Technological Change in Illinois Agriculture: A Reply

INTRODUCTION

Professor Hockmann has raised three issues in his commentary: the first concerns our treatment of the alternative approaches to measuring technical change; the second concerns the measure of bias; and the third, the data used. In this short reply, each of these issues will be considered.

1. ALTERNATIVE APPROACHES

The two alternative methods for measuring technical change outlined in the original paper were the econometric and index-number approach. Professor Hockmann argues that the original paper fails to discuss the advantages of these alternatives, and proceeds to discuss them.

It is our contention that any measure of technical change should represent improvements in best practice techniques as related to production. The econometric approach estimates either an average cost or a production function, and labels shifts in the function through time as technical innovation. The index-number approach labels all of the difference between output and input growth through time as technical change. As a result, both ignore the fact that inefficiency may exist and that firms may not operate on the best practice frontier. As a consequence, either (1) the shift in the cost or production function or (2) part of the increase in output unattributable to increased input usage may be the result of changes in efficiency, and not of attributable technical change. As a result, constructing a best practice frontier and analyzing the shift through time seems to be a more appropriate measure of technical change. This allows the analyst to explicitly consider changes in technical efficiency.

2.BIAS OF TECHNICAL CHANGE

Professor Hockmann also criticizes the use of factor shares in the analysis of the bias of technical innovation. He argues that factor shares can change as the result of changes in physical or monetary units (prices).

In a simple two-input production function it is of course possible to use the ratio of one input to the other to measure factor intensity. However, with more than two inputs any such ratio is only a partial measure of factor intensity; thus factor shares were used. It must be emphasized that the factor shares for each farm were calculated only for the year 1982, not for the year 1984. Thus the regression equation sought to determine whether technical change from 1982 to 1984 was related to the factor shares for each farm in 1982. As a con-

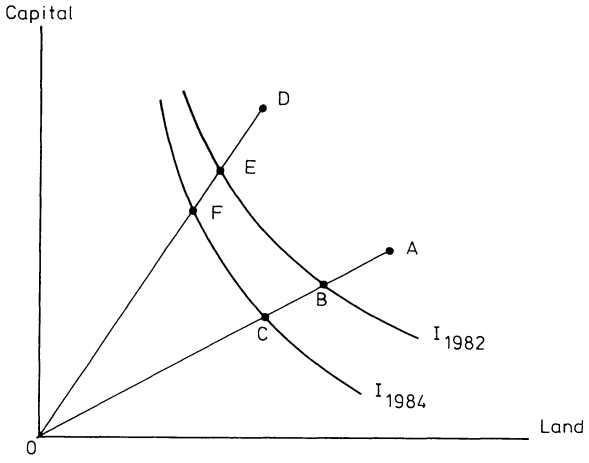

Fig. 1. Technical change and factor shares.

sequence, price changes for inputs from 1982 to 1984 did not influence the factor share calculations.

This point is further clarified by examining Fig. 1. First, we assume that there are two inputs, capital and land. Second, we assume that points A and D represent two farms in 1982. Finally, we assume that both farms face the same relative input prices in 1982. Isoquant I_{1982} represents a particular level of output before technical change (1982), and I_{1984} the same isoquant after technical change (1984). Calculating the factor shares given 1982 relative factor prices, it is obvious that the factor share of land is greater for farm A than for farm D. It is also obvious that farm A has experienced more rapid technical change in that the shift in the isoquant is greater along ray OA than it is along ray OD.

The crucial assumption in the above analysis is that the farms in 1982 faced the same relative prices for inputs. However, we assumed that farmers in 1982 faced a competitive input market and thus the prices of inputs should be fairly uniform for all farmers. Given the study area, it is reasonable to assume that the farm operators faced similar prices for inputs and that land values were approximately the same across farms in the area. Given the location of input suppliers in the area, relatively few farm operators would have large advantages in cost due to differences in transportation. Thus differences in factor shares in 1982 would tend to indicate differences in physical input usage.

3. DATA

Finally, Professor Hockmann argues that the non-parametric method for measuring technical change does not require data on prices and factor shares. However, our empirical analysis of Illinois farms uses outputs and inputs measured in monetary terms.

The method can indeed be used whether one has data on inputs and outputs measured in physical units, monetary units, or a mixture of the two. The data used in the paper were readily available to the authors, and the main thrust of the paper was to illustrate how the methodology can be applied. The fact that inputs and outputs are measured in monetary units does not invalidate the conclusion that only physical measures can be utilized to measure technical change.

Related to the above issue, Professor Hockmann argues that the data used should have been in constant prices. However, it can be shown that if input and output prices rose proportionally, the measure of technical change that was calculated remains unchanged. As a consequence, using the same price index to deflate inputs and outputs does not change the results and would be a useless exercise. The alternative is to deflate inputs and outputs using different price indexes. The difficulty here is that such input and crop-specific indexes are not available for this area. Additionally, the data do not allow for controlling the actual patterns used by farmers in acquiring inputs or marketing outputs.

Of course, if data on factor shares are not available, then analysis of the bias of technical innovation becomes more complex. One must use partial measures of factor intensity, as discussed in the previous section, as the independent variables in the regression analysis.

CONCLUSION

It is argued, in response to Professor Hockmann, that shifts in best-practice frontiers are more appropriate for measuring technical change than average cost or production functions. In addition, the methodology can indeed be utilized when some or all inputs and/or outputs are measured in physical rather than in monetary units. Finally, the regression analysis indicated that technical innovation was most rapid for those farms which, in 1982, utilized land-intensive production processes.

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