A Bayesian Approach to Explaining Sequential Adoption of Components of a Technological Package

Howard D. Leathers and Melinda Smale

Agricultural innovations are often promoted as a package—a new seed variety, a recommended fertilizer application, and other recommended cultivation practices. Nevertheless, many farmers adopt pieces of the package rather than the whole, in a sequential fashion. This paper presents a behavioral model which explains sequential adoption as a consequence of learning by adopting farmers. In order to learn more about the entire technological package, the farmer may adopt a part of the package. The model is shown to be consistent with observed patterns of sequential adoption.

Key words: Bayesian learning, diffusion of technology, technology adoption.

In U.S. agriculture before 1950, the "Green Revolution" of the 1960s, and in other regions since then, agricultural research institutions have developed and promoted innovations as packages of farming practices consisting of a seed variety, fertilizer application, and other cultivation techniques (Moseman, Ryan and Subrahmanyam, Lele and Goldsmith). Empirical evidence suggests, however, that farmers often adopt pieces of the package rather than the whole, in a sequence or "stepwise" fashion (Byerlee and Hesse de Polanco, Mann, Ryan and Subrahmanyam).

Economists working with agricultural research institutions have argued that sequential adoption may reflect rational choice by farmers, but the reasons for the decision are not clearly understood. Byerlee and Hesse de Polanco state that "because of capital scarcity and risk considerations, farmers are rarely in a position to adopt complete packages" (p. 519). Even when provided with advantageous credit and input delivery arrangements, "farmers . . . experiment with recommendations, often adopting them in stages rather than as a complete package" (Cummings, p. 24). In their review of literature on agricultural innovations in developing countries, Feder, Just, and Zilberman conclude that "further work is needed to understand any order and regularity in such chain processes" (p. 288).

Explanations for sequential adoption have not yet been framed in a behavioral model, and most behavioral models have investigated the factors that affect the adoption of a single component or a package, rather than the pattern of component adoption (O'Mara; Hiebert; Lindner, Fischer, and Pardey; Lindner; Lindner and Fischer). Feder's model is one of the first to explore how the interrelationship between recommended inputs influences a farmer's adoption decision.

In this paper, we offer a Bayesian model that explains sequential adoption even when farmers are risk neutral and unconstrained in their expenditures. The model depicts a farmer who is uncertain whether the information she/he receives about a recommended innovation accurately describes her/his own prospects. Uncertainty is reduced but may not be resolved through experience. The model demonstrates that in order to learn more about the innovation, the farmer may choose to adopt a component rather than the package, even when the package is more profitable.

Empirical evidence of sequential adoption is reviewed in the next section, and several plausible explanations for sequential adoption are explored. Following the Cummings suggestion that farmers adopt components to "experiment"

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