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Stochastic Dynamic Modeling: Discussion

G. C. Van Kooten

It is interesting to note that there appears to be an increase in the use of dynamic programming in agricultural economics research. In both papers (Schnitkey, Taylor, and Barry; Gustafson), stochastic dynamic programming (SDP) is employed to examine an agricultural economics problem. The authors attempt the kind of empirical research that, I believe, agricultural economists should be engaged in. Nonetheless, I have some reservations about both papers. I will start with the paper by Schnitkey, Taylor, and Barry (hereafter STB), followed by the paper by Gustafson.

Farmland Investment Decisions

The STB paper demonstrates the inadequacy of deriving optimal decisions from a static as opposed to a dynamic model when decisions occur over time and when events in one period have an impact on subsequent periods. In this case, the error amounts to about 10% of wealth, or about \$200,000—not an inconsequential sum. The SDP approach is certainly relevant for analyzing the farmland purchase decision, particularly since SDP accounts for uncertainty in returns over time, something the static, capital budgeting model does not do. However, I wonder if it would not be possible to develop a capital budgeting model which permits some accounting of time via simulation. In this regard, I think of R. A. Schoney's farm simulation model that is similar to a capital budgeting model. While Schoney's model can be made dynamic, it is not an optimizing model. The true test of the power of dynamic optimization is against such a model.

The STB model has five state variables (returns, current prices, last year's prices, number

of acres, and the debt-asset ratio) and one control variable (farmland purchase). Only returns are stochastic, presumably since production and prices are uncertain. But I worry about correlation between prices and returns nonetheless. How are the equations estimated—as single equations or as a system?

In the real world, agricultural producers are able to rent land as opposed to simply purchasing and selling it. However, renting or leasing of land was not included as an option. This is unfortunate since renting provides farmers with greater flexibility to make (optimal) adjustments to their operations.

Finally, I have three additional concerns. (a) In equation (2), $p_{t+1} = f(DR_t, p_t, p_{t-1})$. Although the authors refer to this as a Markov process, the fact that the model has a second-order lag structure precludes it from being one. What is required is an additional state variable and state transformation equation. (b) Other farm assets are a function of owned acres. As I already noted, land rentals are not permitted. Nowhere are we told about the functional form of the relation between owned acres and other farm assets. Must we assume constant returns to scale?—an unrealistic assumption in my opinion. Further, it appears as if other farm assets adjust instantaneously to changes in owned land. This again is unrealistic. (c) I am not entirely happy with the idea that the debt-to-asset ratio is allowed to become negative. A negative debt ratio may work well in the model, but why would a farmer with assets other than farm assets wish to purchase farmland? He likely has outside assets for the purposes of diversification.

Granting Agricultural Credit

Agricultural credit is an area of research in which it is difficult to obtain information beyond that dealing with industry structure, the

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number and size of loans, the number of foreclosures, and, perhaps, the number of loans that are in arrears. Obtaining data about the decision-making process itself is another matter, let alone the use of such information once it is available. Therefore, the paper by Gustafson is refreshing.

Although SDP is an excellent tool for analysis, and Gustafson uses forward-recursive SDP, I doubt that it is an aid to agricultural lender decision making as the title of the paper would suggest. The author implicitly feels that adaptive DP (e.g., Kao), which permits updating of the transition probabilities, is the appropriate tool to use, but he has insufficient observations to employ this methodology. By not allowing a farmer's leverage or wealth position to change over time, the problem is actually trivialized and the use of SDP may be likened to cracking a nut with a sledge hammer. The agricultural lender may have a better time understanding a simple net present value simulation model which gives the same "dynamic" result as the SDP model.

In this regard, I find the test of stationarity of the transition probabilities inadequate and difficult to reconcile with reality. Using observations on the first and second years of a loan is not sufficient reason to assume stationarity. To me, it appears as if information has little value in the decision process, at least on aggregate. I seriously question the high subjective probability of not defaulting on a loan when the borrower had defaulted on a loan in the previous period (table 2). Perhaps the author should provide more data in this regard. Would such a person be granted the loan amount used in the survey? Is the lender's subjective probability influenced by the fact that the borrower already is in debt to the lender? That is, does the lender believe he will recoup the previous loan as well as earn a profit on the current loan? If this is the case, defaults in previous periods are not "water under the bridge."

The author recognizes that borrowers who have paid back earlier loans might be able to demand more favorable credit terms. Although this is a likely outcome, it does not appear to play a role in the model. In addition, it seems to me that lenders can obtain information on first-time borrowers from credit agencies. If this is the case, then the subjective probabilities that were elicited for the study are true only for the hypothetical situation and not for actual lending decisions, notwithstanding the single observation of consistency between the hypothetical and real-world cases (perhaps the respondent loan officer figured out what was going on). It seems to me that lenders in the real world would be irrational by not using information about the borrower that is available from credit agencies.

Finally, Gustafson argues that "the role of scoring models becomes more narrowly focused and objective" in the SDP model once the transition probabilities are determined. He is correct in this assessment, but the subjectivity of the approach remains firmly embedded in the transition matrix. It has not disappeared.

In conclusion, I have the feeling that, if one is sincerely interested in helping agricultural lenders make better decisions, the SDP model might not be the appropriate tool to use. A simple net present value formulation which lenders understand may do a better job.

[Received July 1988.]

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