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Economic Impact of INBRE Funding on Wyoming's Economy

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Summary. This report estimates the economic impacts of the NIH/INBRE funding received by the University of Wyoming over the period 2004-2017. Standard economic impact analysis is applied using regional economic expenditure multipliers. The report also highlights positive impacts from INBRE funding, such as economic diversification and human capital accumulation, which are more difficult to quantify.

The three main findings of this research are:

- INBRE-related projects since 2004 have generated more than \$40 million of direct revenues to the University of Wyoming and other community colleges across the state of WY. Due to the multiplier effect, these \$40+ million of direct expenditures have led to over \$68 million of total economic output, \$25 million of earnings, \$41 million of value added, and have created 895 new jobs in Wyoming.
- In addition to the economic output, earnings, and new jobs, INBRE-related projects from University of Wyoming faculty have supported several hundred undergraduate students, graduate students, and postdoc fellows. INBRE funding has also led to over 100 pilot, thematic, and specialized projects.
- Other social benefits to Wyoming's economy are accruing, including diversification of the economy's structure, long-tenure well-paid jobs, human capital improvement, and accumulation and the buttressing of Wyoming's "creative economy."

Total Economic Impacts

Since 2004, University of Wyoming faculty have received and spent over \$40 million of INBRE funding from the NIH. The direct economic impact of this funding and expenditures are straightforward to calculate and help support undergraduate students, graduate students, post doctorates, faculty, and research facilities across the state of Wyoming. However, the economic impacts of INBRE funding are not limited to the \$40 million of funding. Local and statewide economy have benefited because of the expenditure multiplier effect. Dollars from the grants are expended by the recipients on salaries, supplies, utilities, and so forth. These expenditures in turn become someone else's income. For any expenditure, \$1 spent generates more than \$1 of total expenditures simply because these expenditures continue to multiply throughout the economy. Thus, the direct effects of the funding (the initial inflow) is augmented by multiplied indirect effects (secondary and tertiary spending). In addition, these expenditures spur the creation of additional jobs in the economy.

Table 1. University of Wyoming NIH Funding (Total, INBRE, COBRE, IDeA)

Year	NIH R-Awards	# INBRE PIs	Total NIH (Million \$\$)	INBRE (Million \$\$)	COBRE (Million \$\$)	Total IDeA	INBRE %
INBRE 1							
2004-05	17		\$8.13	\$2.64	\$2.12	\$4.76	32%
2005-06	17		\$6.29	\$2.55	\$0	\$2.55	41%
2006-07	14		\$7.07	\$2.52	\$2.05	\$4.57	36%
2007-08	16		\$7.23	\$2.39	\$2.01	\$4.40	33%
2008-09	15		\$7.25	\$2.29	\$1.98	\$4.27	40%
INBRE 2 + Bridge Year (2014-15)							
2009-10	15	4	\$8.32	\$3.61	\$1.98	\$5.59	43%
2010-11	14	2	\$7.75	\$3.29	\$1.98	\$5.27	42%
2011-12	10	1	\$6.89	\$3.26	\$1.02	\$4.28	47%
2012-13	12	4	\$6.75	\$3.29	\$1.00	\$4.29	49%
2013-14	12	3	\$7.39	\$3.15	\$0.95	\$4.10	43%
2014-15	14	3	\$7.11	\$2.38	\$1.00	\$3.38	33%
INBRE 3							
2015-16	11	5	\$10.18	\$3.52	\$1.00	\$4.51	34%
2016-17	13	7	\$8.40	\$3.35	\$0	\$3.35	40%
2017-18	10	7	\$10.81	\$3.46	\$1.94	\$5.40	32%
Total			\$109.57	\$41.70	\$19.03	\$60.72	39%

Table 1 shows the total NIH funding flowing into the University of Wyoming by type of program. INBRE funding since 2004 has exceeded \$40 million and accounted for approximately 40% of overall NIH funding.

In addition, Table 2 shows that INBRE-supported projects have supported a large number of faculty, graduate students, undergraduate students, post-doctorate fellows, as well as over 100 pilot, thematic and special projects.

Table 2. Other Impacts of INBRE Funding (2009-Present)

Year	Faculty supported	Graduate students supported	Postdocs supported	Undergrad students supported	Pilot Projects (\$25-\$50K)	Thematic Projects (\$25-\$100K)	UW/CC Projects (\$20-\$25K)
INBRE 2 + Bridge Year (2014-15)							
2009-10	28	28	10	59	4	6	0
2010-11	22	36	6	83	4	7	0
2011-12	25	31	5	67	0	8	0
2012-13	30	36	6	72	4	5	2
2013-14	36	21	9	60	2	5	0
2014-15	28	13	2	113	0	9	3
INBRE 3							
2015-16	39	19	3	64	2	10	4
2016-17	51	24	3	70	6	8	7
2017-18	44	20	1	111	5	8	6
TOTAL	252	228	45	245	27	66	23

Using the U.S. Bureau of Economic Analysis (BEA) Regional Input-Output Modeling System II (RIMS II) model, we estimate the impact of NIH INBRE grant funding on Wyoming's economy. The final-demand industry, the industry that primarily generates this activity, is classified by the BEA as the Education industry, which includes community colleges, private universities, and public universities. The final-demand multipliers that will be used in this analysis estimate the total impact across the state of a change in expenditures in the Education industry. INBRE expenditures will be used to estimate the total dollar-value impact on total state output, value added, employment earnings, as well as the number of jobs generated across all industries and the entire state of Wyoming. The BEA multipliers are also used to find the total impact of all NIH grant funding for the University of Wyoming.

Table 3. NIH/INBRE Economic Impacts Since 2004

Program	Direct Funding	Gross Output	Value-Added	Earnings	Jobs
INBRE	\$41,700,000	\$68,542,290	\$41,249,640	\$25,983,270	895
COBRE	\$19,030,000	\$31,279,611	\$18,824,476	\$11,857,593	408

Total IDeA (INBRE + COBRE)	\$60,730,000	\$87,269,010	\$60,074,116	\$37,840,863	1,303
Overall NIH	\$109,570,000	\$180,100,209	\$108,386,644	\$68,273,067	2,352

The total economic impact of the funding since 2004, illustrated in the gross output column of Table 3, is over 1.6 times larger than the funding alone. This shows that, quite aside from the educational and human capital aspects of the funding, the NIH INBRE grants have generated significant economic activity in Wyoming since 2004. In fact, the total (direct and indirect) impact of NIH INBRE grant funds is over \$68 million in gross output since 2004, and overall gross output impacts from all NIH funding is over \$109 million. The BEA multipliers can also be used to estimate the labor market impacts of INBRE funding. The last three columns of Table 3 show the value added (earnings + taxes on production + profits), earnings, and jobs impact of INBRE-related funding. INBRE funding has led to over \$41 million in value added, \$25 million in earnings, and over 895 new jobs.

Workforce and Industry Analysis

An analysis of the North American Industrial Classification System (NAICS) industries that require a workforce skilled in biomedical knowledge, and supported by the NIH/INBRE funding, reveals several industries in Wyoming that generate significant employment. The top portion of Table 4 below summarizes the industries, the number of establishments located in Wyoming, their annual payroll, and number of employees (2016 County Business Patterns, U.S. Bureau of Census). The industries summarized below range from high-level classifications (3 digit NAICS, a broad definition of an industry) to the most refined classification (7-digit NAICS, the most narrow industry definition). Each has, by its industry description, the need for a workforce with skills supported by the NIH/INBRE program.

Table 4: Wyoming Industries & Occupations Impacted by INBRE Activities

INDUSTRIES			
Industry Name	# of WY Establishments	Annual Payroll	# Employed
Research and Development, Biotechnology (NAICS 541711)	8	\$4,577,000	51
Veterinary Services (NAICS 541940)	110	\$28,619,000	867
Management, Science, and Tech Consulting (NAICS 5416)	550	\$98,028,000	1,704
Ambulatory Health Services (NAICS 621)	1257	\$514,934,000	9,320
Hospitals (NAICS 622)	34	\$683,336,000	11,498
Nursing and Residential Care Facilities (NAICS 623)	138	\$166,673,000	5,893

OCCUPATIONS		
Occupation Type	# Employed in WY	Average Annual Salary
Medical and Health Service Managers	700	\$100,630
Veterinary Technicians	250	\$30,110
Natural Sciences Managers	140	\$95,860
Engineering Technicians	200	\$67,300
Medical Equipment/Precision Instruments Repairers	80	\$39,520
Biological Technicians	260	\$38,270
Environmental Science and Protection Technicians	130	\$46,670
Veterinarians	200	\$85,180
All Health Care Practitioners and Tech Occupations	14,400	\$80,750

Similarly, an analysis of the occupations in Wyoming that require a biomedical education background shows a large number of growing occupations supported by the activities of the NIH/INBRE funding. The occupations and their employment growth (Bureau of Labor Statistics, 2017 State Occupational Employment and Wage Estimates), along with wage and employment estimates, are summarized in the bottom portion of Table 4, below. As with the industry classification discussed above, some are broad occupational categories and others are very narrowly defined; each requires the biomedical educational background supported by INBRE funding.

There is a high degree of variability in these occupations salaries due to the additional educational attainment above an associates' degree to pursue some of them; however, the background knowledge and skills associated with all of them is associated with the biomedical industry, and thus supported by INBRE activities. There are several well-paying occupations in the state that require less education than biosciences in the energy sector. However, even if we grant that those energy-related occupations will continue to be in high demand, the longevity of such occupations (i.e., the tenure of the jobs themselves) is much shorter. Thus, earnings in many of the energy-related occupations requiring less education allow the worker to earn a high income, but only for a short number of years. Bioscience occupations, in contrast, have long-term, steady growth potential, strong longevity, and high earning potential. Adding such industries and related occupations to Wyoming's economy will help stabilize and diversify the economy in the long term.

Additional Impacts

Ancillary impacts from the INBRE project have been and will likely continue to be seen in other, indirect forms. Among these impacts will be general changes in the state's labor force composition and the human capital of the state and the so-called "creative economy" (Howkins, 2018).

Human capital accumulation increases the productivity of a region and enhances economic development. Investment in research and education creates human capital both directly by producing graduates, and indirectly by disseminating knowledge which in turn can be used to increase human capital. Biomedical research and education is likely to be especially effective at human capital formation; the knowledge creation it spurs increases both traditional human capital created by education, including entrepreneurship and productivity, and health as human capital, which further enhances productivity. Thus, the impacts, while certainly modest relative to other sectors of the Wyoming economy, will be persistent, long-lasting, and assist in economic diversification.

According to Beeson and Montgomery (1993), university R&D expenditures have a significant impact on the labor force composition of an area measured by the share employment of science and engineering degree holders in the regional workforce. They found that a 2-3% increase in university R&D expenditures led to a 25% increase, from 2.1% to 2.6%, in the share employment of science and engineering degree holders in the area labor force.

Finally, there has been a myriad of research studies (Mankiw et al. 1992; Romer 1990; Barro 2001) that document the importance of building human capital to spur on economic development. Human capital – the actual and potential skills, abilities, knowledge, and productivity of a person – is built and enhanced by investment in education and health care, in particular. The quality of human capital is increasingly seen as one of the drivers of economic growth, both in attracting new firms and in attracting financial capital that supports entrepreneurship and new business creation.

INBRE has advanced and will continue to enhance Wyoming's human capital in two ways. The educational and outreach components of the funding mean that more Wyoming workers will be educated and better skilled, in higher-level analysis and scientific literacy. Whether those who take advantage of the outreach and education end up as life scientists or biomedical engineers, or whether they simply learn more about biosciences, they will have higher quality human capital. As such, INBRE has directly increased the economic development potential of Wyoming. INBRE has also enhanced human capital indirectly in Wyoming by means of those who will ultimately pursue bioscience careers. Those people, depending on their exact career path, will likely be able to enhance the health – and thus human capital – of Wyoming citizens by treating, diagnosing, and preventing ailments, and by creating ideas and knowledge that will improve health and quality of life.

The level of science literacy and skill proffered by bioscience education, outreach, and research will also create social returns to Wyoming as they support the “creative economy.” The creative economy, which essentially stems from the technology, talent, and tolerance that surround universities and other hubs of development, is similar to human capital in that it is a socially beneficial concept that generates “positive externalities” – society benefits even though it's virtually impossible to assess a price for those benefits. The creative economy, also like human capital, is a draw for economic growth, as both firms and workers find regions more attractive for more “creative” areas.

Summary

Clearly, the NIH INBRE funding has had substantial economic impacts in Wyoming. Not only have the projects funded already generated substantial income in the region through simple expenditure of the grant funds themselves, but they will help create and fill a substantial number of jobs stable, well-paid jobs in the coming years. Less tangibly but just as importantly, the projects will also improve the competitiveness of Wyoming, enhance its development possibilities, and help to diversify the economy.

Sources Used

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