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THE SKILLS AND TRAINING NEEDED BY FARM MANAGEMENT RESEARCHERS IN THE FUTURE

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THE SKILLS AND TRAINING NEEDED BY FARM MANAGEMENT RESEARCHERS IN THE FUTURE*

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My assigned task is to discuss the skills and training needed by farm management researchers in the future. Note that there are a number of elements to this charge. First, there is the subject -- *farm management.* This, of course, is the business of managing farms. This excludes the work that many farm management researchers complete in agricultural policy or agricultural finance, except to the extent those efforts are aimed at helping farmers manage their farms. Next is the term *researchers.* My discussion will only cover those individuals involved in research, and not those involved in the actual management of farms. The training and skills of these two groups may be different, although in an increasingly complex world, farm managers must not only be able to interpret research, but to engage in exploratory research themselves. I will not discuss teaching or extension in farm management. These are important tasks, but are beyond my charge here, and are discussed in the paper on communication of farm management research results. I do believe, however, that the ability to interpret, if not complete research is important in both teaching and extension functions. *Training* I will take as what is required to obtain the *skills* necessary to complete successful farm management research. Finally, there is that apparently innocuous term -- *the future.* This implies that the skills needed for the future may be different from the skills required to do successful farm management research today. The inclusion of the term *future* gives me considerable leeway in my presentation.

My order of presentation for the remainder of the paper will be to first briefly discuss the future of agriculture, to say something about farm management research, and

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then to discuss the skills necessary to do successful farm management research and the training necessary to acquire those skills. Finally, I will say something about the resource mix necessary for the completion of farm management research.

The Future

Before I discuss what skills and training are necessary to do successful farm management research, it might be useful to discuss what the future will look like in terms of farming and the institutions that support agriculture. In my work on technology assessment, I have encountered the work of futurists (Tauer). It seems to me that the primary requirement for being a successful futurist is that you must have the ability to tell a good story -- although McCloskey makes the same claim for economists.

I doubt if my vision of the future is much different than the vast majority of you. The handwriting is on the wall, so to speak, and current trends will continue. We will have fewer farmers. We have gone from 6.8 million farms in 1935 to approximately 2.2 million farms today, so that any future reduction, at least in absolute terms, will pale in comparison. The labor exodus and resource adjustment that will occur will be much smaller than what has occurred in the past. Fewer counties are agriculturally dependent. Thus, the policy implications are different.

Yet, the impact on farm management research may become more significant if we go from 2.2 million farms to, say, 200,000 farms than when we dropped from 6.8 million farms to 2.2 million farms. For example, there has always been one-on-one research work with individual farms, using them as a demonstration farm for the neighborhood.[1] It was never feasible to work directly with every farmer. With future communication technology, that may change. Interactive communication may allow us to "visit" and communicate with a large number of farmers, solving each of their unique research

[1] In some instances, one-on-one work was due to the political clout that particular farmers may have had with state legislatures. By selecting those farmers, we practiced political economy.

problems. The implementation of these new technologies will be challenging but useful and productive. Many of these efforts will spin off as cooperatives or other institutions, similar to the Dairy Herd Improvement Programs (DHIA). A harbinger of this is the various integrated pest management programs currently operating. As the arrangements between farms and input and output firms become more complex, management advice will become a significant component of the goods and services flowing between firms.

Of continued importance will be the dichotomous split in farm sizes. We will continue to see a larger number of small farms that produce little of our aggregate food needs, and a smaller group of large farms that produce the bulk of the food. As is true today, the farm management needs of the two groups will differ. Even within the small-farm group we will see two different types of farmers. One will be a farmer who has a part-time operation and who very much depends upon that farming operation to generate some income to support the family. The other will be what Stanton has labeled the "residential farm." Most of these will have sufficient income from other sources that will permit the farm to be operated much differently. A lot of these hobby farms surround urban areas, but many will be in the mountain valleys of the West. This more affluent group will not find "resources" so scarce that they need the skills of an economist to economize on the use of inputs.[2] In contrast, they may make heavier demands on our colleagues in the production departments to help them understand and manage the production of crops and animals.

Determining the emphasis we place on these various client groups will be one of our challenges of the future. If our task is to maximize the increase in social welfare, our efforts should be focused on the smaller group of farmers that produce the bulk of the commodities. As long as the sector remains competitive, increasing the efficiency of that

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[2] It might be rightfully argued, however, that the only thing different is their objectives (besides, of course, available resources), and good farm management research can assist them in fulfilling their objectives.

group will be transmitted through lower food prices, hence increasing consumer welfare. However, the political economy arena might necessitate that we devote a large amount of our scarce resources to the larger group of small farms. It would be futile to set as our goal social welfare maximization (as traditionally defined) if the process of accomplishing that goal reduces our own numbers such that we are less able to accomplish that goal.

Although many might argue otherwise, I think further commodity specialization will occur, both at the farm level and regionally. In contrast, diversification will occur in production practices, at least regionally. This is evidenced by the concept of "sustainability." The required farm management skills might be greater for production than for product diversification. The necessary management skills are not as great when using moldboard plowing, conventional tillage, and prophylactic pesticides to produce corn as when utilizing some of the termed "sustainable practices." With some slight changes -- i.e., 30-inch or narrower rows rather than 38-inch rows, or some new pesticides -- farmers do what their parents did. The big decision is whether or not you should plant corn before April 21. Contrast that to a concept such as integrated pest management -- where information has to be collected, analyzed, and used to make decisions -- or switching to variable tillage tactics.

We will undoubtedly see more vertical integration in agriculture, or, as those who recently rediscovered this concept call it, "the industrialization of agriculture." As genetic engineering progresses, there will be more integration of the development, production, and marketing process of the unique products possible with those techniques. "Designer" crops will evolve. As more transactions occur outside the centralized marketplace because of these developments, the research concepts of transaction costs and principal/agent theory will be of relevance in farm management research. As central markets diminish, an increasingly common question asked by farmers will be, "Is this a good price?"

Farm Management Research

We first need to make a distinction between farm management and production economics. The two are often grouped together. In the AAEA survey of agricultural economics literature, Jensen surveyed farm management and production economics for 1946-1970. His discussion not only focused on farm management research assisting farm decision-makers in the best use of their resources and testing traditional and developing theory on postulates of the firm for improving farm management, but also focused on policy research, often the emphasis of production economics. A visionary discussion of the subjects was completed a few years ago by Glenn Johnson. Many of the handicaps he foresaw from this grouping continued to materialize during the following three decades.

Unfortunately, for some, farm management research *is* production economics. It is rather telling when they advertise a graduate degree in farm management and production economics. Most graduate programs have courses in production economics, but few have courses defined as farm management. Ever since the famous (and now maybe infamous) meeting at Black Duck, Minnesota, farm management and production economics have been closely linked. There is some belief that the linkage or association of farm management to a production function may have hindered the development of farm management to be a useful field to assist farmers in making management decisions (Upton). The production economics paradigm is only one of many models of the decision-making process. Much farm management research is based upon the concept of a production function, but other approaches can be useful in helping to understand the management process.

Farm management entails decision-making. That encompasses all of the functions specified by the various schools of thought to make those decisions (i.e., goal setting, information collection, planning, implementation and evaluation). Farm management research entails studying that decision-making process in order to improve the process or design mechanisms to assist managers. Thus, for instance, farm management

research would entail evaluating various decision-making techniques under risk, or designing and implementing a farm business summary program. Most of the farm management research done by the profession is a study of the results of management factors related to various measures of net return. We do less research on the management process itself. More focus should be placed on identifying what makes good management and how we can teach people to be good managers. Efforts such as the Inter-State Managerial Study completed in the 1950s is needed to more clearly understand the farm management decision process (Johnson, Halter, Jensen and Thomas).

Farm management research will continue to consist of both problem solving and disciplinary work. The disciplinary work will continue to be centered in the universities, with some problem-solving efforts primarily to test the developments in the disciplinary work and to train M.S. students. Less problem-solving work will be completed at the universities as the number of farm management faculty decreases. That means much of the problem-solving research will have to be completed outside the university in various organizations and institutions. Increasingly, crop or animal production associations will be formed to complete problem-solving research. Although research in agriculture benefits all of society, there will continue to be less public support for it. Even if individual farmers cannot justify research efforts, coalitions of farmers can, especially if the results of the research gives them a competitive edge against other farm groups.

Necessary Skills

To be a successful farm management researcher you must understand the industry and have sufficient knowledge of economic principles and theory to allow you to economically analyze researchable problems. You also need communication skills and the management skills necessary to manage your own research program. Some might argue that you also need training in psychology, law, etc., since farm management is not a discipline unique to economics. Obviously, knowledge in those areas would be useful, but

one cannot be an expert in all areas. Consistent with the concept of "transaction costs," it is much better to have the communication and management skills that allow you to work with a multidisciplinary team of experts that embodies the necessary subject matter skills for the research task at hand than try to master that knowledge yourself.

Let's start with a knowledge of the industry. Traditionally, most farm management researchers grew up on a farm or ranch, studied agriculture at a land grant school, then pursued a graduate degree in agricultural economics. There are now fewer farm-reared children, so it is believed that we can no longer depend upon this traditional path for our supply of farm management researchers. This traditional supply route may not be the general source of agricultural economists, but may still be the source for many agricultural economists specializing in farm management. We not only have fewer farm-reared students but we also have fewer farm-management-interested graduate students, and the ones we have appear to be farm-reared.

We can debate this, but it really is a moot point. You do not have to be farm-reared to be a successful farm management researcher, but you do need a knowledge base of the industry. Too many economists working on agricultural problems lack that knowledge. This lack of knowledge is not overly prevalent in farm management researchers, but can be found in production economic researchers who work on structural or policy research. Too often they apply sophisticated research techniques to a trivial problem, or develop a naive model of the industry. The analysis is often elegant and gets published because the reviewers are in the same mode. No one knows enough to call the work empirically useless. This continues because researchers learn that what appears to be valued is the artistic use of methods, not the usefulness of the analysis.

To be successful requires a knowledge of economic theory. This is not the knowledge of economic theory of the '50s, '60s, or even the '70s. Like agriculture itself, economics does make technological improvements. A farm management researcher would not dream of using animal traction as the power available for machinery in

analyzing a "modern" farm, but many continue to use technologically antiquated economic tools. At the same time, some new agricultural technologies prove to be nonviable when put to the test. Others prove to be useless.

This means that a necessary skill is the ability and willingness to continue to learn. I am surprised how many farm management researchers believe that what they learned in their Ph.D. program is all the economics they will ever need to know for the duration of their career. As justification, they often label the new economics as nonsense or useless. I often wonder whether this belief occurs in the biological and physical sciences (I presume it probably does). I tend to think that those who fail to continue to learn really were not interested in research or a graduate degree (which is a research degree) in the first place. They simply wanted to teach and needed the calling card of a Ph.D. degree to do so.[3] Finally, also necessary are learning the evolving research tools in statistics and mathematics to apply economic concepts to research problems.

Current and future economic theories that may be necessary to do successful farm management research now and into the future are discussed in the other papers at this conference critiquing the various management schools of thought. These should convince you that useful techniques are developed from numerous subject disciplines. My brief assessment of these techniques from the economics discipline is contained in an appendix. It can be very productive for us to reach out to other disciplines for ideas. As we do, our own economic theories will evolve to better analyze economic problems.

I do believe we need to again become empiricists. As in general economics, too much of our model building is done in the ivory tower, with little or no verification. Our elegant, logical models are often not relevant for the real world. Less elegant but more empirically sound models may be more useful.

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[3] A rational decision for even a good researcher, however, may be to halt his or her own knowledge-building five to ten years before retirement and depreciate that knowledge. This may even be optimal for the institution employing the economist because personal knowledge-building reduces current productivity (according to our own adjustment cost models).

Training

Training can be formal or informal. Many believe that the vast majority of their knowledge or skills may have been acquired in formal training, but the vast majority is probably acquired informally. The purpose of formal training is to develop a base of knowledge on which one can informally build through the years. The process of performing research itself is building your knowledge informally and, hopefully, increasing the knowledge base of society. One can view the whole process as an optimal control problem. The initial starting value of the state variable (knowledge) is important, but the control (knowledge-building) is more important in determining the value of your contribution over your lifetime.

I would be considered amiss of my charge if I did not discuss what I thought constitutes necessary training in a graduate degree in agricultural economics. Before I do that, I would like to state what the undergraduate degree should consist of. It seems to me that too many agricultural degrees consist of mostly technical courses and are too narrowly focused on agriculture. Science is more important than technical courses. The same way that I cannot see why an humanities student cannot take a few science and mathematics courses, I do not understand why an agricultural student does not take humanities courses. I do not think that a third course in farm management is as useful to a student's professional and social lifetime as one course in philosophy.[4]

A student entering a graduate program in agricultural economics needs undergraduate training in economic theory and mathematics. This does not require an economics or mathematics degree. The two economic principles courses and intermediate microeconomics and macroeconomics, with one economic application course, should be sufficient undergraduate training in economics. The mathematics should include courses in calculus, linear algebra, and statistics. The calculus should include optimization

[4] Of course, the rent-seeking value to the farm management faculty may be greater with the student taking the third course in farm management.

(constrained) as well as differential equations. Knowledge in analysis and topology can be picked up at the graduate level.

Many students apply to our graduate programs without previous course work in agricultural economics. The only absolute requirement is that a student be bright and creative. The ability to be creative and solve problems is critical. Many bright students can go through undergraduate programs with good grade records without the necessity of showing problem-solving creativity. They simply memorized the material.

Let's discuss the M.S. degree in agricultural economics. First, let me assure you that it is possible to complete good farm management research with a M.S. degree only. The problems investigated may not require the same level of analysis as a Ph.D.-level problem, and very little of it will be disciplinary knowledge-expanding, but it can be good, solid research. I should state that I also think the M.S. in agricultural economics is a research degree. That does not mean that its recipient will not be involved in management or sales, but the training is in research skills and techniques. I think it is inappropriate to take M.S. degree programs and try to turn them into management degrees, as many schools are currently doing. There are numerous M.B.A. programs whose purpose is to teach management principles and concepts. Our absolute or comparative advantage is not in that area. To do so in order to expand our domain or to survive is wrong.

A good M.S. program should consist of eight courses and the completion of a research thesis. These courses should consist of a statistics course, an econometrics course, and a mathematical-programming (linear-programming) course so that the student learns the basic research tools. In the agricultural economics area, these should be a production economics course, a marketing course, and a resource economics course. These should be broad-based M.S. courses in those subject areas. That leaves two courses for the student to choose. Notice that I do not list a course in farm management. I would recommend a M.S.-level farm management research course, but very few departments offer

such a course. I doubt that the demand would be sufficient. A survey of farm management research may be picked up as an independent reading course.

The Ph.D. program would consist of the M.S. courses and an additional sixteen courses. First would be two courses in microeconomics and two courses in macroeconomics. Also included might be mathematics for economists, if the student has an insufficient mathematics background, and then mathematical economics. Another course in econometrics and one in dynamic optimization would be appropriate. Doctorate courses in production economics, marketing, and resource economics should be taken. Probably three courses would be necessary for an outside minor. Management from the business school would be an appropriate minor (Ph.D.-level courses, not M.B.A. courses). That leaves three or four elective courses for the student. Among those electives, I would recommend a course in the philosophy of science (from the philosophy department). A course in ethics would be useful if not taken previously at the undergraduate level. Given the current research emphasis on environmental issues, courses in environmental science would also be useful.

Looking at my recommendations, one would conclude a fairly traditional program. Maybe so, but the courses would cover state-of-the-art topics. In microeconomics, that includes the new economics of the firm. The macroeconomics should include both disequilibrium (Keynesian) and equilibrium models, as well as growth theory. Production economics includes duality and risk; dynamic optimization includes stochastic control theory. Too often graduate courses are taught by those not current with the literature. That may explain why faculty with recently acquired Ph.D.s are assigned to graduate courses. However, their own Ph.D.-received theory can become dated very quickly.

After the Ph.D. is earned, learning must continue. For most people, the rigor of a Ph.D. program has taught them how to study and interpret the literature. However, they must still read the literature. Unfortunately, many of these articles are very technical and

difficult to read. The *Journal of Economic Perspectives*, published by the American Economic Association, has addressed that barrier by publishing symposia and review articles written for those outside a specific area. A number of the regional agricultural economic association journals are also inviting submissions around themes or reviews.

In addition, the AAEA has been offering short courses before the summer meeting as training in specific topics. I do not know how successful these have been. In principle, they are of the right duration (2-3 days).

The academic sabbatical every seventh year has historically been the time to refresh oneself in a discipline. With the two-career family becoming more of the norm rather than the exception, with one spouse often a nonacademic, a sabbatical leave is becoming less of an option. What probably should be utilized are mini-sabbatics of a month or so duration. It seems that more departments are funding visiting professorships. Especially for a small department, the value to the residential faculty can also be enormous.

Research Personnel Mix

I was also given the topic of discussing the appropriate mix of research personnel and other resources in the future (i.e., faculty versus research support people). I think most of us would agree that for much of our work we are not using an appropriate mix of resources, although I do think we are efficient with the allocation that is provided to us.

Most state governments provide funding for the faculty line, office space, some secretarial support, a calculator, and supplies. Computer resources used to be a scarce resource but have become relatively cheap and plentiful, in some cases replacing the state budget line for calculators. Nonfaculty research personnel are rarely budgeted by the state and must be secured by grants and contracts. Grants and contracts in farm management *per se* are relatively rare. Thus, we do with what we have. This is reflected in our research programs.

Being Ph.D.-heavy may explain the type of research we complete at universities. There are calls for more problem-solving research than the disciplinary-expanding work that is published. However, the absolute and comparative advantage of the Ph.D. researcher working alone is disciplinary work rather than the problem-solving work, where a significant component of the research may only require M.S.-level training and possibly a number of man years of that.

I earlier stated that less problem-solving work will be completed at the universities as the number of farm management faculty decrease. It is inevitable that the number of farm management faculty will decrease with the continued downsizing of land grant universities. That does not necessarily mean that problem-solving research needs to diminish. Although grant and contract work in farm management research has historically been small -- most of our work being funded by federal and state money -- there is no reason that contract work cannot expand. There is a need for problem-solving research, and if university faculty show the ability to efficiently complete this type of work, the commodity and organization groups will utilize university facilities. This will change the composition of our research portfolios and raise questions concerning the appropriateness and necessity to complete this research at universities, an inquiry that is ongoing in other disciplines. Again, whether these are the most appropriate research agendas may be a moot issue if the alternative is to do little research at all.

Contract work should allow a more appropriate mix of personnel since each contract would be written to provide the resources necessary to accomplish the objectives of the project. Many faculty will find themselves research managers rather than researchers. Many faculty would use contracts to support graduate students. This may be necessary, but it is inefficient. Supervision of graduate students is foremost an educational activity. Completion of good contract research in a timely manner often requires the use of experienced and trained personnel.

The resource mix at nonacademic institutions is probably more optimal. The research director may have a Ph.D., but most of the researchers have M.S. degrees. This is appropriate given the mostly problem-solving research that is tackled. One might argue that the actual research selected is not the most useful, given alternative research problems, but much of the efforts of research departments is to service the requests of the executive departments.

Conclusions

I think most people would conclude that my suggestions and recommendations for the skills and training needed by farm management researchers in the future are conservative, primarily maintaining the status quo of a good graduate program. There are few revelations as to the knowledge necessary for the future. Yet, I hope I have prescribed what training and skills are necessary to be a successful researcher. It is similar to what we prescribe to farmers. Obtain the latest information possible in a formal education, but in that formal education the most important skill you acquire is how to learn and appreciate knowledge. Then, during your lifetime continue to learn. It is impossible to predict the specific research technique that will be needed throughout the working life of a farm management researcher. It is possible to conclude that those skills will change, and the researcher who begins well trained and has the desire and motivation to continue that training will be successful during his or her career.

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APPENDIX

THE ECONOMICS OF THE AGRICULTURAL FIRM

Most empirical work on the economics of the agricultural firm assumes that the firm optimizes a functional goal subject to a production set. The functional goal is typically to maximize profits or minimize costs, with the production set defined by a production function. To incorporate decision-making under risk, a utility function is substituted for profit, and expected utility is maximized subject to the production function. The current approach to obtaining output supply functions and input demand functions very much depends upon the firm as an optimizing entity subject to a production function (Chambers).

There have been numerous criticisms of this approach (Winter). They have centered on whether the firm's goal is to optimize and whether the firm has satisfactory knowledge of the production possibility set to choose optimal points from that set.

The validity of optimization was initially scrutinized by Simon, who felt that a more appropriate behavior concept was that of "satisfying." Since then, alternative paradigms have been proposed to explain the decision-making process of the firm (Stiglitz). Others have proposed alternatives to how a firm searches for feasible or desirable production plans (Williamson and Winter). These theories generally fall under the concept of bounded rationality. Firms are rational, but they do not have perfect information that allows them to select optimal plans. The results are decisions that deviate from the profit-maximizing paradigm.

Although the specification of the firm as a profit-maximizing production function may have permitted successful insights into the market system, this approach has not contributed much to our understanding of the decision-making process of the firm itself. Since much of economic activity occurs within firms rather than between firms, it has become apparent that organizational theory of the firm is an important topic if

economists wish to understand an economy. Therefore, economists have recently been concentrating on decision-making and efficiency of the firm (Williamson and Winter). Unfortunately, this effort has not occurred to much extent in agricultural economics, either in our coursework or our research programs (Caswell and Cotterill).

The importance of understanding the economics of the agricultural firm can be illustrated by the example of sustainable agriculture. Many agricultural practices defined as sustainable entail the substitution of management and information for chemicals. Thus, for instance, an integrated pest management practice requires farmers to monitor pest infestation (information) and make decisions concerning control (management). In contrast, many strictly chemical-control options require less information and management to implement, especially if the chemicals are used as a prophylactic. The issue is the ability of farmers to successfully utilize the defined sustainable practice given the additional requirements; the costs to farmers may be greater than the chemical alternatives. However, the social costs to society of chemical use could be higher. This is typically discussed in the context of incomplete markets, where farmers do not bear the full externality cost of chemical use. However, rather than try to internalize these costs through laws and regulations, policy-makers hope to be able to encourage farmers to adopt sustainable practices through educational programs (to improve farmers' managerial abilities and, thus, lower cost) and by providing subsidized programs to reduce the cost of acquiring information (i.e., scouting). The issue is that until the decision process is analyzed at the firm level, the conditions are not known under which type of approach would be the most successful.

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