Building Rhode Island's Knowledge Economy

The Economic Impact of Brown University

November 2012

appleseed

Table of Contents

Introduction

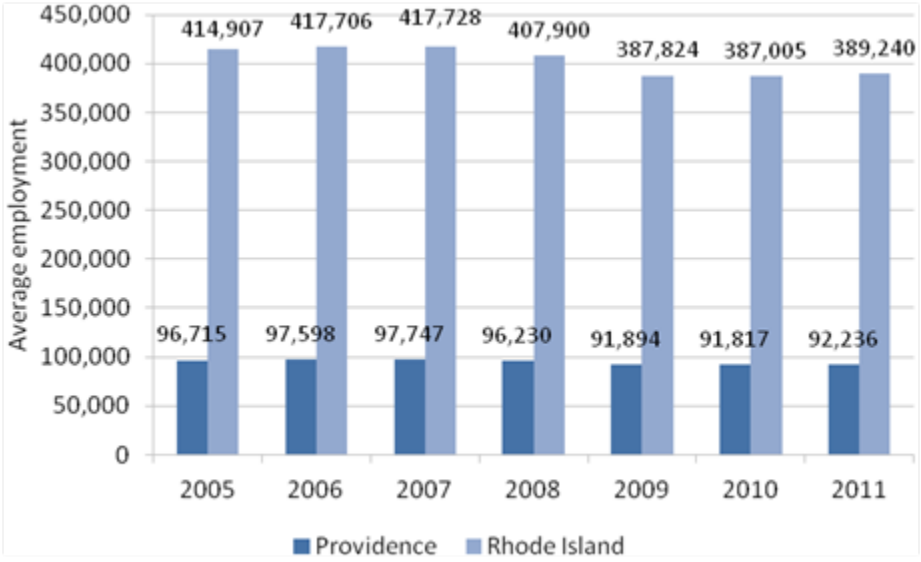
As Rhode Island seeks to overcome the continuing effects of a deep and prolonged recession, Brown University – one of the state's largest private employers, its leading research university, a leading center of biomedical research and the home of the state's only medical school – is especially well-positioned to contribute to Rhode Island's economic recovery.

Rhode Island in recession

Few states have been hit as hard as Rhode Island by the financial crisis that erupted in 2008 and the severe recession that followed. Between 2007 and 2010, private-sector payroll employment in the Ocean State declined by 7.36 percent – a loss of more than 30,000 jobs – and the state's unemployment rate rose from 6.2 percent to 11.7 percent. Rhode Island's manufacturing sector was hit especially hard; between 2007 and 2010 the state lost 20.6 percent of its manufacturing jobs. Government employment in Rhode Island also declined, with a loss of about 3,500 public-sector jobs between 2007 and 2011.

Providence has suffered along with the rest of the state. Between 2007 and 2010 the city lost more than 5,900 private-sector payroll jobs – a decline of 6.41 percent – and the unemployment rate among city residents rose from 6.4 percent to 13.5 percent. As in Rhode Island as a whole, the long-term decline of the city's manufacturing sector accelerated – between 2007 and 2010, manufacturing employment in Providence declined by 27.2 percent.

Figure 1: Annual average private employment, 2005-2011



Source: Quarterly Census of Employment and Wages (Rhode Island Department of Labor and Training)

In 2011, the state's economy began to recover – but only slowly, as private-sector payroll employment rose by 0.6 percent, and unemployment fell to 11.3 percent. Providence has also been slow to recover. In 2011, private-sector payroll employment in the city rose by 0.5 percent – not enough to keep the city's resident unemployment rate from ticking upward once again, to 13.7 percent.

Throughout the recession, the state's colleges, universities and hospitals have been a steady source of employment and economic activity. Between 2007 and 2011, private-sector employment in education grew by 4.7 percent and employment in health care by 2.2 percent. Together, these two sectors added more than 3,000 private-sector jobs between 2007 and 2011. Much of this growth was concentrated in Providence, where employment in education grew by more than 7.9 percent and employment in health care by 4.2 percent – an increase of more than 1,800 jobs in these two sectors. As Rhode Island continues to work its way out of the recession, higher education and health care are likely to be major contributors to the renewed growth of the state's economy.

Assessing Brown's economic impact

As Rhode Island's leading university, home to the Warren Alpert School of Medicine and a leading center of biomedical research, Brown University is particularly well-positioned to contribute to the state's ongoing recovery, and to its future economic growth. This report highlights the multiple ways in which Brown is contributing to the renewed vitality of the state's and the city's economy – and how the University can help Rhode Island and Providence return to a path of sustained economic growth.

Part One of the report highlights Brown's role as one of Rhode Island's largest employers, and its role in generating jobs through its purchases of goods and services from Rhode Island companies and its investments in construction and renovation of university facilities.

Part Two highlights Brown's contribution to the development of Rhode Island's human capital – through both undergraduate and graduate/professional education, and through its participation in efforts to improve the quality of elementary and secondary education in the state.

Part Three discusses Brown's role as Rhode Island's leading research institution and the multiple ways in which University research contributes to the growth of the state's economy.

Part Four examines Brown's role in the development of new businesses in Providence and elsewhere in Rhode Island.

Part Five describes the involvement of Brown students, faculty and staff in efforts to address community needs in Providence and elsewhere in Rhode Island; and Part Six highlights several reasons why Brown's contribution to the redevelopment of the state's economy could be even greater during the next five to ten years than it is today.

Part One: A leading Rhode Island employer – and job generator

Brown University is a leading source of employment opportunities for Rhode Island residents – as a major employer in its own right, through its spending on goods, services and construction, and through spending by Brown students and visitors to the University.

As of the fall of 2011, Brown employed 4,459 people (excluding students), 80 percent of whom worked full-time. During fiscal year 2012, wage and salary payments to Brown employees totaled $271.9 million.

As Table 1 shows, Brown University is the fifth-largest private employer in Rhode Island.[1]

Table 1: Top ten private Rhode Island employers, 2011

Employer	Number of employees
Lifespan	12,378
Care New England	7,045
CVS Caremark Corp.	6,200
Citizens Financial Group Inc.	5,350
Brown University	**4,459**
Roman Catholic Diocese of Providence	3,600
Bank of America	3,500
CharterCARE Health Partners	3,164
Fidelity Investments	2,900
Electric Boat Corp.	2,300

Source: Providence Business News 2012 Book of Lists

Brown provides a broad range of employment opportunities for people with varying skills and levels of education – from full professors, PhD researchers and professional administrative staff to facilities management staff, clerical workers and lab technicians, security guards and food service workers. The University provides competitive salaries and wages, and extensive health, retirement, educational and other benefits.

In 2012, 31 percent of Brown's non-student employees – approximately 1,400 people – lived in Providence. About 50 percent lived in other Rhode Island communities; and 19 percent lived outside the state – the majority of them in southeastern Massachusetts.

[1] Providence Business News 2012 Book of Lists; Brown University

The impact of purchasing and construction

Brown University spent more than $327.5 million in fiscal year 2011 on purchases of goods and services and on construction, of which more than $159 million was paid to Rhode Island vendors and contractors.

Brown's spending on goods, services and construction generates business for Rhode Island companies and jobs for Rhode Island residents. As shown in Table 3, Appleseed estimates that University spending on goods, services and construction directly supported about 1,050 full-time-equivalent jobs with Rhode Island companies in fiscal year 2011 – 740 in Providence and another 310 at companies elsewhere in the state.

Table 2: Brown University spending on goods, services and construction (millions of $) by location of vendor, FY 2011

	Total spending	Paid to Providence Companies		Paid to other RI companies		Total RI	
		$	%	$	%	$	%
Goods & services	$196.105	$48.315	24.6%	$19.735	10.1%	$68.050	34.7%
Construction	$131.457	$64.750	49.2%	$26.457	20.1%	$91.207	69.3%
Total	$327.562	$113.065	34.5%	$46.192	14.1%	$159.257	48.6%

Purchasing

In fiscal year 2011, Brown spent $196.1 million on purchases of goods and services (other than construction). Purchases from Rhode Island companies totaled more than $68 million – nearly 35 percent of all University spending on supplies and services. Businesses based in Providence accounted for about 71 percent of all in-state purchasing.

Appleseed estimates that in fiscal year 2011, Brown's purchases of goods and services directly supported approximately 240 FTE jobs in Providence, and 105 FTE jobs elsewhere in Rhode Island.

Construction

Brown spent $131.5 million in fiscal year 2011 on construction and renovation of University facilities. Of this total, $64.75 million was paid to Providence-based contractors, and $26.457 million to contractors based elsewhere in Rhode Island. Appleseed estimates that in 2011, University construction directly generated 500 full-time-equivalent jobs with Providence contractors in construction and related industries, and 205 FTE jobs with contractors located elsewhere in Rhode Island.

Table 3: Direct jobs created from purchasing and construction, fiscal year 2011

	Providence	Rest of Rhode Island	Total RI
Purchasing	240 FTE	105 FTE	345 FTE
Construction	500 FTE	205 FTE	705 FTE
TOTAL	740 FTE	310 FTE	1,050 FTE

In addition to creating business and employment opportunities for Rhode Island contractors and construction workers, Brown's investments in new and renovated facilities contribute to the revitalization of the state's economy by enhancing the University's ability to fulfill its mission of education and research. Several projects completed in fiscal year 2011 provide examples.

- In the fall of 2011 the Warren Alpert Medical School moved into a new Medical Education Building – a 134,000 square-foot former manufacturing building located in the city's historic Jewelry District, between Brown's main campus and the Medical School's principal teaching hospitals. The $45 million building includes lecture halls, the School's library, lab space and offices.

- The University renovated 74,000 square feet of space in its existing Metcalf Complex to provide a new home for the Department of Cognitive, Linguistic and Psychological Sciences. The $42 million renovation created new classrooms, research space, offices and meeting rooms.

- In 2011 the University completed the Perry and Marty Granoff Center for the Creative Arts, a new 35,000 square-foot building that includes a recital hall, a recording studio, a multi-media lab and artists' studios. The $35 million building is designed to encourage and facilitate collaboration across disciplines.

Indirect and induced effects

Brown's impact on the Rhode Island economy goes beyond the direct impact of its spending on payroll, purchasing and construction; it also includes "indirect and induced" or "multiplier" effects. Rhode Island companies from which the University buys goods and services use some of the money they earn from Brown to buy goods and services from *other* local businesses; and those businesses in turn buy some of what they need from still other Rhode Island companies. Similarly, Brown's employees (and the employees of its Rhode Island-based suppliers) spend part of their take-home pay locally – for housing, utilities, food, child care, entertainment and other routine household needs.

As Table 4 shows, in fiscal year 2011 the indirect and induced effects generated by Brown's spending on payroll, purchasing and construction – that is, the effects of household spending by Brown employees, and of in-state spending by the University's Rhode Island suppliers and contractors – totaled approximately $294.5 million in statewide economic output, and 2,295 FTE jobs.

Thus, the direct, indirect and induced effects of the spending on payroll, purchasing and construction – and the spending by university employees and in-state suppliers that university spending made possible – generate more than 7,800 full-time-equivalent jobs throughout Rhode Island, and more than $725 million in statewide economic output.

Table 4: State-wide impact of purchasing, construction and payroll spending, FY 2011

	Direct University spending		***Indirect and induced impact of spending by vendors, contractors and employees***		***Total impact***
	Payroll	*Purchasing / construction*	*Impact of employee spending*	*Impact of vendor and contractor spending*	
Rhode Island	$271.9 million 4,459 jobs	$159.3 million 1,050 FTE	$183.0 million 1,445 FTE	$111.5 million 850 FTE	**$725.7 million** **7,804 FTE**

The impact of student and visitor spending

Brown University also contributes to the economies of Rhode Island and Providence by attracting students and visitors from around the country and the world. Spending by students and visitors supports employment in a variety of local industries; including housing, restaurants, hotels, retailing and entertainment.

Student spending

Brown enrolled 8,768 undergraduate and graduate students in the 2008-09 academic year, and 400 students during the summer. Based on data provided by the University, we estimate that students living in a dormitory or Brown-owned apartment annually spend an average of about $3,300 off-campus on miscellaneous personal expenses; and students living off-campus, about $11,400. To calculate the impact of summer students, we assumed that summer students would spend a quarter of the amounts spent during the academic year.

In addition to its own undergraduate and graduate students, Brown offers an extensive program of pre-college summer courses, each lasting from one to four weeks. For purposes of this analysis, we assume that these students are enrolled for an average of two weeks, and spend an average of $150 off-campus during their time at Brown.

Based on the assumptions outlined above, Appleseed estimates that in fiscal year 2011, off-campus spending by Brown students totaled $61.1 million.

Table 5: Estimates of off-campus spending by Brown students, FY 2011

Living arrangements	Number of students	Spending per student	Total spending
Academic year on-campus	4,894	$3,300	**$16,150,200**
Academic year off-campus	3,874	$11,400	**$44,163,600**
Summer on-campus	400	$825	**$330,000**
Summer pre-college	2,975	$150	**$446,250**
			$61,090,050

As with spending by the University itself, money spent by Brown students generates economic activity and jobs in Rhode Island, both directly and indirectly. Appleseed estimates that student spending of $61.1 million in fiscal year 2011 directly supported more than 600 full-time equivalent jobs; and through the multiplier effect, another $29.0 million in economic output and 220 FTE jobs.

Visitor spending

Like the University and its students, visitors to Brown spend money while they are in Providence that generates economic activity and jobs in Rhode Island. Based on data and estimates provided by Brown University, we can estimate that there were approximately 120,000 visitors to the Brown campus during fiscal year 2011. This includes prospective students and their parents, relatives and friends who attended commencement ceremonies, participants in academic meetings and conferences and visitors attending athletic and performing arts events.

The impact of these groups varies. By definition, all of those for whom University departments book hotel rooms are out-of-town overnight visitors. And with many students coming to Brown from outside Rhode Island, it is reasonable to assume that a great majority of prospective students who visit the campus, commencement guests, reunion alumni and participants in family weekends are similarly from out of town.

Assuming that they stay an average of two days in Providence, we estimate that local spending by out-of-town visitors totaled approximately $15.2 million in fiscal year 2011. This spending directly supported 218 FTE jobs in Rhode Island; and an additional 64 FTE jobs and $8.4 million in economic output through the multiplier effect.

Putting it all together: Brown as a job generator

When the number of Brown employees is combined with the number of jobs supported by Brown's spending on supplies, services, and construction; the number of jobs generated by the spending of students, employees, and visitors, Appleseed estimates that in fiscal year 2011,

Brown directly and indirectly accounted for more than 8,900 jobs throughout Rhode Island – nearly 2 percent of all wage and salary employment statewide.

Table 6 summarizes Brown's impact on the state of Rhode Island in fiscal year 2011.

Table 6: Impact of University, student and visitor spending in Rhode Island, fiscal year 2011

		Output	Jobs (FTEs)
Brown payroll			
Direct (RI)	$	271,868,900	4,459
Indirect/induced	$	183,007,500	1,445
SUBTOTAL	**$**	**454,876,400**	**5,904**
Brown purchasing			
Direct (RI)	$	65,630,000	345
Indirect/induced	$	40,827,000	324
SUBTOTAL	**$**	**106,457,000**	**669**
Brown construction			
Direct (RI)	$	95,123,900	705
Indirect/induced	$	69,020,900	526
SUBTOTAL	**$**	**164,144,800**	**1,231**
Student spending			
Direct (RI)	$	56,189,700	603
Indirect/induced	$	29,013,300	220
SUBTOTAL	**$**	**85,203,000**	**823**
Visitor spending			
Direct (RI)	$	15,200,000	218
Indirect/induced	$	8,358,000	64
SUBTOTAL	**$**	**23,558,000**	**282**
GRAND TOTAL		**$834,239,200**	**8,909**

Impact on state and local government revenues

Despite its status as a nonprofit institution, Brown – like any other major enterprise – generates revenue for state and local governments in a variety of ways. Overall, we estimate that in fiscal year 2012 Brown directly contributed more $22.9 million to the state and city treasuries.

At the local level, we estimate that Brown's payments to the City of Providence in fiscal year 2012 (including real property taxes, voluntary payments and fees) totaled more than $8.8 million. This total represented an increase of almost 80 percent in the financial support the University annually provides to the City. The increase resulted primarily from a new agreement between the two parties, under which Brown – in consideration of several actions to be taken by the City – committed to making an additional voluntary payment of $3.9 million annually through June of 2016; and $2 million annually through 2022.

Table 7 provides an overview of the University's payments to the City.

Table 7: University payments to Providence, fiscal year 2012

Type of payment	Payments in FY 2012
Voluntary payment (pursuant to the 2003 Memorandum of Understanding with the City)	$1,200,000
Voluntary payment on buildings purchased since 2003 and used for academic purposes	$1,274,000
Voluntary payment (pursuant to the 2012 Memorandum of Agreement with the City)	$3,900,000
Real property taxes paid on non-tax-exempt properties	$1,128,000
Real property taxes paid on leased properties	$466,000
Providence Water Supply fee	$785,000
Other fees	$73,000
Total	**$8,826,000**

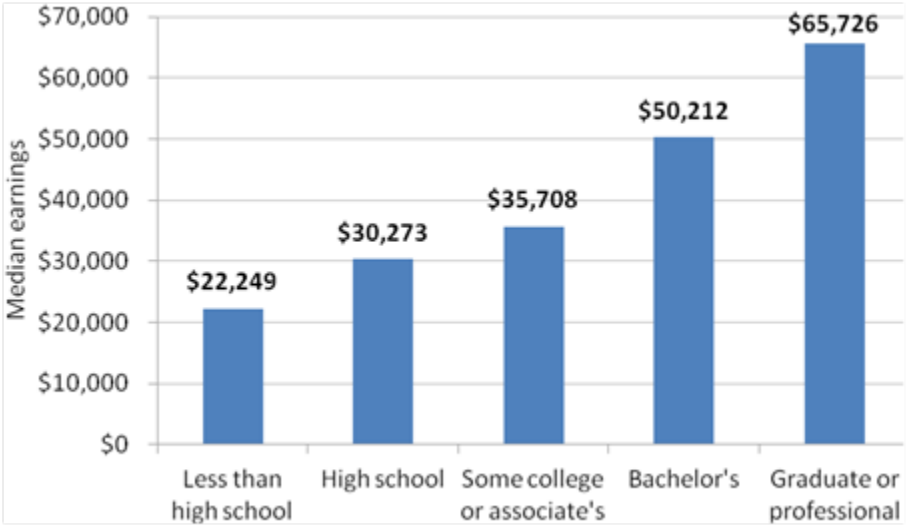
Brown also generates revenues for the state. In fiscal year 2012, University employees paid approximately $11.94 million in state income taxes on the salaries and wages they earned at Brown.[2] The University also paid about $904,000 in state unemployment insurance taxes; and $1.257 million in fees to the Narragansett Bay Commission.

[2] The $11.94 million cited here is the amount withheld from Brown employees' salaries and wages and paid to the state. Taxes finally paid by University employees may vary somewhat from this figure.

Part Two: Developing Rhode Island's human capital

Economists have long recognized that that there is a strong correlation between a city's or state's "human capital" – the accumulated knowledge, skills and experience of its people – and its potential for economic growth and development. At the individual level, of course, the impact of education on earnings is widely recognized. During the years 2006-2010, as Figure 2 shows, the median income of Rhode Island residents who had four-year college degrees was nearly $20,000 greater than the median income of those who had only a high school diploma.

Figure 2: Median earnings by educational attainment (in 2010 inflation-adjusted dollars), 2006-10



Source: 2006-2010 American Community Survey (Social Explorer)

The benefits of higher education, however, are not limited to those who earn degrees. In a paper published by the New York Federal Reserve Bank, Jaison Abel and Todd Gabe found that "a one percentage point increase in the proportion of residents with a college degree is associated with a 2.3 percent increase in metropolitan-area GDP per capita." Summarizing the results of previous studies, Abel and Gabe cite two explanations for the powerful link between human capital and economic growth.

> *First, human capital increases individual-level productivity and idea generation. Second, the concentration of human capital within a region facilitates knowledge spillovers, which further enhance productivity and fuel innovation. Indeed, Glaeser suggests that human capital is a key predictor of urban success because "high skilled people in high skilled industries may come up with more new ideas." In addition, a region's stock of human capital has been shown to lead to more rapid reinvention and increases in the long-term economic vitality of cities.*[3]

[3] Jaison Abel and Todd Gabe, "Human Capital and Economic Activity in Urban America," Federal Reserve Bank of New York, staff report no. 332, July 2008, pp. 1-2.

Even non-college educated workers benefit from these spillover effects. Enrico Moretti, professor of economics at the University of California, has shown that a 1 percentage point increase in the percentage of a city's workers who have college degrees is associated with a 1.6 percent increase in the earnings of workers who only have high school diplomas. [4]

Other research suggests that the spillover effects of higher education may be even greater at the state level. Edward Glaeser, professor of economics at Harvard University, has estimated that increases in educational attainment at the state level have a "social multiplier" of 2.21 – for every 1 percent increase in the college-educated share of a state's population, average earnings increase by 2.21 percent. This finding, he notes, is consistent with the idea that workers' "individual earnings are a function both of their own schooling and the schooling of their neighbors."[5]

Brown students and alumni

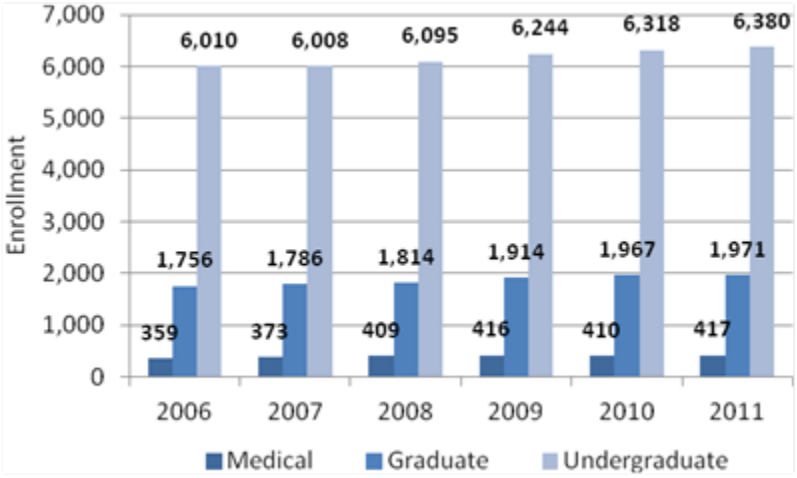
During the fall of 2011, 8,768 students were enrolled at Brown, including 6,380 undergraduates, 1,971 graduate students and 417 medical students. About 16.5 percent of all Brown students cited Rhode Island as their permanent address – including 1,062 (12.1 percent of total enrollment) who were residents of Providence.

Between 2006 and 2011, enrollment at Brown increased by about 640 students – an increase of about 6.9 percent. Graduate enrollment grew especially rapidly. Enrollment in the Graduate School grew by about 12.2 percent between 2006 and 2011; enrollment in the Medical School grew by 16.2 percent during the same period. Undergraduate enrollment also grew during the same period – by about 6.2 percent. The University's enrollment growth is summarized in Figure 3 below.

[4] Enrico Moretti, "Social Returns to Human Capital," NBER Reporter: Research Summary, Spring 2005; and Moretti, *The New Geography of Jobs*, Houghton Mifflin Harcourt, 2012, pp. 100-101.

[5] Edward Glaeser, Bruce Sacerdote and Jose Scheinkman, "The Social Multiplier," NBER Working Papers 2002, p. 18.

Figure 3: Undergraduate and Graduate/Medical enrollment, Fall 2006-Fall 2011



Brown alumni who stay in Providence (or elsewhere in Rhode Island) after graduation add to the city's and the state's human capital. The Brown Alumni Association estimates that more than 6,500 Brown graduates reside in Rhode Island (about 8 percent of all Brown alumni), including more than 2,500 who live in the City of Providence.

Preparing students for tomorrow's economy

Brown offers a wide range of programs that help both undergraduate and graduate students acquire the knowledge, skills and ways of thinking they will need to succeed in tomorrow's economy – and that are needed for the rebuilding of Rhode Island's economy as well. Below we highlight just a few examples.

A new School of Engineering

Engineering has been taught at Brown since the mid-nineteenth century, and the University has a long tradition of successfully integrating the study of engineering into a broader liberal education. In 2011 the University reached an important milestone in the program's ongoing development, with the formal creation of a new School of Engineering. The new school seeks "to address the challenges of an increasingly complex world in which advanced technology – and society's understanding of it – are critically important."

Establishment of the School marks a major commitment by the University to strengthening its engineering program – through, for example, the hiring of thirty new faculty members over several years. As of the fall of 2011, 391 undergraduate and graduate students were enrolled in Engineering. As discussed in Part Four, Brown's engineering students and graduates have become major contributors to innovation and entrepreneurship in Rhode Island.

Connecting students to Rhode Island's life sciences industries

Since it started in the 1990's, the University's Biomedical Engineering program has become the most popular concentration among undergraduate engineers at Brown. The program takes advantage of Brown's strengths in engineering and in medicine, and offers students at all levels a wide range of research opportunities, both within the University and in collaboration with its affiliated hospitals.

Engaging students in the study of business and entrepreneurship

Started in 2005 as Commerce, Entrepreneurship and Organizations, the C.V. Starr Program in Business, Entrepreneurship and Organizations (BEO) engages students in the study of – and prepares them for careers in – business and entrepreneurship. Since 2005 the program has become one of the most popular undergraduate concentrations at Brown. (Additional detail on BEO is provided in Part Four of the report)

Developing Rhode Island's physician workforce

As the only medical school in Rhode Island, the Warren Alpert Medical School of Brown University is a leading educator of the state's physician workforce. In the fall of 2011, 417 students were enrolled in Alpert Medical School; and in 2011-2012 the School awarded 78 MD degrees. Based on data obtained from the Rhode Island Department of Health, we estimate about 7 percent of the state's licensed physicians earned their medical degree from the Alpert Medical School as of 2009.

Medical education at Brown reached an important milestone in August 2011 with the opening of the Alpert Medical School's new Medical Education Building at 222 Richmond Street in the Jewelry District – the first building designed and developed specifically for the Medical School since it was founded in 1972. The additional space provided by the 134,000 square-foot building will allow the Alpert Medical School to increase enrollment to about 480 by 2015, and will provide a greatly improved learning environment for medical students.

The Alpert Medical School also oversees graduate medical education – the training of residents and fellows – at its affiliated teaching hospitals. In the fall of 2011, 725 residents and fellows were enrolled in the Graduate Medical Education program and assigned to affiliated Rhode Island hospitals – about 75 percent of them to Rhode Island Hospital.

Brown University also contributes to the continuing education of medical professionals in Rhode Island. In 2011, the University offered 51 continuing medical education programs. About 59 percent of the 2,894 participants in these programs lived in Rhode Island.

Protecting the public's health

Brown's Public Health Program – the only program of its kind in Rhode Island – prepares students to address some of the most critical health issues facing communities throughout Rhode Island and the U.S., and around the world, including alcohol abuse and addiction, obesity, diabetes, aging, health care delivery and end-of-life care. The program offers undergraduate concentrations in community health and biostatistics, master's degrees in public health and biostatistics; and doctoral programs in epidemiology, biostatistics and health services research.

As a result of the program's continued growth and the success of its research enterprise, in 2013 the University's Board of Trustees is expected to approve a proposal to create a new School of Public Health at Brown.

Preparing executives to succeed in the global economy

In the spring of 2011, Brown and Instituto Empresa (IE), one of Europe's leading business schools, enrolled the first students in a new ***international executive MBA program***. The fifteen-month program combines on-campus courses in Providence and in Madrid with an on-line component; and combines IE's strengths in business education with Brown faculty members' understanding of the economic, historical, political, environmental and cultural context within which global business is transacted. Twenty-three students completed the program and were awarded the MBA degree in June 2012.

Continuing education at Brown

In addition to its full-time undergraduate and graduate programs, Brown offers southeastern New England residents a variety of opportunities for continuing education.

- The ***Brown Continuing Studies*** program allows adult learners to enroll in a wide range of courses across the University. In 2010-2011, 375 Providence-area residents enrolled in 39 different courses at Brown.

- During 2010-2011, 33 high school biology teachers from Rhode Island schools – along with 8 Brown graduate students – participated in ***Project ARISE***. The NIH-funded program helps to develop the teachers' ability to integrate bioinformatics, neuroscience and physiology into their classrooms.

- A two-year ***certificate program in infant and child mental health*** trains licensed professionals in the developmental and behavioral dimensions of children up to age 5. The certificate is aimed at master's degree and doctoral level health practitioners from nursing, psychology, pediatrics and other disciplines. The program is sponsored by the Center for the Study of Children at Risk, the Alpert Medical School, Women & Infants

Hospital, and the Brown University Office of Continuing Education.

- Brown faculty members teach courses at Pfizer's Pharmaceuticals' research and development center in Groton, Connecticut that allow Pfizer employees to earn a master's degree in biology. In 2010-2011, 88 employees enrolled in these courses. Since the program's inception, more that 100 Pfizer employees have earned master's degrees in biology from Brown.

Part Three: Rhode Island's leading research institution

Scientific discovery and technological innovation have been among the most important sources of economic growth in the U.S.

> *Since the Industrial Revolution, the growth of economies throughout the world has been driven largely by the pursuit of scientific understanding, the application of engineering solutions, and continual technological innovation. Today, much of everyday life in the United States and other industrialized nations….is the product of investments in research…*[6]

Since at least the 1950's, America's research universities play an important role in this process. Universities – with strong financial support from the federal government – account for about 55 percent of all spending on basic scientific research in the U.S.[7] Today, university research remains one of America's greatest sources of competitive advantage.

Brown's research enterprise contributes to the vitality of Rhode Island's economy in several ways.

- Each year, Brown attracts millions of dollars in research funding from sources outside Rhode Island – most of which is spent locally.
- Research conducted at Brown expands the boundaries of knowledge in areas that are likely to be continuing sources of innovation and economic growth in the years ahead – including areas of particular concern to Rhode Island companies and communities.
- Opportunities to participate in advanced research projects helps Brown students prepare for jobs in the knowledge economy.
- The "intellectual capital" created by researchers at Brown provides a foundation for the creation of new products and services, new businesses, and new jobs.

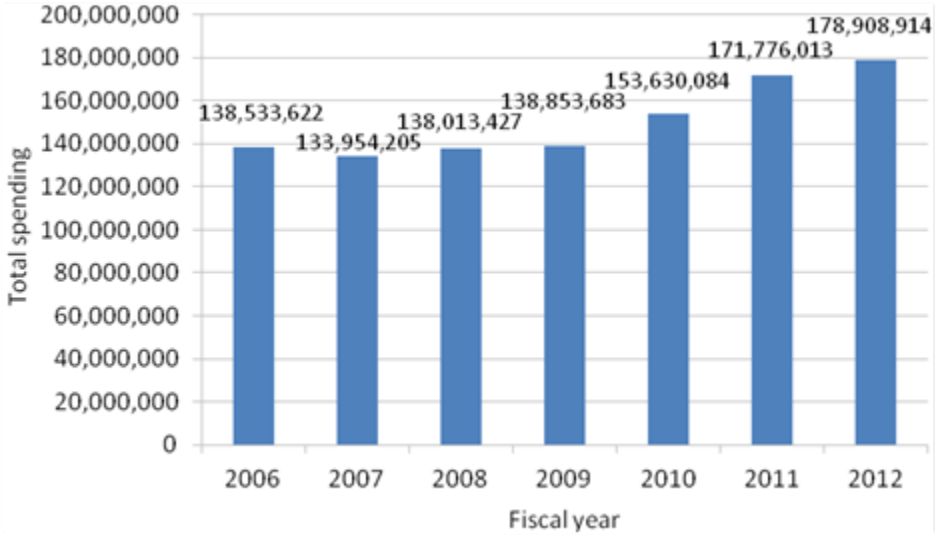
This part of the report addresses the first three of these impacts of University research; and Part Four examines Brown's role in technology transfer and the development of new businesses.

Research spending at Brown

In fiscal year 2012, Brown University spent $178.9 million on research – as shown in Figure 4, an increase of nearly 29 percent since fiscal year 2009.

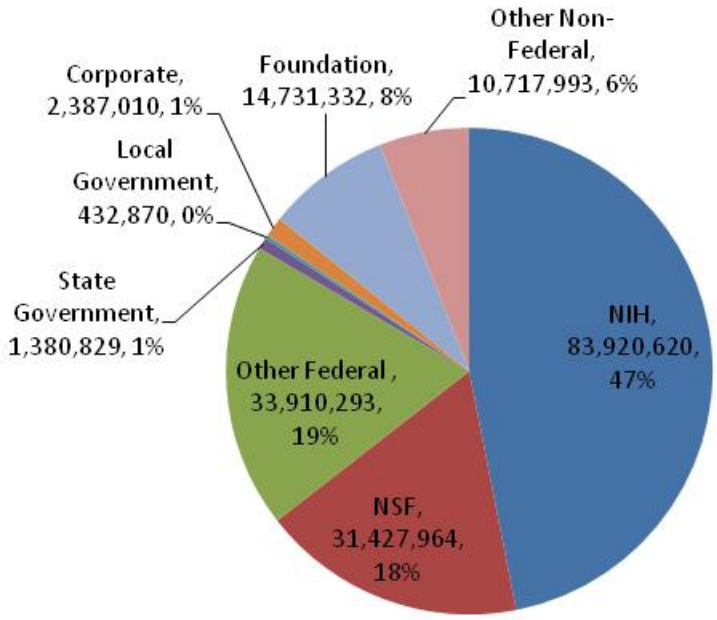
[6] Committee on Prospering in the Global Economy of the 21st Century, *Rising Above the Gathering Storm,* p. 42.
[7] The Science Coalition, *Sparking Economic Growth*, April 2010, p. 3.

Figure 4: Research spending at Brown University, FY 2006-FY 2012



About 99 percent of Brown's research spending in fiscal year 2012 was funded from sources other than state and local government, including $149 million (84 percent) from the federal government, and $17 million (9 percent) from corporate and foundation sources. Brown's research spending in fiscal year 2012, by source of funding, is shown in Figure 5 below.

Figure 5: estimated FY 2012 research spending by source



Creating the knowledge that drives economic growth

Research at Brown is helping to create the knowledge that can provide a foundation for future economic growth – and at the same time, helping to address issues of critical importance to Rhode Island communities. We cite here just a few examples.

- The ***Institute for Computational and Experimental Research in Mathematics (ICERM)***, launched in 2011 with a five-year grant of $15.5 million from the National Science Foundation, builds on Brown's long history of strength in applied mathematics. It is one of only eight NSF-funded math institutes in the U.S., and the only one in New England. Researchers at the Institute use computational tools (including the University's IBM supercomputer) to address problems in mathematics – many with practical implications in areas such as improving search engines and protecting secure communications. Companies that are partnering with ICERM include Google, IBM and Microsoft.

- The ***Brown Institute for Brain Science (BIBS)*** conducts interdisciplinary research in basic neuroscience, brain health and neurotechnology. The Institute's work in neurotechnology includes the development of technologies that can restore lost brain functions, and the development of "smart" machines that can mimic the working of the human brain.

  Researchers at Brown and at several other universities and hospitals have developed a system called ***BrainGate***, now in clinical trials, that could help people regain capabilities they have lost as a result of neurological injury, disease or limb loss. The system uses small electrodes implanted in the brain to read neural signals associated with intent to move a limb, and translate them into a series of instructions to external devices. The system can, for example, allow a person suffering from paralysis to move a cursor on a computer screen simply by *thinking* about moving it.

- Created in 2007, Brown's ***Institute for Molecular and Nanoscale innovation*** is an umbrella group that supports research across multiple disciplines in three targeted areas:

  - Advanced materials research;
  - Using nanoscience and technology to develop new "soft" materials; and
  - Application of nanotechnology to problems such as improving drug delivery or the design of medical implants.

  More than 60 Brown faculty members were involved in some aspect of the Institute's work.

  In 2010, Brown joined with the state and the University of Rhode Island to create the Rhode Island Consortium on Nanoscience and Nanotechnology (RIN^2). The Consortium seeks to enhance Rhode Island's competitiveness as a center for nanotechnology research, and to promote increased collaboration between the universities and Rhode

Island companies engaged in the development and use of nanotechnology.

- Brown's ***Superfund Research Program***, established in 2005, conducts biomedical research on the human effects of chemical contamination, and engineering research on the development of new technologies for assessment and remediation of contaminated sites. Faculty, staff and students also work with affected communities on issues and concerns relating to contaminated sites.

  Since 2005, the program has brought more than $43 million in federal funds into Rhode Island, and has worked on assessment and remediation of contaminated sites in Providence and Tiverton.

Part Four: Developing Rhode Island's innovation economy

As essential as it may be, even the best research does not by itself drive growth. Economic growth occurs only as new knowledge is translated into new technologies, and new products, processes and services – and then into new businesses and new jobs.

Since the 1970's, universities have become more actively involved in this part of the process as well. In a study for the Information Technology and Innovation Foundation, Fred Block and Matthew Keller note that in 1975, academic institutions accounted for only fifteen of the year's 100 "most technologically significant new products," as selected annually by *R&D Magazine*. But over time, academic institutions' share of these promising new technologies has increased dramatically; in 2006, academic institutions accounted for 70 of the innovations listed in the *R&D* 100.[8]

Brown contributes in several ways to this process of translating new knowledge into innovation and economic growth.

- By helping Brown students acquire the knowledge, skills and experience they need to succeed as entrepreneurs;
- Through licensing of technologies first developed in University labs;
- Through the creation of new businesses by Brown faculty, students and graduates; and
- By collaborating with the city, the state, other institutions and the private sector in the development of a new concentration of knowledge-based enterprises in Providence, especially in the Jewelry District.

Developing the next generation of entrepreneurs

Brown has a well established track record for educating students who go on to start and run companies. In 2012 Forbes published the results of an analysis prepared by LinkedIn, using the latter company's database of more than twenty million college graduates. The study ranked U.S. colleges and universities according to the number of companies with at least ten employees started by their alumni. Brown was ranked 13th.[9]

[8] Fred Block and Matthew Keller, "Where Do Innovations Come From? Transformation of the U.S. National Innovation System, 1970-2006" (Washington, D.C.: Information Technology and Innovation Foundation, 2008)
[9] Forbes.com, August 1 2012

During the past few years Brown has significantly expanded the opportunities it offers for students who are interested in entrepreneurship, both through its formal curriculum and through other programs.

- At the undergraduate level, the ***C.V. Starr Program in Business, Entrepreneurship and Organizations*** (BEO), launched in 2005, offers concentrations in business economics, entrepreneurship and technology management, and organizational studies. Students in the second of these tracks must complete a sequence of courses in one of several technology areas – such as biotechnology, nanotechnology, information technology or energy – and courses in entrepreneurship. In their senior year, teams of students also work together to conceive and develop a business plan for a new technology-based business. The program also offers seniors the option of developing a plan for a new social venture. Since 2009, 52 students have participated and have each received $4,000 grants alongside yearlong training and advising to turn their ideas into action.

- Brown's ***Entrepreneurship Program*** (EP) is a student-run club, founded in 1998, that helps students and other members of the University community start businesses. The centerpiece of the program is its annual business plan competition, which helps students develop plans for new ventures, and awards cash prizes totaling $50,000 to the most promising entries. In the past decade, more than 200 teams of Brown students have participated in the contest. EP also sponsors lectures and panel discussions with successful entrepreneurs, arranges mentorships, and provides access to a network of more than 900 entrepreneurs.

- The ***Program in Innovation Management and Entrepreneurship*** (PRIME), launched in 2006, is a master's degree program for science and engineering students who want to learn how to apply their technical skills in the development of new products, processes and companies. Coursework emphasizes business fundamentals like finance, forecasting, and operations as well as technology management and development. As part of the two-semester program, students have an opportunity to develop a technology business idea into a fully-formed business plan.

- The ***Brown Venture Launch Fund*** provides very-early-stage seed money to help students develop ideas for new ventures. Each year, the Fund awards 8 to 12 initial grants of $500 to $1,500 to help students explore a new venture idea, and 4 to 5 grants of $4,000 to begin developing a venture. Since 2011, 16 new ventures have collectively been awarded $50,000.

  Recipients of second-stage grants also participate in the ***Brown Venture Lab,*** an EP program launched in 2011 provides advice and support to students engaged in the development of new businesses. After its first year, six student teams received $24,000 in total funding.

- In October 2012 Brown joined with Betaspring – a Providence-based business accelerator for high-growth technology start-ups – the University of Rhode Island and the Greater Providence Chamber of Commerce to announce creation of a new consortium called the ***Founders League***, dedicated to strengthening Rhode Island's entrepreneurial ecosystem and to supporting the growth of high-potential start-ups. The Founders League will focus on:

- Building a community of entrepreneurs who can draw strength from each other and from the consortium members;
- Educational programs, co-working space, networking events and other programming; and
- Physical space for start-ups and for Founders League programming at Betaspring's headquarters in Providence.

BEO, the Entrepreneurship Program, the Brown Venture Launch Fund are also important resources for students interested in social entrepreneurship. Brown alumni and students' engagement in the development of social ventures is discussed below in Part Five.

Technology transfer

Brown also supports innovation and entrepreneurship by supporting commercialization of technologies first developed in University labs. In fiscal year 2012, the University's Technology Transfer Office:

- Filed 98 patent applications on technologies first developed at Brown;
- Was awarded 15 new patents;
- Entered into 6 licensing or option agreements for commercial use of new technologies developed at Brown;
- Received nearly $1.6 million in licensing revenues.

During the past decade the University has entered into licensing agreements with several Rhode Island companies to further develop and bring to market technologies that were initially developed at Brown. For example:

- ***Neurotech USA***, founded in 2000, uses a technology licensed from Brown called encapsulated cell technology (ECT) to continuously deliver protein drugs directly into the vitreous of the eye, without the need for periodic injections.

- ***NABSys***, founded in 2004 by Brown University professor Xinsheng Sean Ling, is developing technology that by combing solid-state systems with innovations in chemistry can sequence and analyze DNA at a much lower cost and greater speed than existing technologies. As of the fall of 2011, NABSys had attracted $21 million in private investment, as well as funding from the National Human Genome Research Institute of the National Institutes of Health. In 2011, the company's CEO, Dr. Barrett Bready – a graduate of the Alpert Medical School – was named "Rhode Island Innovator of the Year" by the Providence Business News.

- ***Dynadec*** is a Providence-based company that was founded in 2009 by Brown University computer science professor, Pascal Van Hentenryck. The company develops a software

package called Comet™ that optimizes complex decisions in scheduling, routing and workforce management. The package is based on technology developed by Dr. Van Hentenryck's optimization laboratory at Brown and licensed to the company.

Businesses created by students, faculty and alumni

Formal licensing of Brown's *intellectual property* is not the only way in which Brown's *intellectual capital* is invested in the creation of new products and services, new businesses and new jobs. Faculty members, staff, alumni and even students also use the knowledge and skills they have acquired at Brown (and elsewhere) to launch new ventures in a wide range of industries. For example:

- ***Shape Up RI***, founded in 2006 by a student at the Alpert Medical School, promotes exercise and weight loss through team competitions and peer support.

- ***Truth Box Inc*** and ***Stack Design Build***, founded by Brown alumni in 2001 and 2008 respectively, have developed a project in Providence called The Box Office – 12,000 square feet of attractive new office space for small companies that is constructed out of recycled shipping containers.

- ***NuLabel Technologies***, started in 2009, has created an "eco-friendly" form of adhesive label that does not require a liner. The venture was started as a senior-year project by four students in Brown's Business, Entrepreneurship and Education (BEO) program. As of the summer of 2011, the company had attracted $4 million in private investments.

- ***Accelereach,*** founded in 2009 by two graduates of Brown's PRIME program, has developed web-based software that flexibly combines e-mail, voice-mail and text messaging functions to support communications between health professionals and their patients.

- ***CytoSolv Inc***, founded in 2009 by two medical researchers at Brown, has developed a new treatment that accelerates healing of wounds.

- ***Axena Technologies*** was founded in 2010 by three graduates of the PRIME program. The company has developed an anti-microbial coating that can be applied to a wide range of medical and health care products to reduce health care-related infections.

- ***Tivorsan Pharmaceuticals***, founded in 2010 by a Brown faculty member, is developing new protein-based treatments for serious neuromuscular disorders, including muscular dystrophy.

Table 8 lists selected examples of companies started by Brown faculty, staff, graduates or students that are currently doing business in Rhode Island – most of them in Providence. While

not a complete inventory of all of the companies in Rhode Island with "Brown DNA," it illustrates the wide range of companies that are connected to the University. Together these 25 companies employ more than 450 people.

Table 8: Selected Rhode Island companies started by Brown alumni, faculty and staff or based on Brown technology

Company	City	Relationship to Brown	Year founded	Employees
Bay Computer Assoc	Cranston	Brown alumnus CEO	1981	24
Andera	Providence	Founded by Brown alumnus	1996	85
EpiVax	Providence	Brown faculty founder, licensed Brown technology	1998	15
Neurotech USA	Lincoln	Technology licensed from Brown	2000	28
ProThera Biologics	E. Providence	Brown faculty founder	2001	5
The Steel Yard	Providence	Founded by Brown and RISD students	2001	6
Truth Box, Inc	Providence	Founded by Brown alumnus	2002	1
NABsys	Providence	Brown faculty founder, licensed Brown technology	2004	47
Bio-Tree Systems	Providence	Technology licensed from Brown	2004	6
Tizra	Providence	Brown faculty founder	2005	10
Narragansett Brewing Company	Providence	Founded by Brown alumnus	2006	69
Shape Up RI	Providence	Founded by Brown student	2006	41
Greenbytes, Inc	Ashaway	Founded by former Brown graduate student	2007	30
Stack Design Build	Providence	Founded by Brown alumnus	2008	14
NuLabel Technologies	Providence	Founded by Brown alumni	2009	13
CytoSolv, Inc	Providence	Founded by Brown researchers	2009	3
Accelereach Technologies	Providence	Founded by Brown alumni	2009	3
Dynadec	Providence	Brown faculty founder, licensed Brown technology	2009	5
Axena Technologies	Providence	Founded by Brown alumni	2010	3
Bandit Consulting	Providence	Founded by Brown alumna	2010	1
Tivorsan Pharmaceuticals	Providence	Brown faculty founder	2010	6
G-Form	Providence	Founded by a Brown alumnus and adjunct faculty member	2010	35
Care Thread	Providence	Founded by Brown alumnus	2011	4
Fanium	Providence	Founded by Brown alumnus	2011	3
Premama	Providence	Founded by Brown students	2011	2

Developing the knowledge economy in Providence

Among the various strategies through which city and state officials, research institutions and the business community have sought to build Rhode Island's innovation economy, the most ambitious may be the plan to redevelop Providence's historic Jewelry District as a hub for knowledge-based businesses. Since the concept was first proposed nearly a decade ago, Brown has been a major participant in the ongoing revitalization of the Jewelry District. Brown's contributions to this process have included:

- Turning a former factory building at 70 Ship Street into a center for biomedical research;
- Moving the Warren Alpert Medical School to a 134,000 square-foot renovated industrial building at 222 Richmond Street; and
- Moving Brown's Division of Continuing Education into a new building at 200 Dyer Street.

As a result of these investments, Brown estimates that it currently has approximately 1,000 faculty, staff and students working, studying and doing research in the Jewelry District.

In addition to the University's direct investments in the area, many of the new companies cited in the preceding pages are clustered in the Jewelry District. They include Accelereach, Axena Technologies, EpiVax, NABsys, Narragansett Brewing, NuLabel, Shape Up, G-Form and Tivorsan Pharmaceuticals. These companies are on the leading edge of the transformation of the Jewelry District into a community of innovators and entrepreneurs.

Part Five: Strengthening Rhode Island communities

Brown University also contributes to the revitalization of Rhode Island's economy by helping to strengthen communities in Providence and elsewhere in the state. Members of the University community participate in several ways in the building of stronger communities.

- By helping to strengthen elementary and secondary education;
- By participating in a wide range of other community service programs;
- Through the practice of "engaged scholarship;"
- Through development of social ventures that meet the needs of Rhode Island residents and communities; and
- Through the University's role as a cultural resource for Rhode Island.

Strengthening elementary and secondary education

Brown is helping in multiple ways to strengthen Rhode Island's schools and to expand educational opportunities for Rhode Island students. For example:

- Since 2000, Brown has been working with the William D'Abate Elementary School to meet the needs of children in the Olneyville neighborhood in Providence. The Brown-D'Abate partnership has been especially strong since 2008, when the School asked the University to take on the management of its after-school program, called the ***D'Abate Community School***. In the spring of 2012, 208 D'Abate students participated in 40 different after-school "clubs," involving activities ranging from science experiments to the arts to soccer. The Community School also provides daily homework assistance.

  The director of the after-school program is employed by the Swearer Center (the focal point for many of the University's community engagement activities, described below), and in the spring of 2012 about 100 Brown students provided about 500 hours per week of volunteer work in the program. Since 2009 the D'Abate Community School has also offered a summer camp, with about 125 children participating in a six-week program of enrichment and recreational activities.

  Brown's partnership with the D'Abate School is manifested in other ways as well, including a Swearer Center program in which Brown undergraduates are trained to work during the school day as in-classroom tutors, focusing on helping to build students' literacy skills. Brown students also provide ESOL (English for speakers of other languages) training at D'Abate for neighborhood adults.

While Brown's partnership with D'Abate is particularly close, it is not unique. In the spring of 2012, the Swearer Center had 13 employees working full-time in urban public schools in Rhode Island, coordinating and overseeing the work of more than 400 Brown student volunteers.

- ***The College Advising Corps*** at Brown (the local campus affiliate of a national organization) seeks to increase the number of low- to moderate-income high school students who go on to earn bachelor's degrees by providing guidance to students in the college application process and in securing financial aid. In 2011-2012, twelve Americorps members worked full-time and ten worked part-time as college advisors in eleven urban high schools in Rhode Island. They were supported by a team of 70 Brown undergraduate volunteers who assisted students with SAT preparation, essay-writing and exploring financial aid options.

  In 2011-2012, the College Advising Corps (CAC) served 5,466 Rhode Island high school students in individual advisory sessions, 70 percent of whom were from low-income families, and 80 percent members of minority groups. Forty percent of these students, should they go to college, would be the first in their families to do so. CAC also worked more intensively with 1,092 seniors, about two-thirds of whom submitted at least one college application.

- In 2009, Brown faculty members worked closely with the Rhode Island Department of Education (RIDE) to develop a ***new school funding formula***. The new formula was based on detailed analysis of the resources needed to ensure that children learn, while at the same time distributing funds equitably and maintaining fiscal discipline. The new formula – which has the effect of targeting resources to the urban school districts where they are most needed – was enacted into law in 2011.

- In February 2007, Brown President Ruth J. Simmons announced creation of **The Fund for the Education of the Children of Providence (FECP)**, with the goal of raising a $10-million endowed fund to support local public schools and students. FECP is focused on three core areas:

  - Academic learning and achievement;
  - Preparation for higher education and the workforce and
  - Social, artistic, and civic development.

  A total of $1.5 million has been raised to date, and since 2009, the Fund has awarded a total of $232,557 for initiatives such as strengthening early literacy programs and upgrading school wireless networks.

Through programs such as these Brown is working toward the goal of helping Rhode Island's next generation acquire the skills they will need to participate in the growth of a knowledge-based economy, and to take advantage of the opportunities that economy offers.

Other community service programs

Education is just one of several areas in which Brown students serve Rhode Island communities. The Swearer Center for Public Service, created in 1986, is the focal point for many of the University's community engagement efforts. The Center seeks to combine the capabilities of the University with those of the community at large, in order to address more effectively some of society's most pressing problems.

In 2011-2012, 690 students participated in community service programs through the Swearer Center. For example:

- ***Housing Opportunities for People Everywhere (HOPE)*** provides both direct services and advocacy for Rhode Island's homeless people.

- At several public schools in the Providence area, Brown students teach ***ESOL*** classes for adults with limited English skills.

- Through the ***Space in Prison for Arts and Creative Expression (SPACE)*** Brown students run creative arts workshops for inmates at the Rhode Island Adult Correctional Institution.

Engaged scholarship at Brown

Through its Engaged Scholars Initiative, the Swearer Center also provides support for faculty members interested in undertaking research projects on topics of concern to, and in collaboration with, local community organizations and residents. For example:

- As part of her work on community-based agriculture and food justice issues, Assistant Professor of Environmental Studies Kathryn DeMaster has organized research projects involving Brown students and community residents, and has worked with John Hope Settlement House on a community-based agriculture project called Cultivating Hope.

- Assistant Professor of Chemistry Jason Sello has engaged local high school students in his research, collecting and analyzing local soil samples to identify microorganisms that can be potentially be used as natural agents in the conversion of organic matter to biofuels.

- Melissa Clark, an Associate Professor of Epidemiology and Obstetrics and Gynecology, is working with colleagues at Hasbro Children's Hospital to better understand both the physical and social environments where families who use the Hospital outpatient clinics live, and how these environments affect their health and their use of health care. In this project, families are seen not just as subjects, but as participants in the research – and when the results are in hand, as collaborators in improving the health of their community.

Social entrepreneurship at Brown

Through Brown's ***Social Innovation Initiative***, University students are learning how to use the tools and techniques of entrepreneurship to address some of society's most pressing problems – both in Rhode Island and beyond. The program also offers internships with social ventures in Rhode Island and seed money to help students develop new social ventures.

Students participating in this program have launched several social enterprises in Providence and elsewhere in Rhode Island. For example:

- The ***Capital Good Fund***, founded in 2009, provides microloans and financial education to low-income people in Rhode Island and elsewhere. Since its founding, they have provided financial coaching to 100 Rhode Island residents and supplied more than $230,000 in loans, in addition to paving the way to citizenship for two dozen Rhode Islanders and improving the credit scores of 80 residents.

- The ***Generation Citizenship Project,*** founded in 2009, promotes civic engagement among students in public high schools in the Providence area by focusing on issues of particular concern to their communities. Now in 14 Providence schools, the program has 82 Democracy Coaches working with 1,375 students this year.

- ***The Broad Street Synagogue Project,*** founded in 2011, has negotiated an agreement to purchase a historic former synagogue in South Providence, and is planning to renovate it as a community and cultural center.

Brown as a cultural resource

Brown contributes to the vitality of the state's economy by offering cultural and artistic resources -- a museum, galleries, libraries and performing arts – that make Rhode Island a more attractive place to live, work and visit.

- Brown's ***Haffenreffer Museum of Anthropology*** contains more than 120,000 ethnographic artifacts – primarily from the Americas, Africa and Southeast Asia. Admission to the Museum is free.

- The ***David Winton Bell Gallery***, opened in 1971, is Brown's contemporary art gallery. Each year the Gallery presents four to five major exhibitions, as well as an annual exhibition of works by Brown students in a range of media, including an annual student exhibition. The Gallery does not charge admission and is open to the public.

- The ***Sara Doyle Art Gallery***, which is part of the Sara Doyle Women's Center, presents five to six juried art shows each year featuring works by professional artists.

- The ***Cohen Gallery***, located in the new Perry and Marty Granoff Center for the Creative Arts, exhibits works developed in conjunction with interdisciplinary arts programs at Brown, as well as works by visiting artists.

- The ***Annmary Brown Memorial*** exhibits European and American paintings from the seventeenth to the twentieth century, and houses other special collections.

- The ***John Carter Brown Library*** is an independent research library located on the Brown University Library, regularly presents public exhibitions from its collection of more than 50,000 rare books, historical documents and other materials.

- The ***John Hay Library*** houses the University's collection of rare books and manuscripts and other special collections.

- The ***John Nicholas Brown Center for Public Humanities and Cultural Heritage*** seeks to connect the university to the broader community through the arts and humanities. The Center's Public Humanities Clinic provides free assistance to organizations and individuals engaged in bringing humanities projects to the public. Since 2008, the Center's Fox Point Community History Project has sought to preserve and present the history and cultural heritage of Providence's Fox Point neighborhood.

- Brown's ***Department of Music*** sponsors more than 100 concerts each year, including performances by the Brown University Orchestra, choral groups, jazz combos and other groups.

- The University's ***Department of Theater Arts and Performance Studies*** presents a variety of theatrical works each year, including both classic and contemporary works presented by the Brown/Trinity MFA program, and Playwrights Rep, a summer program in which emerging playwrights work with Brown/Trinity students to present new works.

- ***Rites and Reason Theater***, part of the Department of Africana Studies, focuses on the development and presentation of new works, with Brown students collaborating with community and professional actors, writer and directors.

- ***Brown University Gilbert & Sullivan*** is a student organization that presents two Gilbert & Sullivan comic operas each year.

- ***Shakespeare on the Green*** stages outdoor, "site-specific" performances of Shakespeare and related works.

In addition to these cultural resources, the Brown campus includes a number of green spaces that are open to the community, including College Green, Simmons Quad and Ittleson Quad. The University also offers recreational opportunities to community residents, including individual and family memberships in University fitness and recreational facilities.

Part Six: Brown and the future of Rhode Island's economy

For several reasons, Brown University's contribution to the rebuilding of Rhode Island's economy could be even greater during the next five to ten years than it is today.

1) Continued development of the University's academic programs

Over the course of the next five to ten years, the continuing development of Brown's teaching enterprise will enhance the University's contribution to the development of Rhode Island's human capital.

- Undergraduate enrollment in engineering is growing, with Biomedical Engineering now one Brown's most popular undergraduate concentrations. And with the planned addition of new faculty members, graduate student enrollment in the School of Engineering is expected to grow by as much as 50 percent over the next decade.

- Completion of the new Medical Education Building on Richmond Street has enabled the Alpert Medical School to grow its enrollment. By 2014, enrollment will have increased by 20 percent over its 2010 level.

- The establishment of a new School of Public Health – which the Brown Corporation is expected to approve in 2013 – will provide a foundation for continued development of the University's already-strong public health program – the only one of its kind in Rhode Island.

- Building on the success of the joint Brown-IE executive MBA program, the University will be adding other new graduate programs for executives and professionals. The first of these – an executive master's degree in health care leadership – will be launched in 2013; and others are likely to follow – for example, a master's degree focusing on data-driven decision-making. With the continued growth of knowledge-based industries in Providence (discussed below) Brown could be well-positioned to meet the demand for professional development programs in these industries.

These and other new programs will expand opportunities for Rhode Island residents – and will also draw talented students to Providence from around the U.S. and the world.

2) Research strengths that can drive economic growth

The growth of Brown's research enterprise during the past five years in part reflects the University's strengths in several research areas that during the next decade could prove to be important sources of new knowledge, new products and services, new businesses and new jobs. They include brain science, biomedical engineering, nanoscience and technology, environmental science, and public health.

The establishment of a new Center for Energy Research – a partnership among Brown, URI and Cambridge-based Draper Laboratory – will also strengthen Rhode Island's role in the development of solutions to some of the nation's most pressing energy problems. Building on the Swearer Center's Engaged Scholar's Initiative, Brown is also well-positioned to use its research strengths to collaborate with local officials and community groups to address a wide range of other issues of concern to Rhode Island.

Like those of other major universities, Brown's research enterprise is seriously threatened by the prospect of sharp cutbacks in federal funding of university research. But regardless of the overall level federal research funding, the University is likely to remain (at least in relative terms) a leader in these critically important fields.

3) Increased international collaboration

In an era when the success of cities depends in part on the strength of their ties to the global economy, Brown's international reach is a source of real competitive advantage for Providence and Rhode Island. Since 2006, the University has undertaken a number of initiatives aimed at deepening Brown's ties with institutions and communities around the world.

- The Brown-IE executive MBA program, which graduated its first class in 2012, provides a strong connection to one of the world's leading business schools, and each year brings a cohort of rising business executives to Providence.

- Each summer since 2009, the Brown International Advanced Research Institutes – a partnership with Santander Universities, the educational arm of Banco Santander, has brought 150 promising young faculty members from the developing world to Providence for a program of research, lectures and discussion on critical global problems.

- Brown has created new partnerships with several other universities as well, including Exeter University in Britain, University of the Witwatersrand in South Africa, the federal University of Rio Grande do Sul in Brazil and Nanjing University in China. These partnerships provide opportunities for both student and faculty exchange, and for collaborative research as well.

These and other partnerships make Brown a stronger university – but they also raise the city's and the state's visibility on the global stage, and will over time create an ever-growing web of relationships connecting Providence and Rhode Island to the global community.

4) Promoting entrepreneurship and innovation

The University's increased emphasis on (and students increased interest in) entrepreneurship and innovation is already starting to pay off, as is evident from the growing list of start-up companies in Providence with roots at Brown. As the number of graduates who studied entrepreneurship through programs like BEO and PRIME increases, and with the support provided by the Founders League, the number of young Rhode Island companies with Brown DNA is likely to grow –as is their contribution to the growth of the city's and the state's economy.

5) Participating in the development of the knowledge economy in Providence

As noted in Part Four, Brown is already a major participant in the development of the knowledge economy in Providence. Looking to the future, Brown is now working with state and city officials, other institutions and other interested parties (such as the Greater Providence Chamber of Commerce) to determine what role the university might play in development of the state-owned land in the area that has been freed up by the relocation of I-195. This property could provide a site for future development of new research and educational facilities – and space for the growth of knowledge-based businesses as well.

Beyond the development of University facilities, Brown will also continue to support the efforts of Brown students, faculty, staff and graduates in the development of new businesses in Providence, particularly in the city's Jewelry District – and will thus support the continued development of a community of innovators and entrepreneurs in the city.