Analyzing Project Feasibility Through Financial Mathematics

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"Never make predictions, especially about the future . . it hasn't happened yet." *(Casey Stengel)*

Abstract

Companies regularly engage in large-scale capital projects to achieve growth and increase shareholder value. These projects can include, among other examples: internal growth through the development of new facilities, acquisition of other companies, and major R&D projects. As part of the process of researching and planning, a company will engage in complex calculations of the financial feasibility of its proposed project. Steps in this process include: (a) computing the Weighted Average Cost of Capital (WACC) for the company; (b) generating extensive statistical data on the incremental sales and costs of the prospective project over a multi-year term, including variable and allocated fixed-costs; (c) calculating the incremental net revenues accruing from the project over a multi-year term; (d) conducting a Net Present Value (NPV) analysis of this stream of incremental revenues, discounted at the WACC; and (e) using this NPV to determine the financial feasibility of the project.

This is a financial analysis based on data collection, statistical analysis, calculation of revenues and costs, present-value computation, and the calculation of WACC. Most important, it is a probabilistic calculation. Since future revenues and costs cannot be ascertained beyond a certain reasonable level of probability, those uncertainties need to be reflected in the financial feasibility analysis, by using different assumptions of revenues and costs, and estimating their probability.

This process of financial feasibility will be described using a biopharma company ("Bio") as an example. Bio was engaged in developing a new cancer-treatment drug. Given the significant cost of developing this drug, Bio needed to determine for itself, and for its investors, the likely Net Present Value of this investment, under different assumptions. All of these variables were expressed under several different scenarios of probabilities.

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1. Project Overview and Context

One of the core imperatives for any company is to maintain a continuous level of growth. This growth provides a return for investors, additional jobs, increased market presence, and continued technological leadership. It can be argued that in the current climate of no-growth and climate-change environmentalism, a focus on growth may be unethical and not sustainable (Rawoth, 2017; Halliday & Thrasher, 2020). But the reality is that companies are under unrelenting shareholder pressure to grow, maximizing shareholder value, and will continue to do so (Slee, 2011).

Companies can grow organically, through gradual incremental growth in existing sales. However, another pathway for a company to grow, and more rapidly, is to engage in a large-scale capital project. These projects are usually marked by a major investment, including new R&D, acquisition of another company, development of a new facility, or entry into a new market. These large-scale projects usually necessitate additional investment, sometimes from the existing retained earnings of the company, but more commonly through the injection of new investor outside capital, in the form of debt or equity.

To raise this outside capital, and to facilitate internal decision-making on moving forward with the project, companies engage in a rigorous process of computing the financial feasibility of the proposed project, including data gathering, statistical analysis, and financial analysis. This paper discusses that process in the context of a case study of a biopharma company ("Bio"). Bio was considering the feasibility of developing a new drug intended for cancer treatment. The costs of drug development are very large. The potential for substantial profits, or the potential for expensive failure, necessitated a detailed analysis of the project's financial feasibility.

2. Definition of Debt and Equity

Let us digress for a moment to discuss 'capital structure', which is defined as the total mix of debt and equity instruments on any company's balance sheet (Erhardt & Bingham, 2020). All firms have a capital structure, even if it is no more complicated than the owner's stock and a

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small bank loan. All capital is categorized as one of two types – debt or equity - both which come in a number of different forms and structures. All other forms of capital (including debentures, convertibles, and derivatives) are variations of these two types.

Equity is ownership; any form of equity means that the equity owner is a shareholder in the company, however small a percentage.   Dividends may be paid to equity owners, but are not required, and when paid, are not tax deductions for the company but are taxable first at the corporate level, and then taxable for the individual shareholder.

Debt does not convey ownership. It is a contractual obligation between the company and the lender, no matter what the form of the debt.   Principal and interest payments must be paid, by contract, and failure to pay will eventually result in default and foreclosure of any assets that secure the debt.   Interest payments are deductible from the company's taxable income, which means that the tax code favors debt over equity.

Imagine a balance sheet.   Everything on the left side is essentially what the company owns – its assets. The right side of the balance shows how the company paid for the left side, through a combination of debt and equity – this is the capital structure.

Privately held companies (and in the U.S., over 95% of all companies are privately held) (Slee, 2011) usually prefer debt over equity, despite the cost, since issuing additional equity means that the original owners' stake in the company is reduced ('diluted').

3. Research Design

The feasibility of a large capital project can be defined along several dimensions, including a marketing study and an engineering analysis.   But the heart of a feasibility study is financial feasibility, answering the question:

Will the proposed project generate sufficient new net revenues for the company to justify the cost of the project, including the cost of the capital needed to fund the project?

This is a multi-step process:

(1) Calculating the company's weighted average cost of capital (WACC).

(2) Generating statistical data on projected incremental additional sales and costs attributable to the project, based on probabilistic assumptions.

(3) Creating a cashflow proforma over a 3-5 year time frame, using these incremental additional sales and costs for each year.

(4) Computing the Net Present Value of this cashflow, using the WACC as the discount factor.

(5) Based on this analysis, determining the financial feasibility of the proposed project as information for decision-making.

This is the process that Bio undertook in evaluating the feasibility of investing considerable capital, mostly outside investor capital, to pursue the process of drug development.

4. Steps Involved in Analysis

(1) Computation of WACC

Weighted Average Cost of Capital (WACC) is defined as ". . . the average of a firm's equity and after-tax cost of capital, weighted by the fraction of the firm's enterprise value that corresponds to the equity and debt, respectively" (Berk & DeMarzo, 2011, p. 484) (see also Collier, 2012). In other words, WACC is the average cost a company expects to pay to finance its assets and operations, combining all types of capital, weighted proportionately to their percentage of the total capital structure.

The formula for computing WACC is: $\mathrm{WACC}=(VE\times Re)+(VD\times Rd\times(1-Tc))$

E=Market value of the firm’s equity

D=Market value of the firm’s debt

V=*E*+*D*

Re=Cost of equity

Rd=Cost of debt

Tc=Corporate tax rate

Some additional considerations:

- The WACC is a calculation of a firm's cost of capital in which each category of capital is proportionately weighted as its percentage of the total capital structure.
- All sources of capital, including common stock, preferred stock, bonds, leases, short-term notes, lines of credit, and senior bank debt, are included in a WACC calculation.
- WACC is calculated by multiplying the cost of each capital source (debt and equity) by its relevant weight by market value, and then adding the products together to determine the total.
- The cost of equity can be found using the capital asset pricing model (CAPM), or the level of dividends that the company (or similar companies) historically pays investors (assuming it pays dividends at all, which many companies do not).
- The cost of all debt components is calculated by taking the nominal interest rate of each debt component and multiplied it by (1-tax rate), to reflect the fact that interest payments are deductible from net taxable revenues.

(2) Significance of WACC

The WACC is a significant calculation for two reasons. First, it is the responsibility of a Chief Financial Officer (CFO) to create a capital structure for the company that achieves the lowest feasible net cost. This means a capital structure that contains the optimum mix of debt (in different forms) and equity (in different forms) that has the least cost, to contribute towards maximizing shareholder value.

The second reason, as discussed in more detail below, is that WACC becomes the discount rate used in computing the Net Present Value of a proposed project's cashflow proforma. In essence, it is important that the proposed project achieves a greater return than the capital it cost to undertake the project. The WACC becomes the hurdle rate for the project to exceed, indicating that the WACC must be less than the company's Return on Invested Capital (ROIC), defined as the company's efficiency at allocating the capital under its control towards profitable investments. The formula for calculating ROIC is Net Operating Profit after Tax (NOPAT) divided by Invested Capital (Collier, 2012).

Generally, the lower the WACC the better; a project that is feasible at a hurdle rate (WACC) of 6% may not be feasible at a rate of 8% due to the deeper discounting of the future cashflow at the higher discount rate.

(3) Generation of Data, and Calculation of Incremental Sales and Costs, Under Different Assumptions of Probability

The next step is to calculate the net incremental sales and costs attributable to the project under review. In some cases, if the project is essentially the entire company, the incremental sales and costs are those for the entire company. In Bio's situation, the proposed drug research project involved virtually the entire company and was by far its largest project. In that case, the WACC used to calculate the Net Present Value of the drug research is the WACC for the whole company. In other cases, when a large company considers a separate unique project, it may involve only the incremental sales and costs attributable to just that project. For example, a large multinational corporation may be considering an expansion into a new market area, such as the EU. In that case, the feasibility study will consider the incremental net sales and costs of that specific project only, not the overall company, and the discount factor used in the Net Present Value calculation could be just the WACC attributable to how that project is financed, for example bank debt.

All projections of incremental gains start with projections of future sales; sales drive all other elements of a company's financial performance, and it is the beginning point for any cashflow proforma. Projections of sales can be generated in two ways. For the sales of an existing line of products, that has a historical pattern of growth, the simplest method is to generate extensive statistical data on this historical pattern and then to project into the future the Compound Annual Growth Rate (CAGR) of that particular line (Erhardt & Bingham, 2020). The formula for CAGR is:

$$\text{CAGR} = [(\text{FV} / \text{PV})^{1/n} - 1]$$

where PV is the starting level, FV is the ending level, and "n" is the number of years in the period being calculated.

For example, if the sales of product X were $5,000,000 in 2010 and $26,000,000 in 2020, the CAGR would equal 17.92% (26,000,000 / 5,000,000, raised to the power of 1/10, and minus 1). Therefore, in projecting for years beyond 2020, a good reasonable starting point is to increase sales annually (compounded) by 17.92%. However, other factors should also be weighed. For example, is this product on the final stages of its growth cycle, being replaced by products with updated technologies? Is consumer taste shifting? Have costs of production shifted to make the product less viable? All of these judgement factors should be considered when projecting future sales of this product, but the CAGR is a good starting point.

Bio was already selling a line of nutraceuticals, which provided a base level of revenues to maintain most company operations. Projecting these revenues into the future was a relatively straightforward projection into the future based on the CAGR of these products, since the pattern of historical sales was relatively consistent, and future market potential looked promising.

It is more challenging when the product is new to the market. In the case of Bio, they were planning to introduce a new cancer drug into the market, one that had no revenue history and had not been produced previously, but which had the potential to become the dominant revenue stream for the company. How do you estimate sales revenues in that case? It begins with a very detailed statistical analysis of the marketplace competition (size of market, volume of sales, prices), the market needs for the drug (estimated national and international need for cancer drugs based on frequency of cancer disease and population dynamics), the likely market acceptance (including FDA approval), and the potential market demand (based on level of cancer needs, competitive products, and likely price).

This can be highly speculative, but a detailed statistical understanding of the data on market potential, demand, size, and competition, can lead the analyst to start making some initial projections as to sales revenues. Here it is helpful to use probability assumptions, estimating revenues at various levels, from a base line of 100% (conservative expected sales), to 80% (conservative) to 120% (aggressively optimistic). One can then develop a matrix of likely scenarios of revenues.

Once an initial analysis of sales is concluded, attention moves to the other side of the equation of profitability – the variable costs, and the allocated fixed costs attributable to the product or project in question. Variable costs (often referred to as Costs of Goods Sold, or COGS) are those that directly relate to the level of output from the project or sales of the product: raw materials, components, direct labor, sales commissions, and marketing. Fixed costs are those overall company-wide costs (e.g., C-suite salaries, utilities, building expenses, administrative staff) that need to be allocated at some percentage across all of the projects of the company or all of its products.

This is similar to estimating sales. For a known product that has a history of variable costs and allocated fixed costs, it may be as simple as applying a CAGR calculation to historical patterns of costs and project forward from there. Here again, however, it is important to look beyond projecting past trends. Are raw materials prices trending upwards or downwards, due to market forces? For example, if your product involves raw copper, those prices are recently skyrocketing, which will affect your future COGS.

If your product is a new one, with no historical data on sales, there is likely little historical data on its variable costs, which will require the same process of statistical data-gathering as estimating sales revenues. What are the prices of your raw materials in the market? What will be the direct labor costs to make this product? What are the patterns of off-shoring or re-shoring

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for these products? What are the prices for similar companies? What do commodities futures suggest for future prices of materials (like copper)?

(3) Creating a Multi-Year Cashflow Proforma

With the statistically generated data on sales, variable costs and allocated fixed costs, we can now generate a multi-year cashflow proforma. A proforma is simply a Profit and Loss (P&L) statement for future time periods, not historical. Proformas are typically shown for a period of 3-5 years; anything less than that is not particularly helpful and going beyond 5 years becomes too speculative to be of value. Note that the result of each year's cashflow is a statement of the Net Operating Income (NOI). This is a measure of pre-tax profit, although the analyst could also use Earnings before Interest, Taxes, Depreciation and Amortization (EBITDA), which adds back certain non-cash items. In general, the NOI is a reasonable proxy for the company's net cash flow earnings during that time period.

(4) Conducting a Net Present Value Analysis of these Incremental Net Revenues

At this point, the analyst has three-five years of projections of sales, variable costs and allocated fixed costs. This cashflow proforma results in Net Operating Income (NOI) for each of these years. The next step is to convert this data into a Net Present Value calculation.

A NPV calculation simply calculates the present value of each year's NOI, using the WACC discussed earlier as the discount factor in the PV calculation. Why use the WACC as the discounting factor, rather than some arbitrary number, like the 10-year Treasury rate? The purpose of the discount is to apply the company's cost of capital to determine the feasibility of the project. The project should earn a higher rate of return than the capital it cost the company to engage in the project. A company with a low WACC will find projects more feasible than a company with a high WACC.

A present value calculation uses the formula of $PV=FV/(1+i)^n$ where FV is the beginning number for which you want to find the present value, PV is the calculated present value, i is the interest

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rate, or discount rate, by which you will calculate the PV (the WACC, which is why we calculated it earlier), and n is the number of years. This formula is inside Excel and can be used very easily to determine each year's PV.

a. We identified the upfront costs of the project as $1,000,000. In many cases, the project costs will continue beyond the first year, but in this case, those costs only occur in year one.

b. We calculated the net incremental gross revenues of the project over the five years of the proforma. For the first year, there were no revenues, and given that there were costs that year, the NOI for year one is negative. Then in future years revenues increase substantially, based on our estimates of market demand and competitive pricing, among other factors.

c. Then we calculated the variable expenses (COGS) and allocated fixed expenses over these 5 years, to determine the Net Operating Income in each of those five years.

d. We calculated the present value (PV) separately for each of those years, using n = the number of the year, i = the WACC as the discount rate, and FV equals the NOI of that specific year.

e. The respective PVs were summed into year one for a total PV of the project.

f.   Then the upfront cost of $1,000,000 was subtracted from the sum of the PVs, to provide the Net Present Value.

The formula for calculating
$NPV=1\sum n(1+i)tRt$-*initial investment*

where:
Rt=Net cash inflow-outflows during a single period t
i=Discount rate (usually the company's WACC)
t=Number of time periods

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Note that the NPV is the sum of the individual NOIs, present valued back to year one at the WACC, and subtracting the initial investment.

The financial model for the Bio project was significantly more complex. It included, for example, modeling for one Phase 1 trial, three different Phase 2 trials (in three different countries), the base revenue from the nutraceuticals, the expansion of sales staff to handle the sales of the cancer drug, the pricing of competitive products, and the substantial costs of marketing the new drug. But the essence of the analysis is captured in the above example.

(5) Determining the Financial Feasibility of the Project

At this point, we have computed Bio's WACC, generated estimates of Bio's incremental sales and costs, variable and fixed, for the new cancer drug, based on probabilistic assumptions, and used this data to create a 5-year cashflow proforma. We then calculated the present value of each period's cashflow, using the WACC as the discount factor, present valued back to year one, and then subtracted the capital costs of the project from the sum of the present value of future cashflows, to generate a Net Present Value (NPV) figure.

If the NPV is positive, it can be argued that the project is financially feasible, in that the Return on Invested Capital (ROIC) is greater than the cost of the capital needed to fund the project. The total net benefit of the project, as measured by the NPV analysis, exceeds the costs of the project. If the NPV is negative, then it can be argued that the project is not financially feasible, in that the cost of the capital exceeds the expected estimated return from the project.

In this instance, note that the NPV is a positive number, which indicates that at least from a financial perspective, this project is feasible. In other words, the net incremental benefits of the project, at a present value back to the current time, using the cost of capital as a hurdle rate, are higher than the costs of the project, including the capital cost. This project makes sense, at least from a financial perspective.

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5. Lessons Learned from this Analysis

(1) Importance of the feasibility study

A growth project, especially on a large scale, is a very complex undertaking. It necessitates the commitment of considerable time, capital, intellectual property and C-Suite commitment and attention. In some cases, it can be a make-or-break moment for the company, putting its financial future at risk. Success can mean a spectacular increase in shareholder value; failure can mean a significant truncation of the company, or in some cases its demise.

Given the existential significance of a large growth project, it is critically that a company utilize the methods discussed here to generate a very detailed and sophisticated feasibility study, incorporating all relevant elements of feasibility, including marketing, operational and technological, but all of which build into a financial feasibility analysis. Bio, by pursuing this methodology, concluded that their proposed development of a new cancer drug was not only feasible from a scientific, regulatory, and operational sense, but ultimately feasible from a financial perspective. The positive NPV derived from their analysis indicated that the potential return to Bio of this project, based on probabilistic assumptions of future net revenues, was higher than the cost of the capital needed to fund the project, which in fact proved to be the case.

(2) A countervailing perspective

One of maxims that I share with my clients when conducting a financial feasibility study is: (a) never decide on a major project without a detailed understanding of the financial feasibility of the project, based on an analysis like the one discussed here, and conversely (b) never decide on a major project relying solely on the financial feasibility analysis. There should always be other factors, sometimes non-financial, to be considered.

Does a positive NPV automatically indicate that a project should be undertaken, and conversely, does a negative NPV automatically indicate that a project should not be undertaken? There are often non-financial reasons to weigh in a project: political considerations, the personal wishes of the owner, and social considerations such as environmental issues.

Companies have significant bodies of stakeholders - individuals and groups other than the shareholders - who have a deep involvement with the company and a stake in its destiny. This includes employees, clients, vendors, partners, non-governmental organizations that advocate for social issues such as environmental concerns, and the local community.

It could be argued that companies have a moral duty to take into consideration the impact of their decisions on this broader group of stakeholders, which has to be balanced against the company's fiduciary responsibility to maximize share value for its shareholders (see Halliday & Thrasher, 2020).

6. Conclusions

Companies considering large-scale capital projects of any type are faced with the decision of whether or not to invest substantial amounts of financial capital, as well as time and energy, into the project, with the expectation of realizing a significant return to their investments, and thereby maximizing shareholder value.

A financial feasibility analysis is an effective platform through which a company can arrive at the data needed for its decision-making process, generating a Net Present Value number that suggests whether a project is or is not financially viable.

While there are other factors to consider above and beyond a financial analysis, such as visionary goals, political considerations, and stakeholder concerns, the beginning of the decision-making process must consider the projected financial feasibility of the proposed project. Without this type of detailed data-based statistical financial analysis, a company runs the danger of deciding based more on subjective considerations and personal wishes.

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