Abstract

This paper uses a nonparametric approach to measure technical change. The method is applied to individual farm data from Illinois for the years 1981 and 1984. The farms are divided into those that receive subsidized credit and those that do not. The results indicate similar rates of technical change for the two groups.

1. Introduction

The purpose of this paper is twofold. First, a nonparametric method for measuring the extent of technical change is utilized. The advantage of this is that it does not require price or cost information, only data on inputs and outputs. It involves the construction of various nonparametric frontiers. Second, this method is applied to individual farm data from Illinois for the years 1981 and 1984. The farms are divided into two groups: those that receive subsidized and supervised credit from the Farmers Home Administration (FmHA) and those that do not. Thus a comparison of the rates of technical change of these two groups can be made.

The following section discusses in detail the method which is used to measure technical change. In Section 2, the methodology is applied to a sample of Illinois farmers for the years 1981 and 1984. The sample is made up of FmHA and non-FmHA farmers; average rates of technical change for the two groups are calculated and compared. Finally, Section 2 summarizes the paper.

2. Background

In order to measure the extent of technological change, most economists use estimates of total factor productivity. The main problem with the total factor produc-
tivity approach is that some weighting scheme must be used to aggregate over inputs. Generally, the weights are the shares of each input in total cost. Of course, lacking data on factor shares makes it impossible to measure the extent of technological change using this approach.

Assuming that factor share data is available, there is still a more fundamental problem with using this approach. According to Nishimizu and Page [1982], the total factor productivity approach does not allow for a distinction between technological change and changes in the technical efficiency with which a given technique is applied. As a result, total factor productivity estimates may overstate the importance of technological change.

In order to deal with this problem, one could measure technical change by the extent to which the best practice production frontier shifts through time. There are at least four methods available for constructing such frontiers. The first method is the deterministic nonparametric approach which uses linear programming to construct the frontier [Farrell 1957]. No parametric form is specified and the approach uses the whole sample of observations, but constrains all points in output space to lie on or below the frontier. Although this technique corresponds most closely to the theoretical concept of a frontier, empirically it is sensitive to errors in observations (the outlier problem). The second method is the deterministic parametric frontier. It differs from the first method in that a parametric form is specified for the production technology [Aigner and Chu 1968]. The third method is the statistical deterministic approach. Following this approach the frontier can be constructed either by using corrected ordinary least squares [Richmond 1974] or maximum likelihood techniques [Afriat 1972 and Fossum and Hjalmarsson 1987]. The advantage of the former approach is that statistical tests can be performed on the frontier. However, both methods require the specification of a parametric form. The fourth method is the stochastic approach which specifies an error term composed of two parts. A symmetric component permits random variation of the frontier across firms and captures the effect of measurement error and random shocks beyond the control of the firm. A one-sided component captures the possibility that firms may produce less than their potential, that is, below the frontier [Aigner et al. 1977 and Meusen and van den Broeck 1977]. This approach also requires that a specific functional form be specified.

3. Model

The approach used in this paper to measure the extent of technological change draws upon the work of Diewert [1980], Diewert and Parkan [1983], and Fossum and Hjalmarsson [1979] and is very similar to the approach used by Todd [1985] in his study of the West German manufacturing industry. A nonparametric deterministic approach will be used in constructing the frontiers. The advantage of this approach is that no structure is imposed upon the technology. The disadvantage is that all of the deviation from the frontier is classified as being the result of techni-