Current draft: January 30, 2024

Capital Budgeting 1.

Much of the time of financial analysts is spent on capital budgeting / valuation modeling in one form or another. Capital budgeting includes: the replacement versus repair problem; entering a new market, upgrading equipment, building a new factory, acquiring or merging with another enterprise, and related problems. Many of these problems involve a dynamic optimization aspect. For example acquiring vacant land next to an existing plant creates an option for expansion. For projects that involve a significant dynamic component the traditional approach to capital budgeting is not appropriate. This is because the traditional approach ignores the value of being situated to make optimal decisions in the future – when we have more information than we do now. Research and development is a classic type of project for which the traditional approach is ill-suited for this reason.

The traditional approach to capital budgeting is focused on measuring the impact of a decision on the value of the company. It centers on the Net Present Value of a project. The idea of NPV is that we use the company's weighted average cost of capital to discount the project's expected future cash flows. If the project is undertaken then the value of the company will change by the discounted expected value of all of the project's net cash flows. This follows because we are using the company's WACC to discount the project's expected future cash flows, and we are considering all of the cash flows that the project entails.

Constructing a time line for all of the cash flows from a project will typically involve projections from engineers, marketing managers, plant supervisors, and tax analysts. We do not care about the impact of our decision on our accounting statements because these may not reflect the economic value of the company. The economic value of the company is the sum of its "real options" and the present values of all of its projects.

Real Options

Consider the decision to start a new R&D project–for example to use genetic markers to assess the efficacy of various treatments. It doesn't make sense to forecast future cash flows through production, since there is so much uncertainty–but more importantly, starting the project does not commit the company to push through to the bitter end if things don't pan out in early stages. Instead, the correct approach to understanding the effect of starting such a project on company value entails recognition of the fact that as soon as it becomes clear that the project will not pan out, the company will pull the plug. So starting the project does not put the company into a position of generating future cash flows, so much as being in position to make future decisions. Naturally when it makes these future decisions the company will do what is optimal given all the information that it has at that time. This dynamic optimization is similar to the approach used in modern finance to value options. For this reason we use the phrase *real options* to characterize the valuation of such projects. (Here is the analogy: Suppose that I buy an S&P 500 put with a strike price of 22,500 that expires on February 16, 2018 on February 8, 2018. If the S&P closes above 22,500 on February 16, 2018, we tear up the option rather than incur a loss. The simple question of whether the option expires in the money gives us a dynamic optimization problem.)

Example 1. New Plant and Equipment (Also buy vs. make)

3M owns 142 acres outside of Rochester Minnesota, worth $45,000 per acre. Bill Evans, VP of manufacturing has a proposal to put a small specialty chemical plant on this site. The plant would make chemicals that 3M currently buys from various suppliers at an average cost of $190,000 per ton. The company buys roughly 400 tons per year, and is expecting this to grow at 2% (annual rate) over the next 13 years. Bill estimates that 3M can make the chemicals for $130,000 per ton if it builds his factory. Engineers estimate that the construction of the plant will take two years for a total cost of $182 million–half of which would be incurred in each of the two years of construction. Bill says that the plant would operate for 12 years, after which its salvage value would be $500,000. This reflects the value of the equipment as well as clean-up of the site, and does not include the land. This project is a 7-year asset under MACRS. The project includes a solar energy plant, so $50 million of the investment qualifies for a 30% investment tax credit, recognizable in the first year of construction.

Production will require maintaining materials inventory of $5 million at the site.

You know that 3M's beta is 0.85, the yield to maturity on the 30-year T-Bond is 4.5%, and the expected return on the stock market is 9%. The yield to maturity on a recent 30-year 3M bond issue is 5.3%. 3M's marginal income tax rate is 26%. Its capital structure is 79% equity and 21% debt.

MACRS 7-year depreciation schedule

Year	Depreciation (%)
1	14.29
2	24.49
3	17.49
4	12.49
5	8.93
6	8.92
7	8.93
8	4.46

Build a model of this project to compute its Net Present Value. Also conduct sensitivity analysis for all of the operating assumptions underlying the project. For example, what is the minimum amount of cost savings per ton that would make this project worth undertaking?