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Interfaces with Other Disciplines

How real option disinvestment flexibility augments project NPV

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Abstract

In this article we show how a project's option value increases with incremental levels of investment and disinvestment flexibility. We do this by presenting two NPV and seven option pricing models in a strict sequence of increasing flexibility. We illustrate each with numerical examples and determine the maximum value that a project option could ever support. We show that managerial consideration of exit options at the time of project initiation can add value.

Keywords: Financial education; Decision analysis; Real options; Project valuation with disinvestment

1. Introduction

When a new project is examined, considering what happens if that project fails to perform in the future may seem an entirely pessimistic thing to do. However a large proportion of the value of a project may be attributable to the option to close the project at some time in the future. It is possible to show that consideration of this option may lead to the adoption of projects that would otherwise have been overlooked as too risky or offering too low a return.

When considering whether to pursue an investment project, it is typical to use a decision rule to determine whether the project should be undertaken or not. One particular approach, the net present value (NPV) rule, states that if the current risk adjusted value of expected cash inflows exceed the value of cash outflows, then a project should be

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undertaken. It has emerged as the dominant decision rule owing to the shortcomings of other rules. [1]

Whilst the standard NPV approach allows future costs and revenues to depend on future states of the world, it assumes that managers will remain passive if the circumstances change. Thus even if market conditions worsen dramatically, the NPV rule assumes that managers will not alter their level of production in response and will never, for example, close. [2] In other words, the conventional NPV method treats the investment decision as a static, one off affair. In practice managers can and do "undo" past decisions.

How can this future managerial freedom or optionality be valued? Modern finance theory values this optionality by using the ideas based on the pricing model of Black and Scholes (1973) and applying them to the valuation of real world projects. Thinking about how future optionality affects the value of projects has therefore come to be known as the area of real options. [3]

This paper will show how the value of projects can increase dramatically with increasing degrees of future flexibility. A project that has a classical NPV of $1,000 can be shown to have a net present value many times that amount if a sufficient amount of flexibility is allowed for in future managerial decision making.

We will also show that the option to disinvest is as important as the option to invest in enhancing project value. We will show that the important variable for determining project value in this case is the recovery rate if the project is terminated.

1.1. Classical NPV

The normal approach that is used to judge whether to undertake a project is to calculate the net present value of the project and proceed if it is greater than 0. As an example of how to calculate NPV, let us suppose that we wish to value an investment project. It starts out paying cash at an annual rate of v_0 at time 0. For the moment it is assumed that this pay out rate is growing continuously at a certain annual growth rate of g:

$$\frac{\mathrm{d}v_t}{v_t} = g\,\mathrm{d}t \iff v_t = v_0 \mathrm{e}^{gt}.$$

In this certain case the value of the project today, V_0, is the risk free discounted sum of cashflows paid out:

$$V_0 = \int_0^\infty \mathrm{e}^{-rt} v_t\,\mathrm{d}t = \int_0^\infty v_0 \mathrm{e}^{(g-r)t}\,\mathrm{d}t = \frac{v_0}{r-g},$$

where r is the risk free discount rate. If the project has known investment costs today of $\overline{X}$ then the NPV of the project, taking into account the costs of the project is

$$\mathrm{NPV} = \frac{v_0}{r-g} - \overline{X}.$$

So far we have assumed that the investor can either choose to invest today in a risk free project or never do so again. However we have not allowed the investor to choose his time of investment optimally. In the remaining sections of the paper we will show how within an uncertain environment the option to decide on this in the future can dramatically alter the value of a prospective project.

2. Forward start NPV

2.1. Riskless case

Let us assume that the investor has the ability to pre-commit to a given *forward* start time, denoted T, in the future. What are the effects of delaying the start date of a project on its NPV?

If an investor defers investing in a project then the present value of costs will be lower; but the present value of revenues will be lower as well.

[1] Another decision rule that might be used for selecting projects is to choose the project that pays back its costs fastest; this is known as the payback rule. Another similar rule is the internal rate of return (IRR). Both these rules fail to capture the size of the project.

[2] These problems had been considered by Hertz (1964) and Magee (1964) who modelled the impact of uncertainty on the future decisions that managers might make using simulation and decision trees.

[3] The idea of real options was first discussed and named by Myers (1977).