business case
    - Value determined when NPV>0.
  - **Internal Rate of Return (IRR)**
    - Hurdle rate – minimum percentage return a company requires on investments; usually exceeds the company cost of capital
    - A project rate of return that can be compared to company's hurdle rate
    - Value determined when IRR > company hurdle rate
  - **Payback**
    - Number of years before business case pays back the original investment
  - **B/C Ratio**
  - Discounted benefits divided by discounted cost ratio to determine if project benefits exceed costs
  - Used in government.
  - Value determined when B/C>1.

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Taxes

Taxes – biggest distinction between public and private sector cost estimation and business case evaluation

- **Taxes in Public Sector Investments**
  - Little or no impact
  - Except where incurred by private sector customers or stakeholders
  - **Example** – Government acquisitions might require companies to purchase equipment in order to realize benefits from public sector capital investment. Tax implications to companies apply.
  - Tax implications to companies for (1) equipment invested and (2) incremental benefits realized.
- **Taxes in Private Sector Investments**
  - Impact capital investment free cash flow
  - Capital structure impacts taxes paid
    - Depreciation Tax Shields
    - Off-balance sheet financing
    - Project Finance
  - Taxes differ by company and/or by project
    - Project risk, location, financing structures, Accounting strategies

Taxes – Depreciation Tax Shields

- **Definitions**
  - **Depreciation**
    - Method of allocating cost of long-term asset over its useful life
    - Assumes asset value will decrease over time, during its use
  - **Depreciation Tax Shield**
    - Amount by which income tax payments are reduced by deducting depreciation from taxable income
- **Tax Shields in Public Sector Investments**
  - Taxes not applied in Public Sector
  - Only indirectly impact private sector customers or stakeholders
    - (1) Incremental Revenue, (2) Required capital (equipage)
- **Tax Shields in Private Sector Investments**
  - Capital expenditure (CAPEX) spent on investment treated as depreciable asset
  - Depreciation tax shield applies to investment and impacts project Free Cash Flow (FCF)
  - Depreciation "shields" project from a portion of incremental taxes it would ordinarily pay

Taxes – Depreciation Tax Shields

- How do depreciation tax shields work?
  - **Project Example 1 – Straight-Line Depreciation**
    - Revenue = $500,000
    - Costs = $200,000
    - CAPEX = $100,000 with 10-year straight-line depreciation
    - Tax rate = 35%
    - **Result = annual depreciation tax shield of $3,500 ($10,000 X 0.35)**
    - **Post-investment 5-year cash flow = $887,500**
  - **Project Example 2 – MACRS 10-Year Accelerated Depreciation**
    - Revenue = $500,000
    - Costs = $200,000
    - CAPEX = $100,000 with 10-year accelerated depreciation
    - Tax rate = 35%
    - **Result = depreciation tax shields** -> $3,500 in year 1, $6,300 in year 2, $5,040 in year 3, $4,032 in year 4, $3,227 in year 5
    - **Post-investment 5-year cash flow = $892,099**
  - **Using accelerated depreciation, Example 2 saves $4,599 more in taxes than Example 1 during the first 5 years.**

Tax Shields – Straight-line Depreciation

- Example 1 – Straight-line depreciation
- Tax shield = $3,500 per year ($10,000 X 35% tax rate)

Year	2016	2017	2018	2019	2020	2021	2022
Revenue			500,000	500,000	500,000	500,000	500,000
Variable Cost			(150,000)	(150,000)	(150,000)	(150,000)	(150,000)
Fixed Cost			(50,000)	(50,000)	(50,000)	(50,000)	(50,000)
Operating Gain			300,000	300,000	300,000	300,000	300,000
Depreciation Percentage			10.0%	10.0%	10.0%	10.0%	10.0%
Depreciation (Straight-Line, 10-yr)			(10,000)	(10,000)	(10,000)	(10,000)	(10,000)
Taxable Income			290,000	290,000	290,000	290,000	290,000
Cash Income Taxes (35%)			(101,500)	(101,500)	(101,500)	(101,500)	(101,500)
Change in Working Capital			(1,000)	(1,000)	(1,000)	(1,000)	(1,000)
Cash from Operations (CFO)			197,500	197,500	197,500	197,500	197,500
CAPEX ($100,000 over 2 yrs)	(50,000)	(50,000)					
Net Cash Flow (NCF)	(50,000)	(50,000)	197,500	197,500	197,500	197,500	197,500

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Tax Shields – Accelerated Depreciation

- Example 2 – MACRS 10-year Accelerated Depreciation
- Tax shield = $3,500 in year 1, $6,300 in year 2, $5,040 in year 3, $4,032 in year 4, $3,227 in year 5

Year	2016	2017	2018	2019	2020	2021	2022
Revenue			500,000	500,000	500,000	500,000	500,000
Variable Cost			(150,000)	(150,000)	(150,000)	(150,000)	(150,000)
Fixed Cost			(50,000)	(50,000)	(50,000)	(50,000)	(50,000)
Operating Gain			300,000	300,000	300,000	300,000	300,000
Depreciation Percentage			10.0%	18.0%	14.4%	11.5%	9.2%
Depreciation (MACRS 10-yr)			(10,000)	(18,000)	(14,400)	(11,520)	(9,220)
Taxable Income			290,000	282,000	285,600	288,480	290,780
Cash Income Taxes (35%)			(101,500)	(98,700)	(99,960)	(100,968)	(101,773)
Change in Working Capital			(1,000)	(1,000)	(1,000)	(1,000)	(1,000)
Cash from Operations (CFO)			197,500	200,300	199,040	198,032	197,227
CAPEX ($100,000 over 2 yrs)	(50,000)	(50,000)					
Net Cash Flow (NCF)	(50,000)	(50,000)	197,500	200,300	199,040	198,032	197,227

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Cost of Capital - WACC

- **Time Value of Money**
  - One dollar today is worth more than a dollar tomorrow.
  - **Purchasing Power –** A hamburger at a local restaurant should cost more next year than this year. Have greater purchasing power today than tomorrow. (Assumes inflation)
  - **Ability to invest** – Ability to invest and earn interest; the sooner invested, the better.
- **Opportunity Cost of Capital**
  - At what cost can a company raise capital?
  - This should be reflected as the discount rate for company's capital investments (assuming same capital structure for the project)
  - A public company can raise capital by (1) issuing debt or (2) issuing equity.

Cost of Capital - WACC

- **Weighted Average Cost of Capital (WACC)**
  - $WACC = \frac{E}{(D+E)}(r_{eL}) + \frac{D}{(D+E)}(1-t)(r_D)$
    - D = market value of debt
    - E = market value of equity
    - r_d = discount rate for debt (the average interest rate on long-term debt)
    - R_{eL} = discount rate for levered equity calculated using the Capital Asset Pricing Method (CAPM)
    - T = tax rate
  - WACC is used as discount rate for nominal dollar cash flows to calculate present value

Cost of Capital – Private Sector

- **WACC used as discount rate in private sector**
  - Most companies use WACC as discount rate for project nominal dollar cash flows to estimate present value (PV).
  - Calculate NPV to estimate project value
    - NPV > 0 indicates positive value
  - Calculate project Internal Rate of Return
    - Where IRR > hurdle rate (WACC), project has positive value to company
- **Private Sector Discount Rate**
  - WACC is determined by ability to raise equity and debt capital, company liquidity, and cash flow
  - Illiquid companies or companies with low debt rating have higher cost of capital and higher hurdle rate for investments
  - Unlike public sector, discount rate used for capital investments differs from company to company
- **Private Sector Options**
  - If company cost of capital is too high, or if company does not want capital investment on balance sheet, can use **"project finance"**
  - **Project Finance** - financing project capital by group of equity investors and lending institutions based on project's forecasted cash flows. Will have different cost of capital than sponsoring company.

Cost of Capital - Differences

- **Public Sector Discount Rate**
  - Public sector cost of capital is the Treasury Bill (T-bill), government's yield on short-term debt
  - Can either (1) issuing debt or (2) make a capital investment or government acquisition.
  - Last 30 years, T-bill rate has been very low.
  - Historically, public sector's cost of capital much lower than private sector.
- **Major Cost of Capital Distinctions between Public and Private Sectors**
  - Since public sector cost of capital is lower than private sector, government has ability to invest in low-yield projects for common good.
  - Public Sector considers value to multiple stakeholders (public, industry, and agency)
  - Public Sector has infrastructure responsibility and longer durations between upgrades
  - Private sector value is defined by cash flow to the company.
  - Private sector cost of capital varies widely by company based on risk, financing mix, and debt rating.
- **Cost of capital impacts investment behavior:**
  - The amount of risk a company is willing to take
  - Required return on investment
  - Ability to maintain budgets or increase cash flow
  - Types of investments – humanitarian or self-serving
  - Company financed or project financed

Discount Rate Terminology

- **Real Dollars**
  - Variables quantified in current year dollars are referred to as “Real Dollars.”
  - Government term is “base-year dollars,” BY$
  - Variable costs held constant over a time-series
- **Nominal Dollars**
  - When inflation is applied to variables and real rate is escalated each year by variable rate of inflation, classified as “Nominal Dollars”
  - In each subsequent year, variable value is higher than previous year.
  - Government term is “then-year dollars,” TY$
  - Cost of variable is actual cost in year it is attributed

Private Sector – Nominal Rate Discounting

- **Private Sector – Nominal Rate Discounting**
  - When developing Discounted Cash Flow (DCF) valuation models for capital investments, private sector applies "cost-specific" inflationary rates
    - Labor may have a different inflationary escalation than hardware
    - For energy company business case valuations, commodity prices (oil, natural gas, and power) will have their own inflationary forecast.
  - Use nominal rates in cash flow models
  - Discount nominal cash flows by the company WACC
  - Taking into account multiple factor inflation rates, nominal rates provide most accurate assessment of future project cash flows

Public Sector – Real Rate Discounting

- **Public Sector – Real Rate Discounting**
  - In capital investment analysis, government discounts "base-year dollars" or real dollars by the risk-free rate.
  - Excludes inflation in discounting benefits and costs
  - Without inflation, government discount rate is trivial
    - OMB uses approximately 2% discount rate for investments which only benefit the government
    - OMB uses 7% discount rate if investment claims any private sector benefits
- **Why Does Public Sector Use BY$ and Exclude Inflation?**
  - **Constant dollars** – Showing economic variables in "real dollars" allows analyst to show constant dollars across time series, i.e., $1,000 in 2016, $1,000 in 2017, $1,000 in 2018
  - **Easy to interpret** – When there is a real change in variable cost, it is more transparent, easier to audit, and easy to interpret for management
  - **Not complicated or subjective** – Using nominal rates requires a subjective interpretation of inflation applied to multiple variables.
    - Different investments might use different rates of inflation
    - Difficult to compare projects if different rates of inflation applied
    - Nominal discount rates vary more than real discount rates, so BY$ discounting has advantage in standardization

Impacts of Discount Rate Conventions

What Are the Drawbacks of Using Real Rates?

- Since real dollars exclude inflation, real rates do not account for variable rates of inflation
- BY$ or real dollar discounting is less accurate than nominal dollar discounting
  - Excludes inflation and discounts by a rate that excludes inflation
  - If different cost elements escalate at different rates of inflation, BY$ treats them all equally
  - Could underestimate costs or revenue
  - Decision-makers may misinterpret value
- Discount real rates can be a less accurate reflection of value.

What Are the Drawbacks of Using Nominal Rates?

- Less transparent for changes to cost assumptions
  - Cost assumption changes could be concealed by inflationary escalation
  - More challenging to audit
- Nominal rate discounting is more challenging for nonfinancial managers
  - Easier for managers to see constant costs for specific WBS elements over a time series
- Multiple escalation rates could be manipulated by category
  - Program managers could shift costs to WBS elements with a lower inflationary rate

Solution for Discount Rate Conventions

Potential Solution for Discounting

- In order to more accurately discount project benefits and costs in government, analysts could discount cost estimates in **both real and nominal dollar values**
- Could compare results to determine sensitivity of inflationary factors
  - Isolate cost drivers via sensitivity analysis
  - Tornado diagrams
- Can calculate metrics (NPV, B/C, IRR) using both real and nominal discount rates
- In cases where inflation varies widely by cost factor, nominal discounting is preferable

DCF – Cash Flow vs. Benefits to all

How Do the Public and Private Sectors Define Value?

Private Sector

- **Value** measured as incremental cash flow to the company
- Capital investments drive cash flow and organic corporate growth.
- **Value incentives** – profitability, competitive advantage, market share, return on investment (ROI), and payback period (cash returned to reinvest)
- **Capital Budget**
  - Corporate budget allocated by management
  - Partially funded by capital investment cash flow

Public Sector

- **Value** measured as (1) cost to the agency and (2) benefits to the public
  - Investments not measured by cash flow
  - Profit not required
- **Value incentives –** filling a societal need, meeting public interests, and fulfilling infrastructure needs
- **Capital budget**
  - Federal agency capital budget allocated by Congress; subject to annual reviews and funding reauthorization

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DCF – Value Drivers

	Value Drivers	
Benefits	**Public Sector** Public Needs and Interests Public Infrastructure Political interests Private Sector Efficiencies Government Strategic Interests	**Private Sector** Corporate Cash Flow Tax Shields Competitive Advantages Market Share
Costs	**Public Sector** Acquisition Costs Operations Budget funding allocations Risk-free rate (t-bills)	**Private Sector** Cost of Capital Taxes Dividends Funding debt

Management's understanding of value drivers and interests in the public and private sector is critical to make informed investment decisions.

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Valuation Metrics

Which Valuation Metrics Are Best for Capital Investments?

- Using the wrong metric or the exclusive reliance on one specific metric can lead to the wrong conclusion.
- Understanding how best to apply metrics in capital investment valuations helps executives and committees make better informed decisions:
  - Capital improvements
  - New opportunities
  - Government Acquisitions

Primary Metrics

- To better understand strengths and weaknesses of valuation metrics, will compare:
- **Private Sector** – NPV vs. IRR
- **Public Sector –** NPV vs. B/C Ratio

Private Sector – NPV vs. IRR

- **Net Present Value (NPV)**
  - Most common Finance metric and common between both public and private sectors
  - Calculated by discounting capital expenditures (CAPEX) and annual cash flows by the cost of capital

$$NPV = C_0 + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \cdots + \frac{C_T}{(1+r)^T}$$

  - C_0 is the initial capital outlay; C_1, C_2, C_3, etc. are annual cash flows, discounted by the cost of capital, r. T is the final year cash flow.
  - Capital investment determined to have value (in dollars) if NPV > 0
- **Internal Rate of Return (IRR)**
  - Discounted cash flow (DCF) rate of return calculated as the discount rate that makes NPV equal zero

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

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Advantages & Disadvantages of IRR

- **Advantages of IRR**
  - Effective measure of determining value where IRR > Hurdle Rate
  - Easier for nonfinancial managers to understand as expressed as percentage return
- **Disadvantages of IRR**
  - **Lending vs. Borrowing** – metric interpreted differently depending on lending or borrowing
  - **Multiple Rates of Return** – If cash flows alternate, more than one IRR can be calculated
  - **Mutually Exclusive Projects** – Project with the higher IRR might have a lower NPV. Higher NPV project should be chosen.
- **Conclusion**
  - Using IRR exclusively to determine investment value can be misleading and might result in wrong investment decision

Public Sector – NPV vs. B/C Ratio

- **B/C Ratio**
  - To simplify investment analysis metrics for decision-makers in public sector, government uses B/C ratio to compare relative value across capital investments.
  - Government investments (1) do not include taxes and (2) are not measured by cash flow.

$$\frac{B}{C}\ Ratio = \frac{PV(BY\$\ Benefits)}{PV(BY\$\ Costs)}$$

  - The B/C Ratio divides the present value of real or base year benefits by the present value of base year costs.
  - Like IRR, B/C ratio can be misleading when comparing mutually exclusive capital investments

B/C Ratio

- **Disadvantages of B/C Ratio**
  - When evaluating mutually exclusive capital investments, using B/C Ratio exclusively might result in a misinterpretation and a less valuable allocation of capital dollars.

Mutually Exclusive Investment Decisions using B/C and NPV

	PV (Cost)	PV (Benefits)	B/C	NPV
Project A	11,000,000	18,000,000	1.6	7,000,000
Project B	20,000,000	30,000,000	1.5	10,000,000
Project C	25,000,000	36,000,000	1.4	11,000,000

- **B/C Ratio Example**
  - Choice between 3 capital investments
  - Maximum constrained budget of $25M
  - If use B/C Ratio exclusively, would choose Project A
  - If analyze project with B/C Ratio and NPV, constrained budget choice is Project C with highest NPV within budget.

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Public Sector – Other Factors

- **Public Sector considers other factors besides economic value when evaluating investment decisions**
  - **Strategic Fit**
    - Is the project the best fit for the organization's goals?
  - **Infrastructure Modernization**
    - Is the investment required to modernize an aging infrastructure?
  - **Portfolio Value**
    - Does the investment enable value in other investments within a larger portfolio of programs?
  - **Obsolescence**
    - Is the investment replacing a current operational system that is difficult to replace or which is now obsolete?
  - **Other Program Interdependencies**
    - Does the investment have interdependencies with other programs within a larger portfolio or with a common initiative?

Conclusions

- Capital investments are transformative in the public sector and a primary source of growth in the private sector
  - Accurate and informed investment decisions and cost considerations are critical for future investments
  - Understanding other sectors' value and motives helps decision makers align objectives and incentives for successful public sector acquisitions
- Rules are put into place to facilitate understanding, transparency, and interpret risks of capital investments
- Valuation metrics held in isolation can lead to misleading valuation decisions
  - Best to consider multiple economic metrics when evaluation mutually exclusive acquisitions (NPV, IRR, B/C, payback)
- Awareness of public and private sector valuation methods helps managers make better investment decisions and understand consequences of decisions already made
  - Value Drivers (timing of cash flows, taxes, cost of capital)
  - Cultural influences
  - Stakeholders