Trait Based Modeling of GM Crop Adoption

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Project Description

Objectives

The overall goal of this research is to demonstrate the benefits of using a trait based adoption approach to estimate willingness to pay, predicted market shares, and regional differences in the adoption of GM corn varieties. Our research plan has five key elements that go from validating our current model to producing predictions of market shares by crop traits that will be provided to industry professionals. The **specific objectives** are:

(1) Estimate the willingness to pay for genetically modified corn traits currently in the market and for potential new ones using a mixed multinomial logit model. This will be used to validate our current model's ability to predict adoption.

(2) We then further specify the analysis to estimate the willingness to pay for bundled traits (Bt and herbicide tolerance in one seed) using data from before and after the introduction of bundled traits.

(3) We will then collect further data from farmers on their willingness to pay for new crop traits not yet on the market and combine this with our other data to estimate farmer benefits from the introduction of a new trait such as drought resistance in the market.

(4) These estimates will provide predictions of regional differences in willingness to pay, market shares for different traits and trait combinations, and how these change with socioeconomic and agronomic differences across farms.

(5) Using the information generated in steps 1-4 above, the project will produce both academic and general interest articles as well as a series of publications directed towards industry professionals that helps them assess the demand for current and future genetically modified traits.

Procedure
This will involve collection and analysis of data and then estimation of econometric models.

Some of the data will come from two cross-sectional surveys of corn farmers from Minnesota and Wisconsin, one collected in 2004 and the second in 2006. The years covered by the data include information on the 2003 and 2005 growing season experiences and the 2004 and 2006 decisions about which corn varieties to cultivate. These years span the recent innovations in stacking of corn varieties and by 2006 will include sufficient experience with the root worm trait to capture more widespread knowledge and information about its features.

In addition the project will use the USDA-ARMS corn costs and returns data from 2006 from Minnesota, Wisconsin and Illinois.. In order to gather information about willingness to pay for corn crop traits not yet on the market (drought resistance and next generation Bt technology), we will re-survey respondents in MN, WI, and IL from the 2006 ARMS corn costs and returns survey. This data can be combined with the 2006 data to estimate potential market shares and market penetration of these new traits, either singly or in bundles with existing traits on the market.

We will combine these survey data with key market information on seed prices, MN, WI and IL Statistical Services information on insect and weed infestation levels, trial and actual information on yields under varying infestation levels, input prices, labor practices and the like. In this round of survey work, we will also pursue more information on spatial variation associated with biophysical and socioeconomic characteristics. These will be crucial to increasing our capacity to capture more of the heterogeneity associated with observable characteristics.

The mixed multinormial logit (MMNL) model will be used in this research. It can be seen as a generalization of the standard logit models in the literature. In particular, the MMNL relaxes these assumptions of independently and identically distributed error terms and allows for the influence of unobserved heterogeneity in adoption choice. We estimate the MMNL using maximum likelihood techniques and simulation. MMNL choice probabilities cannot be calculated exactly because the integral does not have a general closed form. Therefore, the integral is approximated through simulation.

Impact

The results of the study will allow us to: (1) Estimate sensitivity of the demand for varieties to individual and bundled traits; (2) Test for unobserved heterogeneity of farmers' tastes for specific traits; (3) Test for observed heterogeneity of farmers' tastes for specific traits (based on characteristics of the farm and socioeconomic characteristics of the farmer); (4) Estimate average willingness-to-pay for crop attributes and willingness-to-pay for specific socioeconomic groups or regions; (5) Predict changes in the market shares of varieties as new varieties enter the market; and (6) Validate the model and specify the most parsimonious model structure.