Exploratory Note 26

NPV Revisited and an Introduction to the Logic of Real Options Analysis

**INTRODUCTION**

As we discussed last week, Net Present Value (NPV) is undoubtedly a powerful tool; however, it is dependent upon the rather dubious assumption of certainty. As reality, of course, is rarely quite so predictable, there is an opening for an alternative: real options analysis (ROA) or real options valuation (ROV). Whereas NPV assumes that once a project is accepted it will be pursued until completed no matter what happens, ROA recognizes that many projects are inherently flexible—that they present entrepreneurs and/or managers with multiple decision nodes. Depending on the project and the uncertainty of its cash flows, there may, for instance, be value to waiting, expanding, contracting, or even abandoning a project entirely. Interestingly enough, these real options have value which is quantifiable upfront, at least to an extent, using options pricing models.

**NET PRESENT VALUE – A REVIEW**

As you may recall from our last discussion, the dominant approach, from a textbook standpoint, to capital budgeting is net present value (NPV). The formula, of course, is as follows:



What are the inputs again?

What is the logic behind the NPV approach to capital budgeting? What is the decision rule?

For those who are not as familiar with the time value of money, why are the future cash flows discounted? In practice, what would the discount rate typically be for a project of average risk?

What about for a project with above-average risk? For a project with below-average risk?

What are the strengths of NPV? Does it meet all of the necessary criteria of a sound capital budgeting decision making tool? These criteria include:

* The time value of money is taken into consideration
* All cash flows are taken into consideration
* Cash-flows are risk-adjusted
* Projects can be objectively ranked
* Indicates added value to the firm

Under conditions of certainty, we cannot do better than NPV; however, the practical world is anything but certain—and this ends up mattering a great deal.

**NPV – AN INSTANCE WHERE IT COMES UP SHORT**

Consider, for instance, an investment opportunity which requires $100,000,000 to build a commercial real estate complex which is expected to be sold a year later for $110,000,000—a 10% profit.[[1]](#footnote-1) For the sake of simplicity, assume that the project will be funded 100% by debt at the current yield of 10.3%. Back of the envelope, the NPV for this project is roughly negative $300,000. According to the decision rule, should the project be pursued?

If someone approached the firm and offered to buy the opportunity for $100,000, should the firm accept the offer?

What if, however, the yield dropped in the near future from 10.3% to 9.8%? In such a case, the NPV of the project would be roughly $200,000. According to the decision rule, should the project be considered under such circumstances? But, if the project has already been sold, is this an option any longer?

Now, what if the debt yield was originally 9.99%? The NPV of the project would be marginally positive (about $1,000). Should the project be pursued per the NPV decision rule?

Per Stephen Ross, this brings us to a simple, but important point: “*every project competes with itself delayed in time* [emphasis my own]. This is the essence of the problem with applying the NPV rule. In a capital budgeting context with a budget constraint, undertaking a project means taking on that feasible combination of projects that maximizes the NPV. Clearly with interest rate uncertainty, we trade off the value of taking on the project today against the lost opportunity cost of foregoing the option to undertake the project at some later date when interest rates are more favorable. This same reasoning can also resolve the problem of rejecting the project when it should be accepted, i.e., of selling the rights to the project too low. Selling the project to the dealmaker is not only selling today's project, it is also the sale of all the potential future projects.”

**OPTION LOGIC – VALUE IN UNCERTAINTY AND THE FLEXIBILITY TO RESPOND**

Net present value is supposed to provide us with unbiased conclusions when it comes to investment decisions; however, in the absence of certainty, it completely fails to address the value inherent to optionality and the flexibility to exploit it. Consider the following options: deferral, abandonment, expansion, contraction, extension, and switching.

***Basic Option Definitions***

What is an option in a financial sense?

What is the difference between a call option and a put option?

***The Option to Defer***

With the example from above in mind, are all investments of the variety where you either invest right now or forever lose the opportunity? Why might the option to wait be valuable?

Consider, for instance, the decision as to whether or not to acquire the mineral rights (or development rights) to a particular piece of ground. Does such an opportunity necessarily have to be a do-or-die investment? Some may be, but if not, what is the alternative?

Further, consider changes in the cost of debt (and equity). Could a seemingly worthless project become valuable over time due to the stochastic nature of these variables?

***The Option to Abandon***

NPV calculations are surprisingly linear: if a project is pursued, it will be seen through to the end. But, is this always wise? Consider, for instance, a multi-stage investment. If conditions should shift and the project no longer makes sense, should subsequent stages be funded?

Does the option to abandon mitigate upside or downside potential for a given project?

***The Option to Expand***

Some projects are definitive in both scope and contract—yet others are, or can be made, more flexible. Some projects, for instance, permit you to dip a toe in, test the waters, and consider whether or not to fully take the dive. Is this attractive? Why?

Does NPV take this into consideration?

Other projects may require heavy upfront capital expenditures to get into the game. If excess capacity is built, this gives the holder the ability to rapidly expand to take advantage of unexpected demand. Of course, this costs more upfront, but is it worthwhile? If demand skyrockets and a firm cannot meet it, what might be the consequences?

Does NPV take this into consideration?

Does NPV potentially bias decision makers against building excess capacity?

***The Option to Contract (Scale Back)***

Some projects allow for an aggressive (and ambitious) early effort, but can be curtailed if things do not work out as planned. Is this attractive? Why?

Does NPV take this into consideration?

***The Option to Extend***

Some projects are of a finite life, but others can be extended. Consider development rights once again. To avoid making an irreversible decision, a deferral option might be purchased at some price which has a time to expiration of five years. Could it make sense to contractually establish an extension option which allows for the time to expiration to be extended by five years?

Does NPV take this into consideration?

I have also seen extension option language used to describe investments made which open up future opportunities in ancillary areas. For instance, consider a company that unprofitably builds a large following and then pivots (or extends its offerings)—does building an audience have value?

Does NPV take this into consideration?

***The Option to Switch***

Some projects can be turned on an off like a switch. Consider a gold mine: if gold is expensive, it makes sense to pull it out of the ground; if it is cheap, it should stay where it is. The same goes with productive capacity of all types. Is there potentially value in being able to switch a project on and off (as opposed to either not having exposure or being fully committed)?

Does NPV take any of this into consideration?

**CONCLUSIONS**

If a project is materially uncertain, real options matter. The question remains: can we quantify the value of real options? This is the focus of the second and final note of the evening.

1. This example is borrowed from the assigned Ross article. [↑](#footnote-ref-1)