

Predicting Land Use Change and Its Effect on Nonpoint Source Pollution

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Problem and Research Objectives

Inability to monitor and measure variation in pollution levels resulting from agricultural practices on different fields precludes the use of differential taxes and standards for the regulation of agricultural nonpoint pollution. For this reason, uniform taxes or standards are often proposed as a means of regulating agricultural nonpoint pollution. An extensive line of literature has assessed conditions under which a uniform tax or uniform standard is preferred. Only recently, however, has the literature been extended to make it applicable to the issue of agricultural production. Although the literature is applicable to agricultural production, its applicability is limited by the fact that it is assumed that producers are risk-neutral, despite the fact that studies have shown that many farmers are risk-averse. We incorporate risk aversion into the theoretical model, thereby extending the existing literature and making it more applicable to the regulation of nonpoint pollution stemming from agricultural production. Furthermore, a simulation model is used to provide insight as to how risk aversion can alter conclusions drawn from the risk-neutral model.

Methodology

Weitzman (1974) provides the seminal paper addressing the relative efficiency of controlling pollution through the use of taxes and standards. Numerous extensions have been made to Weitzman's model, including a recent extension by Wu and Babcock (2001), who incorporate spatial heterogeneity and thereby make the model applicable to the issue of regulating agricultural nonpoint pollution. We incorporate risk aversion into Wu and Babcock's model through the use of a Just-Pope production function, thereby making the model more applicable to the matter of regulating agricultural production. We extend Wu and Babcock's simulation model to demonstrate the importance of incorporating risk-averse behavior.

Principal Findings

The theoretical derivation illustrates that risk aversion may affect whether a uniform tax or uniform standard is more efficient for regulating agricultural nonpoint pollution. Previous work by other researchers has identified a number of factors (such as the variance of profits and the covariance of marginal environmental damages and marginal profits) that help determine whether uniform taxes or standards are preferable for regulating nonpoint pollution. The inclusion of risk aversion modifies how previously identified factors affect the regulatory mechanism choice and introduces new factors (such as the covariance of marginal environmental damages and marginal variance of profits) that must be considered in making the mechanism choice. For some factors, it is unclear what effect risk aversion will have on mechanism choice, while for other factors risk aversion clearly favors one mechanism over the other.

Because regulatory mechanism choice depends on numerous site- and case-specific factors, the overall impact of risk aversion must be assessed on a case by case basis. The simulation model demonstrates how risk preferences might affect the choice of regulatory mechanism and that the significance of the impact of risk increases with higher levels of risk aversion.

