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Investment under uncertainty and policy change ☆

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Abstract

In this paper the impact of a policy change on the investment behavior of the firm is studied in an incomplete information setting. The policy change occurs when a stochastic process describing the state of the economic environment reaches a certain trigger. The firm has incomplete information about the trigger and knows only its probability distribution. Consequently, both the firm's conjecture concerning the trigger value as well as the precision of this conjecture serve as input parameters. We derive the optimal investment rule maximizing the value of the firm and show that the impact of the *trigger value* uncertainty on the optimal investment threshold is non-monotonic: the threshold decreases with uncertainty for its low levels, while the reverse is true if uncertainty is high. Furthermore, we provide results concerning the valuation of the firm's investment opportunity and present some policy implications.

JEL classification: C61; D81; G31

Keywords: Investment under uncertainty; Real options; Policy change

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1. Introduction

Corporate investment opportunities can be represented as a set of (real) options to acquire productive assets. In the literature, it is widely assumed that the present values of cash flows generated by these assets are uncertain and that their evolution can be described by a stochastic process. Consequently, identification of the optimal exercise strategies for the real options plays a crucial role in capital budgeting and in the maximization of a firm's value.

So far, the real options literature provides relatively little insight into the impact of structural changes of the economic environment on the investment decisions of a firm. The existing papers (excellent surveys of those are provided in Dixit and Pindyck, 1994; Lander and Pinches, 1998; and Schwartz and Trigeorgis, 2001) mainly consider continuous changes in the values of relevant variables. Most of the time, this results in the assumption that the entire uncertainty in the economy can be described by a geometric Brownian motion.

In case of structural changes, it is more realistic to model an economic variable as a process that makes infrequent but discrete jumps.[1] In such cases, use is often made of a Poisson (jump) process. However, within such a framework the implicit assumption is made that the firm has virtually no information about the mechanisms governing the shocks in the economy. It is natural to assume that the firm can to some extent assess the precision of its conjecture concerning the moment of change, i.e. that it knows the variance of the estimate of timing of the future event. A Poisson based approach does not allow for including this type of uncertainty in the analysis since it entails a single parameter characterizing the arrival rate of the jump. Consequently, such a modelling approach lacks degrees of freedom necessary for capturing both the expectation and the precision of this expectation.

We propose a method to model the impact of a policy change on the investment strategy of the firm that takes into account the precision of information concerning the policy change possessed by the firm while making the investment decision. In our approach, the expectation of the moment of the change as well as its variance serve as input parameters. We model the policy change as being triggered by a sufficiently high realization of a stochastic process related to the value of the investment opportunity. The policy change results in an upward jump in the (net) investment cost. The firm is not aware of the exact value of the trigger but it knows the probability distribution underlying the trigger. Taking into account consistent authority behavior, the firm knows that a jump will not occur as long as the current value of the variable remains below the maximum that this variable has attained in the past. When the underlying variable reaches a new maximum and still the jump does not occur, the firm updates its conjecture about the value of the barrier.

An interesting example of a structural change in the economy has been provided by Hassett and Metcalf (1999), who analyze how the expected reduction in the

[1]For instance, recent tax debates both in the US and across Europe constitute a significant source of uncertainty associated with discontinuous changes in the economic environment.