

Chicago Fed Letter

Higher education and economic growth: A conference report

by Richard H. Mattoon, senior economist

The future of higher education and its relationship to economic growth were the focus of a one-day conference at the Federal Reserve Bank of Chicago on November 2, 2005. Cosponsored by the bank, the Committee on Institutional Cooperation, and the Midwestern Higher Education Compact, the event brought together over 100 academic, business, and government leaders.

In opening remarks, Chicago Fed President and CEO Michael Moskow noted that while the relationship between education, productivity, and economic growth has never been clearer, financial support for higher education has waned while costs have continued to rise.¹ While private universities have been able to raise tuition and draw on endowments to maintain fiscal health, public univer-

sities have faced difficult times as states have reduced financial support and often limited their ability to offset cuts with large tuition increases.

Moskow noted that state governments are facing competing demands for funding from K-12 education and Medicaid, among other priorities. Also, the perception of higher education as an important public good has eroded. Increasingly, Moskow said, higher education is seen as a private good with the benefits accruing to the student in the form of higher future wages and quality of life.

Moskow suggested several strategies for restoring the higher education social

compact. First, universities must be more transparent in their operations so that the public will have a better sense of the value of higher education to society.

Part of this transparency includes more tightly defining the mission of the university in meeting the multiple goals of education, research, and public outreach. Another aspect of transparency is finances. Moskow urged institutions to make explicit how money is spent and what resources are available to ensure that tuition is not a barrier to attendance for talented students regardless of income. Finally, he argued that higher education leaders need to address graduation rates that currently hover around 50%. Particularly in the case of non-traditional students, universities need to devise strategies to help these students succeed. Moskow concluded that while American higher education is still the envy of the world, the rest of the world is rapidly catching up.

Next, Wick Sloane, visiting fellow at the Chicago Fed, offered some provocative ideas. He argued that the U.S. has a national policy on higher education that has emerged largely by default and through provisions in the tax code. He noted that the two schools where he obtained his education (Williams College and Yale University) have implied federal subsidies per student of

1. Annualized real growth rates in public higher ed. costs and GDP

	1980-81 to 1990-91 (percent)	1990-91 to 1999-2000 (percent)
Public higher education spending per student	1.92	2.25
Net public tuition per full-time equivalent enrollment	4.86	3.10
GDP per capita	2.07	2.13
Aggregate public higher education spending	3.14	2.95
GDP	3.04	3.38

SOURCE: M. McPherson, 2005, "Higher education at a crossroad," presentation at Chicago Fed conference, based on data from *Digest of Educational Statistics* and *Economic Report of the President*.

2. 1988 eighth grade cohort by income and parental education

	Percent of cohort who are high school grads (Diploma or GED)	Percent of high school grads who took the SAT	Percent of cohort who took the SAT	Percent of high school grads who scored 1200 or above on SAT	Percent of cohort who scored 1200 or above on SAT
Family income					
Bottom quartile	79.9	34.2	32.2	7.4	2.4
2nd quartile	90.1	40.3	38.8	7.9	3.1
3rd quartile	94.8	50.9	49.3	12.0	5.9
Top quartile	97.1	70.1	68.4	21.4	14.6
Parental education					
Neither parent attended college					
	76.9	30.8	28.0	3.3	0.9
At least one parent attended college					
	92.4	49.6	48.1	13.7	6.6

NOTES: Based on data from the *National Educational Longitudinal Study of 1988* conducted by the National Center for Education Statistics. The maximum SAT score was 1600 for the period in which this study was conducted. Income quartiles are based on the 2000 Census, deflated to 1991 dollars. The third and fourth quartiles are slightly smaller than they should be, and the bottom two quartiles are slightly larger, due to variable coding restrictions. The percentage of the cohort who took the SAT is not equal to the product of those who graduated from high school and the high school graduates who took the SAT because there were nongraduates who took the SAT. SOURCE: William G. Bowen, Martin Kurzweil, Eugene Tobin, 2005, *Equity and Excellence in American Higher Education*, Charlottesville, VA: University Press of Virginia.

\$25,000 to \$35,000 per year. Sloane arrived at this estimate by calculating the value of the tax-exempt investment returns that each institution receives on its endowment and the value of tax-deductible donations. He noted that this is more than twice the cost of attending any community college. An additional subsidy is in the form of indirect cost recovery for doing federal research. This can range from 36.5% to 60% and often helps pay for elaborate buildings on college campuses. Sloane emphasized that these are resources that appear to come before increased financial aid for students.

Sloane questioned the length of time it takes to get a degree as a fundamental driver of higher education costs. He challenged the idea that a bachelor's degree has to consist of four years of study and 32 credit hours. Breakthroughs in the study of human cognition may lead to new ways of reaching students that are not as time bound. Sloane concluded by noting that his real concern was with meeting the needs of nontraditional students. Many of these students, who tend to be older and often have jobs and families, need better support so that they can realize their potential. This will benefit not only these individuals but society as a whole.

Then, Michael McPherson, president of the Spencer Foundation, discussed various measures of the affordability of higher education for private individuals and the public. When comparing public higher education spending per student to gross domestic product (GDP) growth per capita from 1980 to 2000, it is clear that aggregate higher education spending has grown at an equivalent pace to GDP. This suggests from a social affordability perspective that costs have not skyrocketed in this period (see figure 1). However, private affordability, measured as net public tuition growth relative to GDP per capita, has eroded. During the period 1980–81 to 1990–91, net public tuition per full-time equivalent enrollment grew nearly 5% per year versus real GDP per capita growth of slightly over 2%. Over the subsequent decade, public tuition growth slowed to 3.1%, while GDP grew at 2.13%, slowing the erosion in private affordability (see figure 1).

McPherson said that the real question facing higher education is how public resources should be allocated between rich and poor students and among different types of institutions to achieve an optimal distribution for society. Is it more efficient to invest in our most talented students and our best institutions, or can more gains be made by

increasing resources to community colleges and nontraditional student populations? McPherson cited work by Bowen, Kurzweil, and Tobin (2005)² that found that family income and parental education are still major predictors of academic success. Students from the top income quartile receive a combined SAT score of 1200 or better by a ratio of 6 to 1 over students from the lowest income quartile. A similar ratio holds for students that have at least one parent who graduated from college versus those without a parent who graduated from college (see figure 2).

McPherson concluded with two observations. First, higher education policy *is* rocket science. These are complex institutions, and better studies and more careful analysis need to be developed to improve policymaking. Second, the stakes are very high for our society. Higher education can be a critical element in supporting social mobility and improving our economic future.

B. Joseph White, president of the University of Illinois, offered a perspective from the front lines of higher education. He characterized the three campuses of the University of Illinois as the most valuable assets that the state possesses to ensure that globalization benefits rather than harms Illinois residents. White cited a recent visit by a Chinese delegation to underscore the university's economic relevance for the state. The delegation wanted to learn about best practices for livestock development to improve the Chinese diet. University researchers were able to provide expert advice, which could very likely lead to increased exports of midwestern grain to China to feed a growing livestock population. Such a visit demonstrated a clear benefit from the free exchange of ideas through the university that could lead to potential trade for the state.

However, the University of Illinois is facing some significant financial challenges. The university provides a \$25,000 per student education; however, it charges the students only \$8,000 to \$10,000 each. It is a reliable employer that provides benefits to the state, and yet the clear message from the state is that the

university is now on its own financially. White added that a new social compact has been developed to adjust to this new reality. First, it defines what the state can reasonably do to support higher education. The second and third elements are increasing revenue from tuition and having faculty leverage external sources to support their work. The fourth element is increasing private donations and endowment resources. Finally, leadership is needed to push cost reductions and improve productivity.

In conclusion, White discussed the frequent criticism that a university should be run more like a business. Such an approach, he argued, would eventually raise tuition to reach a market-clearing price; this would effectively triple tuition. Running a university more like a business also would lead to the closing of financially unattractive operations that are often critical to the mission of the university.

Higher education finance

Professor and former provost Paul Courant of the University of Michigan and Professor Richard Vedder of Ohio University and the American Enterprise Institute offered perspectives on what drives higher education costs. First, Courant asked the following questions:

- How is a university like, and not like, a business?
- Why does tuition keep rising faster than the cost of living?
- How happy or unhappy should we be about the answers to the first and second questions, or in other words, how close are universities to producing educated citizens and research efficiently?

To answer the first question, Courant suggested that a major research university, such as the University of Michigan, is something akin to a multi-product firm with many lines of business. A partial list would include undergraduate, graduate, and postgraduate education; basic and applied research; and a wide range of services, such as health care, technology transfer, athletics, museums, libraries, concert facilities,

and theaters. A university is involved in all of these lines of work in order to meet its broad mission of creating and transmitting knowledge. In addition, a university takes advantage of shared inputs across its lines of work to provide some cost and quality advantages. Courant suggested that the major disadvantage of this structure comes from administration and coordination problems. While universities tend to operate as high-quality firms, administration and coordination issues also tend to make them have high production costs. Clearly, a university is not a profit-maximizing firm; rather, a university tries to maximize some notion of knowledge-based value. So, how good are universities at doing this? How should they be governed and in whose interest?

The second issue concerns tuition outstripping the cost of living, as measured by the Consumer Price Index (CPI). For public universities, tuition is only one source of revenue. As such, the relative growth of other revenue sources needs to be considered, e.g., declining state support. Second, university costs also rise faster than the CPI. Courant suggested three reasons for rising costs.

The perception of higher education as an important public good has eroded. Higher education is viewed by some as a private good with the benefits accruing to the student in the form of higher future wages and quality of life.

- Baumol's disease. Developed by William Baumol to explain the growth of costs in the theater, it suggests that in certain fields (e.g., the theater) technical change does little to increase productivity because basic inputs (e.g., actors and costumes) are still needed. Since wages still grow to keep pace with other industries, costs tend to grow at the overall rate of inflation plus productivity.
- The role of the university as a conservatory. Universities cannot do all of their innovation through substitution. They need to retain knowledge of the past.

- Desire to stay on the cutting edge. Technology tends to increase costs because the newest equipment is needed to make high-value discoveries. Also, competitive pressure to retain the best faculty puts pressure on wages.

Courant suggests that the important question is how fast should expenditures rise given the high rate of return from university spending.

As for tuition, Courant believes that given declining public tax support (in the case of Michigan, state appropriations for general fund expenditures are down to less than one-fourth of the budget versus one-third three years ago), tuition becomes the major revenue source that the administration has some control over. Still the guiding principle is for tuition to rise as little as possible, but enough to maintain quality.

Courant concluded that the objective of a research university is not profit and should not be cost minimization. Rather the goal should be to maintain quality while promoting access through appropriate financial aid programs.

Vedder offered a different perspective on what is driving college costs. He noted that college costs (as measured by the college tuition fee price index of the U.S. Department of Labor) have risen faster than even the health care cost index, and have more than doubled in real terms since 1980. Even after allowing for grant assistance, higher education costs in real terms are still considerably higher. Of greater concern is that cost increases in tuition have eclipsed increases in family income.

Vedder argued that rapidly rising tuition costs are being driven by surging student demand, which in turn is at least

partially driven by government policy related to financial aid. Essentially, prices can rise because much of the cost of tuition is covered by third parties; as a result, the primary consumers (students) remain relatively insensitive to price hikes. Another factor driving costs has been languishing productivity. Most university instruction is delivered in the same manner as it was generations ago.

In contrast to public higher education, Vedder noted the rise of for-profit universities, such as the University of Phoenix and Strayer University. These schools have seen astonishing growth in enrollment and returns on equity, and have developed a powerful model for meeting the needs of older, career-minded students. These schools offer a real alternative to traditional higher education.

of providing education because it does not have other revenue sources, such as endowments. Finally, Strayer has to pay taxes, and it cannot raise tuition indefinitely or it will lose market share.

Silberman stated that, at its core, education is part of the value chain that is directly related to building income. Strayer's business model focuses on working adults and offers a limited number of academic disciplines and limited campus facilities to hold costs down. It also offers an online university to reach students who cannot attend a campus. Ironically, this model has proven successful enough to attract investments from public universities that have purchased Strayer stock through their endowments.

Silberman cited three imperatives for Strayer. First is open enrollment. Strayer graduates large numbers of minorities, and admits students regardless of high school record, as long as they have graduated. Second, the program promotes academic rigor. Strayer is regionally accredited and offers BAs, MBAs, and technical degrees. Third, high student achievement is required. Between 5% and 10% of Strayer's student population fail each quarter.

Silberman concluded that Strayer's success is based on efficient use of assets and a different student focus. The school doesn't have to offer amenities or pay for expensive real estate. It also does not pay for a faculty that is attempting to push the boundaries of knowledge through research; instead, it hires faculty that focus on teaching and know their academic discipline. He suggested that Strayer's ultimate success can be seen in the annual earnings of its graduates, which a recent survey shows rose from \$28,000 to \$57,000 in two years after graduation.

Adapting to the knowledge economy

James Duderstadt, president emeritus of the University of Michigan, gave the keynote address focusing on the role of higher education in driving economic transformation. Borrowing from Thomas Friedman's book, *The World is Flat: A Brief History of the Twenty-first Century*,

While the public is concerned with accountability, competition at both the national and international levels leads universities to make the investments to stay on top.

Even if instructional productivity has remained constant, it has fallen relative to other segments of the economy. In addition, new staff members are increasingly added outside the classroom. Today there are six nonfaculty professional staff per 100 students versus three in 1976.

University pricing practices are also at play. Schools have become better at price discrimination, meaning that they charge different consumers different amounts of tuition based on the intensity with which the student wants to purchase the education. When this is done successfully, it increases the aggregate tuition yield. There are also issues of cross-subsidy between various functions on campus—research, athletics, undergraduate education, and graduate education—that make pricing less transparent.

According to Vedder's own research, there is a lack of evidence that public spending on higher education promotes economic growth. In fact, his work finds that states that spend more on higher education have lower economic growth rates. Similarly, Vedder finds little evidence that spending does much to increase student involvement in university life.

The goal of universal access, regardless of income, has also not been met. Schools tend to value academic rankings and have focused on becoming more elite rather than expanding access. Median family income of students at most elite colleges is easily many times the national level.

Given the competition from for-profit universities and other current trends, Vedder argued that growth in university budgets is likely to slow. State appropriations will be constrained, along with student financial aid; the earnings differential that college graduates receive over less-educated populations may decline as well. These factors will force universities to find ways to save costs, e.g., by finding applications of technology, increasing teaching loads, and changing their work force practices, including revising tenure.

Vedder concluded that traditional universities are expected to lose market share and will be required to develop new funding mechanisms. He predicted that state aid will become more focused on students than institutions and that for-profit universities will begin to target the traditional 18- to 24-year-old market as they develop innovative models to meet students' needs. While the traditional university will not die, it will need to change significantly to be successful in the future.

The role of the for-profit university was the focus of remarks by Robert Silberman, chairman and CEO of Strayer Education. Strayer is not that different from traditional schools in that it focuses on the value of education that it provides its students. However, Strayer must also pay attention to its return on capital and market returns to investors. In addition, Strayer's revenue must equal the cost

Duderstadt suggested that information and telecommunications technologies have radically changed the economic landscape, allowing new competitors onto the economic playing field. In particular, this is apparent in sophisticated supply chain management practices that allow for global sourcing of not only low-skilled work but almost any form of knowledge work, no matter how sophisticated. The impact of this shift has been particularly disruptive to the industrial Midwest.

For the Midwest, the industrial production paradigm has shifted from material- and labor-intensive products to knowledge-intensive products and services. This places a high value on knowledge institutions, such as research universities, corporate research and development laboratories, and national research agencies, for creating advanced education, research innovation, and entrepreneurship.

Duderstadt said that the region needs to develop a strategic plan to harness these economic forces. As an example, Duderstadt described the Michigan Roadmap,³ which he led as part of the Millennium Project at the University of Michigan. At its core, the roadmapping process analyzes where the economy currently is, where the state would like it to be, and how much of a gap exists between the two. A roadmap is developed from this process to describe how to improve the state's economy. Duderstadt characterized Michigan's economy as facing significant challenges. Its largest city, Detroit, is among the poorest in the nation, and one of its major industries, domestic autos, is suffering staggering losses. Michigan's education system is underachieving, with one-quarter of its adult population without a high school degree and only one-third of high school graduates ready for college. Yet, the state has a system of higher education that is regarded as among the finest in the nation, although it too is beginning to suffer from a withdrawal of state support.

A particular problem is that Michigan continues to try and promote short-term economic strategies to improve its lot. Rather than funding education and research, state support has gone to building prisons, sports stadiums, and casinos, with

tax cuts and tax abatements provided to dying industries. Public debate has tended to pit groups against one another rather than developing a shared vision for the state.

To improve Michigan's and the region's economic future, Duderstadt argued that a commitment to educational opportunity and technological innovation is a key element. This requires not only investments in human capital, infrastructure, and appropriate tax and intellectual property policies, but also the creation of an environment that stimulates creativity and innovation. To achieve this, the region must leverage its economic assets, which include its size and market position, research base, geographic location, key industry and research and development centers, and historical importance to the U.S.

Furthermore, Duderstadt said that the region has one unique asset in its concentration of strong flagship research universities. The Big Ten universities along with the University of Chicago conduct \$6 billion per year in research and development; enroll 300,000 undergraduate and 76,000 graduate students; and award 20% of the nation's doctorates in engineering, chemistry, mathematics,

among these sectors. These could include groups consisting of governors, mayors, CEOs, and university and foundation presidents. Other resources could include the National Academies⁴ and a coalition of midwestern Federal Reserve Banks. Financial support could be drawn from the many foundations that operate within the region that still have an important stake in the region's health. Finally, a roadmapping exercise should be conducted within each major sector of the economy. In the end, the challenge of this coalition would be to transform what was once the manufacturing center of the world economy into what could become its knowledge center.

Perspectives from higher education leaders

Lou Anna Simon, president, Michigan State University; Paul Courant, professor and former provost, University of Michigan; and Richard Saller, provost, University of Chicago, offered their views on the challenges facing higher education. Simon noted that the universities' core mission of providing access to cutting edge knowledge and democratizing information has remained unchanged. A particular challenge to higher education is improving connectivity

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and computer science. Despite this success, all of these universities have seen diminished state support and, increasingly, are largely supported through private funds. For the region to succeed, Duderstadt argued, these institutions must be at the heart of the strategy.

Finally, Duderstadt laid out a structure for improving the region's health. First, this requires the attention and commitment of leaders from all sectors of society, including business and industry, state and local government, higher education, foundations, and the media. Second, organizational links need to be built

with other institutions and the public. Higher education must restore public trust that it provides access in an inclusive fashion. It must also highlight the benefits of its basic, applied, and commercial research. In particular, Simon cited the work of Michigan's Cherry Commission on higher education, which suggested that universities should focus on giving students the ability to acquire any form of knowledge and move beyond an emphasis on vocational training to a broader, more classical education in order to develop the knowledge workers of the future.

Courant suggested that universities have a special problem when it comes to promoting their value to society. Given that universities have a stake in the outcome, there is a moral hazard related to their suggesting that they should receive significant public resources. To make the role of the university in promoting growth more credible, Courant said that the business community should make the case that developing basic and applied research and educating the work force are important public policy issues. Courant offered that part of the reason why universities can fulfill this role is because they promote agglomeration economies where talented people in the same discipline can join together and share ideas. Moreover, some institutions in society still need to serve as repositories for collected knowledge; while technology might promote some efficiencies, there will still need to be a physical place where knowledge resides.

Saller provided the perspective of a private research university. He suggested that higher education benefits from intense competition. While the public is concerned about accountability, competition at both the national and international level leads universities to make

tuition and attract outside resources have helped balance them.

In this discussion, the three leaders agreed that communication was at the center of the higher education problem. Simon suggested that universities often fail to speak the language of the public, and this tends to create distrust. Saller noted that more work needs to be done on the tangible outcomes from higher education spending, and cited a study by University of Chicago economists Robert Topel and Kevin Murphy that demonstrated a huge return to society from university research funded by National Institutes of Health grants. Research on the returns from other aspects of higher education spending would be useful.

North Dakota—A statewide effort to improve higher education

In 1998, North Dakota began a remarkable effort to reform its higher education system. Describing the work of the North Dakota Roundtable on Higher Education were Larry Isaak, former chancellor, North Dakota University System, and president, Midwestern Higher Education Compact; State Senator Ray Holmberg, chair, Higher Education

popular perception was that the North Dakota University System was a burden on the state.

Isaak explained that the roundtable's efforts led to the development of a consensus on how the North Dakota University System could best focus its assets and talents. The plan included:

- Promoting expansion and diversification of the state's economy;
- Enhancing the quality of life of the state's citizens;
- Engaging at every level with the needs and problems of the state and its citizens;
- Becoming academically competitive at the national and international levels; and
- Being accessible and responsive to all citizens of the state, both individual and corporate.

Dunn discussed the roundtable's vision and structure. Consisting of 61 members, the roundtable drew from legislators, private sector leaders, members of the state board of higher education, college presidents, government leaders, faculty members, and students. However, more than half of the members were either legislators or private sector leaders, ensuring that traditional higher education interests would not dominate the discussion. The group established a straightforward goal—"To enhance the economic vitality of North Dakota and the quality of life of its citizens through a high quality, more responsive, equitable, flexible, accessible, entrepreneurial, and accountable University System."

Dunn reported that the roundtable completed its initial work by May 2000, although it had managed to have legislation in support of its recommendations passed as early as 1999. While the process was far from easy, Dunn said that the nature of the process, the ability to establish a common vision, and private sector involvement and leadership were the keys to success.

Senator Holmberg then discussed the legislative process for the roundtable. At the outset, the state legislature had

For the Midwest, the industrial production paradigm has shifted from material- and labor-intensive products to knowledge-intensive products and services. This places a high value on knowledge institutions.

the investments to stay on top. In global rankings, American universities continue to dominate, but a disturbing trend is the increasing stratification between private and public universities. Although some stratification may be necessary, the private universities have been able to attract greater endowment resources and have had more stable funding. The costs of continuing to provide small class sizes, as well as price increases in purchasing new equipment and maintaining lab space for the sciences, have raised private universities' overall costs. Yet private universities' ability to raise

Roundtable, and chair, North Dakota Senate Appropriations Committee; Eddie Dunn, vice chancellor, North Dakota University System; Joseph Chapman, president, North Dakota State University; and Roger Rierson, president, Flint Communications, and Higher Education Roundtable member.

North Dakota's economy in 1998 was struggling and its higher education system was not seen as a player in the state's economic future. There was little cooperation among universities, government, and the private sector, and the

no shared vision of what the university should be and had developed a mindset that saw the system as a financial burden. Proposals to consolidate the system had been popular, and numerous studies had

university system seemed mired in outdated principles. It was slow to react, risk averse, not tuned to the needs of the future work force, and being micro-managed by the legislature. Those in

A recent study of the economic impact of a reformed North Dakota State University on its state economy has seen its contribution rise from \$14 million to \$105 million in just five years.

been commissioned. The key to successful legislative participation, Holmberg said, has been the willingness of the legislature to step back yet demand accountability from the higher education board for a unified higher education system. He stressed that the legislature created a structure and support for higher education without excessive oversight.

Next, Chapman reported that the roundtable process has had a profound effect on the behavior of the universities. It has focused them on placing students first, expanding program offerings while bolstering quality, and leveraging external support. Through these efforts, enrollment at North Dakota State University grew from 9,700 in 1999 to over 12,000 in 2005. Equally impressive has been the expansion of doctoral programs from 15 to 40 and growth in doctoral students from 150 to 500. Research expenditures soared from \$44 million in 1999 to \$102 million in 2005. Chapman suggested that a new entrepreneurial and results-oriented culture, based on flexibility, partnerships, vision, and broad support, is paying real dividends to the state. The most recent study of the economic impact of the university on the state's economy has seen its contribution rise from \$14 million to \$105 million in just five years. Each additional dollar of state funds is now attracting \$9.60 of external support.

Finally, Rierson described the role of business in driving higher education reform. To the business community, the

the business community saw a system that had considerable promise and resources but was underperforming. Most of all, the university system was not an asset for private business other than it provided talent.

What the private sector brought to the roundtable was a perspective of business as the ultimate consumer of university products; it also brought the imperative that the system needed to be more progressive and entrepreneurial. The strategy was to remove barriers and let the college presidents lead and be accountable for results. Rierson argued that the results have been impressive, including new work force training programs, the development of centers of excellence, more trade corridors, and fully occupied research parks. The state is attracting new businesses and start-ups and is retaining college graduates at a higher level. To sum up, Rierson said that a successful higher education system is one that is engaged with its communities.

Conclusion

This one-day conference made it clear that traditional models of higher education finance and service delivery are under stress. Declining financial support from state sources appears to be a structural issue, and changing student demographics require new service delivery models. The question for policymakers is this: If higher education is essential to economic growth, how do we best support this critical sector?

¹ For a condensed version of this conference summary, see Richard H. Mattoon, 2006, "Higher education and economic growth," *Chicago Fed Letter*, Federal Reserve Bank of Chicago, No. 222a, January, available at www.chicagofed.org.

² William G. Bowen, Martin A. Kurzweil, and Eugene M. Tobin, 2005, *Equity and Excellence in American Higher Education*, Charlottesville, VA: University Press of Virginia.

³ James J. Duderstadt (project director), 2005, *A Roadmap to Michigan's Future: Meeting the Challenge of a Global Knowledge-Driven Economy*, University of Michigan, Millennium Project, report, available at <http://milproj.ummu.umich.edu/publications/roadmap/index.html>.

⁴ The National Academies consist of the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, and the National Research Council.

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