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The Dixit–Pindyck and the Arrow–Fisher–Hanemann–Henry option values are not equivalent: a note on Fisher (2000)

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Abstract

Fisher (2000, this journal) offers a unifying framework for the concepts of quasi-option value, suggested by Arrow, Fisher, Hanemann, and Henry (AFHH), and the concept of real option value, suggested by Dixit and Pindyck (DP). He claims that the two concepts are equivalent. We argue that this claim is not correct. We further suggest a decomposition of the DP option value into two components, one of which corresponds exactly to the AFHH quasi-option value which captures the value of obtaining new information, and a second one which captures the postponement value irrespective of uncertainty.

JEL classification: D81; G12; G31; Q20

Keywords: Real option value; Quasi-option value; Decision making under uncertainty; Irreversible investment; Value of information

1. Introduction

In the context of irreversible decision making under uncertainty concepts of option values have been developed independently in different contexts. Most prominent are the approaches by Arrow and Fisher (1974), Henry (1974) and Fisher and Hanemann (1987), on the one hand, and by Dixit (1992), Pindyck (1991) and Dixit and Pindyck (1994), on the other. Arrow, Fisher, Hanemann, and Henry (AFHH) developed the concept of quasi-option value mainly in the context of the economics of the environment, in particular when irreversible

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economic decisions, to be made under uncertainty, may cause irreversible environmental damage. Dixit and Pindyck (DP) were mainly interested in business investment decisions when the future value of an irreversible investment is uncertain. More recently, Fisher (2000) tried to also unify the concepts of quasi-option value by AFHH and of real option value by DP, and claimed that these two concepts are equivalent.[1]

In this note we argue that this claim is not quite correct. By contrast we suggest a decomposition of the DP real option value into two parts. The first part corresponds exactly to the AFHH concept of quasi-option value capturing the pure value of obtaining new information about the value of the investment tomorrow given that no investment takes place today. The second part accounts for both better conditions of investment in the second period and for the benefit foregone by postponing the decision, independently of new information.

In the next section we recall the model in terms of Fisher and Hanemann (1987) and Hanemann (1989), and we set up the decision rules including payoffs. In Section 3 we show that the DP option value can be decomposed into two parts, one of which is the AFHH quasi-option value. In Section 4 we localize the formal errors in Fisher's argument. The final section concludes the paper.

2. Model and decision rules

There are two periods, 1 and 2, where the second period can be interpreted as a whole sequence of further periods. An irreversible (investment) decision can be made in the first period or it can be postponed to the second period. By $d_i \in \{0, 1\}$ we denote the decision variable in period i, where $d_i = 1$ ($d_i = 0$) means that the investment takes (does not take) place in period i. The (certain) benefit of the decision in period 1 is written as $B_1(d_i)$. The uncertain benefit of the investment decision in the second period is written as $B_2(d_1, d_2, \vartheta)$, where $d_1 + d_2 \in \{0, 1\}$, and ϑ is a random variable.[2] To define the value of different decision rules we best work backwards, starting in period 2.

2.1. Decision in period 2

First we define the *open-loop second period expected value*,

$$B_2^*(d_1) = \max_{d_2, d_1+d_2 \leq 1} E_\vartheta[B_2(d_1, d_2, \vartheta)] \tag{1}$$

which represents the *expected value of the ex ante optimal investment decision* at the beginning of period 2 when the decision is made *before* nature has drawn the state of the world ϑ, given any investment decision d_1 in period 1.

Secondly, we define the *closed-loop second period expected value*, given any investment decision d_1 in period 1 by

[1] Other authors have developed similar concepts, many of them drawing on the seminal paper by Arrow and Fisher (1974). Since in this note we comment on Fisher's (2000) claim, we will refrain from giving a further survey on the wide literature on option and quasi-option values.

[2] Our set-up is slightly more general than Hanemann's (1989) who assumes $B_2(d_1, d_2, \vartheta) = B_2(d_1 + d_2, d_2, \vartheta)$.