Journal of Agricultural and Resource Economics 22(2):376–381

Actual versus Stated Willingness to Pay: A Comment

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Offering evidence from the California Irrigation Management Information System (CIMIS) and centering around Kenkel and Norris's conclusions regarding "Agricultural Producers' Willingness to Pay for Real-Time Mesoscale Weather Information," this article questions the use of growers' hypothetical willingness-to-pay responses as the sole basis for deciding whether to invest in Mesonet, a statewide network of weather stations. Survey respondents' lack of familiarity with a new technology and strategic behavior lead to underestimates of actual willingness to pay. Moreover, weather information has numerous agricultural and nonagricultural uses, and only sampling growers overlooks gains to other potential users. Low hypothetical willingness-to-pay responses of a subsection of the potential adopters should not necessarily discourage investment. Rather, a substantial willingness to pay may signal a need for further market research.

Key words: CIMIS, contingent valuation, spillover, technology adoption, weather information

Introduction

Real-time weather data, soil moisture measurements, and irrigation technologies significantly contribute to an agricultural producer's capacity to adjust to weather shocks. A mesoscale weather system is a technology providing weather data that are valuable in farm production. Based on the willingness-to-pay responses of Oklahoma wheat, hay, cotton, peanut, and livestock producers, Kenkel and Norris argue that user fees levied on these producers will not support Mesonet, a network of weather stations providing real-time, mesoscale weather information. Their attempt to determine the value of a technology prior to making a public investment clearly recognizes the need for research into the potential benefits of public investments. However, this ex ante survey of producers likely resulted in negatively biased benefits estimates due to the lack of producer information about the technology's potential benefits, the strategic behavior of those surveyed, and the exclusion of many potential adopters from the survey.

Producers may answer defensively when faced with a possible user fee, and regardless of strategic behavior, producers cannot know the benefits of a technology with which they are not familiar. Further, a publicly provided system such as Mesonet would be available and beneficial to a variety of users in addition to the surveyed producer population. A valuation of a government program that only focuses on a subsection of the

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potential adopters should not be the sole basis on which the decision to fund such a program is made. This discussion of the Kenkel and Norris article offers a methodological basis for questioning such an approach as well as empirical evidence from recent research on the California Irrigation Management Information System. This established network of weather stations in California has proven profitable and at times indispensable to a variety of agricultural and nonagricultural users alike.

Stated Preferences versus Revealed Preferences

The contingent valuation approach used in Kenkel and Norris's Mesonet study presented potential network users with a detailed description of its information contents. The study asked growers what they would pay for only raw data and for additional, refined information. The refined, or "value added," decision models would include irrigation scheduling, peanut and alfalfa pest prevention, cotton planting conditions, chemical application advisory, and fire danger. The aggregate estimates of statewide willingness to pay ranged from $352,488 to $1,949,064 for raw data and from $419,316 to $2,236,368 for the refined ("value added") data. Based on these estimates, the authors conclude that user fees levied on growers would not pay for Mesonet.

In such an ex ante survey, subjects need to be presented with hypothetical benefits to be realized from the use of weather information and a description of the possible education and computer costs to be incurred with adoption. Otherwise, producers simply cannot know the value of a technology they have not yet used, and thus their responses are uninformed guesses. An example is seen in Caswell, who observed that California farmers did not perceive drip irrigation to be beneficial after its introduction and well into the 1970s, despite evidence that it was profitable to adopt. Many extension specialists and farmers were skeptical of its merits then as well. However, California land under drip went from 124,000 acres in 1977 to 305,000 in 1980 to nearly one million acres currently.

This process of drip irrigation diffusion was aided by, and perhaps the result of, considerable marketing and education efforts by private firms and public agencies. Demonstrations and advertisement of new technologies, informational mailings, and educational seminars are strong indicators that potential adopters initially lack the necessary information to make adoption decisions. A marketing study would first identify areas of potential need for the product, then target that population and tailor the survey to address those perceived needs. Simply offering a description of the tools which Mesonet offers potential users without explicitly identifying the needs which those tools address and the potential benefits they offer does not give subjects the ability to make an informed response.

Even the most informed producers may make poor predictions. Thomas Watson, the innovative CEO of IBM, did not believe computers would be used by businesses or homes on a large scale. Similarly, the photography industry's dominant company, Kodak, "dismissed . . . as a toy and turned down a chance to market" (Moskowitz, Katz, and Levering, p. 409) the instant camera developed by Polaroid in the 1940s. Kodak then spent 30 years developing its own instant camera in order to compete with Polaroid's.

Finally, when producers are asked their hypothetical willingness to pay for a service for which they actually expect to pay, they are likely to intentionally understate the

information's value. This is corroborated by studies such as Bishop and Heberlein, which found a hypothetical willingness to pay for hunting permits that was one-third of actual cash offers. Those authors suggest that hypothetical values of willingness to pay be considered a lower bound for actual willingness to pay.

Excepting the issue of strategic bias, however, Kenkel and Norris's estimates provide a measure of farmers' willingness to pay prior to experiencing Mesonet. Mesonet's developers might consider this a point estimate of revenues to be raised from user fees at the system's inception, but the value to producers would be expected to change with producer learning. Though some research shows that willingness-to-pay responses for environmental amenities are consistent over time, in this case of producers' willingness to pay for a new technology about which they have much to learn, such dynamic consistency is unlikely.

Evidence from California

Results from the study of the California Irrigation Management Information System (CIMIS) exemplify the moral hazard involved in a willingness-to-pay survey. Furthermore, data from the CIMIS study illustrate the important role played by retailers of weather information (i.e., irrigation and pest consultants), whose services become more valuable with better information sources. The subsequent section gives further evidence from CIMIS regarding the importance of spillover of benefits into activities not included in the Mesonet survey.

CIMIS is a network of weather stations run by the California Department of Water Resources (DWR) since 1986, and it was developed by the University of California with DWR as a tool for efficient irrigation management. It provides daily and historical weather data, including evapotranspiration (ET) and high and low temperatures, at no subscription cost to growers, consultants, researchers, and a variety of other users statewide (Parker and Zilberman). Current users number in the thousands, and CIMIS benefits in irrigation, pest control, and other agricultural and nonagricultural activities are in the tens of millions of dollars per year, according to users' ex post estimates of their benefits (Parker, Zilberman, Cohen, and Osgood).

The CIMIS study asked adopters of the network about their water use and yield benefits from irrigation scheduling (as well as some other uses) with CIMIS information. They were subsequently asked their willingness to pay for that information. A sample of 41 irrigation adopters answering both questions gave quite disparate answers. The sum of lower-bound benefits responses (water savings plus yield increases) was $780,824, and the subsequent stated willingness to pay of those same producers summed to $20,134. In other words, the sum of lower-bound benefits estimates of this sample of producers was 39 times as large as the lower-bound willingness-to-pay responses. Further, there was almost no correlation between the benefits and willingness-to-pay responses, with a 0.11 correlation between willingness to pay and benefits.

There are, however, proxies for what irrigators are willing to pay for weather information, and these may be thought of as user fees already being paid. Testifying to the information's value, some growers have purchased their own stations. These stations typically cost between $1,500 and $5,000 with an additional $200 per year in maintenance costs, approximately. Many growers use consultants as well, and a large portion

of California irrigation and pest control advisors use CIMIS. Consulting fees offer a good upper-bound approximation of what growers are actually willing to pay for weather data. The CIMIS study found an average willingness to pay of less than three dollars per acre, though irrigation scheduling services in California's Central Valley cost approximately $5–10 per acre for cotton and other field crops. A Southern California consultant providing irrigation scheduling for citrus and avocados charges up to $20 per acre. In a simulation study, Bosch and Eidman calculated the value of weather and soil moisture information to Minnesota irrigators. The authors compared their results with the prices two western Minnesota companies charged for irrigation scheduling: $5.00 and $5.50 per acre.

The costs of consulting services are likely not as large in Oklahoma as in California, due to the differences in per acre crop values. (Perhaps the Minnesota prices are somewhat comparable to Kenkel and Norris's case.) Also, the fact that the California consultant fees were paid by adopters, or those within the total population for whom weather information is most valuable, makes the California and Oklahoma populations even less comparable. However, a comparison of Oklahoma farmers' willingness-to-pay responses with actual consulting fees would be a useful tool in determining the validity of the Mesonet study's conclusions.

Spillover of Adoption and Benefits

Initially, irrigation management was the activity CIMIS targeted. However, there have been large unanticipated benefits in urban irrigation and agricultural pest control as well as considerable spillover into nonagricultural areas. There is a sizable body of literature on the returns to agricultural research and development, including its impact on nonagricultural activities and unexpected agricultural activities. (Evenson; Huffman and Evenson; Alston and Pardey). Had the CIMIS study only examined the benefits to irrigators or to agriculture, it would have significantly underestimated the true benefits. It is clear that there are potential spillover returns to public investment in weather information, and overall willingness to pay for Mesonet will be a function of the degree to which mesoscale weather information is used in nonagricultural activities as much as in agriculture, and in agricultural pest control as much as in irrigation.

An area which exemplifies both the spillover into nonagricultural uses and the high water savings possible with ET-based irrigation scheduling is irrigation of urban turf, such as parks, golf courses, and industrial and residential landscapes. For instance, eight golf course irrigators interviewed realized an average annual per firm benefit of approximately $20,000, and the annual CIMIS-related water savings of ten municipalities (mainly public park irrigators) totaled $1.75 million. Though intended as an irrigation management tool, CIMIS benefits may be at least as high in pest control as in irrigation. Pest control advisors (PCAs) claimed to cut pesticide use by as much as 40%, and up to 80% of the PCAs in some counties are estimated to be using CIMIS.

In addition to urban irrigation and agricultural pest control, the spillover of benefits has reached a host of other important activities. At least two California water districts use CIMIS ET data to set their block pricing structures for water. Many private and public weather reporting services and private weather equipment companies use CIMIS or sell software and hardware that use it. A vector control district uses CIMIS temperature

data to help control mosquito populations. Other users interviewed included a local fire department, an air quality control board, a geothermal power plant, a monitor of endangered tortoises, and a private investigator of auto insurance legal cases. In addition to the surveyed agricultural community, Kenkel and Norris's analysis would have more completely calculated the potential benefits of Mesonet had it investigated the potential nonagricultural users as well. The broad range of unanticipated benefits from CIMIS strongly suggests that producer user fees would not be the only potential source of revenue for Mesonet developers.

Conclusion

In recent years, economists have used contingent valuation surveys as a substitute for a lack of data which would reveal producers' preferences. This article argues that there are problems with willingness-to-pay measures in assessing a technology's market potential. Potential adopters are inexperienced, and users of a product are often followers who need to "see it to believe it." Therefore, asking people ex ante their willingness to pay without expressing to them the needs the technology will address and the potential benefits it will provide underestimates its value. Objective consideration of profitability (i.e., optimization model) may show the potential gains to be had with experience, providing an upper bound for actual willingness to pay.

Because of the limitations of their survey method and restricted population sample, Kenkel and Norris's results may be too pessimistic. Instead, their study's findings may be considered encouraging and not necessarily discourage investment. They show a significant willingness to pay on the part of agricultural producers despite a lack of knowledge of the potential gains. Their results are a signal to examine the value of Mesonet to other potential users as well as the change in value to agricultural producers at a later stage in the diffusion process.

[*Received October 1996; final revision received August 1997.*]

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