Bridging the Gap between Capital Investment Valuation in the Private and the Public Sectors

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Abstract

The public and private sectors have different valuation techniques, motivations, and considerations when evaluating capital budgeting decisions. Understanding the difference between private and public sector capital investment analysis – discounted cash flow, cost/benefit considerations, tax impacts, stakeholders – helps decision-makers make better informed decisions. In the cost estimating community, understanding investment distinctions makes us better stewards of information and more effective Finance professionals.

1 Introduction

In Oklahoma 15 years ago when a major oil and gas company was evaluating power supply options for a refinery with an aging boiler system, the company considered organic legacy replacement, buying power off of the grid, or introducing some creative variation of cogeneration to the refinery where excess power could be resold to the power grid. The largest challenge was understanding the value proposition for not only the refinery but also the third parties who would be providing a service or building a cogeneration power plant. As the economist for that project, I developed multiple cost estimates and discounted cash flow (DCF) models in order to compare the value proposition for the energy company and refinery, accounting for commodity price risk, fuel prices, and the volatile price of electricity. I also interpreted the value proposition to vendors proposing a power generation option, and the lack of financial transparency (cost of capital, acquisition costs, tax structure) required an understanding of the industry, private sector stakeholders, and potential value drivers in order to calculate an accurate cost estimate.

Similarly, 10 years later, when evaluating major capital investments at the Federal Aviation Administration (FAA), I was challenged to understand the distinction between how value is measured in the federal government versus how it is measured in the private sector. For government acquisitions, value is measured to multiple stakeholders, in this case the flying public, airlines, and the FAA. Each stakeholder has specific interests, and measuring those value propositions is not as straight-forward or standardized as calculating sources of revenue and cash flow in the private sector. Financial analysts in the public sector must measure value to the common good, incremental efficiencies afforded to the private sector, and greater efficiencies or cost avoidance to the government. Still, outside of financial quantification, decision-makers must carefully consider strategic objectives, funding constraints, portfolio mix, and culture.

When evaluating major capital investments, the public and private sectors use distinctly different valuation techniques, are motivated by different value drivers, and consider a wide variety of interests and stakeholders. Understanding the primary distinctions between private and public sector capital investment analysis helps decision-makers make better informed decisions.

2 Culture

In the private sector, business development groups become the primary source of new capital investments. Companies grow organically by expanding existing operations, increasing market share, or by investing in new projects. Within business development, companies focused on organic growth invest capital for new ventures or projects within their existing area of expertise, and they evaluate those investments according to calculated or pre-determined hurdle rates. A company often asks, "Is this investment worth it?" That value proposition is determined by financial metrics, the company cost of capital, the potential revenue and cost of the project, and the strategic impact the project has on the company as a whole. Unforeseen cultural influences impact capital investment value and selection, and a greater understanding of these influences can help increase transparency and better align strategic goals.

The public sector makes capital investments for a variety of reasons, but, primarily, these investment decisions are the result of (1) adding new value to the agency, the general public, and/or industry, (2) complying with a government Executive or Congressional Order, (3) sustaining agency, industry, or government existing infrastructure, (4) creating an efficiency within the government that does not exist today, or (5) reacting to a concern in the public's best interest (safety, security, hazard avoidance, providing a public good, alleviating a public burden, etc.).

A closer look within the motivations and cultural influences that define public and private sector capital investments reveals large distinctions between the two groups. Some of these distinctions manifest as hurdles in investment analysis. Others provide insight into the primary recipients of capital investment value. Better awareness of the motivations and investment decision influences within both the public and private sector would allow managers to adjust policies to make better investment decisions with limited capital budgets. Similarly, insight into the corporate business development culture can help executives better align strategic objectives with new portfolios of capital investments.

Understanding these nuances between capital investment culture within the public and private sector allows individual investors and the Finance community to properly evaluate the different investment projects, manage expectations, anticipate project cost, and plan for the challenges they are likely to encounter.

2.1 Cultural Influence within Public Sector Acquisition Management

Within the government, capital investments progress through an intricate and well-defined acquisition regulations and process with multiple checks and balances related to the program engineering and system design, requirements development, shortfall quantification, and cost and benefits quantification in order to justify the investment. Specific research and development, systems engineering, and 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. At some point during the process, these creative organizations hand-off the capital investment business case to a Program Management Organization, which shepherds the business case through the

investment analysis process and through program implementation. Once this transition is made, the agency focus shifts from idea generation to program execution.

Program managers assume the responsibility of navigating the acquisition process with program performance tied to successful investment decisions. Within the government, the program manager focuses on achieving investment process goals, demonstrating leadership of acquisition management and implementation teams, and achieving a favorable investment decision within a predetermined time-frame.

Unlike the private sector, public sector program managers are not rewarded with financial incentives based on the outcome of their programs. Public sector program managers are motivated by more philanthropic rewards. The public sector serves the public good, and business case benefits in the government are measured less by benefits to the sponsor agency and more in how beneficial they are to the government as a whole, private industry, and to the taxpaying public.

Additionally, cost-benefit valuation is not the exclusive means by which public sector capital investments are evaluated. Critical infrastructure programs in the government are often funded to fill a public need, whether or not its financial benefit outweighs required costs. In this way, program managers are less burdened with profitability and near term project return and, instead, can focus on supporting necessary investments regardless of gross margin.

2.2 Cultural Influence within Private Industry Business Development

In the private sector, business developers assume the equivalent responsibilities of public sector program managers, except they also originate new investment prospects, analyze a portfolio of new prospective programs with a team of engineers and economists, and select the most valuable capital investment prospects to proceed through investment analysis and to be implemented.

Companies, in turn, reward creativity, new ideas, and risk. Business Developers are rewarded for bringing forward valuable capital investment ideas and are not penalized for taking risks or coming up with several ideas that are likely to fail or not be approved. Finding the most incrementally valuable investments and providing the company with a competitive advantage requires determination, creativity and a broad reach, and, most likely, produces several investment ideas that are not valuable enough to bring forward. However, the most successful companies do not punish developers for a few poor investment ideas if they end up investing in a few very valuable capital investments. By finding and identifying the most valuable capital investment options, companies can get the greatest yields from constrained capital budgets, while tabling or discarding less valuable options.

In private industry, the developers' careers are tied to the value their selected capital investment ideas add to the company. They are never encouraged to bring forward an investment idea that does not add strategic, cost-effective, positive Net Present Value (NPV) value.

Large corporations usually have specialized operations teams which help lead capital investment implementation and which lead to continued revenue production. In the private sector, business developers and their teams lead capital investments from conception through investment analysis in a streamlined process, consistent with their peers.

2.3 A Comparison of the Capital Investment Process

For a variety of reasons, the investment analysis duration and process differs dramatically in the public and private sectors. Capital investments in the private sector originate out of a business development department and become a feedstock for future cash flow. Because of a dependency on short-term return on investment to sustain cash flow and with a limited timeframe to invest in projects, the private sector depends on a streamlined investment analysis process. Projects funded this year may need to start producing revenue within a few years to sustain future capital investments. In a competitive landscape, capital investment opportunities are not exclusive to one company, and out of concern of competition, the private sector must act quickly to realize short-term gains from current investments.

Just because the process duration is expedited in private industry does not mean the quality and thoroughness of the investment analysis is compromised. In order to manage the compressed workload, companies often develop cross-functional teams of developers, engineers, economists, accountants, treasury, lawyers, and regional experts. This team approach is especially present in the Energy Industry, where developers and economists are responsible for evaluating dozens of potential capital investments in oil, natural gas, and power in order to narrowly focus on a few highly profitable and strategically aligned business cases.

In the public sector, capital investments are evaluated over a two to three-year period. In the government, the acquisition process is formalized, includes many checks and balances throughout agencies, includes legal concerns centered around competitive bids from the private sector, and, in the federal government, is ultimately accountable to Congress. In addition, a disproportionate number of capital investments in the federal government are large acquisitions ranging from over $10MM to more than $2B. As a result of these additional complexities and reporting structures, government acquisitions require extensive due diligence and longer lead times.

Due to the private sector's dependency on cash flow and return on investment, corporate capital investments are usually evaluated and awarded within 12 to 18 months from concept development. In a competitive landscape, where companies which delay investment decisions might concede opportunities to industry competitors or peers, the investment turnaround process is critical to corporate success. While a longer process is critical for large and complex government acquisitions where program managers are responsible for accurate cost estimates and have a fiduciary responsibility to the taxpaying public, private sector investments are focused more on cash flow and shareholder return. Extending the investment analysis process in the private sector could come at the expense of project NPV and negatively impact the project cost of capital. Therefore, companies deploy the most efficient and streamlined processes to make investment decisions while still providing a comprehensive, valuation process.

Understanding the investment process and cultural distinctions between public and private sector is critical for stakeholders, sponsor organizations, and management to make prudent decisions based on investment type.

3 Valuation

Both the public and private sectors devote extensive resources to the development, analysis, and interpretation of business cases for capital investments. The participants in this process come from multiple functional disciplines including: financial analysts, lawyers, engineers, developers, project managers, accountants, and a variety of technical experts.

These capital investments are the foundation for new business, business development prospects, organic growth, market share, infrastructure development, and the continued sustainment of operations. In the Federal Aviation Administration (FAA), capital investments are used to replace the aging National Airspace (NAS) infrastructure, provide new efficiencies in the control of air traffic, improve data communications and analyses, develop a more efficient flow of traffic for airlines (earlier departures, fewer delays and cancellations, increased number of operations), and provide a more seamless experience for the flying public with fewer delays and shorter wait times. Without this infusion of capital, the public sector would have to maintain current aging systems and make only slow incremental improvements.

In the private sector, capital investments provide opportunity for growth, new business ventures, and increased market share. Companies research new investment opportunities, develop those opportunities for implementation, and evaluate those opportunities to determine which ones provide the greatest return, the best strategic fit, and the quickest payoff. Without the luxury of a government funding allocation, the private sector values capital investments in terms of free cash flow. Companies evaluate investments using standard discounted cash flow (DCF) valuation metrics including Net Present Value (NPV), Internal Rate of Return (IRR), and Payback. Each metric provides a different perspective on the investment return, from pure discounted cash flow value (NPV), a rate of return that can be compared to the company's hurdle rate (IRR), or the number of years before the business case pays back the investment (Payback).

The public sector has adopted these same financial metrics to evaluate capital investments, but there are major business case valuation distinctions between the two sectors, especially in consideration for taxes, cost of capital, discount rates, DCF methodology, and stakeholders.

3.1 Taxes

One of the major distinctions between public and private sector cost estimation and business case evaluation is the impact of taxes on capital investments. In the public sector, taxes have little to no impact, except where they are incurred by private sector customers or stakeholders. If a public sector investment requires the private sector to invest in equipment, the company purchasing that equipment to enjoy the benefit from the government investment will have to pay taxes on that equipment and depreciate the asset. Similarly, companies receiving incremental benefits from a government investment will pay taxes on the incremental revenue provided from this investment at their normal tax rate. These tax implications must be considered by the private sector, but public sector awareness of these impacts will allow decision-makers in the government to increase the odds of stakeholder endorsement of government sponsored capital investments.

In the private sector, taxes not only impact project value (NPV, IRR), but they play a strategic role in capital investments in the form of depreciation tax shields, off-balance-sheet financing, and project finance. Just as the tax rates companies pay differ from country to country, effective tax rates applied to capital investments differ based on project location, financing structures, and accounting strategies. Some of these accounting strategies are explored in sections 3.1.1 and 3.1.2, and an understanding of these techniques and motivations assist both private and public sector managers in making better investment decisions.

3.1.1 Depreciation Tax Shields

In the public sector, taxes play a minimal role in investment decisions. For federal government capital investments, taxes are not applied, and, therefore, analysts and accountants do not have to explore ways to minimize the impact of taxes on these investments. Indirectly, government capital investments can include tax impacts. Private sector companies, which receive incremental revenue as a result of government investments, will have to pay taxes on that incremental revenue. Additionally, if a company is required to purchase hardware, equipment, or some other type of asset in order to realize the benefits of a government investment, those purchases will be taxed as well, and the incremental revenue to the company based on this investment will be impacted by the accounting depreciation rules applied.

For private sector capital investments, taxes play a more integral role on investment value, impacting project NPV and IRR. When the capital expenditure (CAPEX) that the company spends on the investment is treated as a depreciable asset, a depreciation tax shield applies to the investment and impacts project free cash flow (FCF). Depreciation is a method of allocating the cost of a long-term asset over its useful life, and it assumes that the asset value will decrease over time, during its use. How fast that asset depreciates or how quickly the company can depreciate the asset depends on the asset type, the definition of its useful life, and other accounting rules.

In a simple example of depreciation, an asset costing $100,000, depreciated over 10 years would incur an annual depreciation value of $10,000. At the end of the first year, the remaining book value, asset value remaining on the balance sheet, would be $90,000.

Other than generating an expense, CAPEX depreciation derives value from reducing the program's taxable income. When a company depreciates asset value of a capital investment, the depreciation reduces the tax basis upon which the project is taxed.

After calculating revenue and costs, the company calculates the depreciation impact on taxable income. In our previous example, if annual project revenues are $500,000, and costs are $200,000, assuming the 10-year straight-line depreciation of the $100,000 in CAPEX, the taxable income is reduced from $300,000 in the first year to $290,000. The analyst then calculates taxes on the $290,000 instead of $300,000. Assuming a 35% tax rate, due to the project depreciation applied, the investment is "shielded" from $3,500 in taxes ($10,000 X 0.35). This is the project's **depreciation tax shield**.

The depreciation tax shield is defined as the amount by which income tax payments are reduced by deducting depreciation from taxable income. Accountants can influence capital investment value and free cash flow by the depreciation basis they use for the specific investment or asset.

Figure 1: Depreciation Tax Shield Impact on Net Cash Flow using Straight Line Depreciation*

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenue			500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Variable Cost			(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)
Fixed Cost			(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)
Operating Gain			300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Depreciation Percentage			10.0%	10.0%	10.0%	10.0%	10.0%	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)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)
Taxable Income			290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000
Cash Income Taxes (35%)			(101,500)	(101,500)	(101,500)	(101,500)	(101,500)	(101,500)	(101,500)	(101,500)	(101,500)	(101,500)
Change in Working Capital			(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)
Cash from Operations (CFO)			197,500	197,500	197,500	197,500	197,500	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	197,500	197,500	197,500	197,500	197,500

*Example in Real Dollars (Excludes inflationary impacts)

In Figure 1, the depreciation reduces annual taxable income by $10,000 and shields the capital investment from $3,500 in taxes each year, increasing the value of the business case.

3.1.2 Accelerated Depreciation

The application of accelerated depreciation in corporate capital investments is one of the most common accounting techniques for maximizing investment value. Utilizing and interpreting existing asset depreciation rules, accountants can use accelerated depreciation tables to calculate depreciation, reduce taxable income in early years, and increase early year net cash flow. If the rate of the depreciation is left at the discretion of the accountant, finding the right match between depreciation and cash flow helps drive investment value.

If a company applies accelerated depreciation tables to a capital investment, the project benefits from larger tax shields in earlier years than in later years. Realizing these tax shields earlier in the project lifecycle allows business cases to realize larger annual cash flows in early years, while deferring tax impacts to later years. Applying the time value of money, and assuming inflationary conditions, cash today is worth more than cash in future years, so deferring tax impacts to future years using accelerated depreciation adds to project value. When an investment is discounted by its cost of capital, out year cash flows are discounted at a higher compound rate and are, subsequently, worth less than near-term year cash flows. Therefore, using accelerated depreciation to maximize value in near-term year cash flows, maximizes investment value.

The cost estimator or financial analyst must consider the anticipated project cash flows in order to find the right match between depreciation tax shields and cash flow. If the depreciation tax shield exceeds taxable income, the tax shield will go underutilized. In this case, spreading the tax shield over more years will afford the capital investment value in future cash flows when taxable income is higher. Finding the right mix between cash flow and depreciation can help companies increase investment value and preserve limited capital budgets for future investments.

In Figure 2, an accelerated cash flow schedule is applied to the business case in Figure 1. As a result, the project increases near term cash flows. When inflation is applied and when the project cash flows are discounted by the cost of capital, the Net Present Value in Figure 2 will exceed that in Figure 1.

Figure 2: Depreciation Tax Shield Impact on Cash Flow using Accelerated Depreciation (MACRS 10-yr)*

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Revenue			500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	
Variable Cost			(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	
Fixed Cost			(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	
Operating Gain			300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	
Depreciation Percentage			10.0%	18.0%	14.4%	11.5%	9.2%	7.4%	6.6%	6.6%	6.6%	6.6%	3.3%
Depreciation (MACRS 10-yr)			(10,000)	(18,000)	(14,400)	(11,520)	(9,220)	(7,370)	(6,550)	(6,550)	(6,560)	(6,550)	(3,280)
Taxable Income			290,000	282,000	285,600	288,480	290,780	292,630	293,450	293,450	293,440	293,450	(3,280)
Cash Income Taxes (35%)			(101,500)	(98,700)	(99,960)	(100,968)	(101,773)	(102,421)	(102,708)	(102,708)	(102,704)	(102,708)	1,148
Change in Working Capital			(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	
Cash from Operations (CFO)			197,500	200,300	199,040	198,032	197,227	196,580	196,293	196,293	196,296	196,293	1,148
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	196,580	196,293	196,293	196,296	196,293	1,148

*Example in Real Dollars (Excludes inflationary impacts)

When compared to the example in Figure 1, the Figure 2 example decreases taxable income in the first several years and increases cash flow. Over the first five years, post-investment (2016-2022) net cash flow is higher using the accelerated depreciation in Figure 2 by $4,599, $892,099 compared to $887,500. If the cash flows in these examples were escalated by inflation and discounted by the cost of capital, the second example in Figure 2 with accelerated depreciation would have a higher NPV.

For financial analysts and decision-makers in the public and private sectors, understanding the impact of taxes and the depreciation tax shield on capital investments allows for more accurate budget forecasts and better investment decisions.

3.2 Cost of Capital

In the classroom, professors teach the first major concept of Finance, the time value of money, where one dollar today is said to be more than one dollar tomorrow or one year from now. The concept is simple. Assuming our country or the world is experiencing inflation, the same dollar you have today will have less purchasing power by the end of the year. A hamburger at your neighborhood bistro will cost more next year than it does today.

Accordingly, when a company forecasts future cash flows, the financial analyst (or economist) forecasts an increase in cost for the same goods or services each subsequent year. Inflation is applied to "real dollars" to be defined as "nominal dollars," and to get the *present value*, or today's value, of the goods or services, these costs are discounted by the company's or the project's cost of capital. What is the cost of capital? It is the opportunity cost of the company for investing the same funds (for this capital investment) in something else, and for major corporations with both debt and equity, the cost of capital is a combination of the cost to raise money or invest in equity and debt with the current mix of assets. In Finance, this is also referred to as the Weighted Average Cost of Capital (WACC):

Formula 1: The Weighted Average Cost of Capital

$$WACC = \frac{E}{(D+E)}(r_{eL}) + \frac{D}{(D+E)}(1-t)(r_D)$$

The WACC is based on the company's cost of raising debt capital (D), the cost of the company to raise equity capital (E), and the corporate mix between these two capital sources, (D/V) and (E/V), respectively. In Formula 1 above, D = the market value of debt, E = the market value of equity, r_d = the discount rate for debt (the average interest rate on long-term debt), r_{el} = the discount rate for (levered) equity calculated using the Capital Asset Pricing Method (CAPM), and t = the tax rate.

For most major corporations, the WACC is used as discount rate for nominal dollar cash flows (see Section 3.3) to calculate the present value of a project's cash flows. When a corporate analyst calculates Net Present Value (NPV), this defines the project's incremental value to the company. When companies calculate a project's Internal Rate of Return (IRR), this rate is compared to the company's WACC. In this case, the WACC is the company's hurdle rate. For example, if a project's IRR is 15%, and the companies hurdle rate is 12%, the project is assumed to have value (15%>12% = incremental value). There are other considerations for the project, including a limited capital budget, mutually exclusive project investments, strategic impact, and portfolio fit, but from a pure Finance point of view an IRR greater than the hurdle rate is interpreted as a good investment.

Since private sector investments are measured or discounted by the company's WACC, the investment decision is measured in part by the company's debt, its ability to raise equity capital and debt capital, its liquidity, and cash flow. Companies who have difficulty raising capital or who have a low debt rating may have a higher cost of capital and, hence, a higher hurdle rate for capital investments. In this way, in the private sector, capital investment NPV is determined not only by the intrinsic value of the investment opportunity, but also by the company's ability to finance the investment.

Most large public companies discount their capital investments by their company cost of capital, but they can alternatively finance a capital investment with a group of equity investors (sponsors) and a group of lending institutions based upon the project's forecasted cash flows. This is referred to as "project finance," and it alleviates the financing burden from the sponsor company. A project-financed investment will have a separate cost of capital other than the sponsoring company's cost of capital.

The public sector's cost of capital is essentially the Treasury Bill rate or the government's yield on short-term debt. This is the government's cost to do business. It can either (1) issue debt or (2) make a capital investment or government acquisition. Typically, and for most of the last 30 years, the Treasury Bill rate has been very low, and, correspondingly, the government's cost of capital is very low. This means that the public sector's cost of capital is almost always lower than the private sector, and it can invest in lower-yield projects. The way that the public sector calculates value or "benefits" is different than the private sector as well (see Section 3.4.1). The government considers capital investment value to many different stakeholders as project benefits, unlike the private sector, which measures benefits in terms of free cash flow to the company.

The primary difference between the public and private sectors' cost of capital is that companies, depending on their risk, financing mix, and debt rating will have a widely varying cost of capital, which will impact their ability to finance projects. The government, on the other hand, has the bare minimum hurdle rate for investments; its cost of capital is often referred to as the "risk-free rate." As company,

investor, financial analyst, or cost estimator, it is important to understand the differences between public and private sector cost of capital and the factors that may impact a project's hurdle rate, value, and opportunity for success. While the cost of capital is just one of many factors that determine capital investment value, understanding the distinctions will further help decision makers identify the best sponsoring organization for a specific investment – corporate financed, project financed, or government funded.

3.3 Nominal Versus Real Values for Discounting

3.3.1 Private Sector DCF – Nominal Rate Discounting

When developing a Discounted Cash Flow (DCF) valuation model for capital investments in the private sector, companies apply cost-specific inflationary rates across all variables. For labor, the analyst may apply market inflation. For software development, the financial analyst may apply an additional factor depending on market demand for those services. For energy companies, whose revenue is dependent upon a forecast of commodity prices, the companies will apply a proprietary commodity price forecast, which may significantly exceed or trail the standard inflation index.

When variables are quantified in current year dollars, they are referred to as "Real Dollars." In this case, variable costs are held constant over a time series. If the cost of an oil rig drilling bit were $50,000 in 2016, applying the real rate means that the same bit would be $50,000 in 2017, 2018, etc. until the end of the business case. The public sector refers to this rate as "base-year dollars" (BY$). When inflation is applied to these variables, where the real rate is escalated each year by the variable rate of inflation, it is classified as "Nominal Dollars," in which case each subsequent year is higher in value than the previous year. The public sector refers to this as "then-year dollars" (TY$) because, when calculated with a nominal escalation rate, the cost of the variable for each year represents the true cost in that year.

In private sector DCF models, once cash flows are estimated in nominal dollars, the time series is discounted by the company's or project's Weighted Average Cost of Capital (WACC) [see section 3.2] in order to be expressed in Present Value (PV).

This method of discounting nominal cash flows by the cost of capital is standard convention for DCF models in industry, and it takes into account distinct inflationary escalation rates for multiple variables before discounting. Assuming these forecasted escalation rates hold true within one or two standard deviations, nominal rates provide the most accurate assessment of future project costs.

3.3.2 Public Sector – Real Rate Discounting – Economics Using Real Dollars (discounting BY$) and Budgeting in Nominal Dollars (Forecasting cost in TY$)

In order to simplify cost estimates during investment analysis for major capital investments in the public sector, government agencies discount "base-year dollars" or real dollars by the risk-free rate without inflation. Without inflation, the current government discount rate is trivial. The current federal government guidance for discount rates in the next several years is less than 2% or 7%, depending on whether or not the public sector investment includes private sector benefits.

What is the public sector's motivation to discount real dollars and to exclude inflation? Expressing economic model variables in terms of "real dollars" allows the cost analyst to show constant dollars across the time series, i.e. $1,000 in 2016, $1,000 in 2017, $1,000 in 2018, etc., which is easy to audit and transparent for agency executives reviewing the business case. However, eliminating the inflation-component from the multiple cost variables erases the impact of different rates of inflation on different model variables.

As stated above, commodities likely escalate at a different rate than government labor, and software development costs escalate at a different rate of inflation than hardware. By discounting cost variables in base-year dollars, the multiple-factor inflation rates are not calculated. Essentially, the public sector trades off inflationary accuracy for simplicity and transparency.

The consequence of this public sector discounting convention is the potential for large government acquisitions to understate the impact of variable risk in independent cost estimates and for decision-makers to misinterpret program value. Fortunately, the public sector applies "then-year dollars" to budget forecasts, incorporating a standard labor rate escalation factor and escalating all other variables by inflation.

Analysts evaluating public sector acquisitions should keep in mind the drawbacks of real rate discounting. By discounting only in BY$, multiple-factor inflation is not applied, escalation assumptions are oversimplified, nominal commodity prices are not captured, and discount rates are applied risk-free. Even if the government's cost of capital is essentially the risk-free rate, ignoring the impact of inflation for economic analysis exposes the government to program risk, a potential misinterpretation of program value, and potential cost overruns.

The government is unique in its use of BY$ (real) discounting. It is actually less accurate to exclude inflation and discount cash flows by a discount rate which also excludes inflation. If different cost elements escalate at different rates of inflation, BY$ treats them all equally. That could understate costs or revenue.

In order to mitigate the potential value interpretation risk from base year discounting, financial analysts developing independent cost estimates for government capital investments could discount costs and benefits in both real dollar values and nominal dollar values and compare the results. In some cases, this exercise will reveal escalation sensitivities of certain cost variables that could drive investment value.

3.4 Discount Cash Flow (DCF) Valuation

3.4.1 Cash Flow versus Benefits to All

How the public and private sectors calculate value is dependent on how they define value within the organization and in their valuation models.

Private sector companies measure value as incremental cash flow to the company with special consideration for how that cash flow impacts net income and shareholder value. They consider tax implications on cash flow, annual capital funding budgets, retained earnings, budgets for research and development, corporate leverage, and debt funding capacity. Where continued cash flow drives

shareholder value, market share, and funding obligations, capital investments are a critical component of corporate value and company growth. A company's continued existence hinges on its ability to identify and capitalize on new growth opportunities, to adapt to changing market conditions, and to evaluate and make prudent investment decisions.

In the public sector, the taxpayers fund and elected officials control government spending, and associated capital investment funding must be spent with those interests in mind. Public sector investments have a specific role in society and for the agencies they maintain. Unlike the private sector, the government is not concerned about profit, except where fees and taxes are used to subsidize future investments. Capital investments are not measured in cash flow; instead, they are measured according to cost to the agency and benefits to the public, for efficiencies in the private sector, and to sustain government infrastructure.

Where capital investments lack profitability, competitive advantage, or payoff, the government makes investments which would go unmet in the private sector. Instead of concerns about shareholder value or debt repayment, the government is concerned about filling a need to society and meeting the needs and interests of the public.

Financial evaluation of capital investments in the public sector are, therefore, complicated when consideration must be made for strategic or political reasons. As a result, it is not uncommon for the public sector to fund investments with little or no investment value. To complicate matters more in the federal government, capital planning can change dramatically year-to-year depending upon funding allocations from Congress. Even more than their private sector counterparts, government agencies must employ flexible capital budgets and develop project contingency plans in anticipation of changes to funding allocations.

As illustrated by Figure 3, distinctions between the public and private sectors value are clear, and managers' understanding of those value drivers and interests are critical to make the right investment decisions.

Figure 3: Public and Private Sector 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

3.4.2 Valuation Metrics (NPV versus IRR & B/C versus NPV)

When the public and private sectors consider capital investment decisions, the type of valuation metric and the exclusive reliance on one specific metric can have unintended consequences. Understanding how each of these valuation metrics work for companies investing in capital improvements, new investment opportunities, or for government agencies investing billions of dollars in major acquisitions will help executives and committees make better investment decisions and make the most use of limited capital.

3.4.2.1 Net Present Value (NPV) versus Internal Rate of Return (IRR)

In the private sector, Net Present Value (NPV) and the Internal Rate of Return (IRR) are the two most popular metrics used to value capital investments. Both metrics are effective measurements used to decide whether or not to invest in the project. However, since each has its strengths and weaknesses, Finance managers usually consider both metrics when evaluating investments.

NPV is calculated by discounting the capital expenditures (CAPEX) and annual cash flows by the cost of capital. In Formula 2 below, C_0 is the initial capital outlay, and C_1, C_2, C_3, etc. are annual cash flows, discounted by the cost of capital, r, the opportunity cost of the company to raise funds for the investment. In the formula, T is the final year cash flow.

Formula 2: Net Present Value

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

NPV measures a capital investment in dollars as having value if the NPV is greater than zero. Using NPV, the larger the total dollar amount, the larger the value proposition. Where companies have a limited budget for capital investments, the initial investment cost or cash outlay is critical in evaluating the investment. Constrained capital budgets are common in both the government and in the private sector. Many companies and government agencies consider NPV as a critical measure in evaluating capital investment projects. However, IRR is even more commonly used, and when it is considered exclusively to evaluate projects, managers might misinterpret relative value.

The Internal Rate of Return (IRR), the discounted cash flow (DCF) rate of return, is calculated as the discount rate that makes NPV equal zero. The equation is similar to NPV, but the IRR becomes the discount rate in the denominator of each cash flow.

Formula 3: Internal Rate of Return

$$NPV = C_0 + \frac{C_1}{(1+IRR)} + \frac{C_2}{(1+IRR)^2} + \frac{C_3}{(1+IRR)^3} + \cdots + \frac{C_T}{(1+IRR)^T} = 0$$

The IRR can be just as effective a measure in evaluating capital investments as NPV, and it is easier for non-financial managers to understand as it is expressed as a percentage return, i.e., 33% IRR. However, without proper considerations, IRR used exclusively can be misleading.

According to Brealey and Myers in *Principles of Corporate Finance*[1], IRR as a measure of value has four major pitfalls including the following:

1) **Lending versus Borrowing** – Considering whether or not cash flows indicate the project is lending or borrowing money, value would be interpreted differently, where the investor wants to borrow at the lowest rate of return and lend at the highest rate of return. If different cash flows represent lending and borrowing, IRR can mean opposite things, investment value as high or investment value as low.

2) **Multiple Rates of Return** – If cash flows alternate, more than once, i.e., negative cash outlay, followed by positive annual cash flows, then more than one IRR can be calculated. Depending on where IRR is calculated, there would be more than one rate where NPV = 0.

3) **Mutually Exclusive Projects** – If a company or government agency has to choose between alternative ways to do a project, those alternatives are mutually exclusive. In other words, you choose one option or the other, not both. When comparing between mutually exclusive investments, sometimes where two projects have favorable IRRs (higher than the company cost of capital), the project with the higher IRR might have the lower NPV. If the company or agency chooses the higher IRR in the case of a lower NPV, it could be giving up value and choosing the wrong investment alternative.

4) **Term Structure of Interest Rates** – In situations where a company or project has several opportunity costs, the Finance manager has "to compute a complex weighted average" of IRRs to have an accurate relative measure.

Both private sector companies and federal agencies use IRR as a measure of value for capital investments, and sometimes to interpret investment values to senior management or to non-financial managers, IRR is used exclusively to interpret value. As demonstrated in the list above from *Brealey and Myers*, IRR used exclusively to interpret investment value can be misleading and might result in the wrong investment decision.

The easiest solution to this value proposition dilemma is to measure IRR alongside NPV and to provide greater investment decision weight to NPV.

3.4.2.2 B/C Ratio versus NPV

In order to simplify investment analysis metrics for decision-makers in the public sector, the government derived an intuitive acquisition metric that can be applied across capital investment programs in order to compare relative value. Since the government is more interested in return on investment, and since that return is (1) void of tax implications and (2) not measured in terms of cash flow, the metric on which the public sector most relies is the B/C Ratio.

[1] Principles of Corporate Finance, Brealey and Myers, 4th Edition, McGraw-Hill Higher Education

Formula 4: B/C Ratio

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

Like the Internal Rate of Return (IRR), which measures relative value, in this case the project percentage return when Net Present Value (NPV) equals zero, the B/C Ratio determines relative program return by comparing benefits and costs directly. To calculate the B/C ratio, the analyst divides the present value of *real* or *base-year* benefits by the present value of *base-year* costs. Any B/C value greater than one is considered a good investment. Any project B/C value less than one cannot justify program costs by its return.

Just like IRR, the B/C ratio has its drawbacks. Sometimes when government budgets are tight, capital investment budgets are frozen at prior year levels or constrained where the agency must choose to fund some programs over others. Program managers recalculate the impact of a funding delay or the capital constraint on their investments, and often these impacts are measured in terms of the B/C ratio.

When considering mutually exclusive capital investments, where a government agency is unable to fund all of the investments in its portfolio and must choose between them, using the B/C ratio as an exclusive measure of value might result in a misinterpretation and a less valuable allocation of capital dollars. In Figure 4 below, the example demonstrates how a public sector investment committee might choose to allocate a constrained capital budget between mutually exclusive projects to a less valuable investment if the B/C is the only Finance metric considered in the investment decision.

Figure 4: 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

In Figure 4, we assume that an agency has a choice between three capital investments with a maximum budget of $25M. With this constrained budget scenario, how would the B/C ratio influence an agency's investment decision?

In this example between mutually exclusive investment decisions, if the public sector investment committee uses the B/C Ratio exclusively to decide which project to fund, they would likely choose to invest in Project A. However, Project A has the lowest NPV. Choosing Project A would leave $14M of capital unutilized and would yield the least investment value between the three choices. If the investment committee compared the three investments using both the B/C ratio and NPV as investment criteria, they would realize that in this case, the project with the lowest B/C ratio yields the highest NPV and provides the largest capital return, or "benefit" in the case of the government, for the constrained capital budget.

With or without budget constraints, the public sector considers other factors besides economic value when evaluating investment decisions. For the government, a B/C ratio less than one does not

automatically disqualify the economic investment. Instead, the program value must be justified by one of several other intangible, qualitative, or strategic factors including the following:

- **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?

For private sector investments, companies conducting DCF valuations for major capital investments can make better investment decisions when balancing the IRR valuation metric with NPV and other objective measures of value. An overreliance on one valuation metric can lead to unintended investment decisions.

For the public sector, while the B/C ratio is convenient and easy for non-financial managers to understand, using B/C exclusively to decide between investment decisions in times of constrained government budgets can result in underutilized capital budgets and unintentionally choosing a project with lower total benefits.

4 Risk

When evaluating major capital investments, both the public and private sectors pay special attention to risk. Not only are companies and agencies concerned about the project management risks associated with implementation, but when conducting investment analysis, risks to cost, benefits, and cash flow take precedence. Management champions any valuation method that allows them to minimize or mitigate these risks, and both the public and private sectors continue to developed processes to ensure accuracy and to minimize surprises.

When evaluating cost and benefits estimates in business cases, the public sector applies risk range conditions when calculating valuation metrics. Instead of a point estimate or Monte Carlo Simulation risk-adjusted estimate for costs and benefits, using triangular distributions for critical cost and benefit variables, the government applies the most conservative Monte Carlo risk ranges, the 80th percentile of costs and the 20th percentile of benefits. By applying these conservative values, assuming that the business case has a sound basis of estimate, the government assures a high probability of not exceeding

the 80th percentile cost estimate and a low probability of achieving fewer benefits than what was quantified at the 20th percentile.

This is a risk-adjustment approach developed to reassure government acquisition officials that the business case will deliver the value that it proposes. It essentially takes a pessimistic view versus the base case valuation of the capital investment and lowers the bar of performance in the rare event where a business case will realize a higher cost as well as lower benefits. Despite this approach, public sector business cases still breach baselines and have cost overruns, but this is partly attributable to the complexity and scope of major federal government acquisitions and the proprietary nature of the business cases.

For public sector acquisitions, program managers navigate a large and sometimes tedious investment analysis process necessary to identify and manage investment risks and to maintain budget baselines. The private sector does not institute such an extensive investment analysis process when evaluating capital investments. While each business case is provided a thorough litmus test and valuation, investment decisions are usually proposed in a flatter organization structure where decision-makers closely follow business development proposals. New business case proposals are more often compared to a portfolio or peer group of business cases and evaluated against pre-defined hurdle rates. In that way, capital investments in the private sector are more likely to be discarded or shelved for more promising, lower-risk high-return investments before extensive resources are deployed.

In both the public and private sectors, risks are identified, documented, and evaluated from a qualitative and quantitative perspective. They account for quantitative risk by running risk ranges for primary variables through risk-analysis software and run thousands of iterations of Monte Carlo simulations to arrive at a risk-adjusted value.

Both the public and private sectors evaluate business case risk, but they account for these risks in different ways. While private sector business case analysis is often more flexible and streamlined, the public sector applies conservative value conventions that reduce the probability of a program coming in over-cost and with less intrinsic value.

5 Conclusion

In companies and government agencies alike, rules and processes are put into place to facilitate an understanding, add transparency, and interpret risks of major capital investments. Unfortunately, there is no single rule or process that can prevent financial pitfalls or eliminate risk in valuing investments. For the financial analyst, having an awareness of the public and private sector valuation methods, sources of value, cultural influences, and stakeholders can help managers make better investment decisions and understand the consequences of the decisions that they make.

While IRR is easy for nonfinancial managers to understand and can be used to compare the relative return of investments of any size or complexity, in cases when capital is constrained and companies must choose between mutually exclusive investments, IRR can be misleading without adding other metrics for context. Since the government investment hurdle rate is minimal and program benefits all-

encompassing, the B/C Ratio is the metric of choice for some government agencies in evaluating acquisitions. Without the addition of NPV, evaluations using the B/C ratio exclusively may lead to the wrong conclusions and investment choices.

In the private sector, taxes, cost of capital, inflation, and discount rates all play a large role in calculating investment value, while in the federal government these factors are standardized and serve a much more limited role in investment analysis. Stakeholders, budget funding decisions, and process continuity play a larger role in public sector investment success. Understanding these distinctions and adjusting investment value to fit the context of public or private sector origination will improve investment success and management decision-making, helping to avoid crucial mistakes in such a critical source of organizational growth and sustainment.

6 References

[1] Principles of Corporate Finance, Brealey and Myers, 4th Edition, McGraw-Hill Higher Education