

The Virginia **NEWS LETTER**

The Economic Value of Publicly Supported Education and Research

By William M. Shobe

Public support for higher education dates back to the country's beginnings and reflects the widespread belief that this public investment will create substantial value for society. Thomas Jefferson clearly held the view that a publicly supported "academical community" dedicated to education, service, and inquiry would benefit the commonwealth by aiding commerce and educating community leaders capable of enlightened self-government.

Many of Virginia's major universities, now important centers of education and research, have leveraged the public funding for their activities to become engines of growth for the whole state. The activities of institutions such as the University of Virginia and Virginia Tech, for example, now bring into the state external funding greater than their annual appropriations of public funds. Support of top-quality higher education across the state enhances the equality of educational opportunities for Virginians and provides a steady supply of high-quality graduates, attracting firms in search of talented and entrepreneurial employees.

This article will explore how the functions of the modern research university contribute to civic and economic well-being. It will consider what

the evidence tells us about the value to the state of public support for major research universities.

The Earliest Days

Even before they had secured their tenuous foothold in the New World some four hundred years ago, the Jamestown settlers began to plan for an institution of higher education to serve the needs of the colony. It is remarkable that efforts to establish those institutions came even as the colonists were struggling for their very survival in the new land. By 1693, Jamestown had received a royal charter for the founding of the College of William and Mary, the first publicly supported college in the Americas.

Until 1800, colleges in the United States were closely affiliated with religious institutions. In that year, Vice President Thomas Jefferson first enunciated his developing vision for a publicly supported, secular university dedicated to the spirit of inquiry so central to the Enlightenment. Chartered by the Commonwealth of Virginia in 1819, the University of Virginia (U.Va.) embodied Jefferson's vision of a community where the search for new knowledge became intimately intertwined with the traditional university functions of teaching and developing future generations of educated



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citizens and community leaders. The University of Virginia went on to be the first institution of higher learning in the United States to expand the list of specializations beyond law, medicine, and religion to include such non-traditional fields as botany, astronomy, political science, and architecture.

Two hundred years later, public funding of higher education is an established practice throughout the nation and in most other countries. Every state in the U.S. has publicly funded institutions of higher learning that encompass the roles of education, research, and service. Many of these public institutions are ranked among the greatest universities in the world.

But why, when individuals have considerable private motivations to acquire an education, is there a strong perceived need to support access to education with public funds? Why, when businesses and entrepreneurs have considerable private motivations to engage in scientific research, is there a strong tendency to spend public money on scientific research at colleges and universities?

These questions are important because every dollar of public funds has a public opportunity cost. The use of one extra dollar for higher education eliminates the opportunity of spending that dollar for another purpose. Public functions such as transportation, public health, law enforcement, parks, and other government activities have their own important benefits. In a broader sense, the opportunity cost includes foregone opportunities in the private sector whenever a private company or individual pays taxes.

The Flow of Dollars into the State

One obvious key benefit of having strong public universities is the money they generate for a state. For example, in FY 2005 the state appropriation from the General Fund for operations at U.Va. amounted to \$132 million. In that same year, the university brought into the state a total of \$456 million in out-of-state research grants, giving, and graduate fellowships. Thus, \$1 of state funding supported activities that ultimately resulted in \$3.45 of new spending flowing into Virginia. Tuition payments by out-of-state students attending U.Va. provided an additional flow of \$166 million into the state, bringing the FY 2005 total to \$622 million, or \$4.71 for each dollar from the state General Fund. Patients who come to Virginia for treatment at the Medical Center bring additional funds into the state. Also excluded

from the total are consulting income and honoraria received by faculty from sources outside of the state. Without considering the value that a university creates in fulfilling its educational, research, and service missions, U.Va. operations directly generate annual inflows of income totaling well over \$600 million from sources outside the state.

As many of these dollars are spent on wages, services, goods, and taxes in Virginia, they create further rounds of gains in economic activity in the state. The status of several of Virginia's colleges and universities as nationally recognized centers of excellence in teaching and research leverages the state government expenditures into a inflow of economic value. In FY 2006 Virginia Tech reported total research and development expenditures of more than \$321 million. Virginia Commonwealth University reported \$211 million in sponsored research, Old Dominion University and George Mason University earned over \$65 million each, and the College of William & Mary over \$45 million.¹

The Value of a University Education

The modern university is usually seen as having three distinct but not independent functions: the transmission of knowledge, the creation of new knowledge through research, and service to the larger community. These roles were explicitly included in Jefferson's vision.

Joining these three functions in a single institution benefits the economy in ways that are hard to separate. For example, faculty research makes a university more productive in transmitting new knowledge to students, and talented graduate and undergraduate students help draw productive researchers. Each benefits from the presence of the other. Furthermore, highly trained graduates who live in the state gener-

1. Virginia Tech, Virginia Tech Factbook: Measures of Excellence, Research Section <http://www.vt.edu/about/factbook/measures-excellence.html> (4/21/08); Virginia Commonwealth University, "Proposed 2007-08 Tuition and Fees and University Budget Plan, April 12, 2007," slide 40. <http://www.budget.vcu.edu/operating/index.html> (4/23/08); Old Dominion University, ODU Research Expenditures Breakdown, slide 1. <http://www.odu.edu/ao/research/about/ranking.shtml> (4/21/08); George Mason University, Office of Sponsored Programs, George Mason University Factbook, FY 06 (Sponsored Programs) <http://www.gmu.edu/research/OSP/Reports.html> (4/21/08); William and Mary, Annual Report of Sponsored Programs, 2005-2006, slide 4, <http://www.wm.edu/grants/AR/> (4/21/08).

ate value in the state economy as workers and leaders. Research generates value in the local, regional, and state economies by generating new knowledge that results in increased productivity and investment.

Education has long been credited with a wide variety of benefits to both the individual receiving the education and to society at large. These benefits include increased productivity of labor with commensurately higher earnings, increased civic engagement and responsibility, greater cultural awareness, and improved public and private decision-making. Recent economic research also points to possible productivity “spillovers” among workers, a sharing of knowledge that increases the overall economic potential of society.

These overall advantages would then include such benefits as higher economic growth rates, greater tax revenues, greater job satisfaction, greater sense of security, or the personal value of the education experience itself.

The Private Value

A college education is associated with substantially higher earnings for those who attend. Data from the U.S. Bureau of the Census indicate that, on average, those with college degrees earn about twice as much as those without a degree.² Evidence suggests that students and their families value other aspects of higher education as well. They may see college as a path to maturity, higher status, expanded horizons, and as an opportunity for social networking.

Investments in higher education are primarily investments in increased knowledge, skills, and other attributes that raise a student’s expected productivity. A student pays for a college education with the expectation that his or her education will result in a net increase in wealth because of higher earnings. While analysis confirms the importance of this private investment incentive, some researchers suggest that higher wages may account for as little as half of the value of an investment in higher education. For example, college graduates are more likely to have fringe benefits as a portion of their compensation package. Census data for 2004 demonstrate a strong relationship between education levels and fringe benefits. Health care coverage at work rises from 67 percent for high school dropouts to 77 percent for high school graduates, to nearly 95 percent

for college graduates.³ A similar pattern can be observed in pension plan coverage. A college degree is usually associated with better working conditions, greater options to substitute between work and leisure, and more choice about where to live. These factors lead to greater job security and satisfaction. From this it is reasonable to conclude that the observed wage differential substantially understates the value of a college degree.

We can conclude from the evidence that, on average, the investment in a college degree can be expected to generate a rate of return competitive with most profitable alternative uses of the time and money. Some of the returns come in the form of higher money income, while the other benefits, already alluded to, are difficult to estimate accurately. The willingness of families to continually invest large portions of family wealth in higher education, even as the real costs rise, provides the most direct confirmation of this expected value.

The Public Value

The most obvious public gain from an individual’s decision to attend college is the increase in tax revenues that would arise from higher earnings. In fact, if government aid to higher education only went to students with high expected wage gains but who would not have otherwise gone to college, the government could conceivably run a profit from funding college degrees. Primarily because aid is not targeted according to likely wage gains nor is it limited to those students who would not have otherwise attended college, the prospect that government itself could earn a competitive rate of return from student financial aid is remote. If this were possible, then we probably would not rely on government to finance higher education to the extent that it does.

Furthermore, there is considerable evidence that additional education is associated with reduced demands on some government services and with a number of positive social outcomes. Voter participation increases substantially with education levels. As a corollary to this, community leaders are drawn disproportionately from the ranks of those with a college education. As the actions of the early settlers amply testify, there was a strong sense, even in the first days of the country, and in Virginia in particular, that the investment in higher education was important for the survival

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2 For detailed Bureau of the Census data for 2005 see Table 9 at <http://www.census.gov/population/www/socdemo/education/cps2006.html> (3/19/08).

3 Anthony P. Carnevale, “Discounting Education’s Value,” *Chronicle of Higher Education* (9/22/06).

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and prosperity of the community and, hence, was worthy of public support.

One of the principal justifications for public support for higher education is based on the proposition that an educated workforce contributes to the state's economic growth rate, above and beyond the increase in productivity of the individual worker. The increase in the individual's productivity is rewarded in the marketplace with higher compensation. Thus, unless there is something beyond the direct gain in productivity, we would generally expect private labor markets to induce the correct investment in college degrees. To justify public investment in education to boost economic growth rates, there needs to be something more.

A number of studies have found suggestive correlations between state spending on higher education and future rates of economic growth. Other studies have explored the connection between the education of the local workforce and rates of economic growth. There appears to be a growing body of evidence that, for urban areas in particular, the education level of the population helps boost future growth rates. These studies suggest that the mechanism for this increased rate of growth is through interaction among workers and firms in the region. This relationship results in a boost to productivity that is greater than the sum of its parts. That is, the knowledge sharing in the urban economy can result in one person's expertise raising other workers' productivity.

Recent theories of economic growth assume a similar mechanism to explain the role that knowledge plays in national and global economic growth rates. Increased knowledge "spills over" from the firm where the initial investment in knowledge is made to other firms and industries. This spillover is value that is generated but that does not result in a gain to the original investor. Under such circumstances, without public support for higher education, the rate of growth will be too low.

In the long run, the availability of substantial numbers of locally trained degree-holders contributes to the likelihood of employers locating their facilities in Virginia, thereby expanding local demand for locally educated degree holders. A 1986 study by the Conference Board provides evidence that "access to needed scientific and technical personnel" is probably the single most important factor in the location of corporate research and development facilities.⁴

Educated Workers and Business Climate

University graduates are part of the supply of highly educated labor available to employers in the state. A consistently low rate of unemployment in Virginia, along with a relatively high demand for labor with advanced training, makes it likely that a substantial proportion of graduates will seek employment in the state. In 2003, the latest year for which information exists, Virginia was first among the states in science and engineering workers and computer specialists as a share of the workforce. The data currently available do not allow us to demonstrate a causal link between the output of Virginia's research universities and hi-tech employment in the state, although research is suggestive that such a link exists. It is not possible to separate the impact of the local supply of well-trained graduates from the large effect that the high concentration of federal facilities and federal contractors has on the supply of hi-tech workers.

Providing affordable and exceptional higher educational opportunities also contributes to a state's quality of life, a measure that also has considerable importance in research and development facility location decisions, according to the Conference Board study. The study also reports that being near a university or research center is an important factor in location choices. These results raise the prospect that there is some public gain to providing high quality college education even when a substantial fraction of students eventually migrate to another state. First, the presence of such colleges enhances the public image of the state as an attractive place to live, making it easier to recruit educated workers and their families. Second, many graduates will donate to their school through alumni contributions or directed corporate giving. Third, the presence of graduates of Virginia universities in positions of leadership in the arts, corporations, and government provides a subtle but effective form of positive publicity for the state.

There is another way that the presence of a prestigious university contributes to future economic growth. The presence of top-notch universities in a state makes a major contribution to the state's business climate. For example, the business website Forbes.com specifically cited higher education as one of the important factors in giving Virginia its "Best State for Business" award in 2006 and 2007:

One of Virginia's strongest attributes is its two highly ranked institutions of higher

⁴ Leonard Lund, *Locating Corporate R&D Facilities* (New York: The Conference Board, Inc., 1986), p. 9.

education. The University of Virginia and the College of William and Mary graduate up to 5,000 graduates a year, many of whom stay in-state. They help contribute to Virginia's college attainment rate of 34% which is the seventh highest in the country. Life sciences businesses have popped up in and around Charlottesville because of U.Va.'s highly rated medical school.⁵

Equalizing Economic Opportunity

Thomas Jefferson's original vision of the University of Virginia was grounded in the view that this academic community should be a meritocracy that would gather the best intellects from all strata of society. As already noted, evidence clearly suggests that the private return on a college degree is large enough to justify considerable investment by students and their families in higher education. However, there is a large and persistent gap in the proportion of students from different income groups who attend any post-secondary institutions. A study in 2000 found that only 28 percent of high school graduates from families in the lowest income quartile attend a four-year college, as opposed to 66 percent of students from top quartile families.⁶

Part of this gap may be attributed to the many disadvantages of growing up in a lower income family, which may result in less effective preparation for college. However, even after controlling for student abilities, students from families with lower socioeconomic status are significantly less likely to continue education past high school. These statistics present a strong case for a breakdown in the meritocratic function of financial aid for higher education. The failure to provide equal opportunity for students of equal academic merit is not just unfair, it is economically wasteful. Given the probability that high achieving students would earn a very respectable private and social return on investment in higher education, the lost returns from not making this investment reduce social welfare accordingly.

Financial aid and other policies designed to increase access to higher education for those

from disadvantaged backgrounds can have a significant impact. There is strong evidence that, other things equal, students and their families increase their investment in higher education as tuition rates fall.

This income gap in college enrollment is not just an issue of financial aid and college access. We know that early childhood development, a stable and nurturing home life, a quality K-12 education, and many other factors contribute to the continued gap. Furthermore, research suggests that, for students with similar achievement measures, those from lower socio-economic status backgrounds receive a larger net benefit from attending prestigious academic programs than do their peers from advantageous backgrounds. The reason for the increased gain to students from disadvantaged family backgrounds in attending a top-ranked program rather than a lower-ranked program is not clear. It may be due to increased educational gains from attending the more prestigious program, or it may be that a credential from a more prestigious school more effectively eliminates any social stigma that may follow a talented but disadvantaged student even after receiving a college degree.

That said, students unprepared for college are unlikely to enroll in highly selective premier institutions. However, students at U.Va., for example, have high graduation rates: 83 percent in four years and 92 percent in six years. The university's 86 percent graduation rate for African American students has been the best among major public institutions in America for thirteen consecutive years.

The "Knowledge Factory": The Value of University Research

Increased knowledge from research is arguably the most important contributor to improvements in our standard of living over time. But to what extent do the benefits of Virginia's investment in its major research universities stay here rather than migrate elsewhere? Since knowledge is highly mobile, why not let others pay the costs of developing new information while we collect a share of the benefits for free?

The research output of the modern university is produced jointly with its other key output, the transmission of knowledge. There are significant advantages to producing these two together. It is cheaper to buy knowledge production and education together than it is to buy them separately.

The research function supports the strengthening of the labor force because top-ranked departments are needed to recruit and train

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5 Kurt Badenhausen, "Virginia: The Best State For Business," *Forbes.com* (8/6/06) http://www.forbes.com/2006/08/15/virginia-business-climate_cz_kb_0815virginia.html (3/20/08).

6 D. Ellwood and T. Kane, "Who is Getting a College Education? Family Background and the Growing Gaps in Enrollment," in *Securing the Future*, edited by S. Danziger and J. Waldfogel (New York: Russell Sage Foundation Publications, 2000).

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top-tier graduate students. Top departments are defined by their creativity and productivity in generating new knowledge and new techniques of measurement and analysis. Thus, the research function is essential for increasing the number of high performing graduate students in the state. While many of these students will eventually move elsewhere, they initially form a pool of ready recruits available to the Virginia job market.

Most obviously, state support for the research function results in a flow of sponsored research funding, most of which comes from outside the state. For example, only 9 percent of Virginia Tech's \$196 million of sponsored research funding in FY 2007 came from the state.⁷ University of Virginia faculty in FY 2007 received \$284 million in research funding from outside of Virginia, including \$245 million from the federal government.⁸ This amount alone was more than 1.7 times the total state appropriation to the university. On average, in FY 2007 each full-time-equivalent faculty position at U.Va. generated \$95,000 in sponsored research funding, most of which was derived from out-of-state sources.⁹

Economic Growth and University Research

Empirical evidence strongly supports the conclusion that, especially in the science and technology fields, the creation of new knowledge is associated with local concentrations of industrial innovation, and industrial innovation is associated with locally increased economic growth. Studies suggest that two possible mechanisms drive this local impact: (1) local knowledge "spillovers" and (2) entrepreneurial activities of leading scientists. Some of the key evidence for this comes from the geographic concentration of patent citations close to the area where the patent was generated, providing a concentration of new firms near university research. Other evidence derives from survey data on industry innovation.

One of the key triggers for this is the entrepreneurial activity of faculty and graduate students. There is strong evidence that firms

seek out contractual relationships with leading faculty even if they are at some distance from the firm's other activities. This is especially true with basic research but also, to a lesser extent, with applied research involving existing development and production activities. Contractual relationships may take the form of consulting contracts or the researcher's direct participation in the start-up of new firms. Top faculty are relatively less mobile than are the firm resources needed to tap that expertise. Hence, the research activities of firms tend to seek out the top researchers by locating activities close to the individuals. Evidence from the biotechnology industry shows a strong correlation between the location of top faculty in related academic departments and the rate of formation of new biotech firms. In addition to increased investment in the area, the faculty consulting income contributes to local economic activity.

Research Parks

The key function of a university research park is as a vehicle for encouraging local contracting with faculty and graduate students and for concentrating firms that can gain particular advantage from this knowledge and expertise. Patenting activities at research universities should generally be viewed not primarily as a moneymaking commercial enterprise, but rather as a supplement to the contracting and spillover mechanisms for boosting university research and its link to local economic development. Nationally, a large share of patent income is earned on a few "blockbuster" patents. Research parks and patenting offices should not be judged solely by the income that they return to the university. They should be viewed more as tools in achieving the university's key goal of maximizing its value in the creation and transmission of knowledge. An important secondary goal is to help retain a reasonable share of that value in the state. Much of their benefit will be subtler: the recruitment and retention of top faculty and students and an increase in local entrepreneurial activity, as well as spillovers from the activities of highly talented researchers and their graduate students.

The increasing body of evidence on the effectiveness of highly ranked university research programs in science and technology has prompted numerous states to push to upgrade the quality of research within their boundaries. This has increased the demand for top researchers who form the core of such departments, which has, in turn, increased the cost of attracting top researchers. Universities face the constant

7 Virginia Tech, *2006-2007 Financial Report*, p. 15. http://www.co.vt.edu/Financial_Reporting/financial_rep (3/20/08).

8 University of Virginia, *Financial Report, 2006-07*, p. 58. http://www.virginia.edu/president/report07/financial_report.html (4/17/08).

9 Based on fall 2007 full-time-equivalent instructional, research, and other faculty. http://www.web.virginia.edu/IAAS/data_catalog/institutional/data_digest/datadigest.htm (4/16/08).

prospect of having their best faculty become the recruitment target for other development-hungry states. The presence of these scholars may be expected to have both direct and indirect benefits for the state economy. They will increase the amount of research funding coming into the state. They will enhance the reputation of the university in the science and technology areas. And, given their status in their respective professions, their presence may lead to local benefits through entrepreneurial activity.

Research parks at U.Va. are developed and managed with the primary aim of supporting the academic mission of the university, not as an independent moneymaking enterprise or a regional development initiative. The University of Virginia's parks are managed to ensure that firms with natural connections to the school can arrange suitable space. Tenants include university offices, firms wishing proximity to faculty expertise, and faculty spin-off firms. For example, the Fontaine Research Park provides clinical and research space to the university's endocrinology department, which is one of the top five in the country. The University of Virginia Research Park, off U.S. Route 29 North, provides space for faculty start-ups and firms that need access to U.Va. faculty for scientific and engineering expertise. Based on discussions with tenants, the U.Va. Foundation has concluded that 75 percent of the tenants chose to locate in the Charlottesville area due to the availability of space in one of the research parks.

Virginia Tech's Corporate Research Center, established in 1985, has among its aims to help transfer technology to the private sector and to contribute to employment and economic growth in the region and state, as well as assist the school's teaching and research missions. With some 140 tenants at present and 2,000 employees, the park attracts about 20 new companies a year.

The Virginia BioTechnology Research Park, a joint project of Virginia Commonwealth University (VCU) and the city of Richmond, is home to a unique mix of more than 50 bioscience companies, research institutes affiliated with VCU and major state and national laboratories. The park works closely with VCU and other academic institutions, businesses and government to facilitate technology transfer and business development.

Not all of those desiring proximity to the state's research universities choose to locate in research parks. Many other firms, although with less direct connections to faculty, have probably

located in Virginia due in substantial part to the presence of the research universities as centers of research, learning, and expertise. These efforts all generally fit the model of a university with the core mission of creating and transmitting knowledge.

Institutional Incentives and Future Economic Growth

There has been much speculation about why American research universities have been able to retain their global dominance through the better part of the last sixty years. The answer that many observers have found convincing is the decentralized, competitive structure of the university system that rewards innovation. An intense competition for resources and for professional status occurs among universities, departments, and individual faculty and administrators. Research universities are akin to large firms producing two valuable products that are most efficiently produced in tandem. These firms compete for customers among students and their families, government funding agencies, foundations, and corporations. It is the competition that gives them incentive continually to innovate, to control costs, and to maximize the value of their effort to their customers. The increased flexibility that Virginia's universities received under the 2005 restructuring legislation may help them better respond to their competitive challenges.

Given that many states are now making strong research universities central to their economic development plans, competitive pressures will make it difficult for Virginia's major research universities to maintain their national and international stature. As Virginia government reduces the state share of funding for research universities in the state, it is possible that these schools may lose some of their prominence due to the fierce competition among states and schools. This, in turn, would make it more difficult for the state to attract the top students and faculty, with the corresponding reduction in development of knowledge-dependent businesses.

If the major research universities in the state are able to maintain their high rankings in teaching and research in spite of reductions in state support, it will be because they have responded to the competitive pressures by shifting university priorities in ways that will maintain and enhance their status. Success in this competition for academic status will ensure that they will continue to provide an important contribution to the economy of the state.

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School. This newsletter article is an outgrowth of a recent U.Va. economic impact study that he co-authored with John L. Knapp, a senior economist at the Cooper Center. The study, *The Economic Impact of the University of Virginia*, which includes a lengthy bibliography, is available for download at <http://www.coopercenter.org/publications/UVAIMPACT>.

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