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Real option valuation of public sector R&D investments with a down-and-out barrier option



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ABSTRACT

This paper presents a real options approach for valuing public-sector research and development projects, using a down-and-out barrier option. Specifically, it considers the potential savings to the tax payer for investing in technology to be purchased by a national government. The valuation is performed with stretched trinomial lattices. Government-driven demand for this technology is equated with the underlying asset, and valuation measured in terms of potential government savings. Two variables, volatility of demand for the technology and unit cost, are treated as uncertain. A Monte Carlo simulation is performed to understand the effects of these variables on the valuation. Other variables are estimated, and a parametric analysis is performed to understand the effects of these variables. To illustrate how this approach could be used, the development of a new sensor, to be used in large networks that track greenhouse gas fluxes, is considered as an example.

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1. Introduction

For firms that rely on cutting-edge research and development (R&D) to drive growth, managers balance controlling near-term costs against maintaining long-term competitiveness through R&D. Within the public sector, science and technology program managers increasingly face similar decisions. At mission-driven agencies, such as the U.S. Department of Defense or the U.S. Environmental Protection Agency (EPA), program managers fund a wide range of basic and applied research related to meeting the anticipated future technology needs of the agency. Typically, the Broad Agency Announcement procedure (Broad Agency Announcements, 48 Code of Federal Regulations 35.106), which invites proposals from companies and universities to perform research that will advance the state-of-the-art in targeted technology areas, is used in this process. Most announcements draw numerous proposals, of which only a handful can be funded. Managers usually select the winners through technical expert review, a process that tends to emphasize intellectual merit, over economic impact or technological potential. During periods of national urgency, program managers are allocated enough resources to fund a range of projects, increasing the odds that some of the funded research will result in discovery and development that will ultimately spur the desired innovation. During periods of tight funding, program managers must be more selective. Moreover, governments increasingly expect science

and technology programs to demonstrate economic impact. Even the U.S. National Science Foundation (NSF), which historically has funded curiosity-driven research, now considers the broader impacts of research proposals, including potential economic impacts, when making awards. In fact, the NSF recently initiated an “Innovation Corps” program (NSF, 2011) to increase the basic research community’s awareness of innovation opportunities and strengthen links between publicly funded researchers and privately held technology companies.

This paper presents a tool for assessing the value of publically funded R&D projects. The paper is structured as follows: In Section 2, we provide a short overview of the literature related to new product development and real options with particular focus on risk management applications. In Section 3, we describe a greenhouse gas sensor, which serves as an example of a publically funded research project whose value is to be determined. Section 4 presents the valuation model based on a down-and-out barrier option, and the following section contains key findings and a sensitivity analysis. We conclude with theoretical and managerial implications and an outlook to future research.

2. The real options and new product development literature

Drawn from the financial sector, real options analyses have proved to be useful in guiding corporate decisions regarding investments in R&D and other capital investments that may not have a positive discounted cash flow. The term real option captures the fact that many investment decisions provide the right, but not the obligation to proceed with a certain course of action. Hence, real

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