

**The Role of South Carolina's Research Universities
in Economic Development**

Prepared by
Clemson University
The Medical University of South Carolina
The University of South Carolina

January 2006

The Role of South Carolina's Research Universities in Economic Development

Executive Summary

South Carolina's research universities play a vital role in the state's economy. Producing graduates who will stay in the state is crucial to our economic success, and the three research universities have 177,729 in-state alumni. Since 2001, the percentage of students who express their intent to remain in the state has increased significantly in the highest SAT categories (1100-1600).

The Palmetto State ranks behind its neighboring states in the number of citizens with at least a high school education, and our per capita income is 82 percent of the national average. The more educated the population of an area, the more likely it is to experience positive economic growth. While unemployment has increased overall, the higher one's level of education, the lower the unemployment rate.

The state's research universities work in tandem with the business community and political leadership to address issues of economic concern, from per capita income to job growth, and provide important research data to support the state's efforts to compete nationally and globally. In addition, the research universities support the state's economy as employers, as engines of technology transfer, and as incubators of new knowledge that leads to new business.

South Carolina's creative legislation to support research university funding is a visionary tool for moving the state to a new level of economic success. In addition, research expenditures financed by the federal government, private foundations and the private sector have increased by \$99 million over the past five years at little or no cost to South Carolina taxpayers.

The human capital investments and research spin-offs that are the products of research universities have important long-run positive impacts on the growth of the South Carolina economy.

South Carolina’s major research universities – Clemson University, the Medical University of South Carolina and the University of South Carolina – play a vital role in promoting the economic health of the Palmetto State through the education of its citizens and through the generation of knowledge. Each institution works from its unique strengths toward the common goal of solving problems of great importance to our quality of life.

The role of education in improving the quality of life and specifically in economic development historically has been seen as critical to society.

“There is an almost perfect correlation between the number of good jobs in a region and the strength of its universities.”

--- Bill Gates

“Research” – defined most basically as the search for new knowledge – is a key component of any institution of higher education. The desire to expand one’s understanding of the world through the search for new knowledge is indeed the seminal element of education.

Producing graduates who will stay in the state and contribute to the overall quality of life for themselves, their families and society at large is a crucial goal of South Carolina’s research universities. Jointly the three research universities boast 177,729 graduates who have remained in the state.

South Carolina has used state education lottery revenues creatively to establish scholarships and incentives designed to retain the “best and brightest” high school graduates. The two research universities that track SAT scores, Clemson and the

University of South Carolina, report Fall 2005 SAT scores for entering freshmen students of 1225 and 1170 respectively, for an average score of 1198, well above the national average of 1026. The state’s research universities, in turn, have created initiatives to provide the “added value” quality of education these top-quality students would once have sought outside the state and to attract other top-quality students from other states to remain in South Carolina, work in high-paying jobs, build businesses, pay taxes and contribute to the state’s economic well-being. The following table reflects the dramatic increase in the number of students declaring their intent to remain in South Carolina.

<u>Percent of Students with Intent to Remain In-State by SAT Score</u>				
	1100-1200	1200-1290	1291-1390	1391-1600
2001	57.0%	47.0%	32.9%	16.1%
2005	85.1%	77.7%	67.8%	46.9%

Educating our citizens to the highest level possible has a direct effect on our potential for economic success. South Carolina ranks significantly below North Carolina, Georgia and the nation in the percentage of population ages 25-64 with more than a high school education; and according to the 2002 census report, South Carolinians earned only 82 percent of the national average. There is also a correlation between unemployment and education. National statistics indicate that while unemployment increased for those at all levels of education from 2002 to 2003, unemployment rates decreased significantly as education increased, ranging from 9 percent for those with three years of high school or less to approximately 2 percent for those with professional and doctoral degrees.

Clemson Economics Professor Curtis J. Simon, in his research on the subject of human intellectual capital, found a significant correlation between economic growth and high knowledge levels of the areas he studied. In layman's terms, the more educated the population of an area, the more likely it is to experience positive economic growth. In its white paper on the State Technology and Science Index, the Milken Institute noted, "Human capital is the most important intangible asset of a regional or state economy."

South Carolina faces critical workforce challenges in the area of intellectual capital, and education offers the solution. According to "Pathways to Prosperity: Success for Every Student in the 21st Century," prepared by the Governor's Workforce Education Task Force in October 2001, only 32 percent of ninth graders will pursue a two-year degree after high school, while 65 percent of the jobs will require one; 40 percent of ninth-graders will pursue "unskilled" jobs while only 15 percent of jobs will be "unskilled." Research universities, working in concert with their K-12 and technical college colleagues, play an important role in developing programs to improve early academic success and move more high school graduates toward the higher education necessary for their personal success (through higher paying jobs) and the demands of the workforce for more highly skilled employees.

The economic impact of research universities has been studied by various states concerned about the proper role of higher education in balancing the traditional role of educating students for careers against the need to recruit businesses that will create jobs and stimulate state economies, since the presence of research universities is an important factor in business recruitment. The economic impact of research universities involves the dissemination of knowledge and economic stimulants beyond the borders of the

institutions' home states, and proximity of research universities to industry is often cited as an important factor in regional economic success as well as in the ability of an industry to expand exponentially beyond its locale. (California's Silicon Valley and its proximity to Stanford University is a frequently cited example of the serendipity and the synergy that are created when a strong academic research component is available to those involved in industry research and development.)

Beyond producing graduates and influencing the development of a more highly trained work force, research universities contribute to the state's economy in other ways.

- As employers
The three universities combined employ a total of 13,221 taxpayers (4,327 faculty and 8,894 staff.)
- As engines of technology transfer
From FY 2001-FY 2005, researchers at the three universities were issued 95 new patents.
- As incubators of new knowledge that translates into new businesses
Fourteen new companies were added to the South Carolina economy from FY 2001-FY 2005 as a result of new knowledge gained through research.

To a great extent, sponsored research pays its own way. South Carolina's research universities generate revenue for the support of educational programs through the acquisition of funding from government agencies and private corporations. In their report on research expenditures at South Carolina's research universities, Clemson University Professors Mark S. Henry and David L. Barkley noted an increase of \$99 million (72 percent) in expenditures over the four-year period from FY 2001 to FY 2005. They wrote:

“Total research spending has grown from about \$264 million in FY 2001 to \$363 million in FY 2005. By FY 2005, the associated economic impacts were about

\$715 million in gross output (sales) by South Carolina industry, \$414 million in income for the state's residents and business owners, and nearly 13,000 jobs. Trends suggest future increases in these totals. To the extent that the research expenditures are financed by the federal government, private foundations and the private sector, these contributions to the state economy are of little or no cost to South Carolina taxpayers. Most importantly, the estimates presented ignore the longer-run impacts that research universities in South Carolina have on enhancing the human capital and innovative activity in the state and nation. These human capital investments and research spin-offs have important long-run positive impacts on the growth of the South Carolina economy.” (Appendix 1)

The research universities in South Carolina have long traditions of working to improve the quality of life, serving as intellectual greenhouses that nurture new ideas, develop and refine them, and send them beyond the laboratories and classrooms to benefit society. From the state's earliest days as an agrarian society, through the Industrial Revolution and the development of a manufacturing economy in the state, the research universities have led the way in the creation of knowledge to support these endeavors.

Rapid technological change and globalization, however, have brought new challenges to the state's economy.

- Our industrial mix needs urgent attention. (The automotive sector is one bright exception.)
- Per capita personal income in our state still lags the rest of the nation. For every dollar the average American earns, the average South Carolinian makes just 82 cents, and the gap is widening.
- We currently rank 48th in the nation in job growth and have America's 7th highest unemployment rate.

The research universities are part of a broad coalition of business and political leaders dedicated to the task of bringing more and better-paying jobs to the state. A recent meeting of the South Carolina Chamber of Commerce brought together the research universities, the State Chamber, the Palmetto Institute, the Palmetto Business Forum and the Council on Competitiveness to discuss such collaborative efforts as strategies to generate new jobs, reform the tax code, and improve per capita income for *all* South Carolinians, not just the top earners. Research universities have played a major role in articulating these needs and contributing data for recommended solutions in a non-competitive academic environment.

A recent case study of regional economic development by the Massachusetts Institute of Technology's Industrial Performance Center examined four universities in the United States and four in Finland. Professors Alok K. Chakrabarti and Richard K. Lester summarized that universities are playing significant roles in local and regional economic development, and the reputation or "tier" of the research university has a significant impact on the nature of the university-industry relationship. The report concludes that policymakers and university leaders, working together, can devise specific policies that optimize the critical role of research universities in economic development. (Appendix 2)

Certainly South Carolina's General Assembly has shown exemplary vision in investing in the state's research universities and their products. Four recent pieces of legislation provide a framework for South Carolina research institutions to recruit and retain top faculty, develop and support programs that attract top students, and leverage private investment. The impact of the state's wisdom will reap benefits for generations to come.

Funding Commitments to Date

- Research Centers of Economic Excellence Act/Endowed Chairs - \$90 million
- Research Infrastructure Bond Act - \$250 million
- Innovation Centers Act - \$12 million
- Venture Capital Act

The economic impact and influence on business of the state's research universities will be essential in driving the future of South Carolina's economy through the development of public-private partnerships that take advantage of existing economic clusters (automotive, advanced materials, health care, agriculture). The Clemson University International Center for Automotive Research (CU-ICAR) and the model it has created for others to follow have already garnered \$213.8 million in investment, with additional partners emerging at a rapid pace.

The success of CU-ICAR has stimulated the creation of a second major cluster in the health sciences through the creation of Health Sciences South Carolina, a health care collaborative that has drawn together three of South Carolina's largest hospital systems (Greenville Hospital System, Palmetto Health, Spartanburg Regional Medical Center) and the state's three research universities, each of which has pledged \$2 million per year for 10 years for a total commitment of \$120 million. This group collectively will work toward developing therapeutics that can serve to attract private investment and generate innovation in the health sciences.

The collaborative already has recruited five distinguished scientists to South Carolina through the Research Centers of Economic Excellence Act/Endowed Chairs

program; and according to an economic impact study by the University of South Carolina Moore School of Business, the collaborative is already a major driver of South Carolina's economy. Prepared by USC research economist Donald Schunk, the report states the six HSSC member institutions were responsible for \$8.5 billion in total economic output for the state during the 2004 fiscal year. The multi-billion dollar figure represents total impact on sales of South Carolina businesses and includes expenditures by the HSSC partners and various ripple effects of households and businesses purchasing goods and services from other in-state businesses. (Appendix 3)

The companies investing in CU-ICAR stress the importance of their proximity to an academic research environment as a key reason for their interest. Governor Mark Sanford, in his remarks at the unveiling of the CU-ICAR Master Plan in June 2005, noted the value of the CU-ICAR model.

“Carving out areas of excellence is what will make us competitive with the rest of the world. CU-ICAR does that, with its combination of manufacturing, supply, distribution, research and engineering in one spot. In the same way that the Research Triangle has produced tremendous fruit for North Carolina, CU-ICAR is going to do the same for South Carolina.”

January 30, 2006

Appendix 1



Research Report
12-2005-01

REGIONAL ECONOMIC DEVELOPMENT
RESEARCH LABORATORY

**Research Expenditures at South Carolina's
Leading Research Universities:
Contributions to State Economic Activity**

by

Mark S. Henry
and
David L. Barkley

Regional Economic Development Research Laboratory
Department of Applied Economics and Statistics
Clemson University, Clemson, South Carolina

Clemson University Public Service Activities

RESEARCH EXPENDITURES AT SOUTH CAROLINA'S LEADING RESEARCH
UNIVERSITIES: CONTRIBUTIONS TO STATE ECONOMIC ACTIVITY

By

Mark S. Henry and David L. Barkley
Professors of Applied Economics and Statistics
Co-Coordinator of the Regional Economic Development Research Laboratory,
Clemson University

December 5, 2005

REDRL RESEARCH REPORT 12-2005-01

Research Expenditures At South Carolina's Leading Research Universities: Contributions To State Economic Activity

INTRODUCTION

It is commonplace to read or hear about the “new economy” and the critical role that innovation and human capital play in fostering economic growth of nations and regions. However, few studies exist of the impact that research expenditures at South Carolina's research universities (Clemson University, the Medical University of South Carolina and the University of South Carolina in Columbia) have on the state's economy.¹ The purpose of this report is to document how the actual research expenditures at CU, MUSC and USC contribute to the generation of state economic activity – as measured by state gross output, state income, and employment of state residents. This is a limited view of the contribution of research universities to the South Carolina economy since it ignores the main function of the universities – the formation of human capital needed for long term economic growth.² This analysis also ignores the positive impacts of university research on new product development and enhanced productivity among the state's businesses.³

Nevertheless, annual spending by these public universities for faculty salaries, staff support, and the materials and supplies needed to undertake research projects does ripple through the state's economy – generating sales, income, and jobs for South Carolina businesses and residents. To the extent that the source of research expenditures are “external” to the state government's contributions to research – Federal Government, private foundations, and the private sector – the cost side of research is, for the most part, not the responsibility of South Carolina taxpayers.

METHODOLOGY

The contribution of research spending by CU, MUSC and USC to the level of economic activity in the state is estimated using a standard impact assessment model for South Carolina, the Impact Model for Planning (IMPLAN). Interindustry models are based on the work by 1973 Nobel Laureate in economics, Wassily Leontief. The model establishes the linkages between industries in the state economy by estimating the dollar value of inputs needed by each industry from all other industries in the state. IMPLAN provides estimates of these linkages and the resulting multipliers for each industry in the State of South Carolina.⁴ For the analysis of the economic impacts of university research expenditures, the focus is on IMPLAN sector 462, Colleges and Universities. For a given year, the total research spending by CU, MUSC and USC is used as an injection of added final user (or final demand) sales to the State of South Carolina economy. This direct added spending for wages, salaries, materials, and supplies generates secondary rounds of

“indirect” input purchases as businesses buy supplies from each other. The research spending also provides income (wages, salaries, rents, and profit type income) to residents of the state who in turn consume goods and services. These consumer related purchases further increase output, sales, and jobs in the local economy. These are called “household induced” rounds of new economic activity. The multiplier process adds together the direct, indirect, and induced effects from university research expenditures in the state. The resulting total economic impacts are measured along three paths: output (sales) by South Carolina industries, income accruing to South Carolina households, and added jobs in South Carolina.

RESULTS

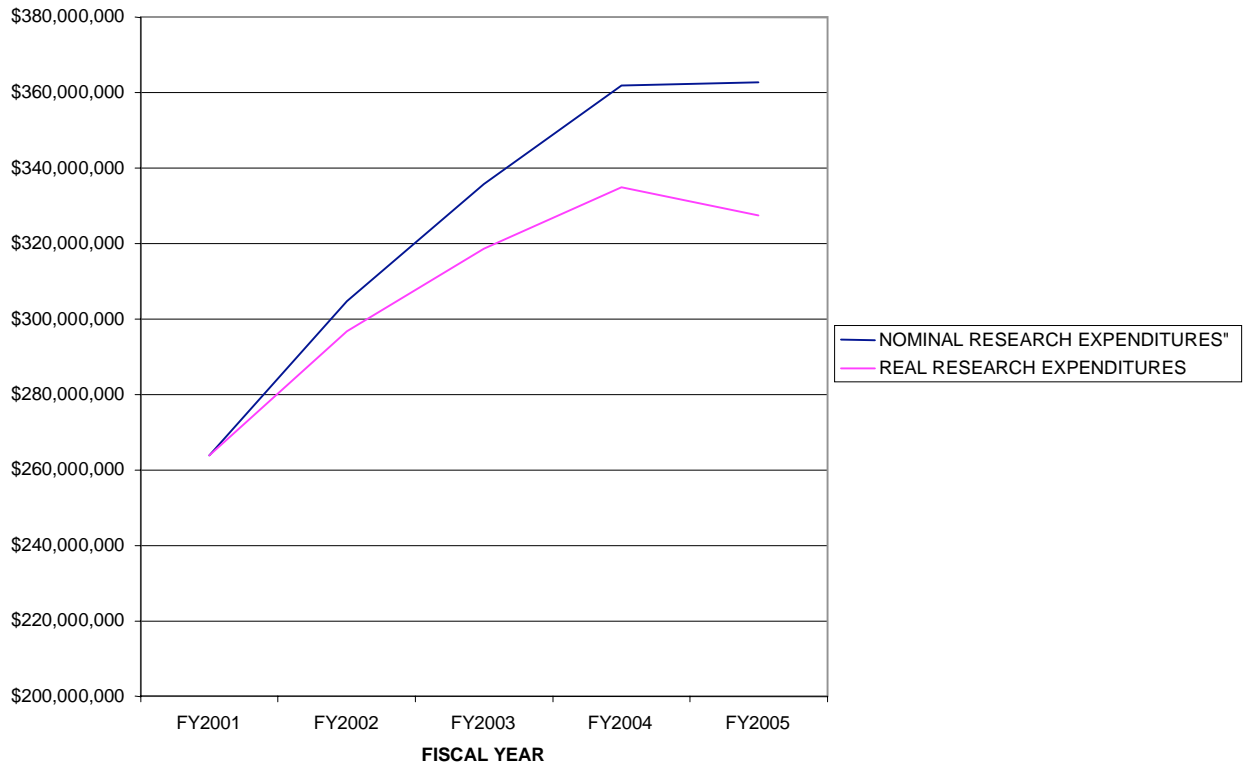
The top portion Table 1 provides an overview of the level of research expenditures by CU, MUSC and USC for Fiscal Years 2001 through 2005. The bottom part of Table 1 shows the associated contributions these expenditures made to the South Carolina economy for each of the five years.

In nominal terms, total research expenditure increased from about \$264 million in Fiscal Year 2001 to almost \$363 million in FY 2005. The total economic impact of this spending on the state’s economy increased from \$519.7 million in gross output in FY 2001 to \$714.6 million in FY 2005. The associated income impacts were \$301.2 million in FY 2001 and \$414.1 million in FY 2005. Jobs in South Carolina associated with the university research expenditures expanded from 10,421 in FY 2001 to 13,228 in FY 2004 before declining to 12,935 in FY 2005.

TABLE 1. RESEARCH EXPENDITURES BY SOUTH CAROLINA'S LEADING RESEARCH UNIVERSITIES

	FY2001	FY2002	FY2003	FY2004	FY2005
CU	\$69,455,310	\$72,379,951	\$84,273,288	\$82,871,131	\$78,583,949
MUSC	\$86,786,581	\$106,322,235	\$128,570,926	\$154,553,800	\$161,742,526
USC	\$107,557,525	\$125,991,445	\$122,876,622	\$124,471,349	\$122,382,317
Total CURRENT PRICES (NOMINAL)	\$263,799,416	\$304,693,631	\$335,720,836	\$361,896,280	\$362,708,792
Total 2001 PRICES (REAL)	\$263,799,416	\$296,702,560	\$318,561,216	\$334,841,120	\$327,433,408
IMPACTS ON THE SOUTH CAROLINA ECONOMY					
METRIC:	FY2001	FY2002	FY2003	FY2004	FY2005
OUTPUT(SALES) CURRENT PRICES	\$519,735,425	\$600,304,877	\$661,434,402	\$713,005,070	\$714,605,878
OUTPUT(SALES) 2001 PRICES	\$519,735,425	\$584,560,932	\$627,626,681	\$659,701,206	\$645,106,596
INCOME CURRENT PRICES	\$301,159,545	\$347,845,320	\$383,266,676	\$413,149,193	\$414,076,784
INCOME 2001 PRICES	\$301,159,545	\$338,722,529	\$363,676,868	\$382,262,407	\$373,805,579
EMPLOYMENT	10,421	11,721	12,584	13,228	12,935
IMPLIED MULTIPLIERS*					
OUTPUT(TOTAL/\$ RESEARCH EXP)	1.97				
INCOME (TOTAL/\$ RESEARCH EXP)	1.14				
EMPLOYMENT (PER MILLION \$ REAL RESEARCH EXP)	39.5				
*IMPLAN sector 462 (Universities, etc.)					

FIGURE 1. SOUTH CAROLINA UNIVERSITY RESEARCH EXPENDITURES



The time patterns of nominal and real (2001 prices) university research expenditures from FY 2001 to FY 2005 are displayed in Figure 1. While growth in nominal research expenditures was a healthy \$20 to \$30 million per year from FY 2001 through FY 2004, there was a leveling off in FY 2005 with real research expenditures experiencing a small decline from the FY 2004 level.

Figure 2 illustrates the linkage between university research spending and the total gross output (sales) impact it has on the state's economy from FY 2001 to FY 2005. Roughly, every dollar of research spending generates about two dollars of state output (sales).

FIGURE 2. TOTAL STATE OF SC OUTPUT FROM UNIVERSITY RESEARCH EXPENDITURES

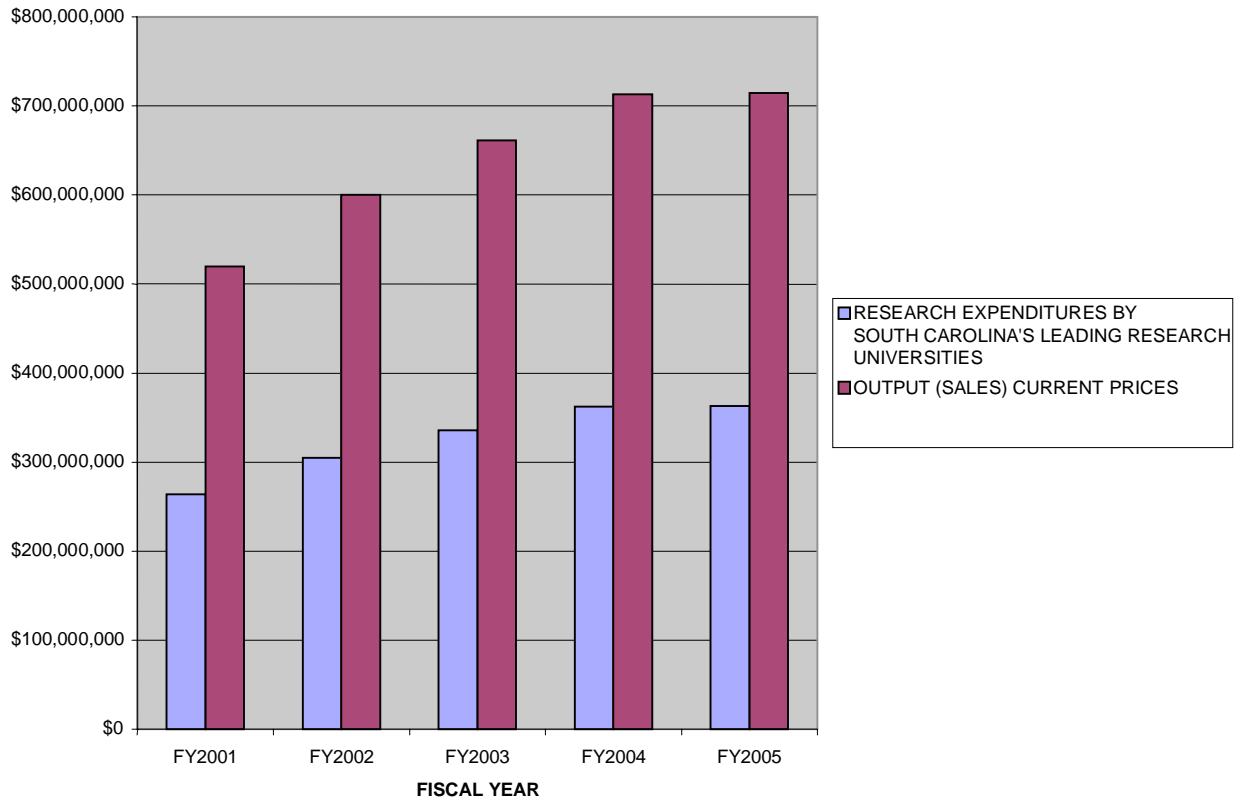
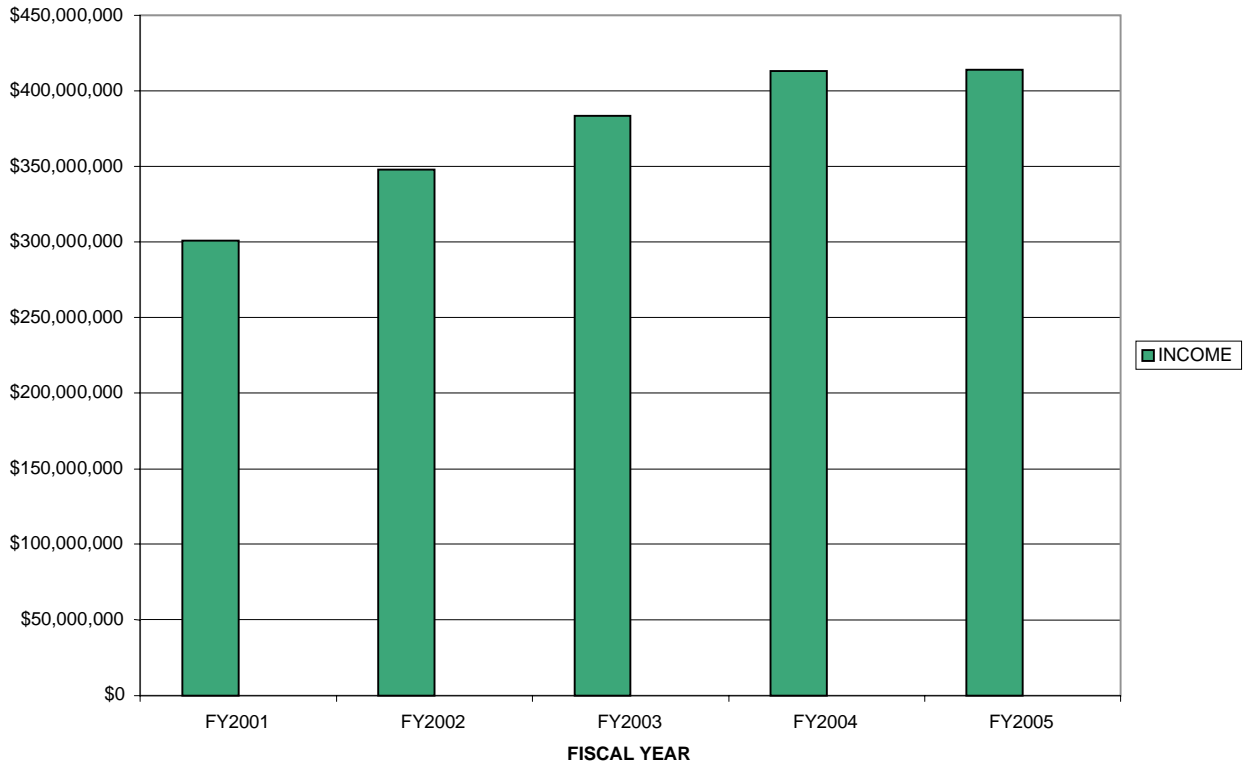


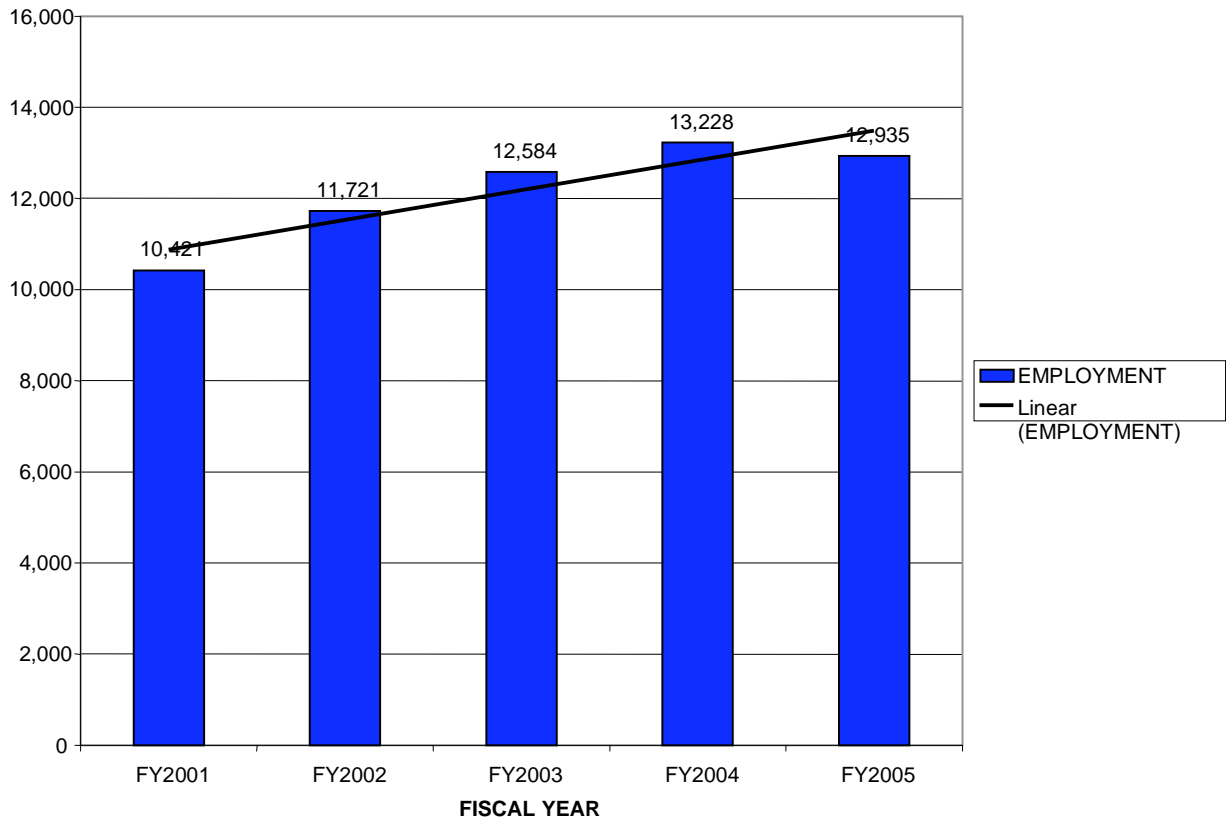
Figure 3 shows a steady increase in nominal income from about \$300 million in FY 2001 to over \$400 million in FY 2005 accruing to South Carolina residents that is a result of research expenditures by the leading research universities in South Carolina.

FIGURE 3. STATE OF SC INCOME FROM UNIVERSITY RESEARCH EXPENDITURES



Finally, Figure 4 shows the trend in added employment of South Carolina residents from research spending by South Carolina's three leading research universities. Starting from a base of 10,421 research based jobs in FY 2001, research spending resulted in almost 3000 added employees by FY 2004 to a total of 13,228, before falling off by about 300 jobs in FY 2005. The black line reveals a steady upward linear trend in jobs associated with university research spending.

FIGURE 4. SC EMPLOYMENT FROM UNIVERSITY RESEARCH EXPENDITURES



SUMMARY

The IMPLAN interindustry model for the state of South Carolina was used to estimate the total contribution of research expenditures by CU, MUSC and USC on the state's economy. Total research spending has grown from about \$264 million in FY 2001 to \$363 million in FY 2005. By FY 2005, the associated economic impacts were about \$715 million in gross output (sales) by SC industry, \$414 million in income for SC residents and business owners, and nearly 13,000 jobs. Trends suggest future increases in these totals. To the extent that the research expenditures are financed by the Federal government, private foundations, and the private sector, these contributions to the state economy are of little or no cost to South Carolina taxpayers. Most importantly, the estimates presented ignore the longer run impacts that research universities in South Carolina have on enhancing the human capital and innovative activity in the state and nation. These human capital investments and research spin-offs have important long run positive impacts on the growth of the South Carolina economy.

ENDNOTES

¹ Recent analysis finds a positive impact of university R&D on per capita income levels. See Woodward (2005) *Innovation, Creative Capacity, and Per Capita Income: Implications for South Carolina. A Conversation About the South Carolina Economy*--sponsored by the South Carolina Council on Competitiveness, Greenville, SC, October 21, 2005. Available at <http://cherokee.agecon.clemson.edu/redrl.htm>

² Recent analyses by Simon and Tamura examine the role of human capital in long term economic growth. *City Growth and Adjustment: The Role of Human Capital*, PowerPoint® presentation by Curtis Simon, Associate Professor, John E. Walker Department of Economics, Clemson University; and *Income, Income Growth and Schooling: Views of the State, Region and Nation*. PDF presentation by Robert Tamura, Associate Professor, John E. Walker Department of Economics, Clemson University. *A Conversation About the South Carolina Economy*--sponsored by the South Carolina Council on Competitiveness, Greenville, SC, October 21, 2005. Available at <http://cherokee.agecon.clemson.edu/redrl.htm>

³ A recent study by Barkley and Henry finds a strong correlation between innovative activity in metropolitan areas and growth in employment and population. *Innovative Metropolitan Areas in the South: How Competitive are South Carolina's Cities. A Conversation About the South Carolina Economy*--sponsored by the South Carolina Council on Competitiveness, Greenville, SC, October 21, 2005. Available at <http://cherokee.agecon.clemson.edu/redrl.htm>

⁴ The multipliers are derived from a system of linear equations that relate input requirements by an industry to the sales by that industry to final users (consumers, exports, investment and government). In the case of research expenditures, the final user is the public university. See Hefner, 1999, for details.

REFERENCES

Hefner, Frank. *Research at the Medical University of South Carolina: an Economic Analysis*. 1999. Unpublished manuscript. Department of Economics, College of Charleston. Charleston, SC.

Minnesota IMPLAN Group, Inc. 1997. *IMPLAN Professional Social Accounting and Impact Analysis Software*. 1940 South Greeley St., Suite 101. Stillwater, MN 55082.

Appendix 2



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
INDUSTRIAL PERFORMANCE CENTER
SPECIAL WORKING PAPER SERIES ON LOCAL INNOVATION SYSTEMS

REGIONAL ECONOMIC DEVELOPMENT:
COMPARATIVE CASE STUDIES
IN THE US AND FINLAND

ALOK K. CHAKRABARTI
RICHARD K. LESTER

MIT-IPC-LIS-02-004

The views expressed herein are the authors' responsibility and do not necessarily reflect those of the MIT Industrial Performance Center or the Massachusetts Institute of Technology.



Alok K. Chakrabarti
Sloan Foundation Fellow

Richard K. Lester
Director, & Professor of Nuclear Engineering
Industrial Performance Center
Massachusetts Institute Technology

ABSTRACT

In context globalization of industries and increased level of competition and rapid changes in technology, firms have formed alliances with many types of organizations, including universities. Universities on the other hand, have faced increasing budgetary challenges and sought to expand their roles. Planning agencies at various levels are considering universities as sources of regional economic development. Studies in regional economics strongly point to the fact that proximity to a university is often associated with recent growth of high tech industries in these regions. Examples of the Silicon Valley and its proximity to Stanford University and the University of California, the industrial belt on Route 128 in Massachusetts and its proximity to MIT, and role of Cambridge University in the UK are commonly cited as the important role of universities in regional development.

Although these examples point to the importance of universities in regional development, the process is indeed a complex one. The dynamics of the relationship between the industrial firms in one hand and the

governmental agencies on the other hand is the subject of a multi country study at the Industrial Performance Center at MIT. Our research questions deal with the changing role of the universities in knowledge generation, diffusion and implementation. In the last area, we postulate that universities play a significant role in interpretation of the technological opportunities as solution for business needs. Finally, universities also contribute to the development of social capital form the region promoting economic growth of the regions.

In this paper we draw from the experience of four technological universities in the US and compare them with four technical universities in Finland. Although, Finland and the US differ a great deal in many socio-economic dimensions, the process followed by each of the universities illuminate the complexity of the process.

All of these universities faced the challenge to help develop their regions. Finland faced a very difficult economic recession in the early nineties when its main trading partner, the Soviet Russia disintegrated and the value of Roubles plummeted. Since then, Finland's

economy has grown as it changed its industrial base significantly and became a leader in wireless communication. Technical universities in Finland, primarily the Helsinki University of Technology and the Technical University in Tampere contributed to the growth of the mobile communication industry. In contrast, the four technical universities in the eastern United States were involved in growth of their immediate regions. The strategies followed by these universities are the result of a complex interaction among the governmental policies, local economy and local policies.

Introduction

The competitive environment for most firms has been transformed by global competition, rapid changes in technology and shorter product life cycles (Ali, 1994; Bettis & Hitt, 1995; Quinn, 2000). Innovation has become increasingly important to competitive outcomes in this environment (Quinn, 2000). The average life cycle of the products in many industries has declined. Moreover, the diversity of performance standards across national boundaries, combined with rapid changes in these standards as technologies evolve, is exacerbating the uncertainty and complexity. Many companies have sought to reduce the costs and risks of innovation by

outsourcing elements of the innovation process.

Quinn (2000) provides several compelling reasons for outsourcing innovation. Continued growth of the world economy has opened new market opportunities, requiring detailed, usually locally-based knowledge of market characteristics. Scientific and technological capabilities are more widely distributed across the world, while the development of information and communication technologies has aided effective coordination among geographically distributed groups. Finally, governments and financial institutions are providing new incentives for inter-organizational collaboration.

The potential sources of technology include competing firms, research organizations, government laboratories, industry research associations, and universities. Universities have certain unique attributes in this regard. Not only can a firm obtain knowledge and technology, but it can also recruit graduates and faculty to serve as employees or consultants. While much of the literature on interorganizational

collaboration in new product development has focused on the interactions between firms, we concentrate here on university-industry interactions. Industry-university alliances represent an evolving trend for advancing knowledge and new technologies (Cohen, et al., 1998; NSB, 2000; Okubo & Sjoberg, 2000; SRI International, 1997).

Universities provide a range of functions in the process of innovation (Lindholm-Dahlstrand and Jacobson, 2002). They help create and diffuse knowledge, not only by pursuing groundbreaking research themselves, but also by diffusing knowledge drawn from the accumulated stock of systematized, codified knowledge in the world. They also influence the direction of technological advance. Lately, many universities have been actively involved in attempting to start new companies based on research carried out by faculty, staff and students. Pavitt (1998) summed up the benefits of academic research as follows: “the main practical benefits of academic research are not easily transmissible information, ideas and discoveries available on equal terms

to anyone in the world. Instead, they are various elements of problem-solving capacity, involving the transmission of often tacit (i.e., non-codifiable) knowledge through personal mobility and face-to-face contacts. The benefits therefore tend to be geographically and linguistically localised.”

Structural framework for collaboration

Industry-university relationships have a long history (Bower, 1993, 1992). Today there are many reasons for industrial firms and universities to work together. We have discussed the benefits to firms of collaborating with prominent academic research institutions (Fombrun, 1996). For their part, universities see opportunities to generate additional funds, particularly for research (NSB, 1996; NSF, 1982a). Universities also want to expose students and faculty to practical problems, to create employment opportunities for their graduates, and to gain access to applied technological knowledge (NSB, 2000; NSB, 1996). University-industry

collaborations have been instrumental in helping firms advance knowledge and propel new technologies in many areas, e.g., in biotechnology (Pisano, 1990), pharmaceuticals (van Rossum and Cabo, 1995) and manufacturing (Frye, 1993).

Smilor, Dietrich and Gibson (1993) identified the following external influences on industry-university collaborations:

- a. Policy changes at the federal and state levels promoting commercialization of technology;
- b. Encouragement by government agencies to form university-industry alliances;
- c. New demands on universities for accountability by the political leaders at the state and local levels;
- d. Development of complex new technologies requiring multidisciplinary approaches and large-scale funding;
- e. The increasing needs of industry for highly-educated employees;
- f. The universities' need to develop alternative sources of funds.

Other factors internal to the university are also contributing to increased interest in research collaborations with industry, including:

- a. The growing importance of multidisciplinary research in the emerging technological fields
- b. Faculty seeking new entrepreneurial opportunities;
- c. Champions within the universities who are trying to change the system;
- d. The demand for new curricula emphasizing issues related to entrepreneurship and commercialization of new technology;
- e. Changes in student's expectations regarding curricula
- f. Need for continuing professional education.

Experience in the US and Finland

In our exploratory study of the role of universities in regional economic development, we will discuss the experience of eight universities, four in the eastern part of the United States and four in Finland. They are mostly technical universities, with the exception

of two comprehensive Finnish universities with strong technical faculties. The four universities in the US are: Lehigh University in Bethlehem, PA; Worcester Polytechnic Institute (WPI) in Worcester, MA; New Jersey Institute of Technology (NJIT) in Newark, NJ; and Rensselaer Polytechnic Institute (RPI) in Troy, NY. The universities in Finland are: Helsinki University of Technology in Helsinki, Tampere University of Technology at Tampere; the University of Turku in Turku; and the University of Oulu in Oulu.

During the early nineties, Finland experienced a deep recession with high unemployment, aggravated by the economic collapse of its principal trading partner, Soviet Russia. Universities at that time emerged as an important engine of economic development. Helsinki became a major center for growth in wireless communication and information technology. The University of Oulu helped build up the Oulu region's capabilities in electronics and information technology. Tampere focused on electro-mechanical and automation industries. The University of

Turku contributed to the development of pharmaceuticals and chemistry based innovations.

Although none of the regions in which the US universities we studied are located experienced economic reversals as dramatic as those of Finland, each has had its share of economic crisis. Newark and its surrounding area have a long history of economic stagnation, and NJIT has embraced economic development as one of its missions. Worcester Polytechnic (WPI) is located in central Massachusetts, a region that has experienced an erosion of its economic base with the demise of many mechanical and electrical manufacturing industries. WPI has been a stimulus to regional growth through its contribution to the development of new industrial activity in information technology and more recently in biotechnology. In the Bethlehem area, long disadvantaged by the decline of the steel industry, Lehigh University has become a facilitator of economic development in the region. RPI is located in the capital district region of the state of New York, which has struggled through a series of economic cycles and whose dominant company, General Electric, has

continued to downsize its local operations including the corporate research center. Both RPI and the nearby State University have set up incubators for new companies and other related activities.

There are also some differences in the contextual conditions of these cases.. In Finland, it was national policy that targeted universities as key actors. Through its technology development agency, Tekes, the Finnish government has been proactive in technology development and implementation by the industry. While the National Science Foundation in the US developed programs to stimulate closer linkages between the industry and the universities, a coordinated national effort for post-competitive research and technology utilization has been lacking.

In both countries, universities have developed structures for collaborative and sponsored research. The U.S. universities have developed systems for intellectual property management, whereas the Finnish universities are still at an earlier stage in this process. Finnish university administrators believe that the legal basis for intellectual

property arising from research done at universities needs modification.

The training of scientists and technical personnel is the most important function for the universities in both countries.

The Finnish universities have generally shown more flexibility in introducing curricular reforms designed to respond to the needs of the industry.

CONCLUSIONS

From our preliminary investigation of eight universities in Finland and in the US, we observe that universities are playing significant roles in local and regional economic development.

National policies and governmental agencies in both countries have played significant roles in promoting university-industry collaborations. Policies and practices differ significantly between the two countries, however. Companies, particularly large companies, in the US are reluctant to become involved in university relationships that encompass their core technology. Public agencies in the US also shy away from any projects that may benefit a specific firm. This leads to support for projects that are

at a pre-competitive stage and that will need a substantial amount of further development before they can be implemented commercially. In Finland, an agency such as Tekes is not as constrained by these policy considerations and tends to be more proactive in commercialization of technology.

Universities in the US differ widely in their research capabilities and reputation. The nature of the industry-university relationship is affected by the reputation or “tier” to which a university belongs. We did not see the same level of overt differentiation among the Finnish universities. Large Finnish companies such as Nokia and Sonera have in fact been instrumental in strengthening the capabilities of the universities at Oulu and Tampere. This in turn helps develop the economies in these regions.

Our study has significant implications for three constituencies. Policymakers at both the local and national levels need to recognize the complexity and diversity of university-industry interactions and should develop policies accordingly. University administrators should consider additional structural and

procedural changes to encourage faculty to interact effectively with industry.

Reference

Ali, A. 1994. Pioneering versus incremental innovation: Review and research propositions. Journal of Product Innovation Management, 11: 46-61.

Bettis, R. & Hitt, M. 1995. The new competitive landscape. Strategic Management Journal, 16: 7-19.

Bower, D. Jane. 1992. Company and Campus Partnership. London: Routledge.

Bower, D. Jane. 1993. Successful joint ventures in science parks. Long Range Planning, 26, 6: 114-120.

Cohen, W., Florida, R., Randazzese, L. & Walsh, J. 1998. Industry and the academy: Uneasy partners in the cause of technological advance. In R. Noll (ed.) Challenges to Research Universities, pp 171-200. Washington, D.C.: The Brookings Institute

Fombrun, C. 1996. Reputation: Realizing Value From The Corporate Image. Boston: Harvard Business School Press.

Frye, J. 1993. University-industry cooperative research yields dividends. International Journal of Technology Management, 8: 577-586.

Lindholm-Dahlstrand, Åsa and Jacobsson, Staffan, 2002. Renewal of academic research and education: The role of universities in the emergence of

THE LOCAL INNOVATION SYSTEMS PROJECT

The Local Innovation Systems Project, an international research partnership based at the Industrial Performance Center (IPC) at MIT, is addressing a central issue now confronting industrial practitioners and economic policymakers throughout the world: How can local economic communities survive and prosper in the rapidly changing global economy?

Our particular focus is on the role of innovation – in products, services, and processes – in promoting productivity growth and competitive advantage at the local and regional levels. National and local governments around the world, as well as other institutions with an interest in economic development, are greatly interested in creating and sustaining local environments that are attractive for innovation. Firms, too, recognize that their innovation performance is affected by their location.

The policy debate has been dominated by a few outstandingly successful centers of technological entrepreneurship, notably including Silicon Valley and the Boston area in the United States, and the Cambridge region in the U.K. But most locales do not have clusters of

high-technology ventures of such scale, nor are they home to research and educational institutions with world-class strengths across a broad range of disciplines. Many, on the other hand, do have distinctive industrial capabilities and vibrant higher educational institutions, and some of these locales have been quite successful in harnessing new technology to revitalize their economies or even to reinvent themselves as centers of innovation and competitive advantage.

The Local Innovation Systems Project is investigating cases of actual and attempted industrial transformation in more than 20 locales in the United States, Europe, and Asia. Our research is aimed at developing new insights into how regional capabilities can spur innovation and economic growth. We seek ultimately to develop new models of innovation-led industrial development.

We are currently completing the initial year of a projected multi-year study. In the first phase of research, we are investigating the roles of universities and other public research institutions as creators, receptors, and interpreters of innovation and ideas; as sources of human capital; and as key

components of social infrastructure and social capital. Later phases of our research will explore the process of enterprise growth and the ability of different locations to attract and retain innovating firms. We are also investigating different approaches to individual and institutional leadership in locally-based systems of innovation.

The founding research partners of the Local Innovation Systems Project consist of an interdisciplinary team of faculty, graduate students and research staff at the MIT Industrial Performance Center, together with their counterparts at the University of Tampere and the Helsinki University of Technology in Finland, the University of Cambridge in England, and the University of Tokyo, Japan.

Current research sites include several locations in the United States (Boston, MA; Rochester, NY; Akron, OH; Allentown, PA; Youngstown, OH; New Haven, CT; Charlotte, NC; and the Greenville-Spartanburg area of SC), Finland (Helsinki, Turku, Oulu, Tampere, Seinäjoki, Pori), Japan (Hamamatsu, Kyoto), and the United Kingdom. Additional research

is being carried out in Ireland, India, Taiwan and Israel.

At each location, teams of researchers from the partner institutions are studying innovation trajectories and developing comparative case studies of growth and transformation in several industries, mature as well as new, including polymers, ceramics, optoelectronics, industrial machinery and automation, auto/motorsports, medical equipment, biotechnology, and wireless communications.

The outreach activities of the Local Innovation Systems Project will include the preparation of discussion papers and books, executive briefings and informal workshops, international conferences, and executive education and training programs for policymakers, research managers, and industry executives.

Current sponsors of the Local Innovation Systems Project include, in the United States, the Alfred P. Sloan Foundation and the National

Science Foundation, Tekes (the National Technology Agency of Finland), the Cambridge-MIT Institute, and the University of Tokyo.

For further information, please contact the Project Director, Professor Richard Lester (617-253-7522, rklester@mit.edu).

new innovation systems, Chalmers University of Technology, Chalmers Sweden

Social Science Journal February pp. 1-12

National Science Board. 1996. Science and Engineering Indicators. National Science Foundation. Washington, DC: US Government Printing Office.

SRI International. 1997. The Impact on Industry of Interaction with Engineering Research Centers. Washington, DC: Science and Technology Program

National Science Board. 2000. Science and Engineering Indicators. National Science Foundation. Washington, DC: US Government Printing Office.

van Rossum, W. & Cabo, P. 1995. The contribution of research institutes in EUREKA projects. International Journal of Technology Management, 10: 853-866.

National Science Foundation. 1982a. University-Industry Research Relationships: Myths, Realities, and Potentials, Fourteenth Annual Report. Washington, DC: US Government Printing Office.

Okubo, Y. & Sjoberg, C. 2000. The changing pattern of industrial scientific research collaboration in Sweden. Research Policy, 29, 1: 81-98.

Pavitt, Keith, 1998. The social shaping of the national science base, Research Policy Vol 27 pp 793-805

Pisano, G. 1990. The R&D boundaries of the firm: An empirical analysis. Administrative Science Quarterly, 35: 153-176.

Quinn, James Brian – “Outsourcing Innovation: The New Engine of Growth” Sloan Management Review Summer 2000 pp. 13-28

Smilor, Raymond W., Dietrich, Glenn B. and Gibson, David V. 1993. “The entrepreneurial university: The role of higher education in the United States in technology commercialization and economic development” International

THE LOCAL INNOVATION SYSTEMS PROJECT

The Local Innovation Systems Project, an international research partnership based at the Industrial Performance Center (IPC) at MIT, is addressing a central issue now confronting industrial practitioners and economic policymakers throughout the world: How can local economic communities survive and prosper in the rapidly changing global economy?

Our particular focus is on the role of innovation – in products, services, and processes – in promoting productivity growth and competitive advantage at the local and regional levels. National and local governments around the world, as well as other institutions with an interest in economic development, are greatly interested in creating and sustaining local environments that are attractive for innovation. Firms, too, recognize that their innovation performance is affected by their location.

The policy debate has been dominated by a few outstandingly successful centers of technological entrepreneurship, notably including Silicon Valley and the Boston area in the United States, and the Cambridge region in the U.K. But most locales do not have clusters of

high-technology ventures of such scale, nor are they home to research and educational institutions with world-class strengths across a broad range of disciplines. Many, on the other hand, do have distinctive industrial capabilities and vibrant higher educational institutions, and some of these locales have been quite successful in harnessing new technology to revitalize their economies or even to reinvent themselves as centers of innovation and competitive advantage.

The Local Innovation Systems Project is investigating cases of actual and attempted industrial transformation in more than 20 locales in the United States, Europe, and Asia. Our research is aimed at developing new insights into how regional capabilities can spur innovation and economic growth. We seek ultimately to develop new models of innovation-led industrial development.

We are currently completing the initial year of a projected multi-year study. In the first phase of research, we are investigating the roles of universities and other public research institutions as creators, receptors, and interpreters of innovation and ideas; as sources of human capital; and as key

components of social infrastructure and social capital. Later phases of our research will explore the process of enterprise growth and the ability of different locations to attract and retain innovating firms. We are also investigating different approaches to individual and institutional leadership in locally-based systems of innovation.

The founding research partners of the Local Innovation Systems Project consist of an interdisciplinary team of faculty, graduate students and research staff at the MIT Industrial Performance Center, together with their counterparts at the University of Tampere and the Helsinki University of Technology in Finland, the University of Cambridge in England, and the University of Tokyo, Japan.

Current research sites include several locations in the United States (Boston, MA; Rochester, NY; Akron, OH; Allentown, PA; Youngstown, OH; New Haven, CT; Charlotte, NC; and the Greenville-Spartanburg area of SC), Finland (Helsinki, Turku, Oulu, Tampere, Seinäjoki, Pori), Japan (Hamamatsu, Kyoto), and the United Kingdom. Additional research

is being carried out in Ireland, India, Taiwan and Israel.

At each location, teams of researchers from the partner institutions are studying innovation trajectories and developing comparative case studies of growth and transformation in several industries, mature as well as new, including polymers, ceramics, optoelectronics, industrial machinery and automation, auto/motorsports, medical equipment, biotechnology, and wireless communications.

The outreach activities of the Local Innovation Systems Project will include the preparation of discussion papers and books, executive briefings and informal workshops, international conferences, and executive education and training programs for policymakers, research managers, and industry executives.

Current sponsors of the Local Innovation Systems Project include, in the United States, the Alfred P. Sloan Foundation and the National

Science Foundation, Tekes (the National Technology Agency of Finland), the Cambridge-MIT Institute, and the University of Tokyo.

For further information, please contact the Project Director, Professor Richard Lester (617-253-7522, rklester@mit.edu).

Appendix 3

**The Economic Impacts of the Member Institutions
of Health Sciences South Carolina (HSSC)**

by

**Donald Schunk, Ph.D.
Division of Research
Moore School of Business
University of South Carolina**

June 2005

The Economic Impacts of the Member Institutions of Health Sciences South Carolina (HSSC)

The South Carolina Health Sciences Collaborative is made up of six member institutions representing both the public and private sectors. These institutions are the University of South Carolina, the Medical University of South Carolina, Clemson University, Palmetto Health, Greenville Hospital System, and Spartanburg Regional Medical Center. Individually, these organizations are each a substantial driver of the South Carolina economy in that they each provide employment and income opportunities and have a mission that is important to the long-term health and growth of the state's economy and South Carolinians.

As a group, the collaborative indeed plays a significant role in the state economy. During fiscal year 2004, the six institutions together employed about 47,100 people in South Carolina and provided these workers with total income of \$2.4 billion. To put these figures in context, the level of employment directly associated with the collaborative represented 2.6 percent of all employment in South Carolina in 2004. That is, roughly one out of every 38 jobs in South Carolina is a job at one of the collaborative member institutions. Meanwhile, the total employee compensation of these workers amounted to about 3.3 percent of all compensation received by employees in South Carolina. Further, these numbers illustrate the fact that these organizations not only provide a substantial number of jobs, but these are jobs that provide compensations levels well above the state average.

However, the economic impact of the collaborative reaches beyond the jobs and incomes directly associated with the member organizations. These universities and hospitals inject money into the state economy not just by providing incomes to employees, but also by purchasing goods and services from other businesses in South Carolina. As these institutions and their employees spend money in the state's economy, there is a ripple effect as funds continue to circulate through South Carolina businesses and households. Using a widely-accepted methodology for analyzing and estimating the economic ripple effects, we can form a better picture of the scope of the economic impact of the collaborative institutions.

Overall, the total impact on economic output of these institutions was nearly \$8.5 billion in fiscal year 2004. This represents the total impact on sales of businesses located in South Carolina, and includes the direct impacts of university and hospital expenditures, and the various ripple effects as both households and businesses by goods and services from other in-state businesses.

The total impact on employment during fiscal year 2004 is estimated to be 88,700 jobs. This is the number of positions in the state that were either directly or indirectly supported by the six member organizations. This level of employment amounts to 4.9 percent of all jobs in South Carolina. In other words, about one out of every 20 jobs in the state can be directly or indirectly attributed to the activities of the collaborative institutions.

The total impact on employee compensation is more than \$3.6 billion annually. Again, this figure includes the direct payroll expenditures of the organizations themselves as well as the payroll generated via the economic multiplier effects. This level of compensation represented 5.0 percent of all compensation received by all employees in South Carolina.

In addition to these substantial economic impacts, these six institutions also accounted for about \$244 million in state-level sales and individual income tax revenues. This is certainly a conservative estimate of government revenue attributable to the collaborative. Depending on the specific institution, the direct operations of these organizations will generate state and possibly local sales taxes on purchases, local property taxes, state and local charges, fees, and miscellaneous taxes, and corporate income taxes. However, these various forms of government revenue can be difficult to estimate. One aspect of the impact on government revenues is more straightforward to estimate, however, and that is the impact on sales and income taxes due to the effects on household income. The household income impact of \$3.6 billion in fiscal year 2004 is estimated to generate the \$244 million in sales and income taxes for South Carolina state government.