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The Future of Teaching Undergraduate Agricultural Economics: Lifelong Learning in an Era of Rapid Technological Change

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The need for institutions of higher education to teach students of all ages how to think, synthesize ideas, and assimilate new information has become crucial in the information age. Analytical ability is increasingly important, not only for traditional university clientele of young adult residential learners, but also for productive individuals throughout their lives. Agricultural economics teachers must invest in the acquisition of new skills and knowledge, including a willingness to change traditional teaching structures and institutions, to take full advantage of the huge opportunities and challenges of the massive changes in technology and the economy. This paper considers how well teaching programs in agricultural economics enhance student learning.

Key words: agricultural economics, extension, teaching, undergraduate education

Introduction

The agricultural economy of the United States is in a state of massive and rapid transition. Recent advances in information technology, biotechnology, and the organization of agribusiness firms have resulted in unprecedented change in the food and fiber industry. In this era of rapid change, agricultural economists are well suited to provide increasingly useful and timely information and knowledge to agricultural producers, agribusiness firms, consumers, policy makers, and participants in the policy process. Teaching and learning the economics of agriculture have never been so important and interesting.

Globalization and information technology have increased the value of solid economic skills and knowledge of agricultural markets. However, teachers of agricultural economics must continuously reinvest in the ability to provide useful and marketable skills to students. This paper investigates the current state of education in agricultural economics, and the urgency of our ability to provide increasingly important skills and knowledge to participants in an information-based economy. The analysis uses simple economic principles to analyze the current state and explore the optimal future path of teaching in the agricultural economics profession.

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First, the theoretical foundations of the demand for higher education are explored, with an emphasis on monetary rewards and large social benefits associated with undergraduate degrees. Second, a simple model of lifetime earnings is used to illuminate "who, when, and where we teach." Next, a critical examination of "how we teach" is provided: distance learning, class size, and student and teacher motivations are explored. Finally, essential changes in "what we teach" are proposed. The paper concludes with 10 recommendations for positive change in teaching programs in agricultural economics.

An Economic Analysis of the Demand for Higher Education

Two models of higher education are developed to analyze the future of teaching undergraduate agricultural economics. First, consider the economic approach to higher education. Here, the source of employment and earnings in the agricultural economics profession is the derived demand for college professors, who can be considered to be an input into the educational production function. The demand for higher education is large and growing. Enrollment in both public and private colleges and universities in the United States grew from 4 million students in 1965 to 11.2 million students in 1997 (U.S. National Center for Educational Statistics). The percentage of the U.S. population with a college degree increased from 9.4% in 1965 to 23.9% in 1997 (U.S. Department of Commerce, Bureau of the Census). These enormous increases in the demand for higher education have been due primarily to the large economic rewards associated with a college degree. A vast literature reports the economic benefits to higher education are substantial (Pascarella and Terenzini). Large financial benefits have attracted new students to enroll in college, resulting in a steady demand for college professors.

Impure Public Good Model of Higher Education

Teachers of agricultural economics provide students with marketable skills and knowledge that allow them to prosper in their selected career (Barkley, Stock, and Sylvius). Not only are private returns to education high, but public returns to education are also significant (Friedman; Galbraith; Stiglitz). Education can be classified as an *impure public good*, meaning education has characteristics of both private and public goods (Cornes and Sandler). To investigate further, a simple model of education as an impure public good is developed, following Cornes and Sandler, and Heisey et al. Assume an economy has N individuals ($i = 1, \ldots, N$) who seek to maximize utility (U) by spending income (I) on two goods: an aggregate consumer good (y), and education (e). An individual i derives utility from purchases of the consumer good, school, and from the aggregate education level (E):

$$U_i = U_i(y, e; E). \tag{1}$$

For the moment, the variable E is defined simply as the aggregate level of education across all individuals: $E = \Sigma_i e_i$. The individual's budget constraint is given by $I_i = p_y y + p_e e$, where p_y and p_e are the prices of the aggregate consumer good and education, respectively. If we further assume that society's level of education (E) is a public good at all levels of E, and that individuals follow Cournot-Nash behavior which assumes all

other individuals' educational attainment is exogenous (let $E^* = E - e_i$), then the individual's optimization problem is:

$$\max_{y,e} U_i(y, e; E^* + e_i), \quad \text{s.t.: } I_i = p_y y + p_e e. \tag{2}$$

As demonstrated by Cornes and Sandler, the first-order necessary conditions imply:

$$(U_e + U_E)/U_y = p_e/p_y. \tag{3}$$

These first-order conditions indicate that when individuals do not take into account the impact of their own investment in education on other individuals in the economy, they tend to underinvest in education. Public subsidies to higher education and funding of public universities are justified by the public-good nature of higher education.

Perhaps the most interesting feature of this model is the term U_E, the individual's marginal utility of societal education. This term reflects the idea that societal knowledge and educational attainment influence the well-being of individuals within the society. Restated, education exhibits a *network externality* (or *network effect*): the value of a product to one user depends on how many other users there are (Shapiro and Varian, p. 13). An individual is assumed to be better off when other people have greater knowledge and understanding ($U_E > 0$). Put differently, education is considered to be a public good.

We can push our simple model further by relaxing the assumption of the simple aggregation of individual education into the aggregate measure of education ($E = \Sigma_i e_i$). Literacy, basic life skills, and knowledge provide huge network externalities to the economy; individuals who lack these skills are typically unable to take advantage of the opportunities provided by a high-income market economy. Therefore, we can assert that the gains to society from education are highest at the primary level, or that societal gains from education increase at a decreasing rate for aggregate educational levels:

$$E = E(e_1, \ldots, e_N). \tag{4}$$

Gains to society are represented as $E_i = \partial E/\partial e_i > 0$, $E_{ii} = \partial^2 E/\partial e_i^2 < 0$, and $E_{ij} = \partial^2 E/\partial e_i \partial e_j > 0$. As education increases, the incremental benefit to society via the network effect decreases. It is possible E could decrease at high levels of e_i, if a highly educated individual had difficulty getting along with others in society, due to snobbery or poor communication skills. The term E_{ij} is assumed to be positive to reflect the network effect, or public-good impact, of education.

Recent innovations in information technology and the globalization of markets increase the return to education. Specifically, higher levels of knowledge and skills, together with specific knowledge, provide large rewards in a highly computerized, globally integrated economy. In mathematical terms,

$$E = E(e_1, \ldots, e_N; t), \tag{5}$$

where technological innovation (t) shifts the entire E function upward, reflecting higher societal returns to education when new innovations are introduced and adopted. This concept supports the previous work of Schultz (1961); Griliches (1957, 1964); and Welch. Huffman found that farmers with higher levels of education adopted technology more quickly, and as a result were made better off relative to those with lower levels of education.

Education: An Investment in Human Capital

Education has been characterized by economists not only as a public good, but also as an investment in human capital (Becker 1975; Schultz 1961). Simply stated, an individual invests in human capital by giving up pecuniary benefits today in order to receive greater economic rewards in the future. The incentive to invest in higher education is enhanced in periods of rapid change, because the returns to education increase in times of economic disequilibrium. Therefore, the number of students enrolling in college is likely to increase as the economy continues to become more global, more technological, and more market-oriented.

Higher returns to education provide an incentive to invest in human capital as early as possible during the work life (Becker 1975, p. 100). Also, the accumulation of human capital results in higher earnings, which increase the opportunity cost of time, and therefore make further investments in human capital more costly. Another feature of a rapidly changing economy is the need for workers to continuously reinvest in human capital to maintain their economic position. Without reinvestment, human capital depreciates because (*a*) unused knowledge may be forgotten over time, and (*b*) marketable human capital may become obsolete if technology changes.

The theoretical model of the economics of higher education, together with the human capital approach to education, highlights four implications for teaching of agricultural economics:

1. There is an important role for the public sector in the provision of education.
2. Rapid societal change increases the economic and social value of education.
3. Early investments in education are more valuable than later investments.
4. Individuals must continually reinvest in education, or risk becoming obsolete.

The first implication was derived and discussed above. The remaining implications are discussed below, in sections about who, when, where, and how we teach.

Empirical Estimates of the Returns to Higher Education

The models above feature high rates of private and public returns to higher education. To discern the magnitude of these returns, empirical estimates can be made of the private returns to higher education over an individual's lifetime. This is accomplished by comparing the annual income stream of an individual with a college degree to the income stream of a person with a high school diploma. Public returns to education (E) are difficult, if not impossible, to calculate, although the overall standard of living in an economy is likely to be a reasonable measure of this type of network externality.

To illustrate the economic benefits associated with higher education, age-earnings profiles were estimated for the 17 Western states. Cross-sectional data at the individual level on annual income, age, educational attainment, and gender were collected from the March 1999 Supplement of the *Current Population Survey* compiled by the U.S. Department of Labor/Bureau of Labor Statistics. Following the work of Mincer (Mincer; Rosen), age-earnings profiles were derived for both males and females with different education levels using multiple regressions of the following structure for individual i:

Table 1. Summary Statistics of Variables Used in the Annual Earnings Regression: 17 Western U.S. States, 1999

	Males (n = 7,391)				Females (n = 5,244)			
Variable	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
AGE	41.435	9.865	25	65	41.396	9.717	25	65
ANNUAL EARNINGS[a]	43,720	43,501	1	419,044	28,424	26,880	1	402,204
Highest Education Attained:[b]								
High School	0.321				0.321			
Some College	0.229				0.251			
Associate's Degree	0.043				0.051			
Bachelor's Degree	0.239				0.227			
Qualitative (0–1) Variables for State of Residence:[c]								
Arizona	0.044				0.047			
California	0.243				0.238			
Colorado	0.051				0.053			
Idaho	0.041				0.036			
Kansas	0.038				0.040			
Montana	0.039				0.035			
Nebraska	0.041				0.039			
Nevada	0.046				0.045			
New Mexico	0.049				0.048			
North Dakota	0.031				0.038			
Oklahoma	0.039				0.041			
Oregon	0.035				0.035			
South Dakota	0.037				0.038			
Texas	0.145				0.155			
Utah	0.040				0.034			
Washington	0.041				0.041			
Wyoming	0.040				0.035			

[a] Annual earnings are gross, nominal earnings in 1999 dollars (U.S. Department of Labor/Bureau of Labor Statistics).
[b] The mean represents the percentage of the sample from each category of educational attainment.
[c] The mean represents the percentage of the sample from each of the 17 included U.S. states.

$$ANNUAL\ INCOME_i = \alpha + \beta_1 AGE_i + \beta_2 AGE_i^2 + u_i, \tag{6}$$

where u_i is the error term. Summary statistics of the data are reported in table 1 for males and females in four educational categories: high school, some college but no degree, an academic associate's degree (not vocational), and a bachelor's degree. The regression results presented in table 2 demonstrate statistically significant relationships between age and earnings for all but two levels of education: the annual incomes of high school and associate's degrees for women were not statistically related to age.[1] The earnings

[1] Regression diagnostics revealed collinearity between the variables *AGE* and AGE^2. Collinearity was judged potentially degrading if the condition index was greater than 30 (Belsley, Kuh, and Welsch). In the eight earnings regressions reported in table 2, the condition indices ranged from 71.2 to 83.1. Collinearity does not bias the estimated coefficients; it simply reduces the level of statistical significance. The high degree of statistical significance of these variables demonstrates that collinearity does not affect inferences made from the parameter estimates, with the possible exception of the insignificant parameter estimates for females with high school and associate's degrees (Belsley, Kuh, and Welsch). The estimated coefficients presented in table 2 have been corrected for potential heteroskedasticity using White's heteroskedasticity-consistent estimator.

Table 2. Earnings Regressions by Gender and Level of Education Attainment: 17 Western U.S. States, 1999
[Dependent Variable = *GROSS ANNUAL EARNINGS* ($ 1999)]

Education Level	Mean of Dep. Variable	No. of Observ.	Intercept	*AGE*	AGE^2	Adj. R^2	Model *F*-Test
MALES:							
High School	31,782	2,371	-14,941	1,908***	-17.6***	0.03	31.4***
			(-1.62)	(3.98)	(-2.98)		
Some College	36,731	1,691	-11,624	2,046***	-20.0***	0.02	20.8***
			(-1.20)	(4.21)	(-3.45)		
Associate's Degree	39,602	316	-22,087	2,650**	-26.5**	0.05	8.6***
			(-1.20)	(2.78)	(-2.27)		
Bachelor's Degree	51,786	1,770	-53,463***	4,459***	-43.8***	0.03	31.3***
			(-2.96)	(4.91)	(-4.04)		
FEMALES:							
High School	21,105	1,684	13,428**	266	-1.88	0.003	3.8***
			(2.11)	(0.91)	(-0.56)		
Some College	25,355	1,314	-10,141	1,491***	-14.51**	0.02	10.9***
			(-1.32)	(3.78)	(-3.09)		
Associate's Degree	29,624	265	5,233	983	-8.85	-0.0003	1.0
			(0.18)	(0.61)	(-0.43)		
Bachelor's Degree	34,927	1,192	-17,562	2,276***	-22.81***	0.03	17.0***
			(-1.58)	(3.94)	(-3.25)		

Data Source: U.S. Department of Labor/Bureau of Labor Statistics.
Notes: Single, double, and triple asterisks (*) denote statistical significance at the .10, .05, and .01 levels, respectively. Values in parentheses are *t*-statistics for White's heteroskedasticity-consistent estimates of standard errors. Regression diagnostics revealed the presence of multicollinearity between the *AGE* and AGE^2 variables (Belsley, Kuh, and Welsch). The Jarque-Bera test for normality of the distribution of regression residuals rejected the normality assumption for each regression. The estimates remain unbiased and consistent; however, they may no longer be efficient.

differences between educational levels are striking, particularly for males. For example, a male aged 50 years earned nearly $60,000 with a college degree, compared to slightly less than $37,000 for a male with a high school degree.[2]

To summarize the private rates of return to higher education, three measures of costs and returns were calculated (table 3): the benefit-cost ratio, the internal rate of return, and the net present value. These calculations were made assuming an individual (*a*) enters college at age 20, (*b*) incurs an estimated cost of $5,000 per year for five years, and (*c*) foregoes earnings while enrolled in college. These costs include tuition, fees, and books, but do not include room and board, because these costs would arise whether the person was enrolled in college or not. The benefits of college are the gap in annual income between a person with a college degree and a high school degree estimated from the regression results of table 2. These benefits are assumed to be earned from the age of graduation from college (25 years of age) to retirement at 65 years of age.

The benefit-cost ratio was equal to 5.1 for males and 3.7 for females, indicating that for each dollar invested in education, a return of $5 resulted, given the assumptions

[2] For recent summaries of research findings concerning the gap between male and female earnings, see Barkley, Stock, and Sylvius, and Blau and Kahn.

Table 3. Rates of Return for Higher Education: 17 Western U.S. States, 1999

Costs and Returns Measures [a]	Males	Females
Benefit-Cost Ratio [b]	5.135	3.743
Internal Rate of Return [c]	0.2839	0.2356
Net Present Value [d]	78,376	51,984

Data Source: U.S. Department of Labor/Bureau of Labor Statistics.

Notes: All calculations assume that college costs (tuition, fees, and books) are equal to $5,000 per year for a five-year period. Costs for room and board are not included, since these costs would occur whether the individual was enrolled in college or not. Benefits are the difference in annual incomes between college graduates and high school graduates in 17 Western U.S. states, excluding Alaska and Hawaii (see tables 1 and 2). Benefits were assumed to be earned from ages 25 to 65 years.

[a] The three rate-of-return measures are simple algebraic manipulations of the estimated earnings of a college graduate minus the estimated annual returns of a high school graduate. As such, the level of statistical significance for all three measures lies between the *F*-test for college graduates and high school graduates, reported in table 2. Thus, all of the calculated rates of return reported here are statistically significant at the 1% level.

[b] The benefit-cost ratio (BCR) is calculated from the equation: $BCR = \Sigma B_t(1+r)^t / \Sigma C_t(1+r)^t$, where B_t is the dollar value of benefits in year t, C_t is the dollar value of costs in year t, and r is the discount rate, assumed to be equal to 10%.

[c] The internal rate of return (IRR) is calculated from the equation: $0 = \Sigma(B_t - C_t)/(1+IRR)^t$, where the remaining terms are as defined in footnote (b) above.

[d] The net present value (NPV) is calculated from the equation: $NPV = \Sigma(B_t - C_t)/(1+r)^t$, where the remaining terms are as defined in footnote (b) above.

stated above. The internal rates of return were also high: 28% for males and 24% for females. The net present value for males was over $78,000, and for females was nearly $52,000 over their lifetime. Thus, we can conclude that in the 17 Western U.S. states, a college education provides a solid investment in human capital with a high monetary return.

Why We Teach

We have explored the economic demand for higher education, emphasizing the growing demand for higher education, based on large financial benefits and positive externalities associated with college degrees. The supply of college teachers, on the other hand, may be determined primarily by nonmonetary factors. Many, if not most, professors choose teaching because they love what they do. In his book, *The Courage to Teach*, Parker Palmer (p. 1) gives emotional expression to this notion:

> I am a teacher at heart, and there are moments in the classroom when I can hardly hold the joy ... teaching is the finest work I know.

Who and When We Teach

For the past several decades, a college education was confined to teaching young men and women for the four years following their high school graduation. Not anymore. The demand for university-level training for mid-career students is increasing, due to the rapid increase in technological skills and information needed to remain professionally competent. The supply of knowledge, skills, and information has been greatly enhanced in recent years due to technological innovations in the computer and communication industries. Consequently, the "product mix" of academic services is undergoing a major

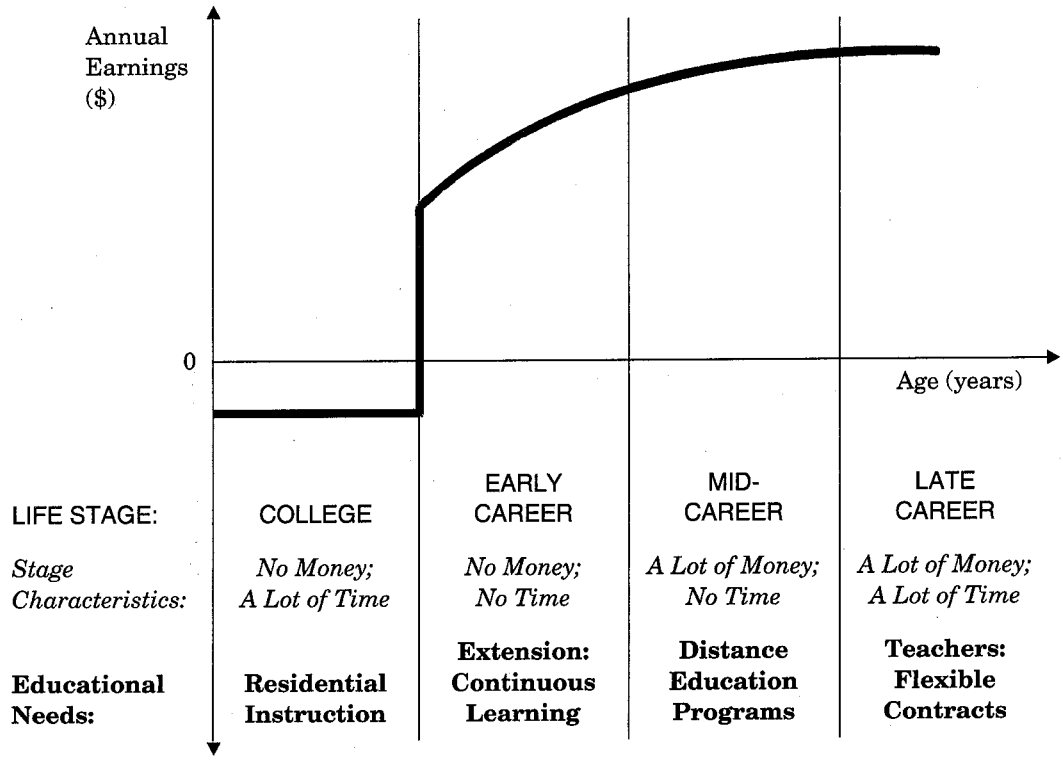

Figure 1. A model of lifetime earnings and educational needs of college graduates

renovation and will continue to change in the foreseeable future. A simple model of lifetime earnings is developed here to illuminate the educational demands of students throughout their careers.

An age-earnings profile for a typical college graduate is shown in figure 1. The investment in human capital of four (or five) years of college is most often undertaken immediately following high school graduation. Earnings are negative during this period, because a college education is expensive and a full-time endeavor. Earnings become positive upon taking a job after graduation. A large literature confirms the concave-shaped age-earnings profile (Rosen), showing real earnings rise rapidly in the early career stage, grow at a slower pace during mid-career, and may stagnate (or decline) toward career end. This age-earnings profile, coupled with a work environment characterized by massive and rapid change, yields insights into the type of academic services demanded of departments of agricultural economics in the future.

The Traditional College Experience: "No Money and A Lot of Time"

Many college professors and administrators are concerned that the traditional four years of residential college experience will be replaced in the near future by distance education programs and correspondence courses offered on the internet. This has not happened to date, and is unlikely to occur in the future, for several reasons. First,

correspondence courses have been offered for a long time, without crowding out the residential college experience. Mail-order diplomas and videotaped courses have been available for several decades, and the demand remains small relative to traditional residential college programs. Every college teacher knows why: education is *relational*. Good teaching requires human interaction. A college education is not merely learning facts. Rather, a residential college experience includes learning how to leave home, live and work with others, and make independent decisions and judgments.

Economic theory provides a second reason for the continued demand for residential programs. Investments in human capital have greater payoffs if made early, particularly costly investments with high rates of return such as a college education. Not only will an early investment pay greater returns, but it is less costly because inexperienced workers have lower opportunity costs. This point is emphasized in figure 1, i.e., college-aged persons have "no money and a lot of time." The combination of higher lifetime earnings and lower opportunity costs provides strong economic justification for the traditional college experience to remain in place in the future. Although internet degrees are available, potential students comparing a full-time job with internet courses at night to a traditional residential degree program are unlikely to give up the opportunity to experience college life—college is productive and fun!

Early Career: "No Money and No Time"

Upon graduation from college, many students find themselves employed in a full-time job. Although starting salaries for agricultural college graduates are high (Barkley, Stock, and Sylvius), many persons at this stage in life have large debts. Young adults often make huge career investments by working hard (and many hours per week). Given the characteristics of early career workers, educational products targeted toward this group of individuals should be (*a*) brief, and (*b*) inexpensive. Specific courses, seminars, and information delivery should be targeted to focus on topics relevant to this group: personal finance and investment, technological updates, and reviews of basic economic principles applied to business decision making.

Interestingly, this idea is not new. This is the concept of the tripartite mission of the Land Grant University: research, teaching, and extension. Specifically, the institution of agricultural extension has a long tradition of providing exactly the kind of useful information needed by workers of all ages. This model could continue to be usefully extended to workers in agribusiness, service industries, or government work. Expansion of the higher education customer base to include nontraditional and/or nonresidential students would dramatically increase the private and public sector returns to education.[3]

Schultz (1975) provided a major contribution to our understanding of the impact of education by viewing problem solving and decision making as the "ability to deal with disequilibrium." Articulating this idea, Huffman (p. 85) wrote: "... schooling augments skills that facilitate the gathering, processing, and interpretation of information, thereby enhancing allocative ability, reducing uncertainty, and contributing to efficient decision

[3] It is important to note the model implies that early investments receive a higher return than later investments. Thus, elementary school skills such as literacy and arithmetic are anticipated to earn higher rates of return than advanced skills learned in college. However, the high rates of return to higher education (table 3) suggest the private and public returns to nontraditional and/or nonresidential students also would be high.

making." To the extent that technology, financial markets, and international trade are rapidly evolving, these skills must be continuously updated to maximize economic efficiency and individual returns.

The university is in a perfect position to provide continuous education for workers throughout their careers. Using data from the 1964 *Census of Agriculture*, Huffman estimated the statistical relationships between education, extension, and how quickly corn farmers adjusted their use of nitrogen to the optimal rate of fertilizer application. The econometric results revealed "education and agricultural extension are substitute sources of allocative efficiency" in 1964. The rapid changes in the information age alter this relationship: even highly educated farmers need continuous upgrading of skills, information, and knowledge to keep up with the enormous technological advances in agricultural production, finance, and marketing.

In the year 2000, the fundamental relationship between education and extension is likely to be complementary, rather than one of substitution, in production agriculture and agribusiness because of the massive and rapid changes in how food and fiber are produced.[4] In mathematical terms, when technological innovation (t) in equation (5) advances, the private and public returns to extension, outreach, and lifelong learning rise, resulting in a higher degree of complementarity between education and extension.

Mid-Career: "A Lot of Money and No Time"

The concept of continuous education complementing higher education, rather than substituting for it, can be applied to professionals in mid-career. Currently, many college graduates at this career stage earn a lot of money (table 2). American workers are often at their busiest in mid-career, as professionals struggle to find a balance between the demands of work, family, and personal time. Educational products tailored toward this group must be of sufficiently high quality to attract successful people with high opportunity costs of time. Given the relatively high incomes of this group, these products can be offered at high prices; successful professionals at mid-career have large amounts of money to spend on high-quality educational products.

Two examples of educational products that could be provided by departments of agricultural economics are (a) executive degree programs, and (b) seminars, meetings, and conferences.[5] Individuals with college degrees are often willing and able to pay significant amounts of money for continuous education, suggesting a complementary relationship between education and extension.

Late Career: "A Lot of Money and a Lot of Time"

Professionals in late career not only earn high salaries, but often they have accumulated a large amount of wealth (figure 1). These accumulations have freed many individuals

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[4] As pointed out by a reviewer, the information revolution has slowly turned education from a luxury good into a necessity good, requiring a response from the higher education system.

[5] Examples of such relevant programs providing benefits to mid-career persons are the Master's in Agribusiness degree offered at Kansas State University (tuition for the degree is $15,000), and the Master's in Business Administration offered at the Food and Agribusiness Institute of the University of Santa Clara (tuition for the degree is approximately $40,000). The Department of Agricultural Economics at Kansas State University hosts a two-day extension conference each August for agricultural and agribusiness professionals. The charge for the conference is $150, and the number of participants has grown to approximately 300 annually.

from the necessity of work. Early retirement and partial retirement are increasingly attractive options for many individuals and families. The demand for educational products can be significant at this stage of life. However, of interest here is the supply side of the market. Some individuals in this age group switch professions from a high-status, high-income position to employment they consider to be socially or personally worthwhile. Higher education is one such occupation that could attract many highly talented and experienced professionals, managers, and executives who desire to "give something back," through both financial donations and occupational choices. Both undergraduate students and faculty members gain enormously through interactions with successful alumni. Colleges and universities would do well to increase the number of guest lectures given by experienced individuals interested in enhancing their connection to their alma mater. Also, part-time or full-time teaching positions should be made available to experienced alumni who desire to switch careers.

To increase the connection between the ivory tower and the real world, boards of advisors could be set up to allow alumni of all ages and careers to return to campus and provide direct input to academic and professional development programs. These alumni groups could discuss and explain how well our academic programs are meeting the needs of employers. The value of intergenerational activities should be made more explicit to alumni and other persons interested in working in higher education. Donations of time and money could improve the educational environment, and opportunities for students. Building and maintaining a strong, healthy relationship with former students could result in large gains to the academic world.

To summarize, the life-cycle model of earnings and educational needs has provided an answer to the question of "who we teach" in higher education. The experiences and needs of workers are quite different at each career stage, and as a result, academic departments must do a better job of providing high-quality, informative, and useful programs to meet the needs of potential students throughout their lives.

Where We Teach

Location and direct personal contact have become less important in the information age, due to communication technology that minimizes the requirement of physical proximity for direct communication. Educational programs can now be offered in a wide variety of formats, ranging from the best case of a highly personal one-on-one tutorial between student and teacher to the worst case of a highly impersonal distance course with no student-teacher interaction. Distance education can provide informational programs to busy professionals. However, distance courses are unlikely to meet the more stringent educational objectives of a residential course or program. Education is a highly relational activity, and in many circumstances requires face-to-face contact for the development of higher-order thinking processes. Stanley Ikenberry, president of the American Council of Education, emphasizes there is more to education than merely mastery of content: "It involves judgment, analysis, synthesis, communication, creativity, and innovation" (Rosenblatt, p. 92).

Simply put, distance education and residential education are not perfect substitutes. Online education can provide content, but it is difficult to produce a truly educated student over the internet, if our conception of education includes the ability to communicate and interact with others. Because of the need for personal interaction, departments of agricultural economics will most likely continue to teach in brick-and-mortar institutions

of higher learning, to thousands of full-time, residential students. Distance education will grow to meet the needs of busy professionals unable to enroll full time. Employers know that a distance education diploma differs from a residential degree, just as they know which universities and which major fields of study offer high-quality graduates to the labor market. As students, faculty, and employers gain more experience with distance education products, the strengths and weaknesses of the new electronic programs will become more obvious.

How We Teach

Scarcity drives many budget decisions in academics. Limited budgets often result in large classes. Limited faculty time and energy can result in short-run teaching strategies which diminish student learning and development. Large classes and poor teaching practices are often rationalized as being economically "efficient." Below, four commonly accepted teaching practices are contested: (*a*) students as consumers, (*b*) large classes, (*c*) overuse of technology, and (*d*) rigidly defined academic appointments.

Students as Consumers?

Economists apply market analysis to nearly all human interactions and situations. The market metaphor is a powerful tool to further develop our understanding of the major underlying forces motivating human behavior. The market model, however, can be incorrectly used. One such misapplication is in higher education. We could consider the university to be the producer of education, and the students to be the consumers. This line of thinking is fraught with difficulties. Students are both consumers and producers of education, complicating the market model. While it is true students pay tuition to receive instruction, the student is the most important input to the production of educational outcomes. Given this dual role that students play, many perverse outcomes can arise if the standard economic use of the term "consumer" is applied to students.

Successful business firms maximize profits by "putting the customer first," or "giving the customer what she wants." This type of business strategy is inappropriate for an institution of higher education, and can result in easy, entertaining classes—maximizing short-run student satisfaction at the expense of solid knowledge and learning that require significant effort. Becker (2000, p. 114) recently addressed this issue: "... if administrators treat student evaluations of teaching as important, then teachers can be expected to react to them in ways that may be inappropriate."

Becker (2000) and McKeachie (1997, p. 1219) list several activities employed to improve student evaluation scores: (*a*) entertaining students, (*b*) "dumbing down" the course, (*c*) manipulating the timing of the evaluation procedure, (*d*) driving the unhappy out of the class, (*e*) blaming others for poor organization, and (*f*) avoiding innovation. The exclusive use of student evaluations is ubiquitous in departments of agricultural economics, resulting in the perverse incentive to maximize student evaluation scores, rather than maximizing student learning. Fundamentally, competent evaluation of teaching requires more than student evaluation.[6]

[6] Hoyt and Pallett (p. 4) observe: "There is a general consensus that students are unable to judge such vital matters as currency of course content or the degree to which it provides a representative (as opposed to biased) view of the subject matter. Nor can they judge clarity, comprehensiveness, or realism of objectives, the degree to which readings and other assignments are balanced and appropriate, the validity of procedures for assessing student achievement, or the degree to which grading standards are in line with the department's or institution's expectations or policies."

Experts in teacher assessment believe student evaluations should comprise no more than 30% of the total evaluation of a course. How to evaluate teaching outside of student evaluations is controversial, however (Hoyt and Pallett). Difficulties are imposed by each method employed to assess teaching. When teaching is taken seriously, a much larger commitment can be made for the improvement of teaching. Faculty peers and department heads/chairs could be trained on how to evaluate teaching, and they could participate in classroom visitations. More time and effort should be devoted to evaluation of teaching by administrators and peers (Seldin 1993, 1999).

Size Matters: Are Large Classes Efficient?

Economists fool themselves by claiming that large classes are "efficient" in the production of knowledge. On the surface, bigger classes may appear to be economically justified; the fixed costs of a lecture can be spread over more students, lowering the average total cost of providing educational outputs. This line of thinking is attractive, particularly to an administrator facing resource constraints. Although appealing, the argument is in error. It relies on the simplifying assumption that the educational outcome of a course with 200 students is identical to a course with 30 students. This is nonsensical. While large courses use fewer teaching resources per student, the educational outcome is not the same. Therefore, efficiency is not necessarily enhanced, due to a decrease in the quality of educational experience. There is a fundamental tradeoff between the lower costs of large classes and the lower quality of learning that takes place in large classes. Teachers who have taught both large and small courses know this, but often rationalize large classes in the name of "efficiency."

A large amount of research on class size suggests size is not an important determinant of the acquisition of subject matter knowledge (Pascarella and Terenzini, p. 87). However, McKeachie (1980) reports smaller classes are more effective than larger ones when the goals of instruction are motivational, attitudinal, or higher-level cognitive processes. Are we limiting the learning process by providing adequate subject matter training in large classes, but at the expense of higher-order analysis? If our goal is to provide students with the ability to think through new situations and issues, do large classes achieve this goal? Perhaps the biggest sin of the large course is the acceptance of multiple-choice assignments and examinations as a replacement for writing assignments, essays, and term papers. Written communication skills are extraordinarily important in the workplace, and it is nearly impossible to develop these skills in a large classroom.

To illustrate the economic importance of class size, a study of the relationship between tuition rates and average class size was undertaken. Data on college characteristics and tuition rates were collected from the *Princeton Review*. A multiple regression was estimated to identify and quantify the determinants of the "price" of a college education. College and university tuition rates were specified in the following equation as a function of institutional size, the quality of education, class size, and the level of diversity in the student body:[7]

[7] A qualitative variable for private schools was included in a previous regression trial, but was omitted due to potentially degrading multicollinearity, with a condition index equal to 36.8 (Belsley, Kuh, and Welsch).

Table 4. Summary Statistics for Variables Used in College Tuition Regression: 17 Western U.S. States, 1999 (n = 200)

Variable	Mean	Standard Deviation	Minimum	Maximum
TUITION ($)	7,729.69	7,190.83	0.0	28,960.0
ENROLLMENT (students)	6,296.83	7,101.81	105.0	35,889.0
STUDENT-FACULTY RATIO	16.27	4.26	6.0	27.0
SELECTIVITY INDEX[a]	71.73	7.86	60.0	99.0
%CAUCASIAN	75.13	19.94	1.0	98.0

Source: *Princeton Review* staff.

Note: The Jarque-Bera test for normality of the distribution of regression residuals rejected the normality assumption for this regression. The estimates remain unbiased and consistent; however, they may no longer be efficient.

[a] *Princeton Review* index of selectivity, defined on a scale of 56 to 100. The rating is determined by a formula that considers, among other things, the school's acceptance rate, the number of acceptees who actually enroll, and the class rank and average test scores of entering first-year students. This is not a measure of academic quality of the school, but simply an indication of how difficult it is to get admitted (*Princeton Review*, p. 5).

$$\text{(7)} \qquad TUITION = f(ENROLLMENT, STUDENT\text{-}FACULTY\ RATIO, SELECTIVITY\ INDEX, \%CAUCASIAN).$$

Class size is approximated by the student-faculty ratio. Although this measure is inexact, due to divergent teaching appointments among faculty, it does capture differences in class size across institutions. Summary statistics of the data for the analysis appear in table 4.

A selectivity index was employed to capture educational quality, with a range from 56 to 100. This rating is determined by a formula which considers, among other things, the school's acceptance rate, the number of acceptances who actually enroll, and the class rank and average test scores of entering first-year students. Equation (7) was estimated using 200 observations for all colleges and universities in the 17 Western states. Regression results are reported in table 5.

Approximately one-third of the variation in tuition is explained by the model, each of the independent variables are statistically significant, and their estimated coefficients are of the expected sign. Larger schools have lower tuition rates, reflecting the subsidized rates charged by many large public universities. For our purposes, the most important result is that larger student-faculty ratios are associated with lower tuition rates, i.e., there is a willingness to pay for smaller student-faculty ratios. Specifically, from the regression results, a $500 premium is associated with a one-student decrease in the ratio.

As expected, institutions with higher selectivity ratings had higher tuition rates. Lower levels of diversity (as measured by *%CAUCASIAN*) were associated with lower tuition rates. This may reflect a willingness to pay for a more diverse student body, or higher tuition rates in urban areas having greater diversity among the student body. Further research could pursue the extent to which greater levels of diversity are associated with the size of the city where the college or university is located. This illustrative regression is intended to demonstrate that smaller classes, as measured by the student-faculty ratio, are valued by registered students, who are willing to pay more for closer relations with their college instructors.

Table 5. Regression Results of College Tuition: 17 Western U.S. States, 1999 [Dependent Variable = *TUITION* ($); Dependent Variable Mean = 7,729.688]

Variable		Parameter Estimate	*t*-Test
Intercept		12,321.00	2.21**
ENROLLMENT		-0.36	-6.64***
STUDENT-FACULTY RATIO		-508.09	-5.66***
SELECTIVITY INDEX		135.84	2.03**
%CAUCASIAN		-50.36	-2.27**
R^2	0.35		
Adjusted R^2	0.34		
Model *F*-test	26.05***		
Root MSE	5,864.46		
No. of Observations	200		

Data Source: *Princeton Review* staff.

Notes: Double, and triple asterisks (*) denote statistical significance at the .05 and .01 levels, respectively. The *t*-statistics are White's heteroskedasticity-consistent estimates of standard errors. Regression diagnostics revealed the presence of multicollinearity between the intercept and the student-faculty ratio (Belsley, Kuh, and Welsch); the condition index equals 34.5. The Jarque-Bera test for normality of the distribution of regression residuals rejected the normality assumption for this regression. The estimates remain unbiased and consistent; however, they may no longer be efficient.

Classroom Technology: Form over Substance?

The introduction of technology has transformed academic life considerably in the past decade. Lectures in agricultural economics have been transformed from "chalk and talk" to elaborate multimedia presentations. There are benefits and costs associated with any technological change, and technology in academia is no exception. The internet and e-mail have brought truly revolutionary improvements to academic communication and research. Classroom presentation technology provides a clear, organized method for presenting material to students. However, lecturers and speakers often misuse presentation graphics by placing too much information on each slide, and merely reading the slides to the audience. This practice, together with printing the slides for distribution prior to a lecture, can make such lectures nearly unnecessary.

For many teachers, learning how to use new technology is fun, interesting, and challenging—frequently resulting in the introduction of technology actually taking precedence over student learning. Technology does not fit every educational situation. Classroom technology meets the needs of very large classes well. When the main objective is clearly communicating facts and information, classroom technology often enhances how well students understand and learn basic concepts. Technology is unlikely to aid in the development of higher-order thinking skills, synthesis, evaluation, teamwork, or written communication skills. Therefore, technology is often overused, under the claim of "efficiency."

Software used to grade multiple-choice questions on homework assignments and examinations may save time and energy, but at the expense of writing and thinking skills associated with essay questions and writing assignments. Well-written and organized

slide presentations distributed before class can result in less incentive to attend class and stay engaged in the lecture. Lecture notes on the internet provide a perceived perfect substitute to attending lectures. Overhead projectors foster a stationary lecture delivery style, rather than energetic chalkboard lectures.

Technology is not all bad. Technological innovations offer teachers an expansive new arena for rethinking, exploring, and improving both course material and pedagogical styles. In summary, the appropriate use of technology can bring benefits to student learning, and the efficiency of teaching. However, technology is often overused in the attempt to substitute computers for tasks requiring judgment, higher-order thinking, or human concern.

Comparative Advantage: Flexible Appointments and Contracts

One of the most fundamental principles of economics is the concept of specialization and gains from trade: allocate productive resources to activities of their comparative advantage, and productivity will increase. Unfortunately, as academic agricultural economists, we do not apply this useful principle to ourselves. Often, academic contracts and faculty opinions are inflexible. Rigid promotion and tenure guidelines can be tightly enforced, limiting the ability of an academic department to take advantage of differences in expertise and interest.

For example, an individual in a "research and teaching" appointment is often expected to publish a certain number of refereed journal articles of a given quality, and teach a specified number of courses each year. Deviations from this recipe into administration, student advising, grant writing, or international development can be risky for a faculty member under peer review. Similarly, an individual with an "extension" appointment may not be sufficiently encouraged or rewarded for academic success in research or teaching.

The economy is changing rapidly, and as a result, the demand for information and knowledge is also changing at an unprecedented rate. This change requires flexible academic appointments that allow capable and productive teachers and researchers to meet the needs for educational products. The distinctions between research, teaching, and extension are becoming less clear over time. In a rapidly changing applied science such as agricultural economics, academic contracts must continue to become more flexible to take full advantage of the numerous opportunities available within the profession. Tying a productive professor's time to budget "tenths" for budgetary purposes is obsolete. Command economies have proven to be inefficient and unproductive.

Instead, academic appointments could be used to allocate faculty time within a department to the highest return use: good teachers could be rewarded for good teaching, and good researchers could be rewarded for good research. Further, when technological, demographic, and economic conditions change, these resources could be reallocated to optimize the level and type of educational outputs under the new situation.

Another example of the type of flexibility needed to improve academic programs is the hiring of nonacademics near the end of a career in agribusiness to bring nonacademic knowledge and experience to the classroom. Also needed is careful consideration of course and curricular content, as discussed in the next section.

Conclusion: What We Teach

Economics provides a useful, rewarding, and marketable way of thinking about the world that continues to become more valuable over time. Basic knowledge of how buyers and sellers interact, how specialization and trade can result in greater efficiency, and how markets are organized is crucial to informed decision making and active participation in a free-market democracy. Quantitative skills, and practice in the application of economic principles to real-world problems, provide students with abilities that will be useful throughout their careers and lives. These skills become even more valuable when economic principles are combined with written communication, oral communication, and problem-solving abilities.

As the demand for economic knowledge and information increases, our profession must strive to provide analytical and communication skills that will not depreciate in a society characterized by rapid innovation and change. Excellent problem-solving skills are likely to be the most durable asset we can help our students develop. Because economics is the study of choice, our profession has a strong comparative advantage in the information age. As more people throughout the world are empowered with new information, new markets, and new opportunities, the ability to make good decisions will become increasingly valuable, fun, and durable.

The Land Grant University structure, together with the subject matter of the agricultural economics profession, is well suited to provide the knowledge, skill, and information demands in the 21st century. In an age of unprecedented economic expansion, government budget surpluses, and relative peace and prosperity, the opportunities for teaching agricultural economics are greatly enhanced. However, only those teachers, administrators, and departments who are willing and able to meet the challenges of the future will have the ability to take full advantage of the exciting prospects provided by the information age. Agricultural economists could enhance higher education through careful consideration and implementation of the 10 recommendations listed below:

1. Recognize the huge private and public returns that higher education contributes to society, and seek to magnify these returns over time and across international boundaries.

2. Target multiple high-quality educational products to a broad spectrum of potential students throughout their lives.

3. Recognize and reaffirm the importance of residential education programs for young adults, and particularly the strong need for human interaction in education.

4. Admit the severity of the problems with current methods of teacher evaluation. De-emphasize the use of student teacher evaluations, and enhance the use of faculty and administrative evaluation.

5. Debunk the false idea that large classes are "efficient." Discontinue teaching large, impersonal courses. Discontinue the use of multiple-choice assignments and examinations.

6. Emphasize written communication in every course through the extensive use of essays, term papers, and writing assignments.

7. Use classroom and educational technology only when learning is enhanced.
8. Provide flexible teaching contracts to academic professionals that allow specialization into areas of comparative advantage. Recognize that the traditional bureaucratic structure of research, teaching, and extension is outdated and rapidly becoming obsolete.
9. Focus course and curricular content on the durable skills of problem solving, written and oral communication, and higher-order thinking, rather than on facts and information that will depreciate rapidly in an era of rapid technological change.
10. Refuse to give up when faced with the frustration of bureaucracy (Palmer, p. 182).

The opportunities for teaching agricultural economics are huge. Careful reflection, the courage to change, and a strong desire to improve the lives of our students will contribute to making our world more peaceful, prosperous, and interesting.

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