Indiana's Major Research Universities:

Indicators of Competitiveness and Success

Overview

Reaching Higher: Strategic Initiatives for Higher Education in Indiana emphasizes the role of the state's Major Research Universities (MRU) as significant contributors to Indiana's economy, competitiveness, and quality of life for citizens. Major Research Universities accelerate research and development funding, spur economic development, contribute to Indiana's human capital by educating Hoosier, out-of-state and international students, attract talented workers to Indiana and encourage the transfer of technology to the private sector.

The MRUs also form the academic and research arm of the Indiana Innovation Alliance, a partnership of academia, business and government created to promote Indiana's assets in bio– and life-sciences through research and economic development.

Indiana's public Major Research Universities (MRUs) include the research campuses of the state's two largest public universities:

- **Indiana University-Bloomington**
- **Indiana University-Purdue University Indianapolis** (IUPUI)
- **Purdue University-West Lafayette**

as well as the research and advanced training programs and outreach centers that these institutions manage throughout the state.

Together, Indiana University-Bloomington, IUPUI, and Purdue-West Lafayette enroll 40 percent of Indiana's public college students, and 29 percent of Indiana's college students, including private institutions. In 2007-08, the MRUs granted over 14,700 undergraduate degrees, 4,900 Masters degrees and 2,255 doctoral and professional degrees. In 2008, IU-Bloomington and Purdue-West Lafayette led the state's public institutions in both on-time and six-year undergraduate completion rates, with 73 percent and 72 percent of students completing in six years or less, respectively.

The purpose of this report is to describe the impact of Indiana's Major Research University activities on the state's economy and society, and to benchmark the performance of the MRUs relative to peer states. The report reviews performance against peer states in three key areas:

- Research and Development
- Technology Transfer
- Institutional Reputation

The report also charts Indiana's MRUs' contribution to the state's advanced workforce and describes the return-on-investment resulting from public funding to the three campuses.

For the purposes of this report, Indiana's MRUs developed a set of peer states which are similar to Indiana demographically, economically, and in terms of educational structure. Where appropriate, the performance of Major Research Universities (as classified by the Carnegie Foundation as "very high research activity) within identified peer states will be utilized to gauge performance. These states are:

- Georgia
- Illinois
- Iowa
- Kansas
- Michigan
- Minnesota
- Ohio
- Pennsylvania
- Wisconsin

Research and Development

Indiana in Context

Indiana is unique compared to peer states. Indiana did not intend its public MRUs to be all things to all people. Instead, through mission differentiation, each of Indiana's MRU campuses is a center of excellence. For example, Indiana's Engineering center of excellence is located at Purdue University, while the center of excellence for biological and medical sciences is located at Indiana University.

What this means is that, individually, Indiana's MRUs may not rank as competitively in broad terms against other institutions that are less mission-differentiated, particularly those that offer a school of engineering, bio-sciences, and a medical school at the same institution. Together, however, Indiana's public MRUs form an extremely competitive system of advanced learning and research, with top-ranked programs at each campus.

To offer a more representative view of Indiana's public MRUs relative to peers, this report will measure the performance of state public MRU systems, and will not benchmark individual institutions.

Research and Development

Academic institutions expend Research and Development (R&D) funds that are generated from a variety of sources: the federal government, state governments, industry and institutional funds, as well as research supported by private foundations and other sources. Each year, public and private universities, non-profit research organizations and federally-funded laboratories compete for limited research and development dollars, most of which are released by the federal government. The ability to win those dollars depends upon the strength of projects proposed and the capacity to conduct R&D.

In Fiscal Year 2007, Indiana's public Major Research Universities expended over $710 Million in Research and Development, over 98 percent of R&D dollars spent by Indiana's public colleges and universities, and nearly 89 percent of all R&D dollars spent in Indiana at any institution, public or independent.[1]

Relative to peer state MRU systems, Indiana ranks in the middle of the pack in total R&D expenditures (*Figure One*). In Fiscal Year 2007, Indiana University and Purdue University expended more than public MRUs in Kansas, Iowa, and Minnesota, but less than institutions in other peer states. Among peer institutions, Indiana's MRUs also house significantly less research facility space.

Indiana will rank in the top half of peer states for total R&D expenditures by 2015.

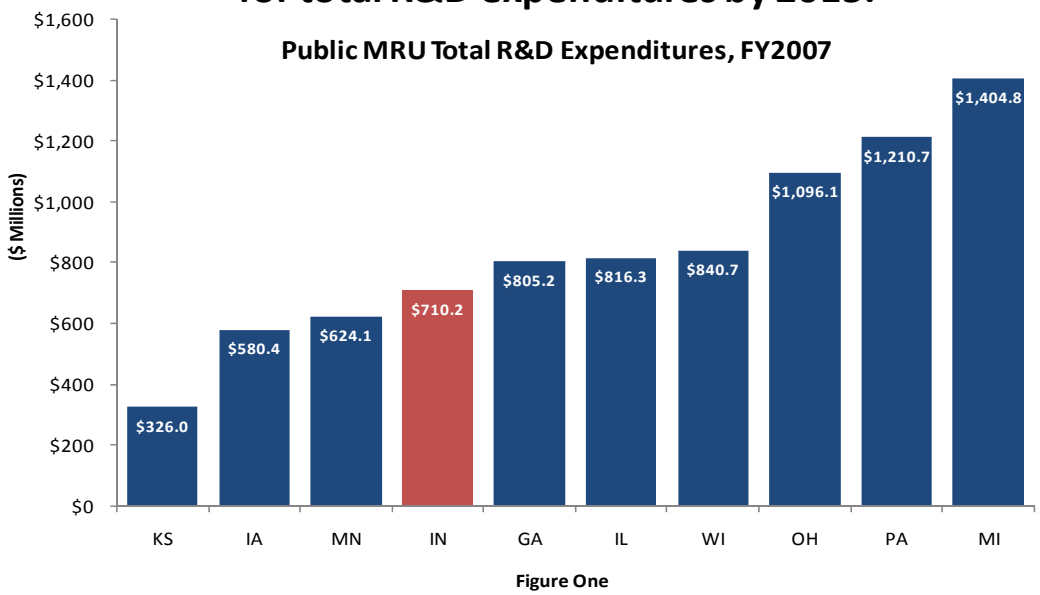

Figure One

[1] National Science Foundation, Academic Research and Development Expenditures: Fiscal Year 2007

While Indiana's peer states have been determined based on similar economic and educational characteristics, Indiana's public MRUs are competing against MRU systems in states with a much larger population base. Adjusted for state population, Indiana ranks in the middle of peer states *(Figure Two)*.

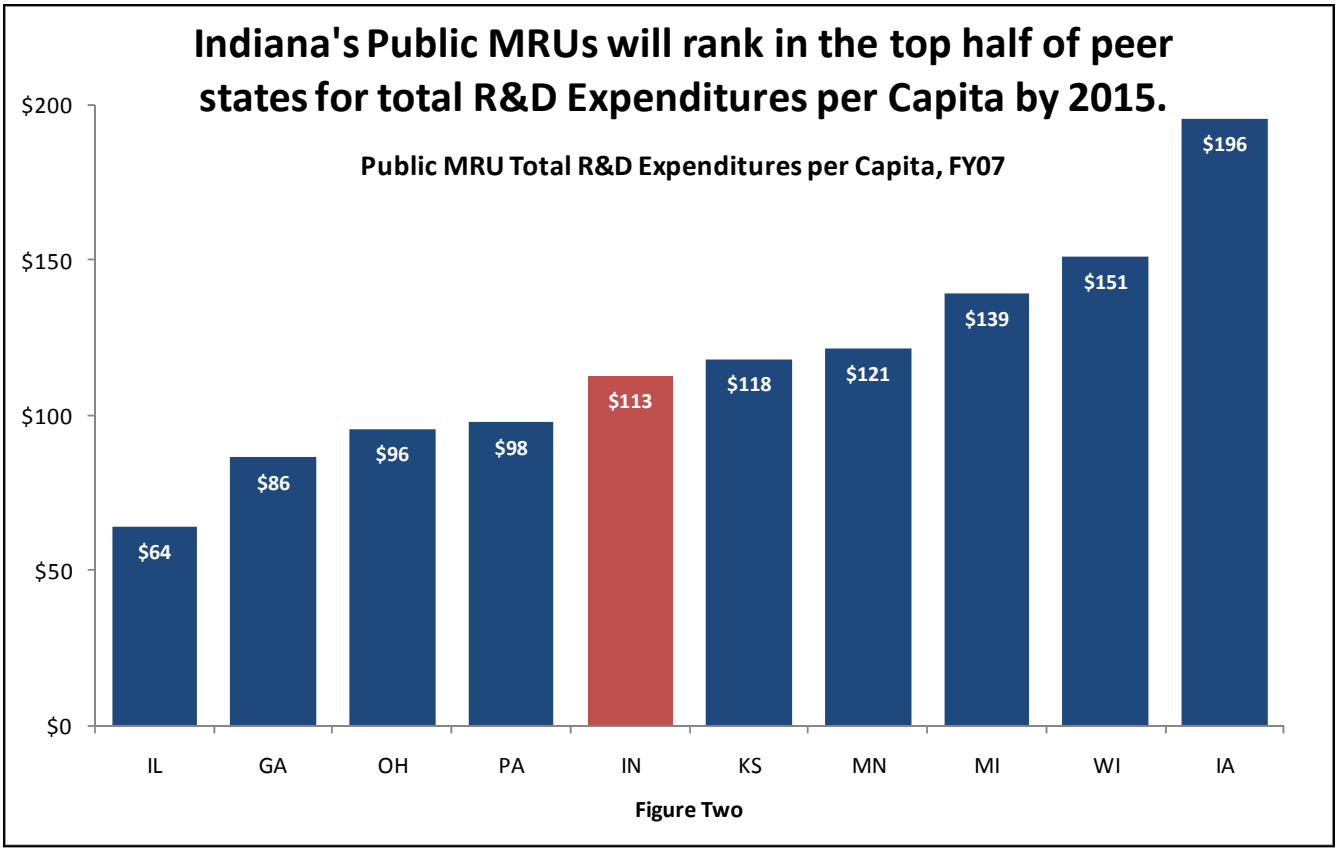

Figure Two

While Indiana's MRUs are behind other states in actual R&D dollars spent, they are among the fastest growing in this field *(Figure Three)*. Between Fiscal Years 2000 and 2007, total expenditures for R&D purposes at Indiana University and Purdue University grew by 54 percent, more than all but two peer states. Nationwide, however, R&D expenditures by colleges and universities grew by 64.3 percent between 2000 and 2007.

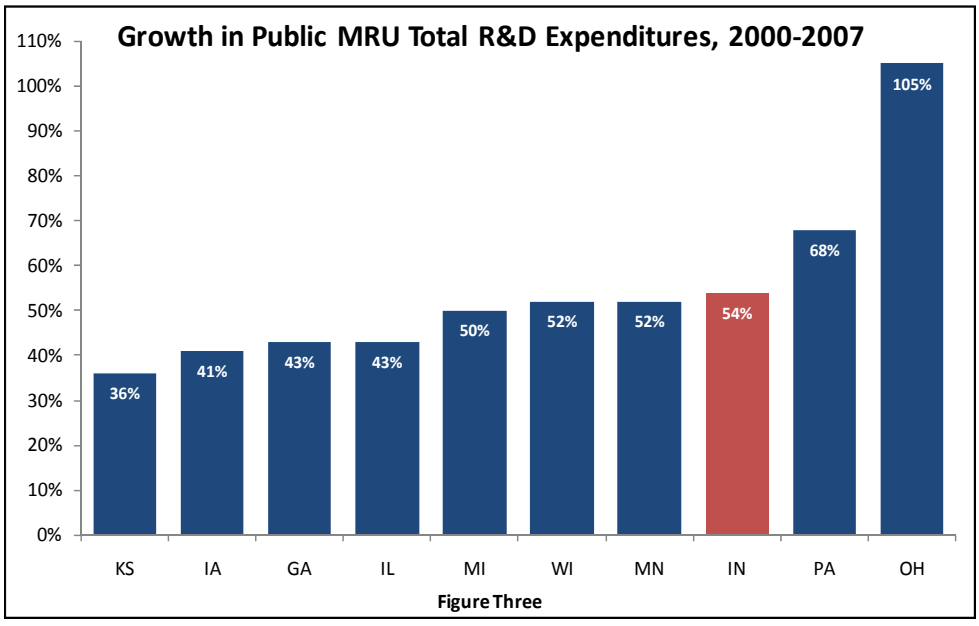

Figure Three

Research and Development

One of the most important sources of R&D funding is the federal government. These grants are extremely competitive and undergo strict peer review. Over the 2000-2007 timeframe, both Indiana University and Purdue University have significantly increased levels of federal R&D funding.

Federally Financed R&D Expenditures by Institution ($ thousands)

	2000	2003	2005	2007	% Change, 2000-07
Indiana University	$107,577	$153,625	$171,528	$165,934	54.2%
Purdue University	$92,010	$129,199	$150,351	$165,637	80.0%

Despite this growth, Indiana's MRUs are still less reliant upon federal funding for R&D than peer state MRUs. Only about 47 percent of Indiana's MRU R&D is funded by the federal government, compared to a peer state MRU average of 56 percent *(Figure Four)*.

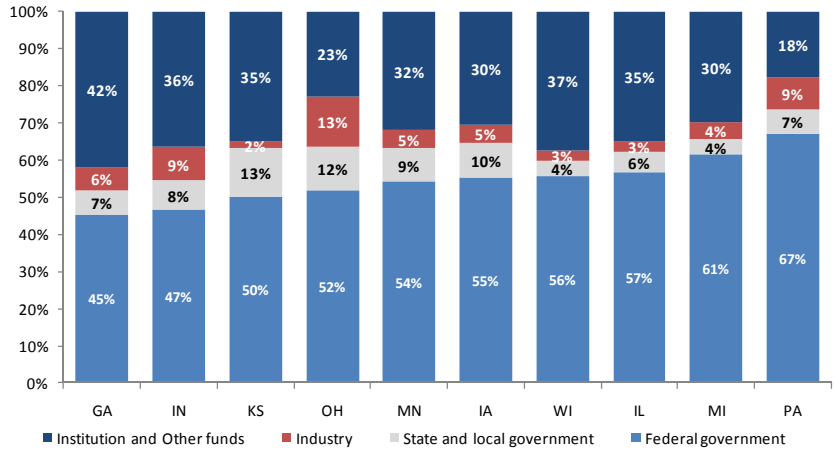

Figure Four

Indiana University and Purdue University have both developed significant infrastructure to bolster the transition between the discoveries and innovations that take place utilizing R&D funding. Through entities created to specifically facilitate this collaboration, IU and Purdue contribute business incubator space to emerging entrepreneurs, technology to support continued economic development efforts beyond the doors of the Universities, and technical support to ensure that businesses and research teams are able to secure patents and licenses.

These research parks and centers that foster emerging technologies and innovations also contribute to Indiana's employment of highly-skilled workers and improve Indiana's ability to compete nationally and internationally for firm placements and talented workers.

Purdue Wins Largest Grant in University History

In early September 2009, the National Science Foundation awarded Purdue University with a five-year grant of $105 Million.

Utilizing its strength in Earthquake Engineering, Purdue will lead a team of scholars from elite institutions across the country to connect fourteen sites of the Network for Earthquake Engineering Simulation (NEES) through groundbreaking cyberinfrastructure, education and outreach efforts.

The Center, called NEESComm, will help researchers share information and equipment, enabling research and innovation in the study of earthquakes and tsunamis. The Center will focus on reducing losses from natural disasters, creating an educated workforce in the field, and conducting wide scale outreach and education.

Utilizing the NEESComm Center, locations around the world will be able to access the unique facilities, equipment, and teaching tools developed by Purdue and grant partners, mitigating losses and creating earthquake-safe buildings and cities. At the Center, scientists and engineers will be able to run simulations that estimate the loss in the event of a major earthquake or tsunami.

Purdue University President France Cordova said, "Purdue's depth of knowledge in earthquake engineering, innovative high-performance computing experts, education professionals and outstanding interdisciplinary research abilities allow the university to make great contributions in this area. I've seen firsthand how devastating an earthquake can be not only to buildings, highways and the infrastructure of a city, but also to families, the community and people's sense of security."

The Path to Commercialization

CS-Keys, founded by IU School of Medicine researchers, is developing a new series of diagnostic tools that can detect the occurrence or re-occurrence of cancer. The company was recently named Innovation of the Year, and has secured venture capital funding from a variety of sources.

ImmuneWorks has recently received a $2 million grant from the Indiana 21st Century Fund and funding from private investors to continue work in developing therapeutics and diagnostic tests for people with autoimmune conditions. The company is currently focusing on the development of treatments for pulmonary diseases. IU School of Medicine researchers founded the company in 2006.

Having secured nearly $5 million in capital from a variety of sources, **FAST Diagnostics, started by an IU School of Medicine** researcher and IU alum, is moving forward in the development of a diagnostic device to provide hospitals and physician offices with the ability to rapidly and accurately diagnose kidney functions.

Established in 2001 by Purdue alumni, **Griffin Analytical** enables customers to conduct on-site chemical analysis with its portable mass spectrometer systems. The technology developed by the company has produced the only portable system that is capable of multi-dimensional analysis. This technology is invaluable in public safety fields, enabling professionals to immediately determine the presence of chemical warfare agents, explosives, and toxic chemicals in air, water and soil.

Imaginestics, founded by a Purdue Alumnus and located at the Purdue Research Park, organizes manufacturing information from around the world using product shape information. Because text-based searches are often context– and language-sensitive, manufacturers have not had the ability to easily determine whether a particular product meets their needs. Imaginestics has developed the world's first online "shape-search" engine that enables manufacturers at any point in the supply chain to effectively search for and find products. Imaginestics has won the Indiana Growth 100 Spirit and Growth Award and the National Business Incubator Association Outstanding Incubator Graduate Award.

Technology Transfer

Technology Transfer is one outcome of Research and Development. It involves the licensing and adaptation of intellectual property and products developed into products and practices for public use. Indiana's public MRUs are particularly strong in industry-funded R&D, which spurs technology transfer, as sponsored research that is focused on resulting in products and practices that industry can use.

Indiana ranks near the top of peer states in Invention Disclosures and New Patent Applications *(Figure Five).* The level of disclosures and applications indicates that Indiana's patent pipeline is filling; the state should experience significant growth in patents in upcoming years. Indiana University alone has 429 patents pending currently.

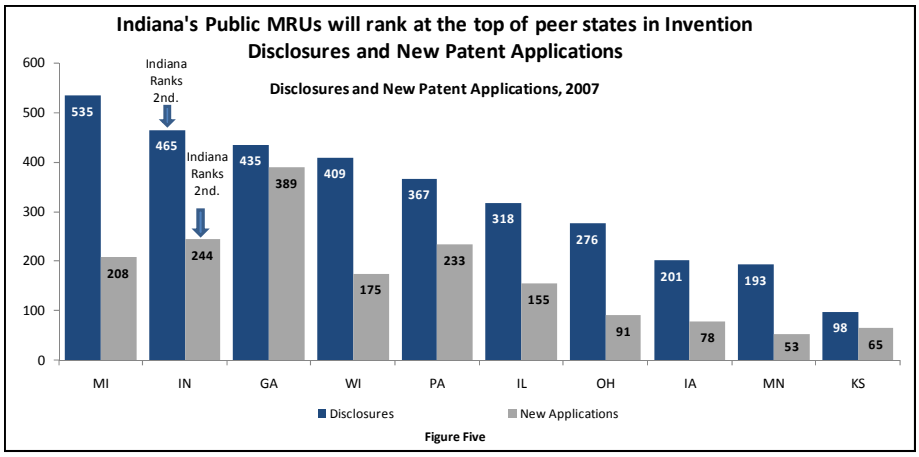

Figure Five

In 2007, Indiana's MRUs received patents for 45 new products. There is often a long lag-time between patent application and patent approval. Indiana ranks in the middle of peer states in new patents issued, outpacing Kansas, Ohio, and Minnesota *(Figure Six)*.

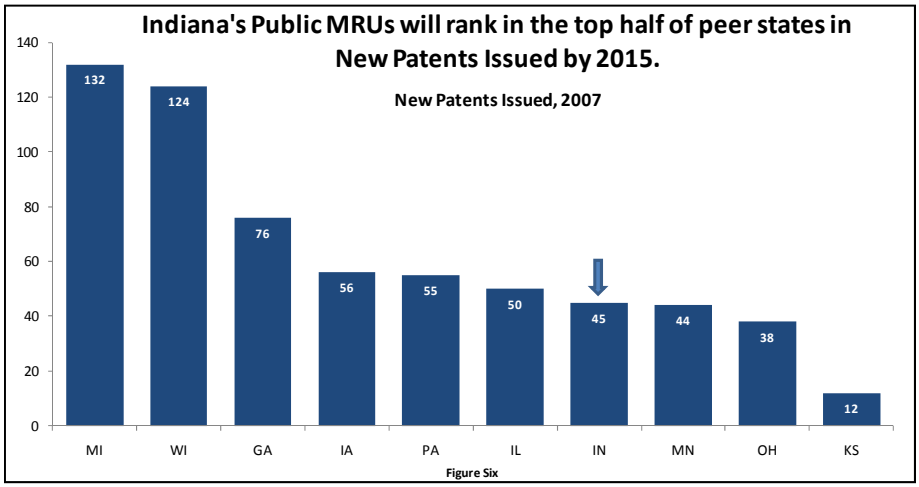

Figure Six

Technology Transfer

Licenses are a common vehicle for transferring the rights for a specific product or practice to another entity for further development and commercialization. According to the Association of University Technology Managers FY2007 Licensing Survey, "Licensing is the process that provides the institute the guarantee that a given technology will be used to further the public good and, perhaps, generate revenue for the institution" (34).

In 2007, Indiana's public MRUs executed 150 licenses to transfer university intellectual property to another entity for commercialization, resulting in **licensing income of over $9.7 Million** for the institutions *(Figure Seven).*

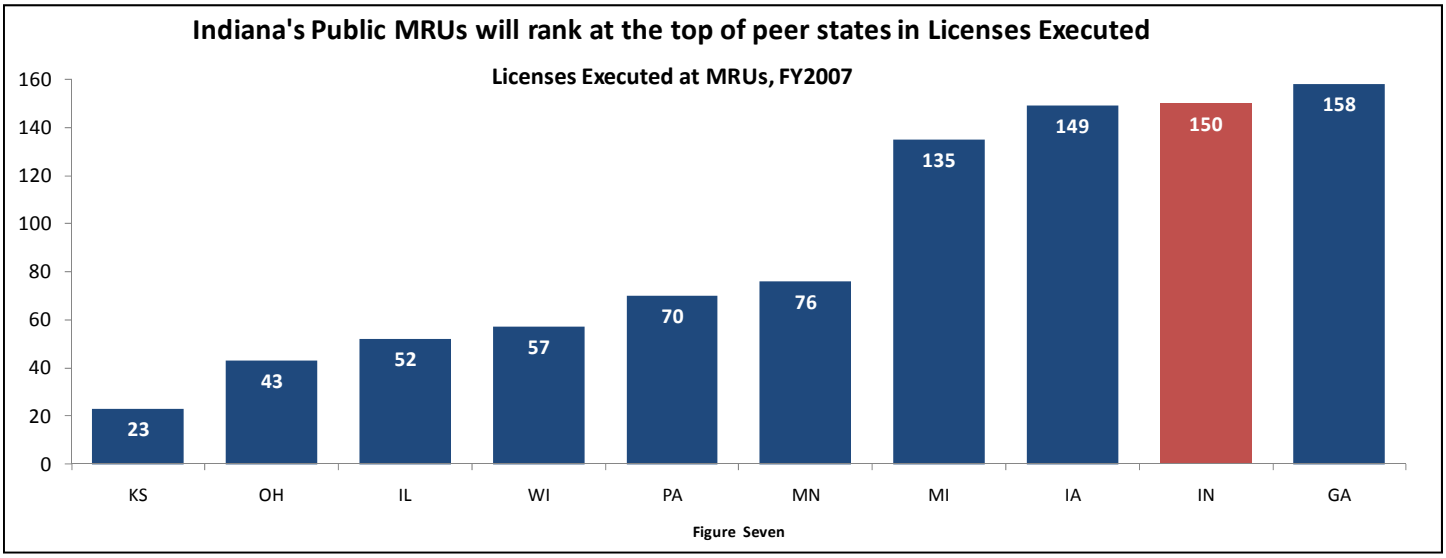

Figure Seven

Start-ups are new businesses based on university technology. While start-ups are measured via a snapshot, and do not take into account the constant churning that happens with new business entities, start-ups do reflect both the marketability to university ideas and products, and the quality of those ideas and products, as start-ups require venture capital to get going. In 2007, Indiana's MRUs contributed to 13 start-ups, more than all but one other peer state *(Figure Eight).* Annually, start-ups and tenant companies at IU and Purdue Research Parks are responsible for the creation of hundreds of new jobs, focused heavily in emerging, high-tech industries.

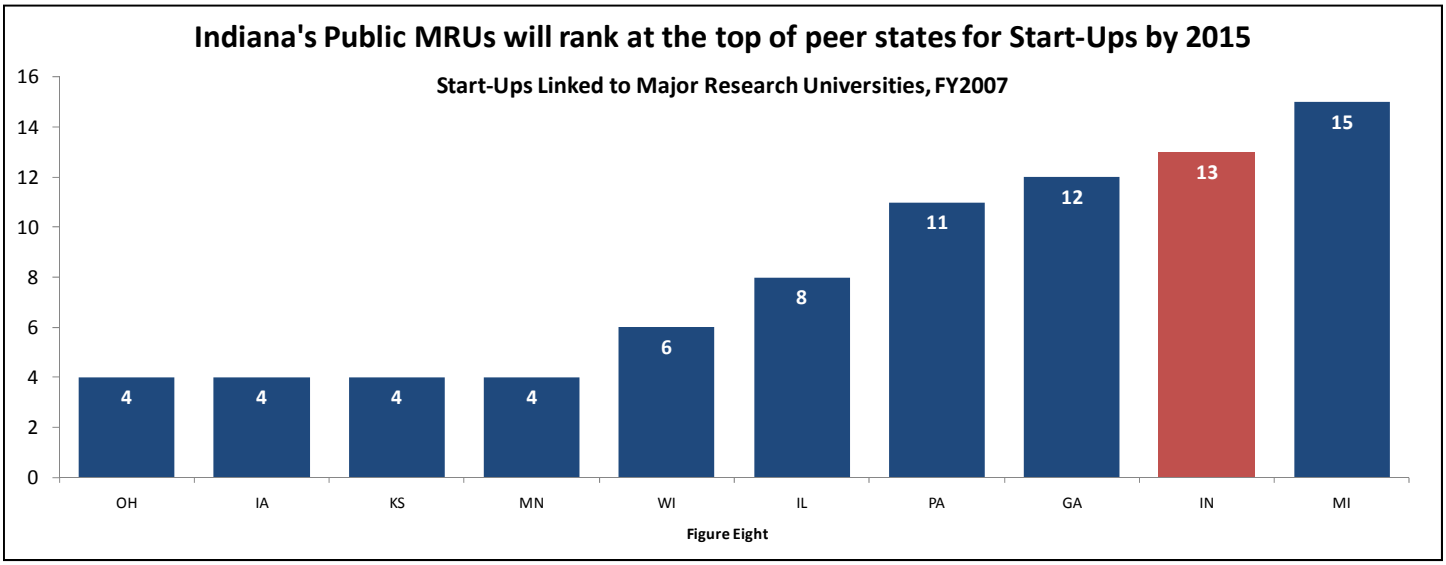

Figure Eight

Institutional Reputation

In its metrics, the Center for Measuring University Performance includes Faculty Awards received at each campus during a given year. These awards include such prestigious programs as Fulbright American Scholars, Guggenheim Fellows, MacArthur Foundation Fellows, and Woodrow Wilson Fellows. All three of Indiana's public MRU campuses employ faculty honored with these awards in 2007-08, ranking competitively against MRUs in peer states *(Figure Nine).*

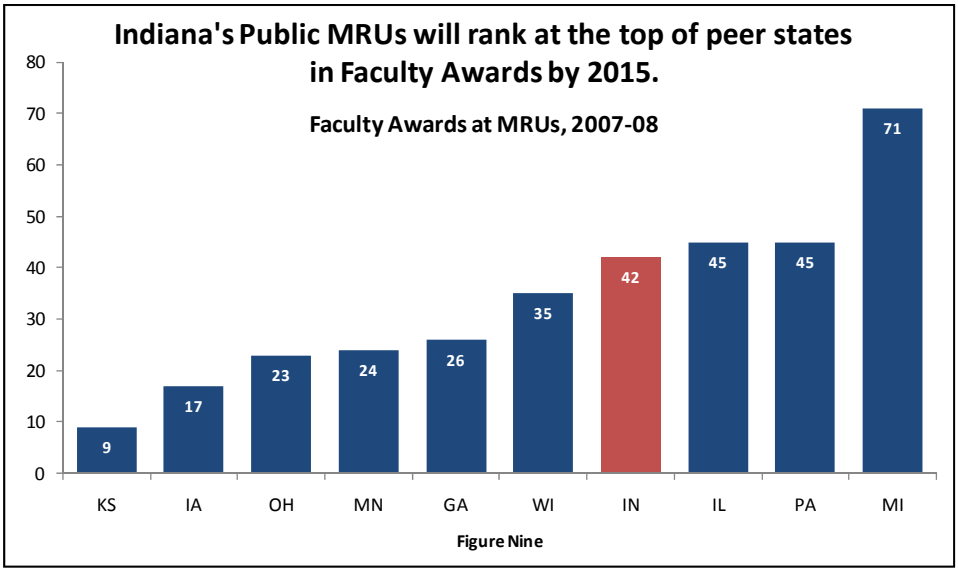

Figure Nine

The federal government established a variety of National Academies, consortia of experts in areas of scientific and public issues. These experts address important national issues and provide advice to the federal government and the public. Membership in the National Academies is one of the highest honors bestowed upon a professional in an Academy field. Indiana's MRU campuses are well-represented in the National Academies.

National Academy of Sciences

- Indiana University: 11 Members
- Purdue University: 2 Members

Institute of Medicine

- Indiana University (Indianapolis): 5 Members
- Purdue University: 1 Member

National Academy of Engineering

- Indiana University: 1 Member
- Purdue University: 19 Members

The **Shanghai Academic Ranking of World Universities** provides a ranking of the top 500 postsecondary institutions in the world. Both Indiana University and Purdue University are included in the top 100 universities in the world:

- Indiana University: Ranks 92nd
- Purdue University: Ranks 65th

The Center for Measuring University Performance measures postsecondary institutions in nine areas, including Faculty Awards, Research Funding, and National Academy Members. All three Indiana MRU campuses have a number of measures ranked in the top 50 in the United States among Public Research Universities:

- Indiana University: 5 Measures in the National Top 50 (2 measures in National Top 25)
- IUPUI: 4 Measures in National Top 50
- Purdue University: 8 Measures in National Top 50 (6 measures in National Top 25)

Indiana's public MRUs are included among the top institutions in the nation, and in the world. All three MRU campuses are ranked in a variety of measures that reflect the reputation of the institutions, programs, and quality of faculty. In fact, Indiana's institutions have among the top ranked graduate programs in the nation, according to the 2010 **US News and World Report**:

- Indiana University School of Public and Environmental Affairs: Ranks 2nd
- Indiana University School of Education: Ranks 19th
- Purdue University College of Engineering: Agricultural and Biological Engineering: Ranks 1st
- Purdue University School of Pharmacy and Pharmaceutical Studies: Ranks 9th

National Research Council Findings

The National Research Council (NRC) works to provide policy leaders and the public with information to improve governmental decision making and public policy. The NRC works under the National Academy of Sciences, the National Academy of Engineering and the Institute of Medicine.

In late 2005, the NRC began work on "An Assessment of Research-Doctorate Programs," which will assess the quality and characteristics of research and doctorate programs at institutions throughout the United States. This report will undoubtedly contain findings that are relevant and valuable to *Indiana's Major Research Universities Indicators of Competitiveness and Success*. Upon release of the NRC report, the *Indicators* will be updated to include findings.

Indiana University Professor Wins Nobel Prize in Economic Sciences

On October 12, 2009, Professor Elinor Ostrom won the Nobel Prize for Economics, and the eighth IU-associated Nobel Laureate.

Ostrom's work, and her Nobel win, has received a great deal of attention, not only because she is the first woman to win the Nobel Prize in Economics, or the first political scientist to be honored, but because her research is grounded in real-world issues and problems.

Professor Ostrom's Nobel award recognizes her contribution to the field of economics and her analysis of economic governance. Her work has focused on the "tragedy of the commons," the theory that publicly owned and managed resources will be over-exploited. Her research, based on evidence gained from a wide array of public settings like fish stocks, lakes, forests and watersheds, shows that the "tragedy" is not necessarily accurate, and that those who use shared resources often develop sophisticated mechanisms for use and preservation. Her work has profound implications for developing nations, and challenges the "top-down" approach to governance.

Professor Ostrom, who has been an IU faculty member since 1965, earned both her undergraduate and graduate degrees from the University of California, Los Angeles. She was also the first woman to chair the IU Department of Political Science in the early 1980s. She is currently the Arthur F. Bentley Professor of Political Science in the College of Arts and Sciences and a professor in the School of Public and Environmental Affairs at Indiana University-Bloomington. She is co-founder and senior research director of the Workshop in Political Theory and Policy Analysis at IU.

Workforce Development

Indiana's public Major Research Universities are the state's main provider of advanced degrees, with 40 percent of all Masters, 75 percent of Doctorates, and 76 percent of Professional (Law, Medicine, Pharmacy, etc.) earned at either IU-Bloomington, Purdue-West Lafayette, or IUPUI *(Figure Ten)*.

While Indiana's economy relies heavily on workers with certificates, Associate's and Bachelor's degrees, the state has a vested interest in improving the proportion of its citizens with advanced education. A wide variety of reports have tied states' economic prosperity to education—high income ties directly to high educational attainment. These workers also fill critical roles in the workforce: doctors, scientists, and entrepreneurs who create additional Indiana jobs through business development.

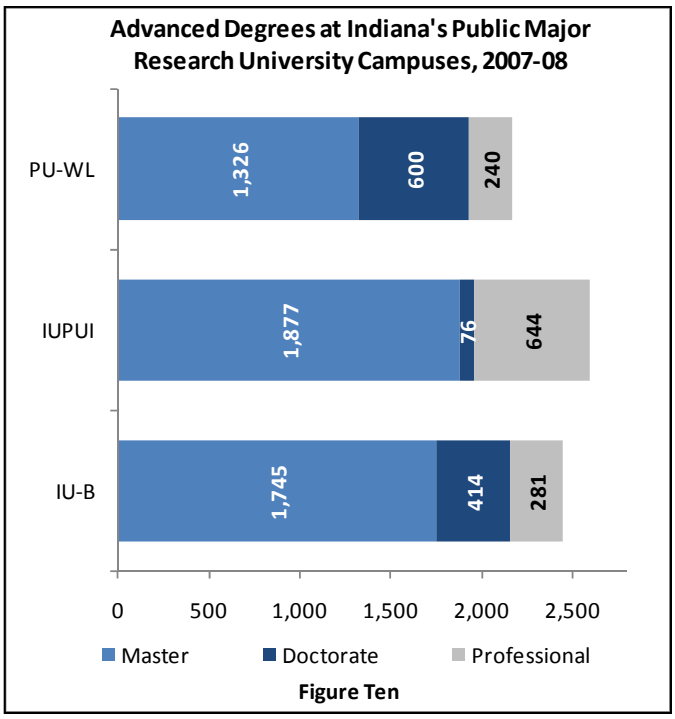

Figure Ten

Over the last two decades, Indiana's public MRUs have contributed to increases in the proportion of Hoosiers with advanced degrees. However, despite those improvements, Indiana is still outpaced by nearly all peer states in this metric, with less than 8 percent of the state's working-age population holding an advanced degree *(Figure Ten)*. In 2007, Indiana lost 800 more Hoosiers with an advanced degree than it gained, evidence of the state's significant brain-drain problem.

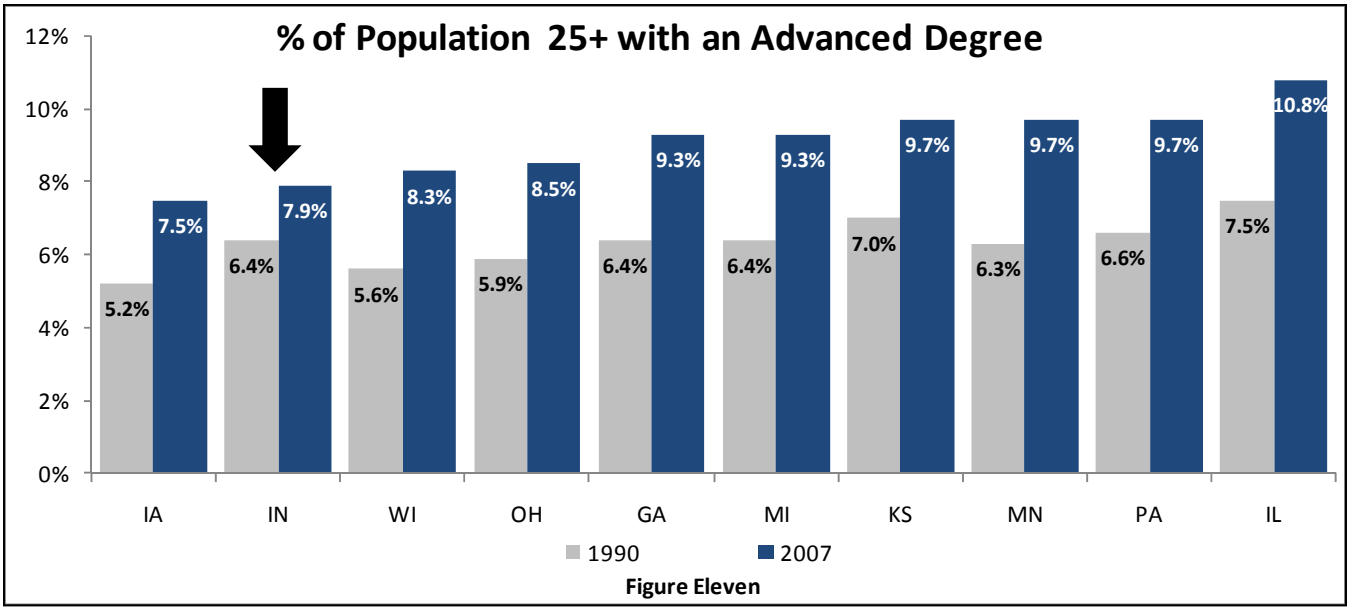

Figure Eleven

Indiana's Advanced Workforce

In 2007, Indiana's public MRUs granted more than 7,200 advanced degrees, many in fields that are in high demand in Indiana's economy. The majority of these degrees are Masters in Business Administration and Professional degrees in Healthcare *(Figure Ten)*.

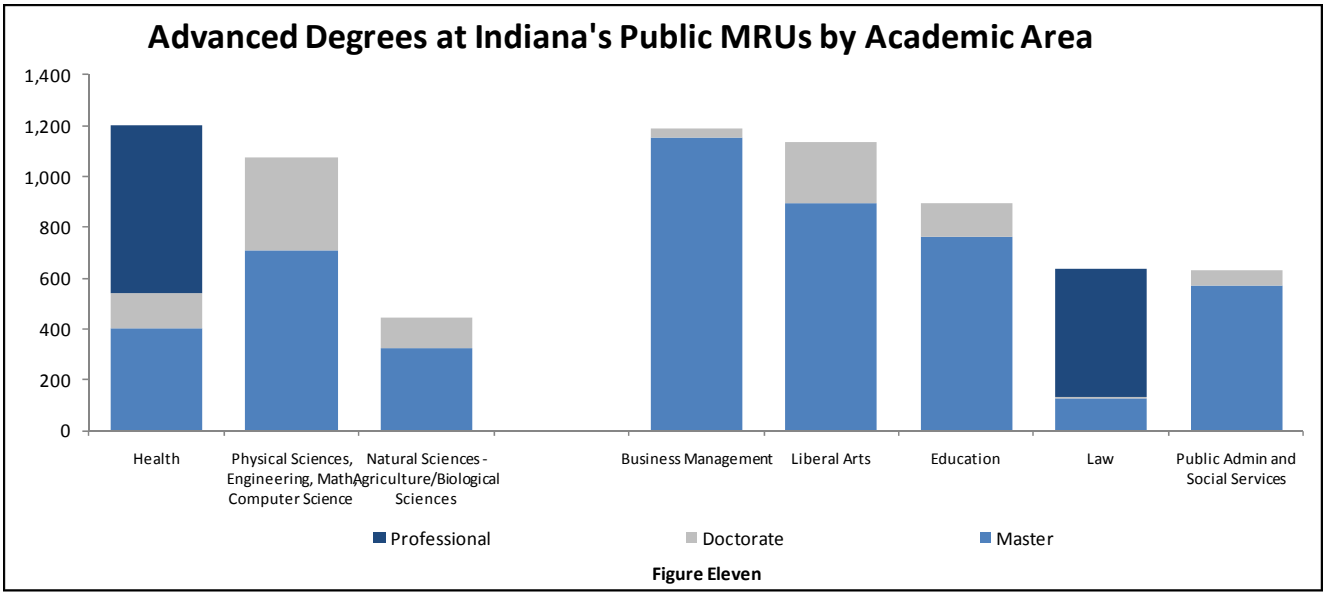

Figure Eleven

The Indiana Economic Development Corporation has identified key industries where Indiana has a competitive edge, or great potential for growth. Indiana's public MRUs are major players in ensuring that these industries have the talent they need to grow and prosper.

- **Advanced Manufacturing:** With growing sectors in Chemical Production and Fabricated Metals and Machinery, Indiana is a national leader in Advanced Manufacturing. This industries need Engineers, Chemists, and Managers with strong backgrounds in business to ensure continued growth.

- **Agriculture:** Indiana ranks in the top 10 of all states in the value of agricultural products sold, and in the total value of crops. Purdue University has one of the strongest Agriculture programs in the nation, reflecting the state's emphasis on its agricultural roots and strength in this industry sector.

- **Information Technology:** Recent investments in Information Technology have placed Indiana in prime position to become a national leader in that sector. Indiana University is home to the nation's first School of Informatics, and is on the cutting edge of technology development.

- **Life Sciences:** As home to companies like Eli Lilly, Cook Group, Inc, and Biomet, as well as top-notch medical centers, Indiana is an international leader in life sciences. In fact, Indiana is home to one of the largest concentrations in the prosthetics/orthotics industries in the world. Both Indiana University and Purdue University produce exceptional professionals in scientific and engineering fields. Indiana University Medical School educates the second-largest student body in the nation, and half of the physicians practicing in Indiana received their MD or internship through the IU School of Medicine.

Economic Impacts

An important component of economic impact is the human capital created through educational attainment. Workers with postsecondary credentials have the skills and abilities to be more productive contributors to society and business. Workers can expect to earn far more with a degree than without.

In 2008, Indiana's public MRUs granted nearly 22,000 undergraduate and graduate degrees. Utilizing the expected earnings premium that credentialed workers can expect, the earnings impact of 2008 MRU degrees produced at Indiana MRUs is nearly half a billion dollars.

Table 1

Degree	2008 MRU Degrees Earned	Earnings Premium over HS Graduate	Impact
Bachelor	14,719	$16,465	$242,348,335
Master	4,948	$26,770	$132,457,960
Doctorate	1,090	$45,708	$49,821,720
Professional	1,165	$60,093	$70,008,345
Total	**21,922**		**$494,636,360**

With more than 25,000 full-time employees, and another 11,300 part-time employees, Indiana's public MRUs are two of the largest employers in the state—in 2008, Indiana University ranked 4th, and Purdue University ranked 6th.

Faculty and staff compensation, as well as the purchase of goods and services by the Universities, student expenditures, and visitors to events at the MRUs, all contribute to a significant direct economic impact. There is a secondary impact, as well, as expenditures by the Universities, students, and staff create jobs and other spending within the state.

Table Two

	Direct Economic Impact	Indirect Economic Impact	Total Impact
Total MRU System	$4,347,487,000	$3,222,531,000	$7,570,018,000

In FY2007, the State of Indiana appropriated $687.6 Million to the public Major Research Universities. With a total economic impact of nearly $7.6 Billion,

the state's return on investment was $11 per $1 of state appropriation.

End Notes

All state-level data is comprised of aggregate institution-level data, limited to state public Major Research Universities. MRUs are classified under the Carnegie system as "very high research activity." No private postsecondary institutions, federal laboratories or other research entities are included in any state-level data.

Figure One
Source: National Science Foundation, Academic Research and Development Expenditures: Fiscal Year 2007, Table 27.

Figure Two
Source: National Science Foundation, Academic Research and Development Expenditures: Fiscal Year 2007, Table 29.

Figure Three
Source: National Science Foundation, Academic Research and Development Expenditures: Fiscal Year 2007, Table 29.

Figure Four
Source: National Science Foundation, Academic Research and Development Expenditures: Fiscal Year 2007, Table 27.

Figure Five
Source: Association of University Technology Managers, Licensing Surveys FY03-FY07.

Figure Six
Source: Association of University Technology Managers, Licensing Survey FY07.

Figure Seven
Source: Association of University Technology Managers, Licensing Survey FY07.

Figure Eight
Source: Association of University Technology Managers, Licensing Survey FY07.

Figure Nine
Source: Center for Measuring University Performance, 2008 Top American Research Universities Report.

Figure Ten
Source: National Center for Education Statistics, IPEDS.

Figure Eleven
Source: US Census, 2005-07 American Community Survey.

Table 1
Degrees Earned: National Center for Education Statistics, IPEDS.
Earnings Premium: US Census, Current Population Survey.

Table 2
Economic Impact from independent analyses from Indiana University and Purdue University.