The Public Interest in Higher Education

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The American public is certainly *interested* in higher education. Fifty-two percent of adults over age 25 and 62 percent of high school graduates (down from 67 percent in 1997) had spent some time in college by the end of 2001.[1] The press produces thousands of pages annually on the topic. Congress spends hundreds of hours each year in debate on it. Millions of citizens take advantage of college athletics events, cultural programs, facilities and the fruits of university research. These facts alone say nothing about the necessity of public funds to *support* higher education.[2] This paper analyzes when and why (if at all) the public should be interested in higher education and provides a brief survey of what economists currently know about the public benefits produced by investments in higher education.

Universities, particularly the publics, are increasingly bemoaning the budgetary squeeze caused by the slowing economy and changing governmental priorities.[3] As academe aggressively pursues business and civic leaders to support higher education, these and other policymakers justifiably want to understand the role that it plays in economic development. Countless studies have demonstrated that the private returns to higher education investments are large and increasing. Comparatively little is known about the social returns to higher education investments.

Social returns are the *net* benefits that accrue to society from both private and public investments in higher education. Taxonomy can be confusing in the literature, so throughout this paper what I call the social returns is actually the sum of private and public returns. The public returns are those returns that accrue to society *beyond* those that accrue to the individuals making the investment.[4] Focusing on the purely monetary aspect of higher education investments, individuals will choose the socially optimal level of education if they can realize *all* of the gains from their investments—assuming they are not restricted from choosing to invest. Society will reap the benefits of increased tax collections when individuals graduate from college. To the extent that individuals would not be able to receive benefits equal to the amount of the increased tax payments (for instance, the more money I earn, the less likely I am to require welfare and Medicaid benefits), they may choose to underinvest in schooling from a societal standpoint.[5]

Private earnings increments constitute a portion of the social returns to higher education that are well understood and whose measurement has become more accurate with the advancement of new and creative empirical techniques—I will discuss them only in passing in this paper. In order for policymakers to make informed decisions, they must address four questions beyond understanding the private investment decisions of individuals. First, what are the economic and noneconomic benefits (both public and private) of higher education investments beyond the expected earnings advantages of individuals? What is the theoretical rationale for when public investments are justified? Second, what types of returns can be expected? Do we know anything about the expected magnitude of these returns? Third, how can one measure the social returns? Fourth, what are the analytical and practical challenges to measuring these returns and implementing policy?

The following section will address these four questions in turn, with a focus on surveying what economists currently know and are working toward with respect to each. The remainder of the paper will discuss issues I feel are particularly important for understanding fully what the public returns to investments in higher education are. These topics include examining the role of agricultural and cooperative experiment programs at universities and the prospects for their future; complementarities between higher education and elementary and secondary education; the role of community colleges; states' capacity to educate their citizens and the role of nonresident enrollments in higher education; the relationship between higher education and the workforce; and support for undergraduate education versus support for "big science" and technology transfer.

The Benefits of Higher Education

Public spending on higher education is justified any time that private individuals, guided by their own devices, would choose suboptimal levels of schooling from the standpoint of society.[6] To a degree, determining

what is optimal for society entails some measure of subjectivity and value judgment on part of its citizens. However, the same can be said of noneducation spending, so while I acknowledge this challenge, I will discuss it no further. A broad economic definition of an educational benefit might be anything that shifts out the utility possibility function of society (including production possibility shifters such as labor productivity);anything that reduces costs and makes resources available for more productive uses, such as increased employment opportunities, which may release resources from law enforcement by cutting crime rates; and anything which increases welfare possibilities directly, such as public spiritedness or social consciousness of one's neighbor. The benefits of higher education, both private and public, can be partitioned into pecuniary and nonpecuniary benefits.

Pecuniary returns are anything that improves the financial well-being of individuals and the public. These would include the increased tax receipts collected from educated citizens. In addition, this larger and deeper tax base would reduce the tax pressure on the lower-income members of society at the same time as reducing the number of people that would require support from all levels of government. A rather substantial pecuniary benefit of higher education that is almost universally ignored in economic research as well as the debate on higher education funding is what Burton Weisbrod (1962) called the "financial option" return of educational investments. Part of the monetary value of completing an education is that passing through various schooling thresholds provides one with the opportunity to obtain still more education. If students are unaware of this option value at the time of making their investment decisions (and this might be especially prevalent among students from disadvantaged families or families with lower average education levels), public subsidies can help avoid systematic underinvestment. Though it is easy to see why the option value is largest for more elementary levels of education, the changing technological and economic conditions of the twenty-first century are inflating the option value of a college education. I am confident you have overheard someone complaining that, "It now takes a college education to land the same job that a high school graduate could have landed 20 years ago." This trend captures the essence of the financial option.

The nonpecuniary benefits of higher education are all of the nonmonetary benefits that accrue to individuals and society. The difficulty in attaching a dollar value to most of these types of benefits (and in many cases, recognizing) is likely responsible for the dearth of economic studies that focus on measuring the public returns to higher education and for the apparent understatement of the benefits in those studies that do exist. The most easily recognizable nonpecuniary benefits include the private and public consumption benefits of higher education. Individuals may gain more than an earnings advantage from going to college—they might actually (gasp) enjoy class and the social activities on campus, have their intellectual and cultural horizons expanded, and be able to tap into a vast network of educated alumni and friends. The public is welcomed at even the most proprietary of institutions, and the benefits they enjoy include taking part in the arts, special lectures, athletics programs, and other campus facilities (coffee shops, arboreta, gymnasia, etc.).

Other recognizable nonpecuniary benefits include promoting educational opportunity, promoting growth and economic productivity, supplying trained men and women to the economy, achieving specific social objectives such as income transfer or equalization, developing an educated citizenry, creating knowledge, and stimulating learning. There is a growing literature in human ecology that finds that female and maternal education affects children's health, female mortality, female fertility, birth rates, and the "quality" of children.

Economist Alfred Marshall knew that it would be difficult to identify all of the benefits of higher education when he said, "All that is spent during the many years in opening the means of higher education to the masses would be well paid for if it called out one more Newton or Darwin, Shakespeare or Beethoven."[7] Colleges not only instruct students, but the society benefits of the research activities from faculty members.[8] Many believe that the volume of basic research would be smaller in the absence of higher education. To the extent that the value of research is captured by faculty salaries (and other mechanisms such as ownership rights on the research), the private returns will capture the externality.

Three additional nonpecuniary benefits deserve mention. First, higher education can widely broaden individual employment choices and expand the geographical area under which one might consider working and living. This private "opportunity option" is particularly important in the twenty-first century as labor markets are increasingly national in scope and transportation and relocation costs (actual and psychic) are much lower

today than in the past.[9] Second, higher education acts as a "technology hedge" in the sense that the more educated a worker is, the more able she is to adapt to technical changes in the workplace. This hedge option lends importance to the support of a broad liberal arts undergraduate education. While these benefits will not manifest themselves through higher earnings, they may be internalized in greater job security, earnings stability, and a greater capacity to benefit from on-the-job training. Third, my obtaining a higher education will have direct and indirect intergenerational benefits. The direct effect is that my children will receive an informal education at home. The indirect externality is that children of college-educated parents are much more likely to receive a college degree or pursue careers in different fields, whose value cannot be solely judged by earnings. Individuals with a high discount rate may not consider these benefits at the time investments are being made—providing the impetus for intervention by an entity that cares about the long-term prospects of our society.[10]

When Public Interest Is Justified

That higher education produces substantial private and public benefits is not prima facie confirmation that public subsidies are justified. For every stated benefit above, there are related costs and the measurement issue is no less difficult on this side of the ledger. A careful accounting of all tangible and opportunity costs is a necessary condition for informed decision making. Broadly speaking then, there are three economic criteria that must be jointly satisfied in order for additional investments in higher education to be a socially efficient allocation of resources.[11] First, higher education investments must have a positive *net* social benefit. That is, the sum of private and public benefits must exceed the sum of private and public costs. Second, individuals must be restricted from investing in the socially optimal level. This may occur if personal discount rates are very high (due possibly to laziness, poor health, economic hardship, etc.) or more generally when private individuals cannot capture all of the private benefits, and/or when there are additional public benefits that private individuals do not take into consideration when choosing to undergo an investment. Third, the net social return to higher education investments must be larger than any competing use of public monies *at the margin*.[12]

Individuals may not choose the optimal level of education because externalities exist. Private investments in higher education may confer benefits upon three different groups of people. The first are residence-related beneficiaries that benefit by virtue of the relationship between their place of residence and the student/institution. University communities have a large pool of energetic young people who perform community service; as mentioned above, universities have a wealth of activities and facilities that are open for public consumption; and most important, universities provide a wide range of public services including, but not limited to, cooperative and agricultural experiment research and programs. The second are employment-related beneficiaries or productivity spillovers. College-educated workers enhance the productivity of others by sharing knowledge and skills through formal and informal interactions of workers with heterogeneous skill levels. They also may produce technological externalities (Lucas 1988), knowledge spillovers (Gilles and Puga 2003), and pecuniary externalities (Acemoglu 1996). Society at large is also seen to benefit from private investments in higher education. Better-educated persons may make better and more informed policy decisions and be more active politically and socially.[13] Society can also be seen to benefit because it is likely that education is an important input into the production functions of other publicly provided and supported goods. For example, it is very likely that the quality and quantity of national defense provided by the federal government depends heavily on the education level of the population and research productivity of college faculty members.

That institutions of higher education are responsible for producing positive spillovers that would not exist in their absence can be understood from watching a few scenes from the movie *Apollo 13*. When NASA understood that the lives of its astronauts were in jeopardy unless they could figure out how to unpoison the air in the lunar module, it did not ask each of its talented scientists to go home and figure out how to solve this problem. Rather, NASA put its best people in a room—where together they used their individual expertise in electronics, air filtration, mathematics, etc., to collaboratively come up with a solution. Colleges and universities bring together the most talented students (peer effects) and teachers precisely because the interaction among these people is likely to enhance learning and improve the quality of research and service above and beyond what would occur if all of America's talented people were spread throughout society.

Imperfect capital markets are believed to cause significant underinvestments in education if left untended. The salient question is not really whether certain persons are

credit constrained—they most certainly exist. The right question is how difficult it would be to target subsidies to those who are constrained and to design programs that reduce the moral hazard resulting from the "savings penalty" imposed on thrifty households. The rationale for broad-based public support is that it is difficult to target the right individuals. Opponents of broad-based support suggest "leakage" is a problem—the extent that general subsidies are merely transfer payments to those that are not credit constrained.[14] Finally, private underinvestment may result from a divergence between individual and societal goals—such as equality of opportunity.

Types and Magnitudes of Returns

The field of human capital was developed primarily because of the inability of standard classical economics to explain differences in national income growth between rich and poor countries. Because these variations could not be explained by the employment of traditional factors of production (labor, capital and land), it was reasoned that variation in quality, specifically in labor quality, must account for the missing variation. This development led to an intense study of the private returns to educational investments, but little study of the public returns. If a state/city wanted to develop a higher education policy to promote economic growth, it would be necessary to obtain information on the impacts of higher education on area wages, income growth, productivity, mobility, and civic behavior. Recent studies have attempted to address each of these issues.

A small number of studies of the public returns emanated during the middle half of the twentieth century. In 1957 Zvi Griliches estimated the social rate of return on hybrid corn seed research to be 700 percent and that the rate of return to all agricultural research was between 35 percent and 170 percent. In 1971, Burton Weisbrod found that economic returns alone to the polio vaccine approached 14 percent. The past 10 years have seen a reemergence of attention by economists toward this question. As in the early studies, it is nearly impossible to directly state what the "overall social rate of return to education" is, though economists are increasingly able to quantify some of the public benefits to higher education investments.

Glaeser, Scheinkman, and Shleifer (1995) studied the relationship between demographic characteristics of American cities and regions in 1960 and growth in income in these areas between then and 1990. Their major finding was that income growth over the period is positively related to the stock of human capital at the beginning of the period. Similar to the international development literature, they find that income growth in cities can be characterized by their workforce structure and the rate of structural change that occurs. They find that income growth was faster in cities with low initial unemployment rates and in cities where a smaller share of the workforce is employed in the manufacturing sector.[15]

A number of studies have focused on the relationship between the stock of human capital in an area and the employment and income conditions in that area. Glaeser and Saiz (2003) show that the percentage of workers with college degrees strongly predicts future income growth rates in urban areas. They cite the dichotomous experiences of Boston and Detroit since 1980 to illustrate their point. In 1980, each city looked similar—shuttered manufacturing plants, declining populations, declining real estate values, and unpleasant winter and spring weather. However, Boston has enjoyed resurgence and Detroit has not. A large reason for this resurgence was that Boston focused on investing in industries and programs that were complementary to the large stock of educated people in that area and Detroit did not. In addition, more highly educated people are more able to adapt to changing technologies and move into new employment (Boston) than a generally less highly educated workforce (Detroit). A more detailed study of the differences between the two cities' economic policies over the past 20 years would be a valuable exercise for any city, county, or state government trying to spur its own economic development.[16]

In a series of papers in 2004, Enrico Moretti examines how a more highly educated workforce may lead to economic growth. In one paper (2004b), he shows that highly educated workers produce positive spillovers to less skilled workers. He finds that cities that have larger shares of college-educated workers have higher wages for high school dropouts and high school graduates. A 1 percentage point increase in the city's share of population who are college graduates will increase wages of dropouts by 1.9 percent and graduates by 1.6 percent.[17] In a subsequent paper (2004c), he analyzes plant-level data to show that plant productivity in cities that experience large increases in the share of college graduates rises more than the productivity of similar plants in cities that experience small increases in the share of college graduates.[18]

Bound et al. (2004) investigate the relationship between the number of college graduates *produced* in

a state with the number of college graduates *residing and working* in that state. They demonstrate that the rate of production of college graduates in a state is weakly related, if at all, to the number of college graduates in a state—implying that it might not be necessary for a state to invest heavily in higher education for the purposes of economic development if it can import the talent from elsewhere. Groen (2004) asks a similar question at the individual level—what is the impact of attending college in a state on the probability of remaining in, and working, in that state? His results suggest a modest link between attending college in a state and working in the state. Each of these papers raises questions about the validity of government assertions that public support for higher education promotes increases in the human capital stock in an area. State monies may be better spent by creating research corridors and business environments that attract talented workers to their areas rather that trying to use merit scholarships and institutional aid in the hopes that talented students will remain after graduation.

Turning to the civic returns to higher education investments, two papers attempt to study the relationship between the education level of a population and voting behavior and other civic responsibilities. Dee (2003) finds large, positive, and significant correlations between education levels and voter participation (an additional year of schooling increases voter participation by 7 percentage points). He also finds strong, positive correlations between educational attainment and attitudes toward free speech and newspaper readership.[19] Milligan, Moretti, and Oreopoulis (forthcoming) find, using U.S. and U.K. data, that voter participation is higher the higher the education level of the population. Raw data (that is, unconditional) from the Bureau of Labor Statistics show that that 45.6 percent of four-year college graduates participate in volunteer activities, while only 21.7 percent of high school graduates do (34.1 percent for students with some college). Further, the median hours donated per year is 12 hours higher for college graduates than high school graduates. Additional unconditioned data suggest that the civic returns to college education are large. DDB Worldwide reported in 2002 that 17 percent of college graduates donated blood regularly, while only 11 percent of high school graduates donated. Finally, a RAND study in 1999 completed by Vernez, Krop, and Rydell finds that government spending on social programs is substantially lower for 30-year old college graduates than for 30-year-old high school graduates. The savings are larger for women (up to $2,700 annually) than for men (up to $2,300 annually), and are largest for African Americans and Hispanics (up to $2,700 annually) than for whites and Asian Americans (up to $1,500 annually).

How Are Social Returns Measured?

Social returns to higher education investments can be examined in three ways. The most commonly employed technique is a traditional benefit–cost analysis, or the rate of return analysis (ROR). These analyses compute the amount and timing of all private benefits and costs and all public benefits and costs and impute from these cash-flow streams an internal rate of return. A second technique that is gaining popularity is the economic impact study (EIS). An EIS attempts to add up all of the money generated and spent in a community by an institution of higher education—it then applies a multiplier to this dollar amount to determine the economic value of the institution to the community. The multiplier reflects the number of times a dollar is spent in the local economy before it flights—or leaves the boundaries of the community. A third approach, which is easier to implement for higher levels of government entities, estimates the contributions of higher education to the economy. These studies are always done econometrically—researchers regress net national (regional/local) income growth on traditional factors of production. The residual from this regression is typically attributed to education and is considered the amount of growth attributable to knowledge and other miscellaneous items.

Rate of Return Studies

Many economists would agree that the social returns found in these studies represent a lower bound on the returns to higher education investments. This derives from the difficulty in first identifying, and then measuring all of the relevant costs and benefits. A proper rendering of these models requires identification of four elements: private benefits and costs and public benefits and costs. Private costs are well understood—they include the out-of-pocket tuition and fees expenses (including books and other campus services), *incremental* living expenses, and the wage earnings given up by the student while enrolled. Getting a handle on the public and thus social costs has been more challenging.

In most studies, the *social* costs (that is, private plus public costs) are computed—they are taken to be the educational and general (E&G) expenditures of institutions plus all or part of a student's forgone earnings.

Though this has the advantage of including all private tuition payments, marginal living costs and costs of books and supplies are ignored. Research and public service costs are typically added to the cost side of the calculation, without any consideration of the benefits of these activities—only to those resulting from undergraduate or graduate instruction. Given this methodology, it seems inconsistent, then, to not decompose the E&G expenditure category further—it includes a large number of noninstructional dollars, even within the instructional expenditures category.[20] Upwards of 50 percent (or more) of faculty time at some universities is considered research time and, to the extent that students and society at large do not receive 100 percent of the benefits of this time (or if they do, if researchers choose not to include them), these calculations should not include 100 percent of the costs. As our colleges and universities move rapidly toward a research and big science model of higher education, correctly accounting for these factors will become more challenging, and more important.

The benefits side of the ledger is more difficult to account for correctly. Only pretax returns to private individuals are typically included in ROR analyses (the post-tax earnings account for the private benefit while the tax payments account for the public benefit). A large number of private and public benefits are either impossible to measure, or plainly ignored. These include the consumption benefits to students (Greek life membership, attendance at cultural and athletic events and,the pleasure obtained from learning) and to nonstudents as well (attendance at cultural and athletic events, educational programming, etc.). They also include the social investment benefits (lower welfare and crime rates, community leadership, and volunteer work of graduates, etc.) and all of the public benefits mentioned earlier in this paper. Ignoring the magnitude of these benefits will significantly depress the social rate of return calculations. However, the challenge in including them is that each benefit needs to be converted into an additional years of schooling equivalent or earnings equivalent to be included in the calculations. Some of these benefits are already being approximated, as evidenced by the studies cited earlier. Some benefits can be approximated with some effort—valuation methods adopted from the environmental economics discipline can be used to compute consumption and existence values for example. However, some benefits are nearly impossible to approximate—how much should a city of 500,000 value a 15 percent increase in the probability that a cure for cancer will be found as a result of the research happening at the local university?[21]

Economic Impact Studies

These play an increasing role in state calculations of the value of public investments in higher education and in state attempts to stabilize and enhance their economies. States now often require economic impact statements and universities themselves prepare them to use in lobbying for increased support. There are three ways to implement an EIS. First, economic base studies employ surveys to obtain financial data—and can usually assert causality because they track expenditures from the institution throughout the local economy. The difficult task here is to separate expenditures representing local actual gains to the community economy from those that are recycled funds. An additional challenge is to determine which community funds are spent elsewhere, such as when a school uses local taxes to purchase goods and services produced elsewhere. A key issue to be resolved in these studies is whether the multiplier is larger for expenditures on higher education than it is for other items—admittedly, a very difficult proposition.[22]

Second are traditional input–output approaches. These techniques derive from the field of regional and urban economics and divide a system of producers and consumers into different branches, which are defined in terms of the resources they require as inputs and what they produce as outputs. The quantities of input and output for a given time period, usually expressed in monetary terms, are entered into an input–output matrix within which one can analyze what happens within and across various sectors of an economy where growth and decline takes place and what effects various subsidies may have. The third approach is to use econometric modeling.

EIS are testimony to the fact that conventional ROR studies do omit important external benefits. These studies focus on the benefits captured by individuals other than college graduates, such as the community members who profit from spillovers from academic institutions. Further, these studies make a case for community support for local colleges and universities *independent* of the case that can be made at higher political levels. Among the expenditures and contributions that are captured by these analyses are the direct expenditures made by the institution and its students in

the locality. The most important of these are those that originate from outside the locality. Students and institutions receive funds from higher levels of government in the form of federal research grants and contracts, federal tuition aid, and fees from nonresident students that would otherwise not be part of the revenues of the local and state economy. Additional impacts are made through employee tax payments and local expenditures and monies generated from visitors to the institution and town. Faculty, staff, and students may collaborate with or lend expertise to businesses, government agencies, and nonprofit organizations—many are even setting up research centers and consulting services of their own. Significant proportions of all public university graduates stay in the area in which they attend college and become part of the area's human capital.[23] The higher earnings of college graduates mean greater demand for area products, more state and local tax revenue, and decreased pressure on the social services system.[24]

To what extent do universities bring money into an area (or state) rather than take it out? It depends largely on schools' abilities to attract out-of-area (state) students that spend their money in the area (state), as well as federal research and financial aid dollars. This would bias support for large research universities that are magnets for nonresidents and that generate large amounts of external research support. The notion of EIS is easier to understand for community colleges that are funded out of local tax revenues and are located entirely within those tax boundaries. Thus, any noncommunity funds expended in the tax area, including any from state or federal governments, represent potential financial gains. In the case of state universities, all of the gains emanate from resources derived from out of state. The best estimates of the local economic contributions are for the community colleges—where estimation is least problematic. Leslie and Brinkman (1987) find that for each dollar in a college's operating budget, an additional $1.50 to $1.60 in local business volume is created. For each $1 million (in 1985–86) spent, about 59 jobs were created. For the research universities, NASULGC (2003) finds an enormous return for its member institutions—$5 for every $1 spent and 1.6 extracampus jobs for every campus job. In addition, they find that every $100 spent by their institutions is associated with another $64 in employee spending, $60 in student spending, and $14 in visitor spending.

One must still regard these studies with some degree of hesitation. The counterfactual required to understand the true economic impact of a university in its locality is difficult to simulate in analyses and certainly rarely happens in practice. The question that needs to be answered is, what would happen to income, employment, and education levels if a college instantly vanished from its community? The question could also be framed as, what would wages, employment, and education levels be in the community had the college never located here?

Contribution Studies

This approach overcomes the concern of omission of benefits from ROR analyses. Education undoubtedly enhances productivity by contributing to research and development efficiency and to the speed of innovation application, both of which may not be fully reflected in the earnings of an educated workforce. However, these contribution studies likely represent an upper bound on the net social benefits of higher education investments. Since the estimates of education's impact on economic activity derive from econometric residuals and not from "education" per se, the amount that higher education directly contributes to this activity is to some degree arbitrary. Leslie and Brinkman (1988) cite that education contributes approximately 15–20 percent of growth in the national economy, with higher education accounting for up to one-quarter of that growth. Another 20–40 percent of national income growth is ascribed to improvements in knowledge and its application.

Analytical and Practical Challenges to Implementation

Knowing how to measure net social benefits and affirming that they are substantial enough to merit public involvement are just the starting points for policymakers. The answers to several questions are still in order. Are the social returns the same for all students and investments, or do they vary significantly by demographic characteristics and type of education? What form should public investments in higher education take? How large a public interest is required to achieve the desired social outcomes? Just how sensitive are students from different socioeconomic backgrounds to changes in college costs? Does student aid promote access? Choice? Retention? What impact do public education subsidies have on the income distribution of an area? Any public service essentially favors one group or another and the issue alone should be not whether particular groups benefit from a particular service, but also whether the tax system is progressive.

Student enrollments are responsive to price. Student price sensitivity declines as family wealth increases, college price increases, and selectivity improves—therefore, response is greatest among low-income students in public community colleges and least among the wealthiest students who enroll in private colleges. Hence, subsidies that reduce net prices should effectively increase enrollment levels for targeted students. While targeting student aid seems a logical approach, funding institutions with broad-based unrestricted appropriations will avoid the potential for targeting the wrong students—which may exacerbate the existing (and growing) inequalities in the United States.

Student financial aid is intended to promote access, school choice, and student retention. It is very probable that student and family income play a large role in shaping the initial choice set of colleges—the range of schools considered to be viable options. If disproportionately large numbers of low-income students have low-cost and less prestigious institutions as their first choices, then even if these students realize their goals, the goal of equal opportunity would not necessarily be reached. Further, Dale and Krueger (2002) find that while on average students who attended more selective colleges earned about the same as students of seemingly comparable ability who attended less selective schools, students from low-income families earned more if they attended selective colleges. Student aid monies have traditionally been used to equalize educational opportunity. Since public monies are increasingly being spent to reward academic achievement, the effect of merit aid should be considered carefully. Dynarksi (2000) finds that Georgia's merit scholarship program has widened the gap in college attendance between blacks and whites and between those from low-income and high-income families.[25]

Along with careful consideration of the impacts of student aid programs, policymakers would be wise to address the question of equitability under alternative financing schemes. How much of the taxes that support higher education are paid by the various income groups, and how much does each receive in indirect and direct tax subsidy through college enrollment? The progressive impact of need-based aid programs is obvious. However, the equitability of merit-aid programs is not as easily determined—largely due to the variation in how merit programs are funded and the types of students the benefits are extended to. Rubenstein and Scafidi (2002) find that lower-income and nonwhite households tend to have higher purchases of lottery products in Georgia while receiving lower benefits, as compared to higher-income and white households. The benefits of the HOPE program, therefore, accrue disproportionately to higher-income and more educated households. Singell and Stone (2002) find that while merit-based aid increases enrollment probabilities for all students at a large public research university, financially able students respond disproportionately, even holding student ability constant. Alas, the shift to merit aid may exacerbate the trend toward greater income inequality in the United States, even among students of comparable ability.

Increases in spending, whether they are for institutional or student aid, must not add economic rents to those who would have gone to college anyway. The key point in analyzing the access question is that even if student enrollment responses to price changes are inelastic, we as economists usually see these as ceteris paribus reactions. However, higher-quality schools are typically more costly. If students have elastic responses with respect to school quality, they will attend a lower-quality school only if it is less costly. The implication is that if high-quality schools yield more externalities than lower-quality schools, then subsidies will induce a larger share of the student population to attend a higher-quality school, and would therefore produce a larger amount of externalities.

The results from studies on the equitability of the traditional method of public funding, institutional appropriations from state general fund budgets, are mixed. While Hansen and Weisbrod's (1969) study indicated a severe regressive redistribution in the case of California, many recent studies have refuted those results. Progressivity of the higher education finance system is primarily a function of tax progressivity, the public–private enrollment mix, and the "center of gravity" of the higher education system.[26] Finance systems are more progressive where state taxes are most progressive; where a large private sector attracts students from wealthier families, leaving proportionally more lower-income youth in the public sector; and when lower-income students are equally represented at the community colleges, four-year colleges, and graduate schools.

PUBLIC UNIVERSITY EXTENSION SERVICES

All universities engage in research and teaching, but the more than 100 public land-grant colleges and universities have a third critical mission—extension. The term derives from the fact that these institutions are expected to extend their resources to solve public needs through nonformal, noncredit programs. Extension programs help farmers grow crops, homeowners plan and maintain their homes, and children learn skills to become tomorrow's leaders. These programs are largely administered through thousands of county and regional extension offices, which bring land-grant expertise to almost every one of the more than 3,000 counties in the United States. Today, extension works in six major areas: 4-H youth development, agriculture, leadership development, natural resources, family and consumer sciences, and community and economic development. While the withdrawal of public support for higher education would certainly not return our higher education system to its aristocratic days of the mid-nineteenth century, it is unlikely that the private sector would step up and provide these extension functions in the absence of a mandate.

The perception that agricultural and cooperative extension funding has materially declined, however, is not borne out in the aggregate data. Between 1994 and 2003, the average share of institutional E&G expenditures allocated for public service remained constant at all of the public colleges and universities—hovering around 4 percent. However, at the PhD-granting public universities, where most of the extension activities are based, the share allocated to public service fell to 5.3 percent from a starting point of 6.1 percent in 1994 and a high of 6.6 percent in 2001. This happened during a time when overall state support for higher education fell substantially—the average (nominal) state appropriation fell by 4 percentage points in the 2003 and 2004 fiscal years (Illinois State's Grapevine System). The concern here is that public institutions that receive reduced appropriations may assign these cuts more heavily to extension programs, in order to preserve enrollments that generate tuition revenues.

The state experiment station system receives funding from state appropriations, federal formula funding, federal grants and contracts, cooperative agreements, private industry, commodity groups, product sales, and various nongovernmental organizations. Huffman and Evenson (2003) demonstrate that since 1980, real funding for experiment stations has increased by 17 percent. However, the share coming from state appropriations fell by 5.5 percentage points to 50 percent of funding. The largest increases in funding are coming from industry, commodity groups, and foundations—making up 9 percent of sources in 1980 and 15 percent today. They also show that states place a high value on the services provided by extension. Ceteris paribus, more highly ranked extension programs receive larger shares of funds from state sources. They also construct a measure of "public agricultural capital spill-ins" and find that states in regions where the public agricultural research stock is larger receive more money from state appropriations.

Extension programs have been successful in large part due to their tradition of research-based outreach. Data on expenditures for research undertaken explicitly under the extension umbrella were not available at the time of this publication. Nonetheless, it is informative to understand how the sources of funding for research have changed universitywide in the past two decades. Between 1983 and 1998, the share of public university research and development expenditures derived from state and federal sources fell by $5^{1/2}$ percentage points to 62 percent, while the share derived from institutional sources increased by 3.2 percentage points (to 24.1 percent) and the share from private industry increased by 2.5 percentage points (to 7.3 percent).[27] While industry's share fell back down to 6 percent by 2002, institutional sources account for nearly a quarter of all research dollars. As public support for public colleges and universities has fallen, this increase in institutional funding is increasingly derived from private tuition and other sources.

There is a concern that an increased private presence in university research matters may result in a shift from basic to more applied research. The federal government has maintained a strong commitment to basic research, for it is supposed to look out for the long-term well-being of our society. Between 1972 and 1990, the share of federal obligations for research and development intended for basic research increased from 39 percent of federal funds to 52 percent of federal funds. Federal commitment to basic research has remained steady since. This type of data is not readily available for nonfederal funding sources. However, during the time when federal and state support for higher education waned, the share of research expenditures at public colleges and universities allocated to the traditional physical sciences fell from 22 percent in 1983 to 19 percent in 2002, while the share devoted to life sciences and engineering increased by 3 percentage points to 73 percent.

Though it is likely that a strict and direct accounting of research investments would indicate that applied research yields the largest returns, the benefits of basic research, like many social benefits, are not easily measurable or immediately recognizable.[28]

There is a more serious concern that an increased private presence may generate conflicts of interest that compromise the research that is being done. McDowell (2001) believes that the cooperative extension service in many states and counties has been captured and held hostage by agricultural interests. Much has been written about the significant relationship between Berkeley and Novartis, and the concern is that scholarly objectivity requires detachment from society and private interests.

I am currently in the midst of conducting a survey of the land-grant colleges and universities to understand whether funding for extension programs is stronger in states that appropriate funds directly to them as opposed to indirectly through appropriations to their sponsoring universities. In addition, I have asked questions about whether budget difficulties have forced extension programs to cut staff and faculty, close offices, reduce services, and/or restructure their program fee structures—and whether these changes are permanent if funding was to be restored. An early review of the survey responses (institutions from 10 states have responded thus far) indicates that extension programs in states where funding comes from a direct appropriation in the state budget (that is, a line item) or a formula based on overall state appropriations to the university systems (such as in Vermont, Florida, and Alabama) have enjoyed far greater support than programs in states where funding is determined by flagship campus chancellors and other university sources (such as Hawaii, Maine, and North Carolina). However, for all survey responses received thus far, significant reductions to faculty, staff, and program offerings have occurred in extension offices since the early 1990s. In those institutions that received line-item support, cuts tended to be temporary or smaller in magnitude than in states where university centers have more control over the allocations.

COMPLEMENTARITIES BETWEEN HIGHER EDUCATION AND K–12 EDUCATION

A consensus has not been reached regarding the impact of resources on student outcomes in primary and secondary education. We do know, however that student learning is greater when they have bright teachers (see, for example, Rockoff 2004; Schacter and Thum 2004; Hanushek, Kain, and Rivkin 1998; Ehrenberg and Brewer 1995). To the extent that positive externalities result from higher education investments, they are likely to be greatest for investments in teaching. A recent paper by Randall Reback (2004) demonstrates that selective (private) postsecondary institutions are far less likely to offer teacher certification programs, and those that do offer them are less likely to allow students to complete them within their four undergraduate years. He estimates models that suggest that the addition of teacher certification programs that may be completed within four undergraduate years could increase rates of entry into public school teaching by at least 50 percent among recent graduates of selective colleges.

To the extent that current elementary and secondary school teacher salaries are not large enough to attract the best and brightest potential teachers, higher education policies can be enacted to encourage college students to choose the teaching vocation. Programs such as the privately funded Bonner Scholars,[29] institutional, state, and federal loan forgiveness programs, or university policies to discount tuition for students who choose an education major are all potentially powerful instruments to shift the quality teacher supply curve to the right. In addition, implementing and funding these programs at the higher education level may be less costly than an across-the-board national teacher recruitment initiative at the elementary and secondary school district level.

The foregoing discussion is particularly important because damage to the student achievement and development pipeline near its source will have a cascading negative impact throughout the rest of the line. The gaps between high school dropout and high school graduate earnings are wide, and that between college graduates and high school graduates even wider. These gaps are increasing.[30] There is a projected severe shortage of skilled workers in America, and our workers will be thoroughly unprepared to adapt to the rapidly changing workforce requirements of the twenty-first century's knowledge-based economy if gaps between other developed nations and U.S. educational achievements are allowed to develop and widen.[31] In 1999, the United States ranked nineteenth and eighteenth in eighth-grade math and science achievement, respectively, behind countries like Bulgaria, Malaysia, Slovenia, and South Korea.[32] No longer the world leader in higher educational attainment, the United States trails England,

New Zealand, Australia, the Netherlands, and Norway in the share of its eligible population with bachelor's degrees.[33] Therefore, our institutions of higher education play an increasingly important role in the training of quality teachers, who are essential in not only getting their students to go to college, but for preparing them to do well once they arrive.

NONRESIDENT ENROLLMENTS

Between 1979 and 1998, the weighted average proportion of first-time, full-time freshmen students who are nonresidents increased from 16 percent to 18.5 percent at the public flagships.[34] When nonresidents are used to fill seats at institutions with excess capacity, the marginal net benefits accrued by receiving states are likely to be larger for each nonresident enrollee than for the marginal in-state student (that is, the last in-state student enrolled). This is largely due to the fact that nonresident tuition is substantially larger than corresponding in-state rates.[35] Nonresident students and their families also spend money on housing, travel, other consumer goods and bring federal financial aid with them—adding revenues to the state that would not exist in their absence.

In the event that states have reached enrollment capacities (indeed, many in the Northeast plus Washington and California already have), the benefits from enrolling nonresidents are less clear. If nonresidents displace otherwise qualified resident students, then unless they have a much higher propensity to remain in the state upon graduation, these short-term financial gains may correspond with long-term social losses. Empirical evidence by Groen (2004) indicates that this might be the case. He finds that attending college in a state has only a modest impact on the probability that a student will work in the state upon graduation. However, Rizzo and Ehrenberg (2004) find that nonresident enrollments are not sensitive to the tuition charged by institutions, nor are institutions raising nonresident tuition rates to meet funding shortfalls. They do find evidence that the increasing reliance on nonresident enrollments by the public flagships represents an explicit attempt to augment student quality when schools have already reached enrollment capacity.

COMMUNITY COLLEGES

Given the general consensus by education researchers that the returns to schooling are larger for investments at more elementary levels of schooling, it is natural to ask how the private and public returns to investments in two-year (community) colleges compare to those at their four-year counterparts. If student demand follows the highest returns, then the fact that the share of U.S. full-time equivalent enrollments in community colleges increased from 39 percent to 43 percent between 1980 and 2001 suggests that the returns to community colleges are increasing relative to four-year colleges.[36] If this is true, the higher returns are likely to be due to the lower costs of operating and attending community colleges and/or their comparative advantage in being able to adjust rapidly to the ever changing needs of the workforce. However, I have been unable to find any empirical work that directly asks the question of what the social returns are to investments in two-year colleges. The empirical evidence that does exist implicitly addresses this question by evaluating the transfer function of two-year colleges, by asking how two-year colleges meet the needs of local communities or more generally by evaluating the economic impact of two-year colleges in their local areas.

With respect to vocational education and job training, Krueger and Rouse (1998) find only small, positive impacts of community college workplace training programs in subsequent earnings at a manufacturing company. They find no impact for employees of a service company. More recently however, Gill and Leigh (2003) find that community college graduates of terminal training programs enjoy returns on their investments equivalent to noncompleters at traditional four-year colleges.

Massive layoffs by Kodak, IBM, and many other companies have emboldened those who believe our community colleges are vital retraining grounds for the thousands of workers who have lost (or will) lose their jobs. In fact, one of President Bush's major reelection campaign platforms is increasing support for community colleges—largely with an eye toward retraining displaced workers. Whether job losses are due to technical change in product and labor markets (for instance, Kodak's sluggishness in adapting to digital photography) or the outsourcing of unskilled or simple-skilled

labor jobs (such as computer call center jobs), it is clear that displaced workers need to enhance their productivity and expand their skill sets. Leigh and Gill (1997) have found evidence that suggests the president's proposals have some merit. For both degree-seeking and nondegree-seeking adult workers in transition, access to long-term education and training programs at community colleges generates returns that are positive and essentially the same size as they are for continuing high school graduates. Of particular interest is that among males in nondegree programs, returning adults enjoy an incremental earnings effect of 8 percent to 10 percent above that received by continuing students.

Two-year colleges are widely believed to be a "democratizing" force in higher education. That is, they are believed to expand educational access and promote equality of opportunity. Empirical evidence supports these claims. Cecilia Rouse (1995) finds that community colleges increase total years of schooling by attracting students who might not have otherwise attended college. However, since they also attract some students who might otherwise have attended a four-year college, they do not likely increase the probability of students' obtaining a bachelor's degree.[37] An important outcome of democratization is demonstrated by Gill and Leigh (2000). They were able to attribute approximately 10 percent of the closing between the male–female wage gap in the early 1990s to the relative increase in women's enrollment in two-year colleges. If their findings are externally valid, then there is reason to be optimistic that measures can be taken to encourage the closing of the white–nonwhite earnings gap as well. In 2004, they studied how community colleges affect the educational aspirations of students and found that for students from all family, racial, and ethnic backgrounds, each year of attendance at a community college substantially increases the educational aspirations of students, as measured by changes in response to the National Longitudinal Survey of Youth (1979) question asking about the highest grade of schooling they would like to complete.

Finally, since it costs a state much less to educate a community college student than a four-year college student, evaluating the efficiency of the traditional transfer function of two-year colleges is of paramount importance, particularly given the microscope under which states' higher education expenditures are increasingly viewed. Rouse (1998) asserts that community colleges provide a potentially economically efficient way to increase access to higher education, as well as increase overall educational attainment by a state's residents by expanding access to a larger degree than it suppresses ultimate educational attainment. Per the transfer function, Hilmer (1997) demonstrates that students ultimately choose to attend higher-quality four-year colleges if they first attend a community college than if they come straight from high school. Of particular importance is his finding that these effects are largest for students from poor families, low achievers in high school, and from students with low measured ability. In other words, community colleges may play a vital role in overcoming inadequacies in students' college preparation that may not have resulted from any behavior on their part. Further, Leigh and Gill (2003) show that for individuals who initially expressed a desire to obtain a bachelor's degree, attending a community college before transferring to a four-year college increases average educational attainment by one-half to one full year.

There is a wealth of research still waiting to be done regarding community colleges and our larger social concerns. How well do community colleges meet the needs of local communities, and how do they provide trained workers for the local area? Are two-year colleges taking over some of the traditional functions of state extension systems by devising courses and programs in conjunction with local businesses? Are two-year colleges better able to provide training in the areas that are crucial for workers to succeed over time, and what are these areas? And finally, do states with more developed community college systems have (ceteris paribus) better employment, higher wages, more advanced firms, etc.? While the foregoing microeconomic research indicates that there are indeed positive spillovers emanating from community college investments, a more complete treatment of the above questions will help direct public policy in the right direction.

HIGHER EDUCATION AND THE WORKFORCE

There are two productivity-related arguments for the public support of higher education. The first is that a more educated workforce leads to higher incomes and faster economic growth (and ultimately a larger tax base).[38] The second is that investments in scientific research, and perhaps in the knowledge sector in general, exhibit increasing returns. That the outcomes of successful research include higher employment growth and/or the creation of new firms in an area makes this second argument significant. Together, these arguments suggest a role for government policy to help ensure that

investment in complementary goods takes place. For example, an area might need to change its industry mix to secure the gains from a more highly educated workforce. Similarly, a more highly educated workforce may be stifled if the right industries and jobs are not created in that area.

A biotech firm is highly unlikely to locate in my hometown of Danville, Kentucky, as there are very few PhD biologists and researchers in this area. At the same time, newly minted biology PhDs and experienced researchers are unlikely to relocate to Danville (ignoring the fact that it is an extremely desirable place to live) because there are no firms here for them to advance their crafts at. Though the biotech firm may be very profitable if workers were here and PhD biologists would prefer researching in Danville to a larger city, the firm is unlikely to open and PhDs are unlikely to locate here unless there is an instrument to coordinate both of these investments, as well as to ensure investments are made in any other sector that workers and biotech firms may rely on. These could include things as simple as encouraging entrepreneurs to open new restaurants on Main Street (who themselves need to be convinced that the new business and workers will be coming) to more complicated investments in (or commitments to invest in) necessary infrastructure or the changing of zoning ordinances, assignment of property rights and creation of new laws. You can easily see the vital role that transparent government processes and efficient collection and dissemination of news and information play in this process.

Is increasing productivity really as important as we claim it is? Paying close attention to the media, candidates, and pundits (MCP) during the 2004 election cycle would lead one to believe that it is not so. Despite productivity gains between 1.5 percent and 2.5 percent in the business sector and between 5 percent and 10 percent in various manufacturing sectors (a fair portion of which has been due to decreases in hours worked with no corresponding fall in output), real wages in all sectors actually fell during the second quarter of 2004.[39] Further, job growth has been slow to respond to these productivity increases and has never really recovered from the slump in 2001. Economic theory suggests that real wages and employment should rise with worker productivity. So what is the problem? The MCP would have you believe that outsourcing and our inability to compete with low-wage international firms is the culprit. However, data recently released by the Government Accountability Office and the Bureau of Labor Statistics would lead us to a different conclusion. Of the 1.5 million jobs lost in 2003 to mass layoffs, fewer than 15,000 were lost due to relocation of these jobs overseas. While it is risky to make sweeping generalizations based on one firm's experiences, the release of 15,000 jobs at Kodak this past year indicates that technical changes and advances in the knowledge sector are responsible for the lion's share of the problem—they were simply unprepared for the explosion in popularity of digital technologies. In other words, at the same time that labor demand should be expanding due to increases in productivity, it is likely contracting for those same jobs due to changing technologies and movements into different business sectors.

Where does higher education fit in? The supply curve for skilled workers is likely to be steeply sloped in the short run. Therefore, even when firms are expanding into emerging industries and applying new technologies, wages for existing skilled workers are likely to increase substantially with little corresponding increase in short-run employment. The expansion of income inequality in the United States suggests this may in fact be the case.[40] Under these rapidly changing market conditions, employment will only be increased when the supply of highly educated workers increases. On the whole, the empirical evidence (cited earlier in this paper) points to there being strong positive spillovers from higher education to the workforce and suggests that there may be tools for policymakers to employ in order to jump-start or maintain economic growth in their areas.

Several recent papers examine the relationship between the production and retention of human capital in an area. The evidence indicates that if spillovers are likely to be captured at all, they would be due to investments made at the graduate and professional levels as opposed to investments at the undergraduate level. Sumell, Stephan, and Adams (2004) study the geographic placement of newly minted PhDs in industry by estimating the probability that science and engineering PhDs will remain local or stay in the state after graduation. While they do find that state and local areas capture knowledge from newly minted PhDs headed to industry, the rate at which they do so is small. Among the important correlates of retention are marital status, age, level of debt, previous work experience, local technological infrastructure, and visa status. A somewhat sobering finding

is that retention is greatest in the areas where universities are not new but have a long history of producing scientists and engineers—again highlighting the need for coordinated investments if gains to education investments are to be realized. Zucker, Darby, and Brewer's (1998) finding that geographic differences in the number of key researchers located there is a major determinant of where and when new biotech firms locate illustrates this point.

However, research using older data implies that there may be some direct benefits to increasing investments in higher education institutions directly. Beeson and Montgomery (1993), using data between 1975 and 1980, find that both overall employment growth rates and the share of workers that are scientists and engineers in the 218 largest standard metropolitan statistical areas were positively correlated with the increase in research and development funding at local colleges and universities in those areas. Further, the quality of the science and engineering programs (as measured by how many are nationally ranked) is positively correlated with these outcomes as well. Finally, Hedrick, Henson, and Mack (1990) find that employment levels in local retail sectors, service sectors, and finance, insurance, and real estate sectors are larger when college enrollments and expenditures are larger. Unfortunately, these results were for 1978 and 1985. It would be worthwhile to replicate these studies using more recent data.

There is little question that America's persistent growth in per capita income is due in large part to continued advances in science and technology and associated improvements in worker productivity. That the existing evidence does not overwhelmingly suggest that local and state public support for higher education is the driving force for accumulating human capital in an area does not mean it will not be important in the future. Were one to glance at the education headlines in the mid-1980s, there would be a striking disconnect between America's economy as we know it in 2004 and what it was predicted to be at the time. Enormous shortages of scientists and engineers were projected largely because of what the American student pipeline looked like. Fewer and fewer American students were going into PhD study in the sciences at the same time as the demands of the knowledge economy required more highly trained scientists and engineers, not less. However, the shortage of skilled scientists and engineers has never materialized, largely due to the influx of top international students into the United States to substitute for the shortage of American scientists. Three recent trends portend a more serious problem in the coming years. First, top American talent is increasingly choosing the professional school ranks and eschewing careers in science and engineering (Zumeta and Raveling 2003). Second, the quality of international graduate programs is improving rapidly and international students are now choosing to study in Australia and Europe at far greater rates than in recent years. Finally, the impact of 9/11 on the ease of obtaining a student visa in the United States has surely restricted the number of talented foreign graduate students gaining entry into American universities.[41] In fact, the number of foreign students studying in the United States declined in the 2003 academic year by 2.4 percent—the first such decline since 1972.[42]

SUPPORT FOR UNDERGRADUATE EDUCATION VERSUS BIG SCIENCE AND TECHNOLOGY TRANSFER

Little is known about how the distribution of funding *within any* particular institution of higher education affects either individual private returns or any public spillovers that may emanate from the educational activities of our colleges and universities. To the extent that undergraduate instruction and faculty research activities exhibit complementarities, the returns to either can be augmented by the level and quality of investments in the other.[43]

At all public colleges and universities between 1984 and 2003 the share of educational and general (E&G) expenditures allocated to research increased by 20 percent.[44] The largest percentage increases have occurred at the master's and baccalaureate level institutions, each nearly doubling their commitments to research relative to undergraduate instruction over this 20-year period.[45] Similar trends can be observed in the enrollment composition at these institutions—an increasing share of students are enrolled at the graduate and professional levels than at the traditional undergraduate levels.[46] Whether the causes of these changes are aggressive prestige competition or rent seeking in the form of attracting government dollars, there is a concern that the push toward the big science model of higher education has come at the expense of, not as a supplement to, undergraduate education. In addition to the direct crowding out of undergraduate priorities, this "mission creep" should be of concern because research activities and postbaccalaureate-level education are much more expensive than undergraduate instruction, and may be

partially responsible for the increasing costs and tuition levels at even the most affordable public institutions.

Anecdotal evidence on the negative impacts of such endeavors is persuasive. Less than a decade ago, freshman calculus classes at the University of Kentucky were limited to 25–30 students per class. In the fall of 2004, 370 freshmen crammed into a single section—a majority of those coming from high schools throughout the commonwealth with total enrollments resembling that magnitude. University president Lee Todd, when asked about this "problem" replied, "the University of Kentucky needs to continue to expand in order to join the ranks of the elite research universities."[47] Survey research suggests that aspiring to join these ranks is an expensive proposition.

In 2002, the Cornell Higher Education Research Institute (CHERI) surveyed vice presidents for research, deans of schools of science and engineering, and various cience and engineering department chairs about the start-up costs that research institutions incur for new faculty at both the junior and senior levels and the laboraory space allocation rules that the institutions follow.[48] Among the findings were that colleges spent, on average, $1.5 million for start-up costs to attract new senior level faculty, with a maximum reported amount spent of $7 million. Across all public institutions, the average start-up costs needed to hire a new assistant professor in their most expensive department was $265,112, while hiring a new senior-level researcher would cost over $550,000. When asked where their colleges find the funds for start-up costs, the deans indicated that the largest sources of funds were the general budgets of the college and university, with 45 percent of start-up cost funds coming from these sources. The survey found that public institutions are almost twice as likely as private institutions to generate start-up costs from keeping faculty positions vacant. Hence, start-up costs appear to adversely influence the teaching program of public universities more than they do the teaching program of private universities.

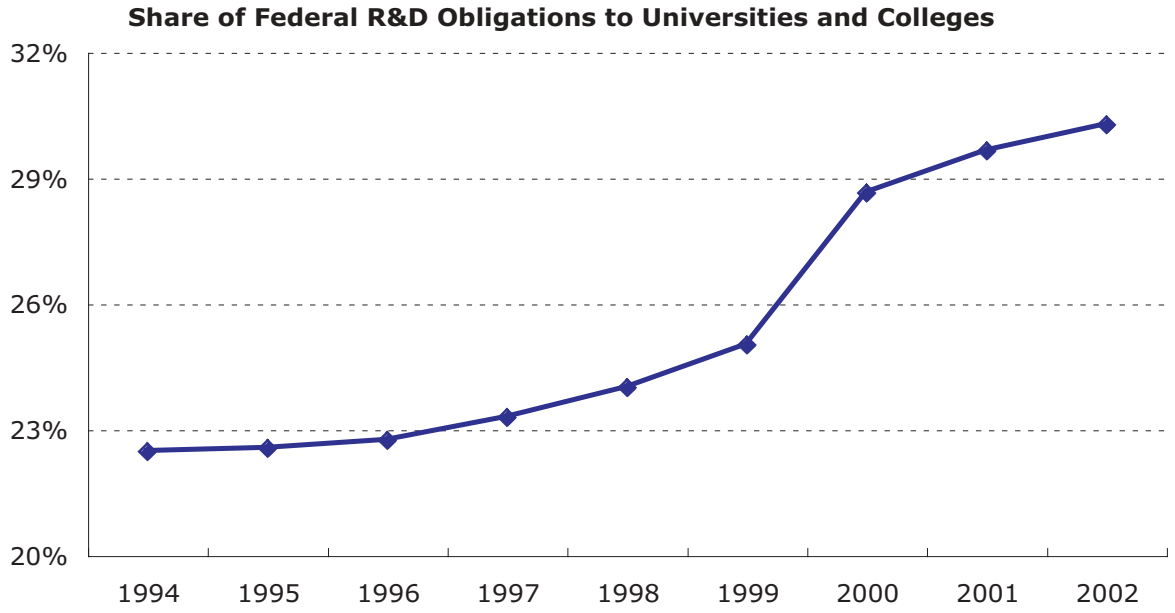
Empirical evidence for the public and private PhD-granting institutions suggests that the negative impacts are less striking. Ehrenberg and Rizzo (2004) find that student–faculty ratios increase the fastest at universities whose research per faculty increases the fastest. They also find that institutions increase tuition as the composition of their enrollments weigh more heavily toward graduate students. Though significant, they demonstrate that the magnitude of the estimated effects of the increasing costs of science on easily measurable outcomes were quite small.

The public's stake in the research activities of our colleges and universities has been increasing just as their stake in undergraduate education has declined. Figure 1 shows that between 1994 and 2002, of all of the federal monies committed to research and development, the share going to higher education increased dramatically and monotonically by over 8 percentage points. To the extent that investments in research and development exhibit increasing returns to scale, it is very clear why research and development efforts in the United States enjoy broad public support.[49] It is less apparent why this support is increasingly being directed toward our colleges and universities. I suspect that a major reason for this is the potential economies that can be achieved by having teaching and research activities performed in a single location—economies that can be captured by both institutions and the public at large.[50]

A common misconstruction is that though the costs of research are substantial, colleges and universities receive windfall after windfall of revenues from increasing commercialization of their faculty members' research. The Association of University Technology Managers (AUTM) reported in their fiscal year 2002 survey of their members that American colleges and universities received $959 million in net licensing income and other forms of royalties relating to patents that year. While this figure seems large, it was concentrated in a few large "winners"; 90 percent of the universities in their sample received less than $2 million and almost half received less than $1 million. This is suggestive that the proliferation of "research" at nonresearch universities is not cost-effective.

In analyzing the 2000 AUTM survey results, Ehrenberg and Rizzo (2004) calculate that though the mean net licensing income in the sample was $6,554,200, the median was only $343,952. Fifty-one of the 138 institutions actually lost income that year on their commercialization activities and the median net licensing income for the 87 that made money was $1,309,828. When one remembers that the licensing income received by universities is split between them and the faculty members whose patents have generated the income, it seems clear that commercialization of research has yet to provide most universities with large amounts of net income to support the universities' scientific research activities.

Figure 1



Source: Digest of Education Statistics 2003, Table 372.

Critics of technology transfer at universities and colleges, however, may be quieted when considering two facts. First, there is little evidence to suggest that professors and students are more frequently engaging in research activities that have commercial potential. The share of federal research funding at universities and colleges intended for applied research fell from a high of 64 percent in 1976 to 52 percent in 2003. An official at the Stanford Office of Technology Licensing echoes this evidence. He said that "Universities are not shifting to become SRI (International) or Battelle (dedicated research institutes), because there are places like SRI and Battelle to do that kind of work. Work done at a university by a graduate student using university resources has to be original basic research."[51] Second, it is the rare case that university inventions find their way into the commercial marketplace. The Stanford official continued, "It's the nature of this business that a very few discoveries generate any kind of meaningful income… venture capitalists hope 1 in 10 of their investments produce big income. At universities, it's more like 1 in 100." Given these circumstances, it seems unlikely that universities are in the research business solely to make money. If this were not the case, we would expect to observe the number of ventures universities taking a chance on decrease dramatically.

That universities continue to invest heavily in research (and that government continues to heavily subsidize these activities) suggests that the benefits of these activities are accruing more broadly to society. Jaffe et al. (1993) compare the geographic location of patent citations with where the cited patents were produced as evidence of the extent to which knowledge spillovers are geographically localized. They find that citations to domestic patents are more likely to be domestic and more likely to come from the same state and SMSA as the cited patents, compared with a "control frequency" reflecting the preexisting concentration of related-research activity. The public is also likely to benefit from the proliferation of industry-funded interdisciplinary research centers and other new business start-ups that result from university research activities.

Since 1980, 4,320 new companies have been formed based on a license from an academic institution, including 450 established in 2002. Of these start-ups, 2,741 were still operating as of the end of 2002. Of the new companies, 83.1 percent were located in the state of the academic institution where the technology was created (AUTM 2003). Though licensing revenues are small, universities have been able to maintain an equity interest in over two-thirds of these start-up companies. Taxpayers might expect a large return on university investments in

research as well given the magnitude of their stake. In the 2002 academic year, total spending on research and development at U.S. academic institutions was $36.3 billion (with $24.8 billion at the publics and $11.5 billion at the privates). Of this total, $24.3 billion came from government sources ($21.8 billion federal, $2.5 billion from states and localities).[52]

Recent macroeconomic evidence suggests that universities may in fact be capturing a surprisingly small share of the immediate external benefits from their research and development activities. In his book *The Mystery of Economic Growth*, Elhanan Helpman shows that research and development capital stocks in 21 industrial countries have a sizeable impact both on the total factor productivities of each of these countries, but also a sizeable impact on the total factor productivity of developing nations. It is, however, an open question whether the degree of exchange of ideas and transfer of technologies across countries would be greater or diminished if more of the research and development was undertaken outside of academia. American taxpayers should also be interested in a recent paper by William Nordhaus (2004). He examines the social returns from technological advances in the nonfarm business economy over the 1948–2001 period and finds that most of the gains from technical change are passed on to consumers rather than captured by producers in the form of "Schumpeterian profits" (2.2 percent to producers, 97.8 percent of value created to consumers).[53] That entrepreneurs seem to be able to capture such a miniscule fraction of the gains to their hard work, but that technical innovation and new business generation continue at a fever pace in the United States, is a testament to the incentive effects of innovation and may also have us reduce our concerns about university efforts to expropriate the benefits from their research activities.

CONCLUSION

In this paper, I examine the theoretical justifications for public support for higher education. Broadly stated, the public may have an interest in subsidizing higher education if the presence of substantial *net* positive spillovers, imperfect credit markets, or asymmetric information result in private investments in schooling that are below the socially optimal levels. Even in the presence of such market imperfections, public monies should (theoretically) only be directed toward higher education when the marginal expenditure of taxpayer money on higher education produces a net social return that is at least as high as the marginal expenditure on any other budget item.

Though difficult to measure, the growing body of research using rate of return techniques, economic impact studies, and contribution studies suggests that the public, and hence social, returns to investments in higher education are positive and sizable. I also discuss several factors that I feel are particularly important to consider when policymakers are deciding how to fund higher education. These include the role of public university extension services, the relationship between primary, secondary, and tertiary levels of schooling, the impact of nonresident enrollments, the importance of community colleges, the relationship between higher education, and the workforce and finally the role that universities play in research and development.

Improving the productivity of our higher education system is essential for the United States if it wants to reign in its nagging, persistent increases in income inequality and to also calm the (misguided) hysteria over the real impacts of outsourcing on our labor market. While the number of jobs lost to outsourcing in the United States is sizable at 300,000 per year, this number represents only 2 percent of the 15,000,000 lost per year overall.[54] Some other fundamental aspect of the economy must be responsible for this difference in 14.7 million jobs. Increasing productivity is not the problem, but rather the answer. Between 1960 and 2003 real adjusted output per worker in the nonfarm business sector increased by 119 percent. At the same time employment expanded by 115 percent with total compensation increasing by over a factor of 20. In the durable goods manufacturing sector, a productivity increase of 99 percent between 1987 and 2003 was matched with a 65 percent increase in total compensation. However, employment has fallen in this sector by 16.6 percent. On the whole however, while the United States increased its reliance on nominal imports to 14 percent of GDP from 4 percent of GDP between 1960–2003, unemployment has remained low (currently 5.5 percent) and nonfarm, private-sector employment has expanded by a net 60 million jobs.[55] I assert that the majority of this job creation and destruction has been a result of a rapid expansion and implementation of technical improvements and the corresponding employment of a significantly more highly trained labor force.

The relevant policy issue is captured by the question of whether it is society or the individual that should pay

more. If societies should pay more, then state support for institutions should increase so that tuition levels need not rise. Ultimately, lawmakers and policymakers must decide (1) how much to spend on higher education; (2) where to spend it (two- or four-year, public or private); and (3) in what form to spend it (institutional or student aid). While the information I presented in this paper is sure to be helpful in seeking answers to these questions, a number of difficult questions remain unanswered. States should want to know who in the student quality–family background plane is not currently being served. Knowing this information will help guide policymakers in deciding between trying to attract and retain the best and brightest students, or trying to expand access to economically disadvantaged but highly qualified students. This needs to be augmented with information about why six-year graduation rates are dreadfully low (less than half of entering freshmen in the United States end up graduating in six years) and why these measures are lowest for students from low-income and certain minority backgrounds—particularly if societal goals include creating equality of opportunity for all citizens.[56]

Policy Recommendations and Considerations

Cost Control

I strongly believe that it would be irresponsible to make recommendations without first considering the current cost crisis in higher education. Conventional wisdom posits that spending more on higher education will enable more low-income students to obtain a college education. Opponents of public involvement in higher education argue that institutions divert resources to programs that benefit high-income students or no students at all. They believe that spending increases merely raise the "rents" so aggressively sought by faculty and administrators. Staffing statistics lend support to these objections. Salaries and staff sizes have gone up much more than have the number of students graduating college. Further, colleges and universities are competing for students by offering more attractive campus lifestyle options including higher scale dining and recreational facilities. Since most students that attend college are from the upper half of the income distribution, when states increase spending on institutional and student aid and when federal aid to colleges and universities increases, the "good life" of the relatively wealthy families is being supported in part by tax revenues from less affluent families.

For a typical private industry, company performance and ultimately price control is regulated by the threat of free entry and exit. This is not the case in higher education. In perfectly fluid markets, firms would respond to increasing input costs by becoming more productive. Bob Martin (forthcoming) demonstrates that just the opposite has happened in higher education. In his book he concludes,

> The prices paid for inputs by higher education did not rise much faster, if at all, than other price indices such as the GDP implicit price deflator. Hence, the input prices do not explain the rise in net price charged to students that is the basis for so much public criticism of higher education. Since costs are the sum of all input prices times the quantity of those inputs used to produce a given output level, the rapid growth in cost per student must be explained by a decline in productivity (students per unit of input). That's exactly what the staffing ratio data suggests—smaller numbers of students per faculty, staff, and administrators.

Ehrenberg (2004) shows that faculty salary increases for all full-time faculty members at American colleges and universities have outpaced inflation by less than 1 percent per year over the past 30 years. There has been much written about why measured productivity in higher education has lagged and it needs to be even better understood. Have the cost increases been a result of an increase in the (unmeasurable?) quality of higher education? Have they been a result of spending on the aesthetic aspects of higher education (such as better food, performing arts, and health facilities)?[57] An influx of money into the system as it stands may only serve to exacerbate the negative outcomes associated with aggressive quality competition and rent-seeking behavior.

Spending Smoothing

Nothing damages prospects for growth and continued research and development more than uncertainty. As far as public colleges and universities are concerned, there may be systematic underinvestments in campus infrastructure and long-term projects because of the high volatility of state appropriations. In order for institutions to "smooth spending," states should provide colleges and universities with multiyear plans for state support. More important, states should not penalize institutions that are successful at raising private monies during lean budget times with future appropriations cuts. Rizzo (2004) has found evidence that states aggressively reduce future funding to institutions that raise large amounts of private gift revenues.

Alternative Methods of Public Support

States can do a better job at targeting aid dollars toward students and universities. If taxpayers are uneasy about broad-based appropriations to schools and merit-aid programs to students, then dollars can be directed toward loan forgiveness and other economic incentives for graduates of both public and private universities to fill the ranks of occupations in the areas where pay alone is not enough of an incentive to pursue it (for example, elementary and secondary school teaching, social work, public-sector law, etc.).[58] To help control costs some states are implementing performance-based budgeting models (for instance, Washington) and targeting investments to specific programs that states find important. One suggestion that is gaining momentum in statehouses across the nation is for states to promote competitive bidding by institutions for funding particular schools and programs.

A measure that may promote cost control as well as social equity would be for states to push institutions of higher education, public and private alike, to move to an average cost, rather than marginal cost, pricing scheme. It is likely that higher education operates in the region of production where there are increasing returns to scale—and hence average costs exceed marginal costs through a large range in production levels. In an effort to enroll more (and sometimes higher-quality) students, institutions have discounted tuition aggressively to the point where marginal revenues equal marginal costs. This policy has led to a significant weakening of institutions' financial positions. Coupling an average cost-pricing scheme with perfect price discrimination would increase net revenues and improve the progressivity of the higher education funding system by forcing all those able to afford it, to pay the full cost of attending college, while those unable to pay would receive grants from the state to cover these expenses. In addition, such a financing strategy would provide a stronger incentive to reign in costs than the current system where over 80 percent of the funds for public higher education come from third-party sources.[59]

Discount Rates and Political Support

Efforts need to be made to make politicians and taxpayers alike more accountable to our future generations. Herein lies the rub in today's political climate—the returns to alternative investments of public monies are immediately recognized and more concentrated. The expenditures and costs of alternative investments are better understood but less publicized, very easily targeted, and more identifiable. For example, most taxpayers could not tell you the cost of the most recent prison that was built in their state, although it would be easy for them to describe what these tax dollars were spent on, who would be benefiting, and that the outcomes would be immediately and easily recognizable. Prisons can be built in a manner of months; the benefits can be highlighted in the newspaper as we can see exactly which bad people are being taken off the streets, so people in higher crime areas receive a perceived strong benefit. However, ask any taxpayer about the cost of higher education and they will at the very least say something about high tuitions and expanding class sizes. Investments in higher education may take years before benefits are realized and people without their own children in the system may not perceive that any benefits would spill over to them. Therefore, though the net social benefits to a marginal higher education investment may be much larger than one in corrections, factors leading to suboptimally high discount rates may prevent the proper investments from ever taking place. Granted, states do have a system of governing and coordinating boards in place to look after the long-term interests of our public colleges and universities. However, for those that are politically appointed, allegiances are likely to align with those of the governor and not necessarily in the long-term interests of the state. For those that are elected, it is unlikely that voters have enough information beyond party affiliation with which to make choices over. Further, these positions are often unpaid, which may significantly reduce the pool of qualified people running for the position.

Transparency and Accountability

The public's expectations of institutions need to be made clear—which can largely be achieved by policymakers making clear what is on a state's agenda. For instance, if the goal of a state is to enhance economic development, research universities should be held accountable for the level and quality of research they generate, the new business they generate and the share of funds used for research externally sourced. It would make little sense to apply this standard to institutions with different missions. Master's-level universities can be evaluated by how well they prepare and place students in local skill-based industries. Finally, community colleges should be evaluated both on how well they expand access to underserved areas of the state and how successful they are at responding to the training and other needs of local businesses. Institutions on their part have a responsibility to make it clear to taxpayers how well

their money is being spent. Rather than relying on dramatic news stories of faculty and administrators behaving badly to form their impressions, the general public should be able to learn about all of the good things their local college or university is doing.

Coordination

Even if investments in higher education produce positive spillovers, simply increasing funding for higher education will not insure that these gains will be realized. Policymakers need to understand that the economic health of a state is a result of a multiplicity of factors and it will take a great deal of coordination for their jurisdiction to be able to enjoy employment increases, wage increases, and the other public benefits associated with having a highly educated workforce. This coordination should not only be between the different education sectors (for example, the benefits of expanding access to higher education will be severely compromised without a coordinated effort at the primary and secondary school level to improve student preparation), but also within the higher education sector and across different industries and social institutions. For instance, if we believe more highly educated people would produce more considerate and better-qualified politicians, simply increasing the number of educated citizens will not ensure that our political system would improve. To ensure such an outcome, significant efforts need to be made to reform the political system today so that highly educated citizens feel like they can truly have an impact, or be able to reform the system themselves. Otherwise, the incentives to enter into public service will be greatly diminished and the potential gains to the higher education investment would never be realized.

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ENDNOTES

[1]See *Digest of Education Statistics* 2002, table 9.

[2]There are two ways the public can be involved in higher education. First, higher education can be publicly *provided* and *controlled*. The second, which is not necessarily mutually exclusive of the first, is that higher education can be publicly *funded*. In this paper, our reference to *public interest* references the latter. Elementary and secondary education is an arena where the relevance of public control and provision is a more pressing concern.

[3]For example, between 1977 and 2001, the share of state discretionary funds allocated to higher education fell by 3 percentage points to just 6 percent of total state general fund budgets. Higher education expenditures as a share of overall education expenditures fell over 6 percentage points during the period to 16.4 percent of education budgets (Rizzo 2004).

[4]In the literature, what we call "public returns" happen to also be called "social returns." Therefore, the total social returns in the literature are considered to be the sum of private and social returns.

[5]Suppose that a hypothetical society levied a marginal tax rate of 100 percent on earnings above $50,000. Suppose further that bachelor's degree holders expect to receive postschooling earnings of $50,000, while master's degree holders expect $80,000. In this society, very few, if any, students would choose to obtain a masters degree—100 percent of their earnings gain is taxed away. Although society would clearly benefit from the additional $30,000 in expected tax revenues, individuals would be unlikely to obtain the master's degree without being able to realize at least some of the $30,000 earnings gain.

[6]Thus, even if the entire social return is comprised of the private return, if private agents systematically underinvest due to their inability to recognize the private benefits, some government intervention is justified. For example the "options" features of educational investments are often unrealized at the time investments are being made. The same argument holds for the supply side as well.

[7]*Economics Principles*, 1927.

[8]Barham, Foltz, and Kim (2002) demonstrate that land-grant universities account for most U.S. ag-biotech patents and provide evidence that these ag-biotech patents are more cited than the average university patent.

[9]To illustrate this point, an undergraduate student believed that the economic returns to PhD study for him are negative. He left a high-paying Wall Street job that he landed out of college, spent five years in graduate school, and then landed a job for half the salary he earned pre–PhD receipt (ignoring even the opportunity costs incurred during graduate school).

[10]However, Black, Devereaux, and Salvanes (2003) use a unique Norwegian data set and find that most intergenerational correlations between children and parents education are due to family characteristics and inherited ability—not to education spillovers. They do find that mother's education is positively associated with son's education.

[11]See Bloom and Sevilla (forthcoming) for a complete discussion of these.

[12]This last condition is often wildly misinterpreted. As with most public goods, spending more money on it will benefit someone. However, the relevant question is not whether spending more will make people happy, but rather if spending more on this budget item will make people happier than spending more on any other item. In other words, for public investments to be distributed optimally, the net social return on the *last* dollar invested in all goods should be equal.

[13]Not all externalities represent market failures. If externalities generated by highly educated workers make less skilled workers within a firm more productive, then the externality is internalized and there is no need for an intervention. If spillovers occur between firms then there is an impetus. Citizenship externalities may not be due to education directly, but rather derive from the increased income resulting from education. Demonstration of the positive externalities is not enough to merit public support of higher education—for it to be justified, the net externalities need to be positive. Many are guilty of ignoring potential negative externalities in education investments—you may use your enhanced education to more effectively pressure the government to benefit you at my expense. While ignorance may result in crime and a burden on social programs, your education may produce a more competent and powerful criminal. If schooling is used in the competitive pursuit of status it can produce a negative externality as well. If I pursue education only to have more money and degrees than my neighbors, and if they have similar tastes, my consumption of education comes at their expense and vice versa.

[14]Leakage is measured by the proportion of the at-risk population that is not credit constrained.

[15]They also find that racial composition and segregation are uncorrelated with urban growth across all cities. This result is encouraging because it indicates that cities with high concentrations of low-income populations and underdeveloped areas still have the opportunity to achieve economic growth and prosperity.

[16]AnnaLee Saxenian wrote a book in 1994 comparing the high-technology sectors in the Silicon Valley and Route 128 in New England. She argues that Silicon Valley grew much more quickly than Route 128 because of (formal and informal) information sharing between firms on the West Coast as opposed to the proprietary attitudes among firms in the East. Such an analysis suggests that positive externalities produced by investments in higher education will be larger the more integrated our colleges and universities become.

[17]A difficulty in this analysis is properly controlling for selection biases. Workers with high (unobserved) ability likely sort themselves into cities where education levels are higher. It might also be the case that unobserved regional characteristics matter—differing geography, industrial structure, weather and amenities, and high average worker productivity—may also pay higher wages, which also attracts skilled workers implying reverse causality in the data.

[18]Two caveats are again in order. He finds that what plants gain in output per worker is offset by increased labor costs. He also demonstrates that within a city, spillovers between industries that are economically "close" are larger than spillovers between industries that are economically "distant"—emphasizing the need for coordinated investments to take place to ensure growth.

[19]The difficulty with these types of studies and the reason for their dearth is that schooling and civic outcomes are likely simultaneously determined by individual, family, and community characteristics. Education is thought

to affect these civic outcomes through two broad channels. First, it reduces the effective costs by making it easier to process information, wade through our bureaucratic morass, etc. And second, it may directly shape preferences for civic engagement and indoctrinate students with fundamental democratic and pluralistic values. Though, it may actually decrease engagement by increasing opportunity costs of time and making me more aware that my one vote counts for little. These studies also suffer from an inability to fully control for the selection problem inherent in these analyses—more civically minded people may attend college in higher percentages than less civically minded people. Therefore, it is difficult to disentangle an increase in civic behavior resulting from college attendance or from an inherent unobserved quality.

[20]These expenditures include both economic costs as well as economic rents. See Martin (forthcoming) for a discussion.

[21]An additional difficulty with ROR studies stems from the moral philosophy inherent in resource-allocation questions. Should all people be counted in the cost–benefit calculations? Do we undertake investments if there are clear-cut winners and losers? How should the losers be treated?

[22]A recent collection of papers edited by Lewis and Hearn (2003) examines the economic impact of the University of Minnesota. In it, they cite that the transportation multiplier is around two. Paper topics include the role of technology transfer from the university, magnet and multiplier effects of the university, the library and its service to Minnesota, the monetary returns to instruction, and the nonmonetary benefits of undergraduate education.

[23]NACUBO 2003.

[24]However, EIS typically ignore the displacement effect of college graduates on earnings and the higher real estate costs, amenities costs, etc., that have a negative effect on the native populations.

[25]She also finds that Georgia's program has likely increased the college attendance rate of all 18- to 19-year-olds by 7.0–7.9 percentage points, but ignores the similar effects of programs from other states. Further, states need to think about the quality of the marginal out-of-state student versus the quality of the marginal resident student that originally attended out of state.

[26]The center of gravity refers to the fact that university graduate students are more expensive to educate than college undergraduates, who are more expensive to educate than community college undergraduates.

[27]See the National Science Foundation's WebCASPAR at http://webcaspar.nsf.gov.

[28]White and Araji (1990) find that the marginal product of a one dollar investment by extension into research yields $53.80 for applied research, $33.60 for basic research, and $8.49 for maintenance research

[29]See http://www.bonner.org/campus/bonnerscholars.htm.

[30]For full-time male workers age 25 and higher, the high school graduate dropout earnings advantage rose from 1.28 in 1990 to 1.37 in 2000. The advantage gained by college graduates was more substantial, rising from 1.60 in 1990 to 1.80 in 2000. See the Current Population Survey, *Digest of Education Statistics 2002*, table 381.

[31]Ellwood (2001).

[32]See *Digest of Education Statistics 2002*, tables 398 and 400.

[33]Sara Lipka, *Chronicle of Higher Education*, September 14, 2004, and *Digest of Education Statistics 2002*, table 410.

[34]Rizzo and Ehrenberg (2004).

[35]In the absence of tuition-reciprocity agreements.

[36]IPEDS.

[37]This latter effect may not be as bad as it appears if, in the absence of community colleges, we have an inefficient sorting and matching of students of varying abilities and colleges of varying quality (and also of varying, higher, cost).

[38]This is particularly important if we want to increase domestic savings levels, if not rates. This would serve to allay the fears of people who claim that substantial capital account surpluses and current account deficits are detrimental to the United States economy and society at large.

[39]See http://www.bls.gov/news.release/prod2.nr0.htm.

[40]The gini index for the U.S. income distribution was 0.450 in 2001, up from 0.426 in 1990 and 0.403 in 1979 (see http://www.census.gov/hhes/income/histinc/rdi5.html). In 2003, families at the 80th percentile in the income distribution made 8.4 times more than families at the 20th (U.N. Development Programme, *Human Development Report 2004*).

[41]John Gravois, "Admission of Foreign Students to American Graduate Schools Continues Its Post-9/11 Decline," *Chronicle of Higher Education*, September 17, 2004.

[42]Burton Bollag, "Foreign Enrollments at American Universities Drop for the First Time in 32 Years," *Chronicle of Higher Education*, November 10, 2004.

[43]In this regard, an obvious place for additional research would be to compare the private returns (and perhaps public if possible) to otherwise similar individuals that attend colleges with two different levels of emphases on research in their particular field(s) of study. Monks (2000) analyzes the earnings experiences of college graduates in the National Longitudinal Survey of Youth to show that graduates from graduate-degree-granting, research, and private universities earn more than their counterparts from liberal arts colleges and public institutions. He was not able to control fully for the potential selection problems inherent in career and college-choice decisions. For example, graduates of liberal arts colleges may be more inclined to take (lower-paying) jobs in the public sector than their research-university counterparts.

[44]See the National Science Foundation, http://webcaspar.nsf.gov. From 5 percent of overall E&G expenditures in 1984 to 6 percent in 2003, peaking at nearly 7 percent before the recession of 2001.

[45]See the National Science Foundation, http://webcaspar.nsf.gov.

[46]At the PhD-granting institutions, postbaccalaureate enrollment shares increased by 20 percent—to 21 percent of overall enrollments by 2003. It increased by 25 percent to 10 percent of overall enrollments at the master's institutions.

[47]Linda B. Blackford, "UK's Freshmen Learn a Hard Math Lesson," Lexington Herald Leader, September 26, 2004.

[48]Available at www.ilr.cornell.edu/cheri and click on "Surveys."

[49]Public support for research and development is thought to encourage a "critical mass" of research and development to take place, so that increases in investments will be self-sustaining. For example, suppose we all agree that pollution reduction in urban areas is a desirable goal. Scientists and engineers may be reluctant to research methods of improving pollution reduction technologies if economists and political scientists are not trying to understand the macroeconomic, tax, and political implications of implementing these technologies. Similarly, the social scientists may not try studying the impacts of pollution-reduction technologies if they do not expect these technologies to ever be developed. Intervention of some kind may be required to convince each group to pursue these socially beneficial research agendas since the individual benefits to any one researcher depend on the activities of other researchers taking place.

[50]In fact, at even the most teaching-oriented liberal arts colleges, there is an expectation that faculty remain active in their respective professions.

[51]Carolyn Shaw, *San Francisco Chronicle*, August 29, 2004.

[52]See the National Science Foundation, WebCASPAR at http://webcaspar.nsf.gov.

[53]The profits that exceed the risk-adjusted return to innovative investments.

[54]Speech by Federal Reserve Board vice chairman Roger Ferguson, Jr., http://www.federalreserve.gov/ board docs/speeches/2004/20041007/default.htm.

[55]See the Bureau of Labor Statistics, Productivity and Costs database.

[56]It is unclear how inefficient this behavior really is. Studies find that the wages of individuals who have attended some college but with no degree are substantially higher than those of high school graduates with no

college experience. Second, the degree to which low retention rates reflect suboptimal sorting between students and institutions resulting from the current financial aid systems and interinstitutional competition is unclear.

[57]It is important to recognize, however, that spending on amenities has been largely driven by consumer demand for these amenities.

[58]We have yet to come across any research that analyzes the success of these types of programs.

[59]*Digest of Education Statistics 2003*, table 330.

REFERENCES

Acemoglu, Daron. 1996. A Microfoundation for Social Increasing Returns in Human Capital Accumulation. *Quarterly Journal of Economics* 111(3): 779–804.

Association of University Technology Managers (AUTM). 2003. AUTM Licensing Survey, FY 2002: A Survey Summary of Technology Licensing (and Related) Performance for U.S. and Canadian Academic and Nonprofit Institutions, and Patent Management and Investment Firms. http://www.autm.net/index_ie.html.

Bania, Neil, Randall W. Eberts, and Michael S. Fogarty. 1993. Universities and the Startup of New Companies: Can We Generalize from Route 128 and Silicon Valley? *Review of Economics and Statistics* 75(4): 761–66.

Barham, Bradford, Jeremy Foltz, and Kwansoo Kim. 2002. Trends in University Ag-Biotech Patent Production. *Review of Agricultural Economics* 24(2): 294–308.

Beeson, Patricia, and Edward Montgomery. 1993. The Effects of Colleges and Universities on Local Labor Markets. *Review of Economics and Statistics* 75(4): 753–61.

Black, Sandra E., Paul J. Devereux, and Kjell G. Salvanes. 2003. Why the Apple Doesn't Fall Far: Understanding Intergenerational Transmission of Human Capital. Working Paper No. 10066, National Bureau of Economic Research.

Bloom, David E., and Jaypee Sevilla. Forthcoming. Should There Be a General Subsidy for Higher Education in Developing Countries? *Journal of Higher Education in Africa*.

Bound, John, Jeffrey Groen, G. Gábor Kédzi, and Sarah Turner. 2004. Trade in University Training: Cross-State Variation in the Production and Stock of College-Educated Labor. *Journal of Econometrics* 121(1/2): 143–73.

Dale, Stacy Berg, and Alan B. Krueger. 2002. Estimating the Payoff to Attending a More Selective College: An Application of Selection on Observables and Unobservables. *Quarterly Journal of Economics* (117)4: 1491–1527.

Dee, Thomas S. 2003. Are There Civic Returns to Education? Working Paper No. 9588, National Bureau of Economic Research.

Dynarski, Susan. 2000. Hope for Whom? Financial Aid for the Middle Class and Its Impact on College Attendance. *National Tax Journal* (53)3: 629–61.

Ehrenberg, Ronald G. 2004. Don't Blame Faculty for High Tuition. The Annual Report on the Economic Status of the Profession: 2003–04. *Academe* 90(2): 20–46.

Ehrenberg, Ronald G. and Dominic J. Brewer. 1995. Did Teachers' Verbal Ability and Race Matter in the 1960s? Coleman Revisited. *Economics of Education Review* (14)1: 1–21.

Ehrenberg, Ronald G., Michael J. Rizzo, and George H. Jakubson. Forthcoming. Who Bears the Growing Cost of Science at Universities? In *Science and the University*, ed. Ronald G. Ehrenberg and Paula Stephan. Madison: University of Wisconsin Press.

Ellwood, David T. 2001. The Sputtering Labor Force of the 21st Century. Can Social Policy Help? Working Paper No. 8321, National Bureau of Economic Research.

Fernandez, Raquel, and Richard Rogerson. 2001. Sorting and Long-Run Inequality. *Quarterly Journal of Economics* 116(4): 1305–41.

Florax, Raymond, and Henk Folmer. 1992. Knowledge Impacts of Universities on Industry: An Aggregate Simultaneous Investment Model. *Journal of Regional Science* 32(4): 437–66.

Gill, Andrew M., and Duane E. Leigh. 2000. Community College Enrollment, College Major, and the Gender Wage Gap. *Industrial and Labor Relations Review* 54(1): 163–81.

———. 2003. Do the Returns to Community Colleges Differ between Academic and Vocational Programs? *Journal of Human Resources* 38(1): 134–55.

Gilles, Duranton, and Diego Puga. 2003. Microfoundations of Urban Agglomeration Economies. Discussion Paper No. 4062, Centre for Economic Policy and Research.

Glaeser, Edward L., and Albert Saiz. 2003. The Rise of the Skilled City. Working Paper No. 10191, National Bureau of Economic Research.

Glaeser, Edward L., Jose A. Scheinkman, and Andrei Shleifer. 1995. Economic Growth in a Cross-Section of Cities. *Journal of Monetary Economics* 35: 117–44.

Griliches, Zvi. 1957. Hybrid Corn: An Exploration in the Economics of Technological Change. *Econometrica* 25(4): 501–22.

Groen, Jeffrey A. 2004. The Effect of College Location on Migration of College-Educated Labor. *Journal of Econometrics* 121(1/2): 125–42.

Hansen, W. Lee, and Burton A. Weisbrod. 1969. The Distribution of Costs and Benefits of Public Higher Education: The Case of California. Journal of Human Resources 4(2): 176–91.

Hanushek, Eric A., John F. Kain, and Steven G. Rivkin. 1998. Teachers, Schools, and Academic Achievement. Working Paper No. 6691, National Bureau of Economic Research.

Hedrick, David W., Steven E. Henson, and Richard S. Mack. 1990. The Effects of Universities on Local Retail, Service and F.I.R.E. Employment: Some Cross-Sectional Evidence. *Growth and Change* 21(3): 9–20.

Helpman, Elhanan. 2004. *The Mystery of Economic Growth*. Cambridge, MA: Harvard University Press.

Hilmer, Michael J. 1997. Does Community College Attendance Provide a Strategic Path to a Higher Quality Education? *Economics of Education Review* 16(1): 59–68.

Huffman, Wallace E., and Robert Evenson. 2003. Determinants of the Demand for State Agricultural Experiment Resources: A Demand-System Approach. Working paper, Iowa State University.

Jaffe, Adam B., Manuel Trajtenberg, and Rebecca Henderson. 1993. Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. *Quarterly Journal of Economics* 108(3): 577–98.

Krueger, Alan, and Cecilia Rouse. 1998. The Effect of Workplace Education on Earnings, Turnover, and Job Performance. *Journal of Labor Economics* 16(1): 61–94.

Leigh, Duane E., and Andrew M. Gill. 1997. Labor Market Returns to Community Colleges: Evidence for Returning Adults. *Journal of Human Resources* 32(2): 334–53.

———. 2003. Do Community Colleges Really Divert Students from Earning Bachelor's Degrees? *Economics of Education Review* 22(1): 23–30.

———. 2004. The Effect of Community Colleges on Changing Students' Educational Aspirations. *Economics of Education Review* 23(1): 95–102.

Leslie, Larry L., and Paul T. Brinkman. 1988. *The Economic Value of Higher Education*. Macmillan Series in Higher Education. New York: American Council on Education.

Lewis, Darrell R., and James Hearn, eds. 2003. *The Public Research University: Serving the Public Good in New Times*. Lanham, MD: Oxford University Press.

Lucas, Robert E., Jr. 1988. On the Mechanics of Economic Development. *Journal of Monetary Economics* 22(1): 3–42.

Martin, Robert E. Forthcoming. *Cost Control, College Access, and Competition in Higher Education*. Northampton, MA: Edward Elgar.

McDowell, George R. 2001. *Land Grant Universities and Extension into the 21st Century: Renegotiating or Abandoning a Social Contract?* Ames: Iowa State University Press.

McMillan, Steven G., Francis Narin, and David L. Deeds. 2000. An Analysis of the Critical Role of Public Science in Innovation: The Case of Biotechnology. *Research Policy* 29(1): 1–8.

Milligan, Kevin, Enrico Moretti, and Philip Oreopoulis. Forthcoming. Does Education Improve Citizenship? Evidence from the U.S. and the U.K. *Journal of Public Economics*.

Monks, James. 2000. The Returns to Individual and College Characteristics: Evidence from the National Longitudinal Survey of Youth. *Economics of Education Review* 19(3): 279–89.

Moretti, Enrico. 2004a. Human Capital Externalities in Cities. In *The Handbook of Regional and Urban Economics*, vol. 4, ed. V. Henderson and J. F. Thisse. New York: North Holland-Elsevier.

———. 2004b. Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-Sectional Data. *Journal of Econometrics* 121(1/2): 175–212.

———. 2004c. Workers' Education, Spillovers, and Productivity: Evidence from Plant-Level Production Functions. *American Economic Review* 94(3): 656–90.

Nordhaus, William D. 2004. Schumpeterian Profits in the American Economy: Theory and Measurement. Working Paper No. 10433, National Bureau of Economic Research.

Oehmke, James F., David D. Weatherspoon, Christopher A. Wolf, Anwar Naseem, Mywish Maredia, and Amie Hightower. 2000. Is Agricultural Research Still a Public Good? *Agribusiness* 16(1): 68–81.

Reback, Randall. 2004. The Impact of College Course Offerings on the Supply of Academically Talented Public School Teachers. *Journal of Econometrics* 121(1/2): 377–404.

Rizzo, Michael J. 2004. A Less Than Zero Sum Game? State Funding for Education: How Public Higher Education Institutions Have Lost. PhD diss., Cornell University.

Rizzo, Michael J., and Ronald G. Ehrenberg. 2004. Resident and Nonresident Tuition and Enrollment at Flagship State Universities. In *College Decisions: How Students Actually Make Them and How They Could*, ed. Caroline Hoxby. Chicago: University of Chicago Press.

Rockoff, Jonah. 2004. The Impact of Individual Teachers on Student Achievement: Evidence from Panel Data. American Economic Review 94(2): 247–52.

Rouse, Cecilia. 1998. Do Two-Year Colleges Increase Overall Educational Attainment? Evidence from the States. *Journal of Policy Analysis and Management* 17(4): 595–620.

———. 1995. Democratization or Diversion? The Effect of Community Colleges on Educational Attainment. *Journal of Business and Economic Statistics* 13(2): 217–24.

Rubenstein, Ross, and Benjamin Scafidi. 2002. Who Pays and Who Benefits? Examining the Distributional Consequences of the Georgia Lottery for Education. *National Tax Journal* 55(2): 223–38.

Saxenian, AnnaLee. 1994. *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Cambridge, MA: Harvard University Press.

Schacter, John, and Yeow Meng Thum. 2004. Paying for High- and Low-Quality Teaching. *Economics of Education Review* 23(4): 411–30.

Singell, Larry D., Jr., and Joe A. Stone. 2002. The Good, the Poor and the Wealthy: Who Responds Most to College Financial Aid? *Bulletin of Economic Research* 54(4): 393–407.

State Higher Education Executive Officers. 2004. *State Higher Education Finance—FY 2003*. Denver, CO: State Higher Education Executive Officers.

Sumell, Albert J., Paula E. Stephan, and James D. Adams. 2004. Capturing Knowledge: The Location Decision of New PhDs Working in Industry. Unpublished manuscript, Georgia State University.

Surette, Brian J. 1997. The Effects of Two-Year College on the Labor Market and Schooling Experiences of Young Men. Finance and Economics Discussion Series No. 1997/44, Board of Governors of the Federal Reserve System.

Vernez, G., A. Krop, and C.P. Rydell. 1999. *Closing the Education Gap*. Santa Monica, CA: RAND Corporation. http://www.rand.org/publications/MR/MR1036/.

Weisbrod, Burton A. 1962. Education and Investment in Human Capital. *Journal of Political Economy* 70(5): 106–23.

———. 1971. Costs and Benefits of Medical Research: A Case Study of Poliomyelitis. *Journal of Political Economy* 79(3): 527–44.

White, Fred C., and A. A. Araji. 1990. An Analysis of Experiment Station Funding Decisions. *Western Journal of Agricultural Economics* 15(2): 282–90.

Zucker, Lynne G., Michael R. Darby, and Marilynn B. Brewer. 1998. Intellectual Human Capital and the Birth of U.S. Biotechnology Enterprises. *American Economic Review* 88(1): 290–306.

Zumeta, William, and Joyce S. Raveling. 2003. Attracting the Best and Brightest. *Issues in Science and Technology*. Winter: 36–40.