Economics and Interdisciplinary Collaborative Efforts

David Zilberman*

Research on environmental and resources issues is interdisciplinary by nature. For example, studying the economics of pesticides may entail working with both entomologists to address pest problems and toxicologists to address the human health problems associated with pesticide use. Interdisciplinary efforts require familiarity with the findings of other disciplines as well as direct collaboration with professionals in other disciplines. This paper presents a somewhat personal perspective on the issues that economists may encounter in interdisciplinary work. It also presents suggestions on how to increase the acceptance of economic thinking /theory by professionals in other disciplines. The paper starts with a theoretical discussion on relations between disciplines and between professions, followed by discussion of the issues affecting the relationships of agricultural economists with other professions.

On the Relation Between Economists and Members of Other Professions and Disciplines

Professionals are educated to perform specific tasks. Doctors prescribe medicine, engineers design highways and water systems, etc. As new tasks are identified, new professions are created to conduct them. Furthermore, over time responsibilities for tasks may shift or be shared between professions.

Economics is a relatively young profession, and agricultural economics is even younger. Traditionally economists have addressed prediction of market outcomes (prices), economic impact assessments, and macroeconomic policy design. However, some of the issues that are being addressed today by agricultural and resource economists have historically been assigned to other disciplines, and members of these disciplines are not necessarily happy with our invasion of their turf!

Academic research disciplines underlie many professions. The discipline investigates problems related to the responsibilities of the profession, and it provides methodologies and intellectual support for the profession. There is cross fertilization between disciplines, and the universe of disciplines changes frequently. The relationships between professions and disciplines are not straight forward. Not every profession is matched with a discipline, and even when matching is possible, it is not always clear which came first, the profession or the discipline. A discipline tends to address a larger set of issues than is addressed by its corresponding profession, and several disciplines may address the same problem from different perspectives. In particular, applied disciplines have their own notions and criteria for policy interventions, and these approaches guide the associated professions.

Understanding the essence of professions and disciplines is important in inter-professional and interdisciplinary work for two reasons. First, when economists address subject matter that has been traditionally studied and controlled by another discipline, members of this discipline may feel threatened and ready to protect their turf. A good example is water resource management. Historically this field has been controlled by engineers. Throughout the United States, managers

*David Zilberman is a professor in the Department of Agricultural and Resource Economics, U.C. Berkeley. This paper is Gianinni Foundation Paper Number 1091 (for reprint identification only).

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of State Departments of Water Resources are engineers, and the Army Corps of Engineers and the Bureau of Reclamation are both controlled by engineers. Now, as the construction of new projects is more difficult due to environmental and financial constraints, the efficient use of existing water resources is an objective of major importance. Agencies have to make tough adjustments, which may include replacing some engineers with economists or agronomists and emphasizing incentive policies rather than the construction of new projects. Such adjustments are difficult for those in directing the engineers employed at these agencies, and, obviously, they may resist such changes.

Furthermore, it is important to understand other professions and disciplines for another reason. Each discipline has a different framework for analyzing policy in the area it addresses. This policy framework is the result of an analytical approach and a world perspective which comprise the essence of the discipline, and, in many cases, these perspectives differ significantly from the perspective taken by economists. Economists assume that the world consists of economic agents who maximize profit or utility. Members of other disciplines may consider objectives other than profit or hedonic utility to be most important in determining human behavior. If, in their interaction with other disciplines, economists presume that behavior is consistent with only *economic* models, they may alienate these colleagues.

As an economist, I believe that pursuit of self interest is central to the behavior of everyone and that economics applies to almost every situation. But, effective collaboration with other disciplines requires that I make the effort to understand where others are coming from in order to build to build common ground. Economists cannot presume that they alone understand behavior because of economic theory.

An example illustrates this point. The field of public health was developed by sanitary engineers and medical professionals. The perspective of the discipline can be likened to that of a hospital nurse who seeks the elimination of all germs to prevent infection. Policy criteria developed public health professionals tend to be absolute, and it is very difficult for them to look explicitly at trade-offs between risks and costs. The famous Delaney Amendment which requires that food additives have zero health risks represents this type of thinking. Economists have to recognize this perspective and, at the same time, try to educate public health professionals about trade offs and the need for compromise, say, safety, in order to improve productivity. Presuming that we know best, ignoring other professionals, and aggressively advocating policies that are contrary to the foundations of other disciplines can only lead to alienation and a lack of communication. Instead, economists have to encourage dialogue and mutual exchange and acceptance.

Economics provides a logical way to balance different considerations and integrate the work of different disciplines. The essence of economic calculus is the balancing of different objectives under constraints. In order to do the calculus, economists need to obtain information from different disciplines that derive the technical relationship between objectives and identify some of the constraints. Thus, economic analysis to define an optimal pesticide regulation may involve an economist who should obtain data from agronomists, entomologists, and plant pathologists on the agricultural aspects, and from toxicologists and ecologists on the environmental aspects. Unfortunately, in many areas of the political reality, economists do not take charge of the complete analysis and are assigned to contribute only partially. For example, in the current regulatory process, economists assess economic impacts of alternative pesticide policies but are rarely asked to assess the complete environmental production trade offs associated with the policy set and their implications.

Currently, decisions regarding specific issues are too often relegated to particular professions or disciplines and they remain within distinct domains until some sort of constraint or crisis arises. For example, once a financial constraint is hit, then economics or law may become important. Members of other disciplines know their limits and recognize when they need to consult economists. In some cases, economics may be internalized to the working of another profession. For example, economic considerations are essential

in engineering, but generally engineers try to be self-reliant and they use economics in a limited way. In other cases, economists may be invited to address problems that members of another discipline feel unqualified to solve.

I believe this explains the institutional innovation called agricultural economics. Agricultural scientists, including agronomists and animal breeders, realized that they did not have the analytic tools to deal with budgetary issues or the allocation of resources between activities, and they encouraged the development of a new field to address these tasks. Thus, I believe that agricultural economics was originally developed, and is currently seen by many agricultural scientists, as glorified accounting. Agricultural economists are responsible for allocating resources between farm activities and for addressing issues related to marketing and trade, but they are not seen as experts on the management of *production* activities. This is left to agronomists.

With growing public concern for the environment, and realization of problems associated with externalities and the myopic behavior of producers, resource economists now have more to say about the production of crops. Excessive fertilizer use has led to groundwater contamination, and economists may be able to develop measures to assess excessive use and design incentive schemes that encourage farmers to use less. Obviously, however, when economists address particular production activities, such as the way corn is grown or the application of pesticides, they enter the territory of agronomists. Here they must be respectful, try to learn from the scientists, and make an effort not to impose preconceived notions about how things are done. It is most important to fully explain the purpose of economic research and suggest cooperation.

From my own experience and speaking with others, I believe that agronomists and agricultural scientists are relatively eager to cooperate once their perspective is acknowledged and they understand what the agricultural economist wants to accomplish and can offer. For example, entomologists and agronomists are very well informed about the problems of pest resistance, and they appreciate the contributions economists can make in developing a framework to deal with these problems. The notion of economic thresholds developed in the pesticide literature is an excellent example of interdisciplinary cooperation where economists have understood the production process and modified it so it is consistent with economic thinking. Applied agricultural scientists seek the help of economists in understanding why people fail to adopt new technologies or why farmers fail to follow the recommended practices.

Public health scientists are another group of professionals with whom agricultural economists have collaborated. Members of several disciplines are integrated under the heading of public health, including toxicologists, epidemiologists, and even hydrologists (who study movement of toxins in the ground). In one case Eric Lichtenberg, Carolyn Harper, and I needed estimates of the health risks associated with pesticide use, in order to develop models of the trade-offs between health and profit. Agricultural economists, public health professionals, and entomologists served on the same team. Our collaborators had strong mathematical backgrounds and scientific orientations and we found that the more educated we were about their work, the more productive was the collaboration. We also found that these scientists appreciated our ability to develop models which enabled them to present some of their findings in a more clear and statistically meaningful way.

Generally speaking, the main cause of friction among economists and agricultural, environmental, and public health professionals is related to policy recommendations and conclusions. As I mentioned earlier, for some public health professionals in particular, policy means *elimination* of pollution or risk, and they cannot accept the notion of compromise between conflicting objectives that is associated with economic thinking. Some environmentalists may suspect that economists will reach conclusions that compromise the environment and public health, and some agriculturalists may suspect that economists give up to easily to the environmentalists. Still, in our experience, natural scientists respect the rigor of economics and they seek the input of economists when it comes to statistical and technical issues. In essence they see economists as members of an important

complementary discipline and are ready and even eager to cooperate.

My experience has been quite different with engineers, especially in the water area. It seems they view economists as competitors who produce a substitute product. They see themselves as working on issues of resource allocation and management, and when economists come along with an alternative approach to management, they disagree and may also feel their income and status are threatened. Furthermore, some engineers perceive economists to be "soft" social scientists, who are inferior to the "hard" scientists engineers perceive themselves to be. Indeed, their mathematics may be more complex than ours. They appreciate accuracy to the tenth decimal point, and economists think more in terms of orders of magnitude. Some aspects of economics have been internalized to engineering procedures, and engineering firms may employ economists for targets of project assessments and cost benefit analysis, but it is clear in these situations who is the boss, and the degree of freedom that economists have is very limited.

This assessment of the relationship between economists and members of other professions can be verified by observing the role of economists in agencies controlled by members of other disciplines. Agricultural economists figure prominently in the USDA which has been controlled mostly by agriculturalists. They play in important role in the EPA, even though the environmental scientists set the agenda in this agency. But it is my impression that they are relegated a relatively minor role in the Bureau of Reclamation and the Army Corps of Engineers which are controlled by engineers. It seems that in these engineering-dominated organizations the main role of economists has been for cost benefit analysis for the construction of new projects, but they had very little input into the actual design and management of these projects.

Over the last several years things have started to change. Environmental considerations and the pressure for conservation have made economic thinking much more important in water resource management, and hopefully, will make economic analysis more important in the working of water management agencies. Economists played a major role in the evaluation of alternative policies before the recent California Central Valley Improvement Act. Water markets have become a very important policy tool and are perceived as a solution to water management inefficiency problems. Project finance considerations and water pricing are taken seriously and economists suddenly have a more important role even in the design of policies and guidelines for project development.

Because of their reliance on other professionals to obtain technical relationships, economists can serve as a link between different scientific disciplines that address similar problems. Again, water provides an interesting example. It is my impression that engineers have simple assumptions about water productivity, believing in fixed proportion production functions, and they design water systems accordingly. Economists introduced conservation considerations to water project design and have also introduced the key findings of soil scientists and agronomists to the water management framework developed by engineers. For example, economists were important in pointing out the savings associated with modern irrigation technologies and irrigation scheduling and the implications of aggregate water system design (see Boggess et al.).

Economists and Other Social Scientists

Thus far I have discussed mostly the relationship between economists and physical and natural scientists, but another group of professionals with whom we have to relate includes scholars of social sciences and the humanities. It seems that economists treat members of other social sciences, such as sociologists and political scientists, in much the same way engineers treat economists. We consider them "soft" and do not seek their input in the design of policy or systems. Economic models based on individuals' pursuit of satisfaction of needs are used to provide answers to policy problems, and we have very little room in our analysis to incorporate considerations of group affinity, cultural identity, habits and customs, and passions and emotions.

But, as economics becomes more important in the policy process and economists play a growing role in shaping environmental and resource policy, they are likely to realize that policies that make sense from an economic perspective are not

necessarily adopted. They must recognize that political, sociological, and psychological considerations have strong effect on the policy process and not accommodating these perspectives makes economics partial and not very useful. Furthermore, there is a growing recognition that the model of the "economic man" provides only a partial explanation for human behavior, and there is a growing need for information from other disciplines to obtain a more complete picture.

Notions and contributions provided by other disciplines are making a growing contribution to our profession. The psychologists Kahneman and Tversky altered the way economists think about choices under uncertainty. Ackerloff and Dickens introduced the psychological notion of cognitive dissonance to an economic decision making framework and demonstrated how it reverses well-established familiar policy recommendations. More importantly, there is growing recognition of the importance of legal institutions and political arrangements in resource allocation and the need for incorporating them in economic analysis.

Coase demonstrated how productive the integration of law and economics can be. He changed our thinking about environmental economics and increased the set of policy tools used by economists to include legal actions. His intellectual contributions paved the way for fruitful collaboration between economists and lawyers. Ostrum works on management of irrigation systems and other pioneering efforts in integration of political science and economics for natural resource management. The political economics literature (Rausser and Zusman) borrows heavily from models of political scientists and applies them to resource management problems. One of the main advantages of game theory is that it allows for better incorporation of political considerations in economic modeling.

Thus, economists are internalizing the economic tool kits, models, and notions from political science, law, and psychology. This increases the applicability of economics and the range of problems it can solve. Yet, cooperation with social sciences and the humanities is still limited. Important aspects addressed by sociologists and psychologists are ignored in economic models. The philosophical foundations that lead to environmental preferences are hardly considered by economists which makes dialogue with some environmental groups difficult, if not impossible. Academic institutions that promote interdisciplinary cooperation between social sciences are quite rare (California Institute of Technology is one exception), and, for the most part, economists still operate with much isolation from other social scientists.

To increase the relevance and accessibility of economic thinking, economists have to increase their interaction with other social scientists. One thing that makes it difficult is differences in style and modeling approaches. Economics has become very quantitative and mathematical, and access to economic writing requires more and more specific knowledge. Furthermore, economists feel ill-at-ease with things that are not quantifiable or are not presented within a formal mathematical framework. I believe that economics has become very formal and technical in order to legitimize itself as a *science* in the eyes of the natural and physical sciences. Now economists have a hard time with other social sciences that do not follow the same route, and that is sad and suboptimal.

Finally, it is instructive to assess how economists interact with one another in order to evaluate their interaction with other disciplines. It seems that the economics literature has become more and more technical and the journals more homogenous. In agricultural economics we have one only major issues-oriented journal, *Choices*, and other journals mostly emphasize methodology. Furthermore, the regional journals of agricultural economics have changed their names to eliminate any trace of parochial identity, and all present themselves as global and general and compete for the same sort of articles. I do not believe that this trend is healthy, and it hurts our performance as a profession and our ability to be accessible and relevant. Most economic journals have become inaccessible to economists, so, obviously, members of other disciplines do not feel welcome! Economists interested in particular policy issues relevant for specific regions, say water management in the southwest, have fewer publication outlets unless they emphasize solutions or analytic techniques. Debates presented in the professional

journals are more about techniques and methodologies than about issues, and, obviously, that is not inviting to members from other disciplines.

It is fine that a national journal such as the *American Journal of Agricultural Economics* emphasizes methodology, especially when it is accompanied with a journal like *Choices*. But I believe that the journals of regional associations should preserve some regional flavor and be accessible to members of regional organizations and serve as centers of communication and debate. It is amazing that none of the economics journals have letters to the editor, editorials, survey articles, or other pieces that are fun, easy-to-read, and accessible to the educated but general reader. We lack economics or agricultural economics journals that publish articles of different degrees of generality and sophistication (like *Science* or the *New England Journal of Medicine*) and of interest to audiences of varied interests and backgrounds. An important step for improving our interdisciplinary collaboration capacity is improving our communication channels.

Suggestions for Improving the Effectiveness of Economists in Interdisciplinary Collaboration

Economists have had some experience with interdisciplinary collaboration, and in the future this is likely to increase. However, in many cases the input of economists to decisions related to agricultural and natural resource management have been limited. They have provided some technical assistance rather than an overall integrating approach. It seems to me that agricultural and natural resources are sectors where the contribution of economics has not yet reached its potential, management strategies can be much improved if good economics is given the chance. We are challenged to sell ourselves better and improve our collaboration with members of other disciplines.

Demand for economic input in interdisciplinary efforts is in part limited because of competition from other disciplines and other reasons outside our control. But incorrect perceptions about what economists can offer as well as the conduct of economists themselves may also hinder economics from playing the role it deserves in many important decision making situations. By modifying our approaches and improving our communication efforts and image, we can benefit society.

First, we need to explain what economics is and how economists can help members of other disciplines. Almost every educated professional has had at least an introductory class in economics, but they still do not really know what economists do and how economics can help. Again, too often people see economists as glorified accountants, or as experts in cost benefit analysis, and they do not realize the potential of economics in designing systems, developing incentives, formulating policies, and presenting policy choices.

Second, economists must accept that other people simply do not think like economists (or even economic agents), and the do not take for granted some of the basic axioms of economics. One of the biggest challenges I face in interacting with professionals from other disciplines is convincing them that incentives work. In agricultural economics there is a large literature on why policy makers use direct controls rather than financial incentives to control pollution (Zilberman and Marra). But members of other disciplines are not convinced by the invisible hand and they doubt people will behave "correctly" unless told what to do. Therefore, I think it is important to collect convincing evidence to show how incentives work. By evidence I do not mean regressions to demonstrate the negative coefficient of price by running quantity on price and other variables. Rather, we need case studies and actual points of data to demonstrate how behavior changes with changes in price or economic conditions.

Similarly, not everybody is a devotee of markets, accepting their efficiency and good performance as givens. When we suggest market solutions or the introduction of markets, we should make every effort to document from case studies and previous studies that markets work. We should identify ahead of time some of the practical objections people will have to the use of markets, and we should design markets taking these objections into consideration.

Furthermore, many of the objections that non-economists voice to the use of incentives may

reflect real world problems that are not covered very well in economic theory. We have to admit that economics has a very elegant theory that comes up with many good answers, but it is far from perfect and it can be improved. In particular, we need empirical work to better understand the implementation of incentive schemes and markets. One approach that seems to be very promising in this direction is experimental economics. Improved computer software will be very useful for experimentation with alternative incentive schemes and alternative mechanisms and for finding methods to debug reforms before they are introduced in practice.

Another obstacle to the interdisciplinary use of economics is that we have developed a lot of methodologies and jargon for internal use, and many of our notions are not user-friendly or accessible. Sometimes we tend to be sticklers for detail and puritans, and we pay high costs in terms of communication. In communicating impact analysis, it is much better speak in terms of consumer expenditure savings, producer's income, and national or regional income, than in terms of consumer and producer surplus. Policy makers may be interested in welfare methods that are not rigorous or meaningful to us but are meaningful to them. They are interested in employment effects, regional impact effects, bankruptcy rates, as well as the impacts on consumer and producer welfare. We have to provide them with a menu of impacts so they can choose the ones that are most easily comprehended or the ones that are most relevant. Furthermore, when we provide impact analysis or other analysis we have to realize that models that were derived under assumptions of perfect competition and perfect labor markets have real world problems of which policy makers are aware. And, therefore, we have to pay attention to these issues. In a region where there is very little substitution for agricultural employment, conducting an analysis using producer surplus as a major measurement of impact on the producing sector is wrong economics, and is not credible to policy makers who recognize that the impacts on unemployment may be as important.

I think the most important issue we have to address is our tendency to abstract from reality and to rely on second-hand data and to remove ourselves from primary data collection and from learning and communicating with people associated with the problem. While we as a profession may be impressed with a production function estimated by the duality approach, someone who is good at such exercises may not be very useful when it comes to understanding the production of milk in the San Joaquin Valley. I think estimations based on primary variables, with good knowledge of the idiosyncrasies of the particular region and the production methods actually controlled by the decision maker, may be much more useful than elegant estimations that are not recognized in local situations. I personally think that it may be worthwhile in a lot of cases to make the structure complex and realistic and maybe simplify the analysis of the error and statistical specifications rather than to have sophisticated error term analysis with simple structure. Clients and members of other disciplines will not believe econometric results unless the framework seems reasonable and the tradition seems consistent with common sense and their own experience. Common sense and realism should be the main criteria in disciplinary research, but unfortunately often rigor and theoretical purity outweigh this criteria. So when we work with other disciplines our modeling standards will be different than when we develop models to be published in professional journals.

Interdisciplinary cooperation is both frustrating and beneficial. It is frustrating because members of other disciplines are skeptical about a lot of the concepts and beliefs that are at the heart of economics. The status of theories (and of individuals) changes when viewed from an interdisciplinary perspective, and that may leave the economist sometimes perplexed and insecure. On the other hand, an outside view of the profession is healthy and refreshing, and may lead to modification and changes in the way we work so we produce more useful, relevant, and truthful theories and models.

If there is one lesson that I have learned working with members of other disciplines, it is that relative to several other disciplines, economic theory is far removed from applied work, and theories in economics are held in much higher esteem than in other fields. In biological science the mere discovery of more raw empirical evidence is an end in itself. Someone who discovers a new species or a rare plant may do very little subsequent analysis

in order to get scientific credit. However, among economists the development of new data sources or documentation of how an institution works are of little value unless they are associated with detailed analysis. I am all for analysis, but it should not be an end in itself. It has to be connected to data that is grounded in reality, and exposure to the outside world and other disciplines is one way to assure that economics is more realistic and relevant as a discipline.

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