TEACHING AGRICULTURAL ECONOMICS

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Abstract

Rapid technological and economic change has been the defining characteristic of food production, processing, and consumption over the past several decades. Improvements in production techniques, business practices, and information assimilation have enhanced the role of public universities: the provision of knowledge and information by public universities has become increasingly necessary, urgent, and profitable. This trend is likely to continue into the future as rapid development of information technologies, globalization of markets, and natural sciences occur.

The thesis of this paper is that the need for institutions of higher education to teach students of all ages how to think, synthesize competing ideas, and assimilate new information has become more critical and more urgent in the information age, or "New Economy." Analytical ability and new knowledge in the economics of agriculture are increasingly important not only for the traditional university clientele of young adult residential learners, but also for productive women and men throughout their careers and lives.

The original structure of the Land Grant Universities (Research, Extension, and Teaching) is well suited to accomplish this enhanced mission of providing lifelong education and information to producers, consumers, and decision-makers in the food and fiber industry. However, teachers of agricultural economics must invest heavily in the acquisition of new skills and knowledge and institutional change to take full advantage of the huge opportunities and challenges of the New Economy. This paper considers how well our traditional institutions, programs, and teaching practices in Agricultural Economics meet the objectives of student learning in a new era.

Teaching Agricultural Economics.

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.

The globalization of market economies has resulted in a large, unmet need for knowledge about the motivation for and consequences of free markets and free trade. This is true not only in the emerging market economies, but also in capitalist nations becoming more integrated into global economic systems. The rapid development, adoption, and use of information technology have dramatically increased the demand for computer, internet, and communication skills. The information revolution has allowed producers to engage in precision agriculture; purchase fertilizer, tractors, and chemicals online; and receive high quality, instantaneous market and weather information. As the standard of living increases, consumers demand higher levels of environmental amenities. Informed policies are needed to preserve and improve the natural resource base, and to protect the environment from agricultural practices that deplete resources, contaminate water, and destroy habitat.

These revolutionary changes 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 the "New Economy," characterized by technology and globalization. The analysis uses simple economic principles to analyze the current state and explore the optimal future path of teaching in the agricultural economics profession.

First, the theoretical foundations of "***why we teach***" are explored, with an emphasis on monetary rewards and large social benefits associated with higher education. Second, a simple model of lifetime earnings is used to illuminate "***who, when, and where we teach***." The repercussions of advancements in information technology, biotechnology, and globalization of agricultural markets will continue to reshape the demand for economic, computer, and communication skills offered by Departments of Agricultural Economics curricula. Emerging opportunities to teach these skills are investigated.

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. It is argued that knowledge of fundamental market principles is an increasingly marketable skill. Understanding the motivation for and consequences of free trade is also crucial to current and future public policy debates. The paper concludes with ten recommendations for positive change in teaching programs in agricultural economics.

Why We Teach

Good teaching requires considerable effort. Why do we do it? Although there are numerous answers to this question, economic theory can be employed to identify important causes and consequences of occupational choice. Two models of higher education are developed here to analyze of the future of teaching agricultural economics. The theory is used with

empirical estimates of age-earnings profiles for college graduates in the Western region. The economic analysis is extended to include noneconomic factors that influence our decision to teach agricultural economics.

To begin, 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. The demand for higher education is large and growing, primarily because of the large economic rewards associated with a college degree. A vast literature reports that the economic benefits to higher education are substantial (Pascarella and Terenzini, 1991). Large financial benefits have attracted new students to enroll in college (figures 1 and 2), resulting in a steady demand for college professors, who can be considered to be an input into the educational production function.

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 et al. 1999). Not only are private returns to education high, but public returns to education are also significant. In market economies, the value of a highly educated workforce is large: an educated individual typically earns higher returns (income) than a less-educated person, and society is made better off as well. This outcome provides the foundation for the idea that education is a *public good*: a good that has benefits that are not easily confined to a single buyer. Kaul et al. (1999) state in their introduction to *Global Public Goods*:

> To calculate the benefits [of education], we take the income a person earns over a lifetime with education, and subtract that which she would get without an education. But that figure does not tell the whole story. What about the numerous employers the person will have over a lifetime, and the savings realized because these employers do not have to

> train her in-house? What about the benefits that literacy brings to all the companies that rely on the written word to advertise? The benefits to those who issue public warnings, put out signs or seek to implement laws? If one were to put a figure on these benefits, they would dwarf the amount that accrues strictly to the educated person. This difference between the public and the private benefits is called an externality. And because of its substantial externalities, education is a public good.

Milton Friedman (1962) defined this externality as a "neighborhood effect," where:

> circumstances under which the action of one individual imposes significant cost on other individuals for which it is not feasible to make him compensate them, or yields significant gains to other individuals for which it is not feasible to make them compensate him—circumstances that make voluntary exchange impossible. (pp. 85-86)

There is remarkable agreement among economists that education is a public good, requiring government intervention. From the left end of the political spectrum, John Kenneth Galbraith in *The Affluent Society* (1958) wrote:

> Once a society has provided itself with food, clothing, and shelter, all of which so fortuitously lend themselves to private production, purchase, and sale, its members begin to desire other things. And a remarkable number of these things do not lend themselves to such production, purchase, and sale. They must be provided by everyone if they are to be provided for anyone, and they must be paid for collectively or they cannot be had at all. Such is the case with streets and police and the general advantages of mass literacy and sanitation, the control of epidemics, and the common defense (p. 135).

From the right, Milton Friedman in *Capitalism and Freedom* (1962):

> A stable and democratic society is impossible without a minimum degree of literacy and knowledge on the part of most citizens and without widespread acceptance of some common set of values. Education can contribute to both. In consequence, the gain from the education of a child accrues not only to the child or to his parents but also to other members of society. The education of my child contributes to your welfare by promoting a stable and democratic society. It is not feasible to identify the particular individuals (or families) benefited and so to charge for the services rendered. There is therefore a significant "neighborhood effect" (p. 86).

More recently, Stiglitz (1999) has extended the concept of public good to a *global public good*, which is a public good with international consequences and implications.

Since education provides both private returns (higher salaries) and public returns (lower transactions costs in society), it can be classified as an *impure public good*, meaning that education has characteristics of both private and public goods (Cornes and Sandler, 1996).

To investigate further, a simple model of education as an impure public good is developed, following Cornes and Sandler (1996) and Heisey et al. (1997). Assume that an economy has N individuals (i = 1, …, N) who seek to maximize utility (U) by spending their income (I) on two goods: (1) an aggregate consumer good (y), and (2) education (e). An individual i derives utility from purchases of the consumer good, school, and from the aggregate level of education in the economy (E). This is a result of Friedman's "neighborhood effect:" one individual is made better off if others are educated, as shown in equation (1).

(1) $U_i = U(y, e; E)$

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: $I = p_y y + p_e e$, 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 that assumes that all other individuals educational attainment is exogenous (let $E^* = E - e_i$), then the individual's optimization problem is:

(2) $\max_{y,e} U(y, e; E^* + e_i)$ s.t. $I = p_y y + p_e e$

Cornes and Sandler demonstrate that the first-order necessary conditions imply:

(3) $(U_e + U_E)/U_y = p_e/p_y$

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.

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 that 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 1999, p. 13). An individual is better off when other people have greater knowledge and understanding (E). Simply put, common knowledge, language, and customs lower the cost of making a living and cohabitation.

An example from academia is in order. When agricultural economists congregate, the discussion often includes marginal analysis ("my marginal utility became negative during the intermission at the opera last night"), supply and demand ("the demand for agribusiness majors appears to be increasing relative to the demand for agricultural economics majors"), and quantitative analysis ("there is a bimodal distribution of grades in my Principles of Agricultural Economics course, and it is correlated with class attendance"). The knowledge of economic principles allows for efficient and meaningful conversation between individuals with economic training. When economists work in interdisciplinary teams, however, transactions costs are higher. Economic reasoning can be used, but with much more effort, and often with communication breakdowns and frustration ("can't they see that their policy proposal is horribly inefficient? Don't they understand how markets work?") Education can provide a common language and ability to understand individual behavior, current events, and public policy

decisions. Therefore, the term U_E is assumed to be positive, and 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 and basic life skills 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, as in equation (4) and figure 3.

(4) $E = E(e_1, \ldots, e_N)$, where $E_{ei} > 0$ and $E_{eiei} < 0$

As education increases, the incremental benefit to society (the network effect) decreases. It is possible that 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 people skills.

Recent innovations in information technology and the globalization of markets increase the return to education. Specifically, higher levels of knowledge and skills provide large rewards in a highly computerized, globally integrated economy. Technological skills provide greater opportunities to workers, and efficiency gains in production, marketing, and distribution of goods and services enhance the network effect of education. In mathematical terms:

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

Where technological innovation (t) shifts the entire E function upwards, reflecting higher societal returns to education when new innovations are introduced and adopted. This concept reflects the previous work of Schultz (1961), Griliches (1957 and 1964), and Welch (1970). 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. The effect of technological progress on the relationship between individual educational levels (e) and societal education (E) is shown in figure 4.

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 current era of rapid technological, institutional, and economic change results in important implications for the magnitude and timing of investments in human capital in general, and specifically higher education.

The incentive to invest in higher education is enhanced in periods of rapid change, since 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. Earlier investments in higher education will result in greater lifetime earnings than investments that occur later in life. Becker (1975) states, "…with finite lifetimes, later investments cannot produce returns for as long as earlier ones and, therefore, usually have smaller total benefits" (p. 100). Greater returns to education provide an incentive to invest in human capital as early as possible during the work life.

Related to this point, the accumulation of human capital results in higher earnings. Higher earnings increase the opportunity cost of time, and therefore make further investments in human capital more costly. According to Becker (1975), "Other things being the same, an

increase in the value of time raises the marginal cost of later investments compared to earlier ones since the former use more expensive time" (p. 100).

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, for two reasons. First, human memory is imperfect, and unused knowledge may be forgotten over time ("use it or lose it"). Second, marketable human capital may become obsolete if technology changes (examples include the ability to use a slide rule, and the ability to record music on vinyl).

The theoretical model of the economics of higher education, together with the human capital approach to education, highlight 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.

Each of these implications will be discussed further in what follows.

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) would be 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, excluding Alaska and Hawaii, and are presented in figures 5 (males) and 6 (females). Data on annual income, age, educational attainment, and gender were collected from the March 1999 Supplement of the Current Population Survey of the U.S. Bureau of Labor Statistics. Following the work of Mincer (Mincer 1974; Rosen 1992), age-earnings profiles were derived for both males and females with different levels of education using multiple regressions of the following structure for an individual i:

(6) $\text{Annual income}_i = \alpha + \beta_1 \text{Age}_i + \beta_2 \text{Age Squared}_i + u_i$

where u_i is the i.i.d. 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 Associates Degree (not Vocational), and a Bachelors 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 Associates degrees for women were not statistically related to age.

The estimates presented in table 2 are graphed in figures 5 and 6. The earnings differences between educational levels is striking, particularly for males. For example, a male aged 50 years earns nearly $60,000 with a college degree, compared to slightly less than $37,000 for a male with a high school degree (figure 5).

To summarize the private rates of return to higher education, three measures of costs and returns were calculated: the Benefit Cost Ratio (BCR), the Internal Rate of Return (IRR), and the Net Present Value (NPV), and are reported in table 3. These calculations were made assuming that an individual enters college at age 20, and incurs a cost of $5,000 per year for five years.

These costs include tuition, fees, and books, but do not include room and board, since 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 five dollars resulted, given the assumptions stated above. The Internal Rates of Return (IRR) were also high: 28 percent for males; 24 percent for females. The Net Present Value (NPV) for males was over $78,000 and for females was nearly $52,000. Thus, we can conclude that in the 17 Western states, a college education provides a solid investment in human capital with a high return. Major technological advances, the information revolution, and globalization of market economies are expected to provide even greater opportunities for financial reward to those who invest in the skills and knowledge that will allow them to take advantage of the "New Economy."

Thus far, we have explored the economic motivations behind why we teach, emphasizing the large financial benefits and positive externalities associated with higher education. Although the economic analysis of college and university teaching provides an important foundation to our understanding of why we teach, noneconomic factors certainly influence our professional choices. Many, if not most, professors choose teaching because they love what they do. This key determinant of the supply of professors is summarized by Palmer (1998, p. 1):

> I am a teacher at heart, and there are moments in the classroom when I can hardly hold the joy. When my students and I discover uncharted territory to explore, when the pathway out of a thicket opens up before us, where our experience is illuminated by the lightening-life of the mind—then teaching is the finest work I know.

Who 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. Therefore, the product mix of academic services is undergoing a major renovation and will continue to change in the foreseeable future. A simple model of lifetime earnings is developed here to illuminate the educational needs of students throughout their careers.

An age-earnings profile for a typical college graduate is shown in figure 7: 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, since 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 1992), showing that earnings rise rapidly in the early career stage, grow at a slower pace during mid-career, and may stagnate toward career end. This age-earning profile, coupled with a work environment characterized by massive and rapid change, yield 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. These elements of college life are the foundation for the large and increasing number of students enrolled in higher education programs (figures 1 and 2). Most individuals with a college degree would be unwilling to give up their college experiences, both academic and nonacademic. For most students, college is fun and productive!

Economic theory provides a second reason behind the continuation of 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 7: college-aged persons have "no money and a lot of time." The combination of higher lifetime earnings and lower opportunity costs provide 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.

A rapidly changing economy provides a third argument for a large, early investment in education. As the global economy develops, and new opportunities unfold, the value of time increases for participants in the "New Economy." Higher opportunity costs of time result in large investments in human capital being made earlier, rather than later.

Given these arguments, it appears unlikely that college and university life will change from a bricks and mortar institution to purely electronic education. However, major changes are likely to take place within the traditional residential college experience, as will be discussed later. Not only will demand for residential university programs remain in place, but it is likely to increase, given the increasing returns to individuals with higher levels of education relative to those without college degrees. And that is not all. Educational programs for nontraditional students are expanding rapidly, as individuals with work experience require more technical, business, communication, and economic skills to remain competitive in the workplace.

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 et al., 1999), many persons at this stage in life have large debts (student loans, car loans, credit card debt, and in many cases, a mortgage on a home). Young adults at this stage often make huge career investments by working hard (and late) in order to "get ahead." Investments in human capital at this stage are often career investments, learning the professional knowledge and gaining experience in how to "play the game." Given the characteristics of early career workers, educational products targeted toward this group of individuals should be (1) brief, and (2) 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 that is needed by aspiring young workers. This model could be usefully extended to workers in agribusiness, service industries, or government work. A modern extension program that includes cutting-edge research on important topics, information dissemination through electronic publications and e-mail, and extension presentations are outstanding examples of the direction that all colleges and universities need to go. Through expansion of the higher education customer base to include more than the residential students, the private and public sector returns to education will be increased dramatically.

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." Huffman (1974, p. 85) articulated this idea: "…schooling augments skills that facilitate the gathering, processing, and interpretation of information, thereby enhancing allocative ability, reducing uncertainty, and contributing to efficient decision 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 place 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 indicated that:

> education and agricultural extension are substitute sources of allocative efficiency. An increase in extension (an activity of disseminating decoded technical information) substitutes for some of the advantages associated with additional schooling. Hence, increased extension can reduce losses from ignorance that are associated with insufficient schooling. However, the optimum amount of extension will decline as farmers attain higher levels of education (p. 96).

The rapid change of the New Economy alters 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.

Mid Career: "A Lot of Money, 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 (figures 5 and 6). Loans for college, cars, and houses are often paid off. 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 extraordinarily high opportunity costs of time. The educational product must provide skills and information of higher value than the managers' next-best alternative use of their 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 in order. Executive programs, such as the Masters in Agribusiness degree offered at Kansas State University, or the Master's in Business Administration offered at the Food and Agribusiness Institute of the University of Santa Clara are examples of providing relevant programs to persons in mid career. Second, seminars, meetings, and conferences for mid-career professionals are increasingly popular methods of disseminating information. The Department of Agricultural Economics at Kansas State University hosts a two-day extension conference each August for agricultural and agribusiness professionals. The number of participants at this conference has grown to approximately 300 in each of the past several years.

This type of activity provides evidence that the demand for quality continuous education is large and growing for alumni and others at mid career. 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."

In the "New Economy," professionals in late career not only earn high salaries, but they have accumulated a large amount of wealth, in the form of personal savings, personal investments, and retirement accounts (figure 7). The New Economy has had a huge impact on this wealth by personalizing the access to these accounts. It is not uncommon for experienced workers to check their investment portfolio daily, and make desired changes via internet or cell phone. This type of financial management is not limited to wealthy investors, as in the past. The

internet, together with deregulation of financial markets, has resulted in the democratization of investing. Professional workers with several decades of work experience often have accumulated large amounts of money.

These accumulations have freed up many individuals from the necessity of work: early retirement and partial retirement are increasingly attractive options for many individuals and families. Some individuals in this age group switch professions from a high-status, high-income position to employment that 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 in the New Economy. 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 rapid changes in agricultural production, processing, distribution, and consumption have generated a large and increasing demand for educational products throughout the productive lives and careers of agricultural college graduates. Continuous education is a growth industry in times of rapid change. Departments of Agricultural Economics could modify and expand existing research, teaching, and particularly extension education programs to meet this growing demand.

When We Teach

Information, skills, and knowledge are increasingly demanded throughout the working lives of college graduates. In economic language, information and knowledge are *luxury goods*: as income rises, a greater proportion of the consumer's budget is spent on educational products. Given this large and increasing demand for educational products and activities, institutions of higher education need to match educational products to students (and potential students). 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. Specialization of academic programs into targeted products would enhance our ability to provide quality education to more groups and individuals. When should we teach? Quality programs should be extended to attract and retain any students who would benefit from an increased understanding of economic principles applied to real-world problems.

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 highly personal one-on-one tutorial between student and teacher to the 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 all of the educational objectives that a residential course or program can meet. Education is a highly relational activity, and in many circumstances requires face-to-face contact for the development of many higher-order thinking processes. Stanley Ikenberry, president of the American Council of Education, states that there is more to education than merely mastery of content: "It involves judgment, analysis, synthesis, communication, creativity, and innovation" (Rosenblatt, 2000).

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 this, Departments of Agricultural Economics will most likely continue to be taught in bricks 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. Thus, we will continue to teach agricultural economics in an ever-widening variety of formats, but the foundation of higher education will remain the four-year full-time residential degree. Traditional degree programs are not perfect, however. The next section describes solutions to four common problems with teaching programs in Agricultural Economics.

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 that 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: (1) students as consumers, (2) large classes, (3) overuse of technology, and (4) 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 that motivate human behavior. The market model, however, can be incorrectly used. One such misapplication is 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 that 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 that maximize short run student satisfaction at the expense of solid knowledge and learning that require significant effort. William 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." Specifically, Becker lists several activities that are used to improve student evaluation scores: (1) entertaining students, (2) "dumbing down" the course, (3) manipulating the timing of the evaluation procedure, (4) driving the unhappy out of the class, (5) blaming others for poor organization, and (6) avoiding innovation.

McKeachie (1997, p. 1219) summarizes the result of using student evaluations as the sole source of measuring teaching effectiveness:

> Many students prefer teaching that enables them to listen passively-teaching that organizes the subject matter for them and that prepares them well for tests… research, however, points to better reflection, thinking, and motivational effects when students are more actively involved in thinking, writing, and doing… Thus, some teachers get high ratings for teaching in less than ideal ways.

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. Hoyt and Pallett (1999) 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 that student evaluations should comprise no more than thirty percent of the total evaluation of a course. How to evaluate teaching outside of student evaluations is controversial, however (Hoyt and Pallett 1999). There are difficulties 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). University teachers should be comfortable with classroom visits by peers and administrators. Faculty and Department Heads should invest in learning how to visit classrooms and provide feedback that will improve teaching. Agricultural economists place the highest of praise on the process of peer review in research, but totally ignore peer review of teaching. Teachers could be held to a higher degree of accountability, and students would learn more if the use of student evaluations were more limited, and peer evaluations were emphasized.

Size Matters: Are Large Classes Efficient?

Economists fool themselves by claiming that large classes are "efficient." On the surface, it appears that bigger classes are economically justified, since the fixed costs of a lecture can be spread over more students. This lowers the average total cost of providing educational outputs. This line of thinking is attractive, particularly to an administrator facing resource constraints. Although attractive, the argument is incorrect. The argument 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.

Efficiency gains occur when fewer inputs are used to produce the same amount of output. 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 previous research in this area suggests that class size is not an important determinant of the acquisition of subject matter knowledge (Pascarella and Terenzini 1991, p. 87). However, McKeachie (1980) reports that 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, 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 this skill 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 expected to be related to institutional size, the quality of education, class size, and the level of diversity in the student body, as in equation (7):

(7) tuition = f(enrollment, student-faculty ratio, selectivity index, percent 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: there are 200 observations for all colleges and universities in the 17 Western states.

A selectivity index was employed to capture educational quality, with a range from 56 to 100). This rating is determined by a formula that considers, among other things, the schools acceptance rate, the number of acceptances who actually enroll, and the class rank and average test scores of entering first-year students.

Regression results are presented in table 5. Approximately one-third of the variation in tuition is explained by the model, each of the independent variables is statistically significant, and of the expected sign. Larger schools have lower tuition rates, reflecting the subsidized rates that many large public universities charge. For our purposes, the most important result is that larger student-faculty ratios are associated with lower tuition rates: there is a willingness to pay for smaller student-faculty ratios. Specifically, the regression results indicate that a $500 premium is associated with a one student decrease in the ratio.

As expected, institutions with higher selectivity had higher tuition rates, and lower levels of diversity, as measured by percent Caucasian, were associated with lower tuition rates, indicating a willingness to pay for a more diverse student body. 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.

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. However, recent evidence suggests that the use of the internet for personal, rather than professional, reasons at the workplace is commonplace, resulting in a loss of productivity, at least in the short run.

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 out the slides for distribution prior to a lecture, can make lectures nearly unnecessary.

For many teachers, learning how to use new technology is fun, interesting, and challenging, 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 that grades 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 presentations slides 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 result in a stationary lecture delivery style, rather than energetic chalkboard lectures.

Technology is not all bad. Two major advantages to the introduction of technology to the classroom are indirect advantages. First, technological innovations are reversible, and (2) any innovation that causes professors to rethink their material in a new way will lead to deeper understanding of the material and of teaching the material. Innovations that change the way that a class is taught provide long-term benefits, almost without exception. Why? When a new teaching technique is introduced, if it benefits learning, then both the teacher and the students benefit from the adoption of the new technique. Consider the opposite situation when a new teaching innovation is introduced, and fails miserably. Careful consideration of the causes and consequences of the failure inevitably leads to improvement of the course the following term. This process of continuous trial and error, success and failure, results in dynamic improvement of teaching over time. Static teaching styles and course content result in obsolescence. Teaching is an art that requires continuous improvement, particularly in times of rapid technological change. Technological innovations provide an excellent method of causing teachers to rethink, explore, and improve both course material and pedagogical styles.

To summarize, the appropriate use of technology can bring benefits to student learning, and the efficiency of teaching. However, technology can be overused in the attempt to substitute computers for tasks that require judgment, higher order thinking, or human concern. In economic jargon, the possibility of using the input of computer technology in teaching college courses is subject to the law of diminishing returns: educational outcomes can be negatively affected when the use of technology is pushed beyond the optimal level and into Stage Three of production.

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, academic agricultural economists 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, which limit the ability of an academic department to take advantage of differences in ability 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 over time to take full advantage of the numerous opportunities available within the profession. Tying a productive professor's time to budget "tenths" for government budgetary purposes is out of date: command economies have fallen.

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. Hiring nonacademics near the end of a career in agribusiness is one example of the type of flexibility needed to improve academic programs. Also needed is careful consideration of course and curricular content, as discussed in the next section.

What We Teach

The food sector is undergoing rapid structural change. The former Soviet Union, Eastern Europe, and China continue to make the transition from command economies to market economies. Market capitalism has been revolutionized by the internet, vastly enhancing competition and empowering consumers with market information and opportunities. The demand for knowledge of fundamental economic principles is large, growing, and vital for participants in the New Economy.

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. Practice in the application of economic principles to real-world problems provides students with skills that will be useful throughout their careers and lives. This is particularly true when the economic principles are combined with written communication, oral communication, and problem solving skills.

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 that we can provide to students. Since economics is the study of choice, or how to allocate scarce resources among competing ends, our profession has a strong comparative advantage in the New Economy. 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.

Conclusion

The Land Grant University structure, together with the subject matter of the agricultural economics profession are well suited to the provision of knowledge, skill, and information needs in the 21st century. In an age of unprecedented economic expansion, government budget surpluses, 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 become "New Agricultural Economists" will have the ability to take full advantage of the exciting prospects provided by the information age. New Agricultural Economists could enhance higher education through careful consideration and implementation of the following ten items:

(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. Deemphasize 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 our 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 the New Economy.

(10) Refuse to give up when faced with the frustration of bureaucracy. In the words of Parker Palmer (p. 182):

> I am a teacher at heart, and I am not naturally drawn to the rough-and-tumble of social change. I would sooner teach than spend my energies helping a movement

> along and taking the hits that come with it. Yet if I care about teaching, I must care not only for my students and my subject but also for the conditions, inner and outer, that bear on the work teachers do. Finding a place in the movement for educational reform is one way to exercise that larger caring.

The opportunities for teaching agricultural economics are huge. The need for economic knowledge applied to food, trade, and resource issues is growing and changing. The institutional setting of the Land Grant University, combined with the subject matter of our discipline, provide a solid foundation upon which to build meaningful academic programs. 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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Table 1. Summary Statistics of Earnings Regression Data.

	Males[1]				Females[2]			
Variable	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
Age	41.435	9.865	25	65	41.396	9.717	25	65
Earnings	43,720	43,501	1	419,044	28,424	26,880	1	402,204
Highest Education Attained:								
High School	0.321	0.467	0	1	0.321	0.467	0	1
Some College	0.229	0.420	0	1	0.251	0.433	0	1
Associates Degree	0.043	0.202	0	1	0.051	0.219	0	1
Bachelors Degree	0.239	0.427	0	1	0.227	0.419	0	1
State of Residence:								
Arizona	0.044	0.205	0	1	0.047	0.212	0	1
California	0.243	0.429	0	1	0.238	0.426	0	1
Colorado	0.051	0.220	0	1	0.053	0.225	0	1
Idaho	0.041	0.199	0	1	0.036	0.185	0	1
Kansas	0.038	0.191	0	1	0.040	0.197	0	1
Montana	0.039	0.193	0	1	0.035	0.185	0	1
Nebraska	0.041	0.199	0	1	0.039	0.195	0	1
Nevada	0.046	0.209	0	1	0.045	0.208	0	1
New Mexico	0.049	0.216	0	1	0.048	0.215	0	1
North Dakota	0.031	0.173	0	1	0.038	0.191	0	1
Oklahoma	0.039	0.193	0	1	0.041	0.198	0	1
Oregon	0.035	0.185	0	1	0.035	0.183	0	1
South Dakota	0.037	0.189	0	1	0.038	0.192	0	1
Texas	0.145	0.352	0	1	0.155	0.362	0	1
Utah	0.040	0.197	0	1	0.034	0.181	0	1
Washington	0.041	0.199	0	1	0.041	0.198	0	1
Wyoming	0.040	0.195	0	1	0.035	0.185	0	1

[1]Male observations: 7391.
[2]Female observations: 5244.

Table 2. Earnings Regressions by Gender and Level of Education Attainment.

Dependent Variable: Earnings ($).

Variable	Parameter Estimates[1]							
	Males				Females			
	High School	Some College	Associates	Bachelors	High School	Some College	Associates	Bachelors
Dep. Var. Mean:	31782.081	36731.180	39601.646	51786.493	21105.249	25354.815	29623.894	34927.078
Intercept	-14941	-11624	-22087	-53463	13428	-10141	5233.446	-17562
	(-1.581)	(-1.088)	(-1.011)	(-2.813)***	(2.000)**	(-0.934)	(0.163)	(-1.346)
Age	1908.153	2045.529	2649.587	4458.699	266.328	1491.415	983.293	2275.655
	(4.162)***	(3.927)***	(2.444)**	(4.817)***	(0.824)	(2.831)***	(0.619)	(3.488)***
Age Squared	-17.567	-20.020	-26.543	-43.831	-1.881	-14.511	-8.854	-22.806
	(-3.292)***	(-3.281)***	(-2.047)**	(-4.044)***	(-0.502)	(-2.360)**	(-0.465)	(-2.902)***
Model F-test	31.424***	20.773***	8.627***	31.275***	3.800**	10.879***	0.956	16.999***
Observations	2370	1688	315	1769	1683	1313	264	1191
RMSE	27490.603	25803.722	20616.368	45141.100	15753.510	23130.677	27125.836	25334.852
R-square	0.026	0.024	0.052	0.034	0.005	0.016	0.007	0.028
Adj. R-square	0.025	0.023	0.046	0.033	0.003	0.015	-0.0003	0.026

Note: t-statistics appear in parentheses.

Table 3. Rates of Return for Higher Education, Western Region, 1999.[1]

	Males	Females
Benefit Cost Ratio[2]	5.135	3.743
Internal Rate of Return[3]	0.2839	0.2356
Net Present Value[4]	78,376	51,984

[1]All calculations assume that college costs (tuition, fees, and books) are equal to $5000 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 the seventeen Western states, excluding Alaska and Hawaii (see tables 1 and 2). Benefits are assumed to be earned from ages 25 to 65 years of age. Data are from the March Supplement of the Current Population Survey of the U.S. Bureau of Labor Statistics.

[2]The Benefit Cost Ratio (BCR) is calculated from the equation: $BCR = \Sigma B_t(1+r)^t/\Sigma C_t(1+r)^t$.

[3]The Internal Rate of Return is calculated from the equation: $0 = \Sigma (B_t - C_t)/ (1+IRR)^t$.

[4]The Net Present Value (NPV) is calculated from the equation: $NPV = \Sigma (B_t - C_t)/ (1+r)^t$.

Table 4. Summary Statistics of Data for College Size Analysis.[1]

Variable	Mean	Standard Deviation	Minimum	Maximum
Tuition ($)	7729.69	7190.83	0	28960.0
Enrollment (students)	6296.83	7101.81	105.0	35889.0
Student to Faculty Ratio	16.27	4.26	6.0	27.0
Selectivity Index[2]	71.73	7.86	60.0	99.0
Percent Caucasian	75.13	19.94	1.0	98.0

[1]Number of observations = 200.

[2]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 difficult it is to get admitted (Princeton Review, p. 5).

Table 5. Regression Results of College Size Analysis.

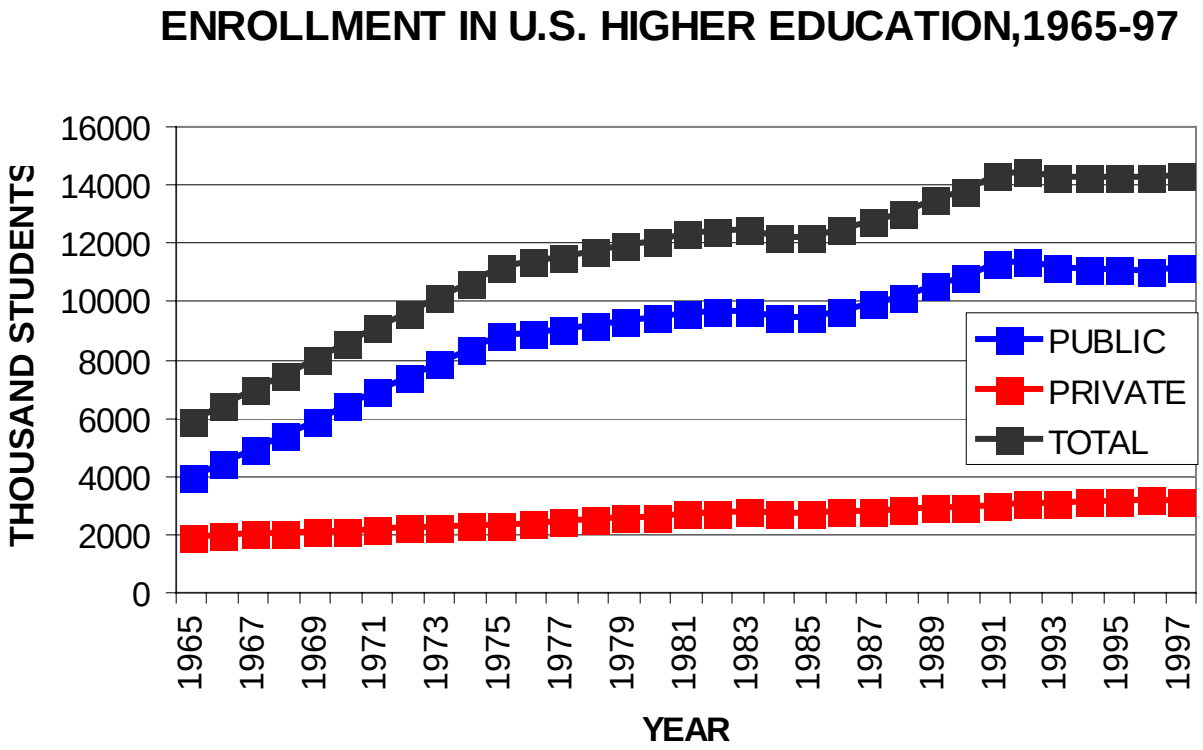
Dependent Variable: Tuition ($). Dependent Variable Mean: 7729.688

Variable	Parameter Estimate	Standard Error	t-test[1]
Intercept	12321.000	5460.150	2.257**
Enrollment	-0.363	0.068	-5.331***
Student to Faculty Ratio	-508.088	118.613	-4.284***
Selectivity Index	135.840	58.092	2.338**
Percent Caucasian	-50.359	21.736	-2.317**

R-square	0.348
Adjusted R-square	0.335
Model F-test	26.049***
Root MSE	5864.461
Observations	200

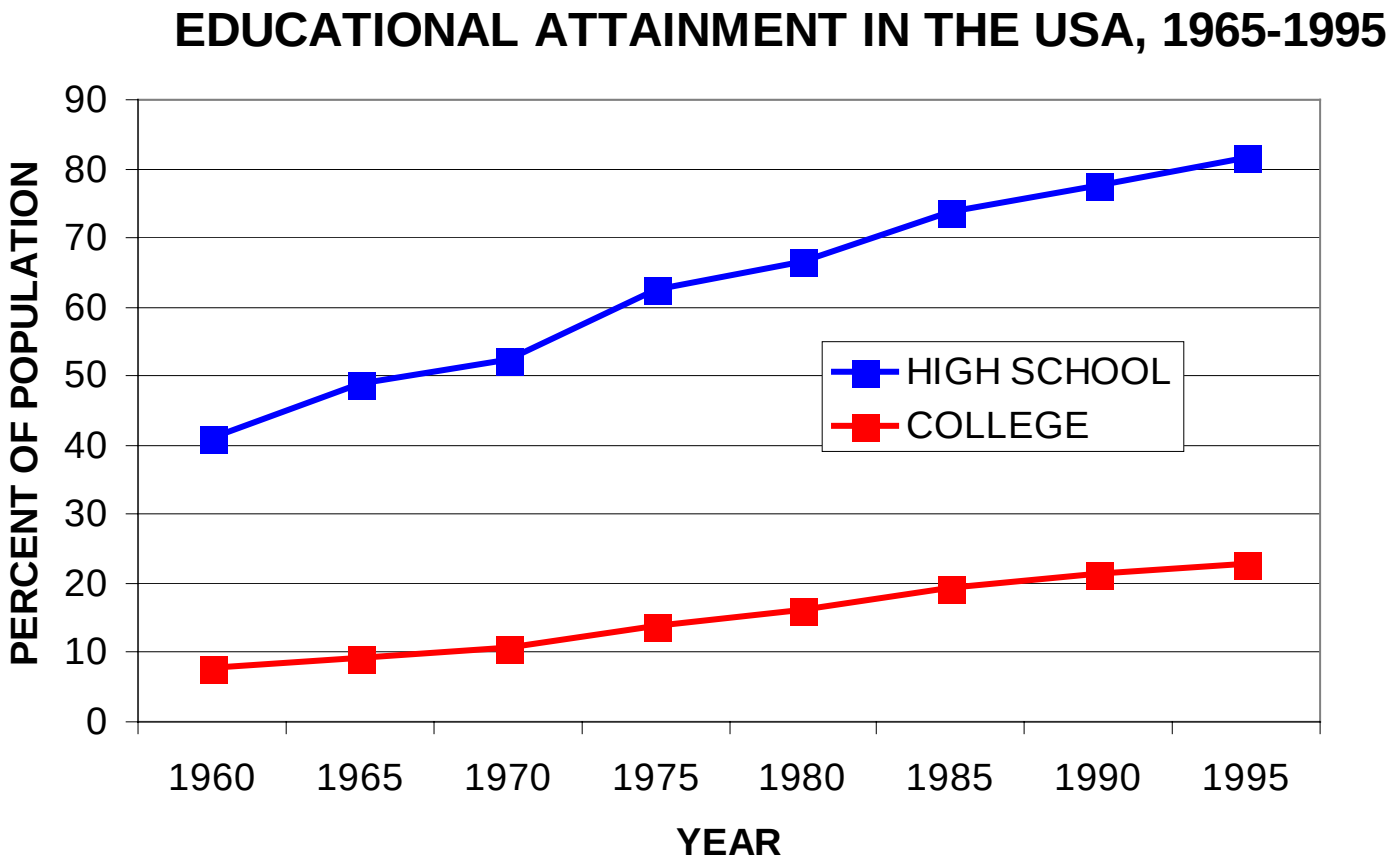
[1]Three asterisks (***) refer to statistical significance at the one percent level, two asterisks (**) at the five percent level, and one asterisk (*) at the ten percent level.

Figure 1.



Source: U.S. National Center for Educational Statistics. *Digest of Education Statistics*, annual.

Figure 2.



Source: U.S. Census Bureau. U.S. Census of Population, U.S. Summary, PC80-1-C1.

Figure 3. The Effect of Individual Educational Attainment on Societal Benefits from Education.

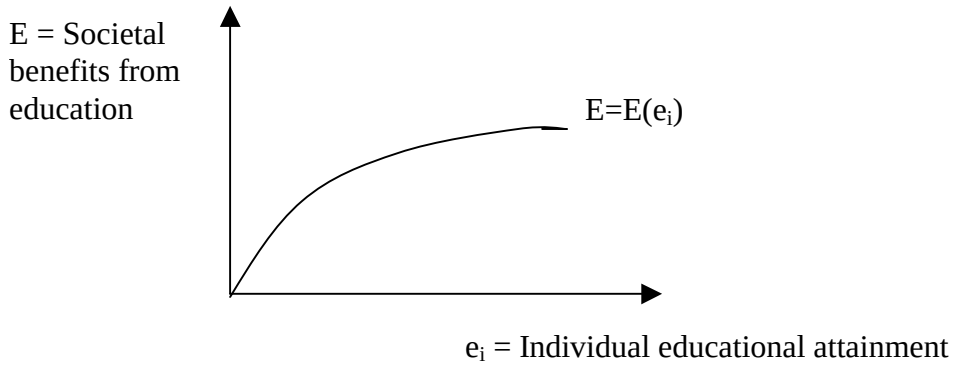


Figure 4. The Effect of Technology on Societal Benefits from Education.

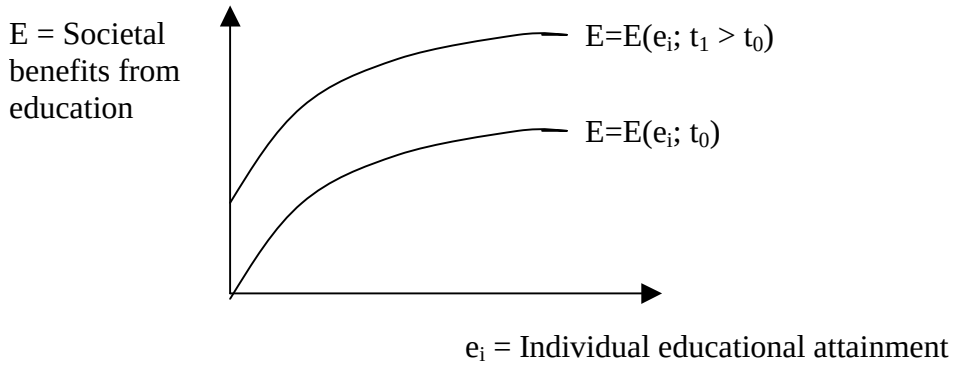


Figure 5.

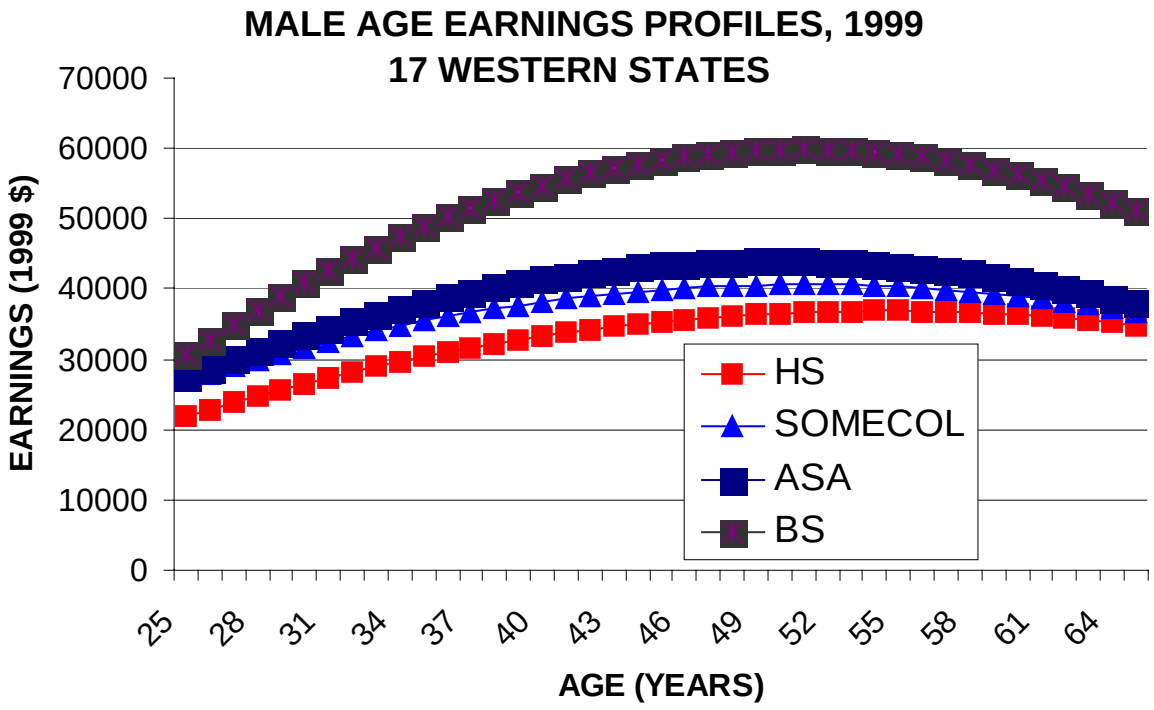
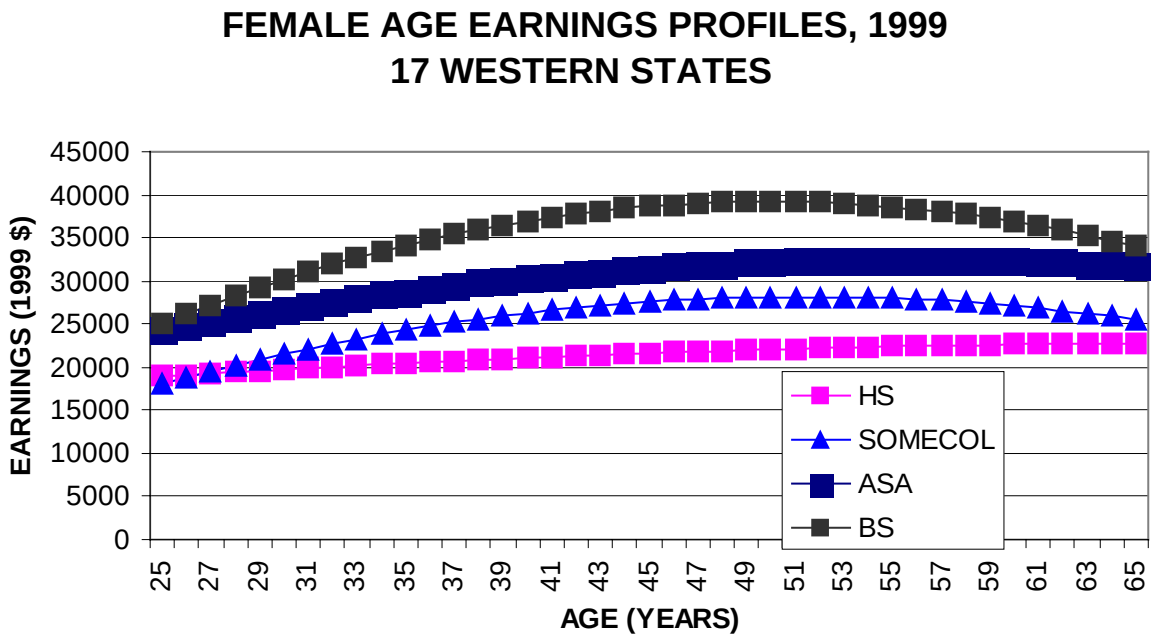

MALE AGE EARNINGS PROFILES, 1999
17 WESTERN STATES
EARNINGS (1999 $)
70000
60000
50000
40000
30000
20000
10000
0
25
28
31
34
37
40
43
46
49
52
55
58
61
64
AGE (YEARS)
HS
SOMECOL
ASA
BS

Figure 6.


FEMALE AGE EARNINGS PROFILES, 1999
17 WESTERN STATES
EARNINGS (1999 $)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
25
27
29
31
33
35
37
39
41
43
45
47
49
51
53
55
57
59
61
63
65
AGE (YEARS)
HS
SOMECOL
ASA
BS

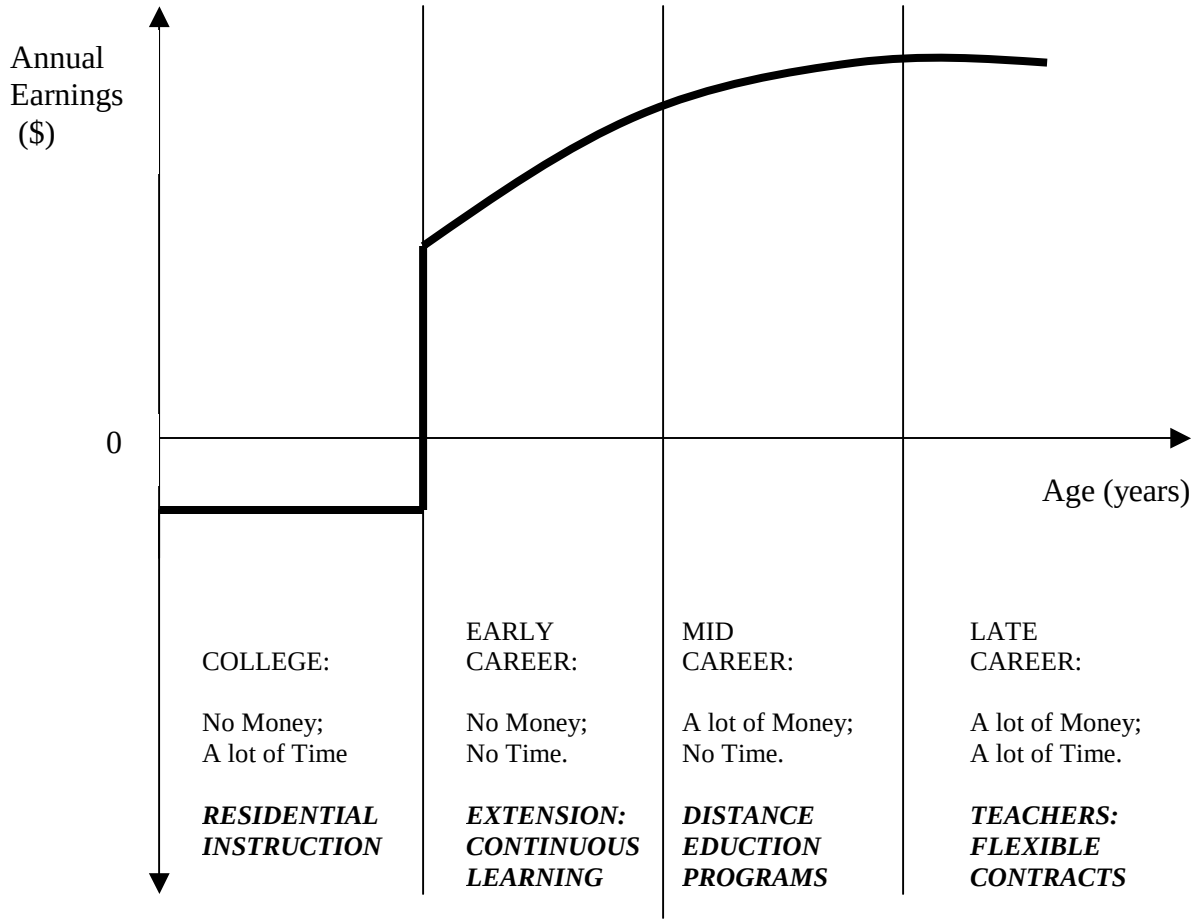



Figure 7. Model of Lifetime Earnings and Educational Needs.