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How Much Do West Virginia College Graduates Add To The State's Economy?

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Executive summary

In this report we estimate the overall economic benefits that West Virginia public college and university graduates generate for the state's economy. We account for the likely productivity increase associated with the attainment of higher education as well as the additional spending in West Virginia that results from higher wages and salaries associated with college graduates.

In our analysis we consider the 2009-2010 class of graduates of West Virginia's public colleges and universities who worked in the state in 2012 – a total of just over 6,300 men and women. Based on work and income patterns from 2012 and prior years, we begin by projecting the additional income that these graduates will earn in the state over the coming decades above what they likely would have earned absent the attainment of higher education. We then use a sophisticated economic modeling system to estimate the additional economic activity that will likely occur in West Virginia due to their income premiums and likely productivity increases generated by their higher levels of educational attainment. Finally, we compare our estimated increase in economic activity to the public spending associated with their college education.

Overall, we estimate that the total economic benefits to the West Virginia economy associated with increased productivity and spending resulting from the 2010 public college and university graduating class is nearly $6 billion over our 20-year period of analysis, 2013-2032. By comparison, we estimate that $1.4 billion was spent to educate these men and women beyond high school, of which approximately $404 million was derived from direct state appropriations to colleges and universities, $92 million from state-supported scholarship programs, with the remainder originating from tuition, gifts, and other sources.

1 Introduction and Overview

Today it is standard practice for US states to provide hundreds of millions of dollars or more in support of institutions of higher education. For instance, total spending at public colleges and universities in West Virginia was $1.6 billion in fiscal year 2011,[1] which included approximately $404 million in direct state appropriations to the colleges and universities and approximately $92 million in various state-supported scholarship programs for college students.[2] Overall this $1.6 billion expenditure represented 9.7 percent of total state and local government spending in West Virginia in 2011, making higher education one of the largest expenditure categories for state and local government in the state, surpassing highways, public safety, and housing.[3] Furthermore, direct government support provides a significant share of total revenues at the state's public higher education institutions. For instance, consider the state's three largest public universities: direct state support provided nearly 22 percent of the total revenues at West Virginia University, nearly 31 percent of total revenues at Marshall University, and nearly 28 percent of total revenues at Fairmont State University.[4] The public higher educational system in West Virginia produced nearly 17 thousand graduates in 2012.[5]

There are various channels in which higher education can benefit a state's economy. Most fundamentally, higher education, to the extent that it leads to increased levels of higher educational attainment, can produce workers who enjoy increased skill levels. Greater skills for workers will, in turn, lead to an overall economic system with higher levels of productivity, or output per hour worked. A higher level of productivity will ultimately lead to a higher standard of living. In short, increased levels of educational attainment, supported by public spending on higher education, have the potential to enhance an economy's productive capacity – or supply side – and ultimately standard of living.

In addition to higher levels of productivity, higher levels of educational attainment may also generate demand-side benefits for an economy. Since college graduates usually possess higher skill levels, correspondingly they typically receive higher wages and salaries. For instance, research has found that in West Virginia, the average bachelor's degree recipient who graduated between 2002 and 2012 from a public institution of higher education in the state earned $36,499 per year while working in the state in

[1] Spending data come from the US Census Bureau Survey of State and Local Government Finances. The most recent data available are from 2011. http://www.census.gov/govs/local/

[2] http://www.wvhepc.com/wp-content/uploads/2014/01/2013-Report-card-LR.pdf

[3] Total State and Local Government Expenditure for 2011 was $16.4 billion. http://www.census.gov/govs/local/

[4] Data are for 2014 for WVU and 2013 for Fairmont State and Marshall. Revenue numbers come from the publicly available budgets produced by each University. http://planning.wvu.edu/budget_planning/budget_reports
http://www.marshall.edu/finance/files/2012/07/Approved-FY13-Budget.pdf
https://www.wvhepc.org/finance/fs2013/FSU_fs.pdf

[5] http://www.wvhepc.com/wp-content/uploads/2014/01/2013-Report-card-LR.pdf

2012.[6] This compares to a typical income in the low-to-mid-$20 thousand range for the average West Virginia worker who holds only a high school diploma. Income differentials become significantly more pronounced as workers become more experienced and for those with advanced degrees. While higher wages provide a private benefit for individuals, they can also generate additional spillover benefits for society at large. The spending that results from these higher incomes creates additional income for business owners and employees, which can lead to a virtuous demand cycle creating even more economic activity in the broader economy.[7]

Despite the sizeable amount of public spending in support of higher education in West Virginia, the large number of graduates produced by the state's public higher educational system, and the potential economic benefits that these graduates bring to the state's economy, no research has been identified that rigorously examines the extent to which these graduates affect the state's economy. As such, in this report we estimate the overall economic benefits that West Virginia public college and university graduates generate for the state's economy. We account for the likely productivity increase associated with the attainment of higher education as well as the additional spending in West Virginia that results from higher wages and salaries associated with college graduates.

In our analysis we consider the 2009-2010 class of graduates of West Virginia's public colleges and universities who worked in the state in 2012 – a cohort of just over 6,300 men and women. Based on work and income patterns from 2012 and prior years, we begin by projecting the additional income that these graduates will earn in the state over the coming decades above what they likely would have earned absent the attainment of higher education. We then use a sophisticated economic modeling system to estimate the additional economic activity expected to occur in West Virginia due to the graduates' income premiums and likely productivity increases generated by their attainment of higher education. Finally, we compare our estimated increase in economic activity to the public spending associated with their college education.

Overall, we estimate that the total economic benefits to the West Virginia economy associated with increased productivity and spending resulting from the 2010 public college and university graduating class is nearly $6 billion over the period of our analysis, 2013-2032. By comparison, we estimate that $1.4 billion was spent to educate these men and women beyond high school, of which approximately $404 million was derived from direct state appropriations to colleges and universities, $92 million from state-supported scholarship programs, with the remainder originating from tuition, gifts, and other sources.

Our research is organized as follows: In section 2 we provide a summary of higher education spending and graduates in West Virginia over the past decade or so. In section 3 we provide a statistical overview

[6] Bowen, Eric, and John Deskins. "From Higher Education to Work in West Virginia, 2012." Morgantown, WV: West Virginia University Bureau of Business & Economic Research.

[7] Additional non-monetary benefits that may be generated by higher education – such as a greater appreciation for the arts or an enhanced level of civic engagement – are beyond the scope of this research.

of the sample of graduates upon whom we base our analysis on – 2010 graduates of public colleges and universities in West Virginia who worked in the state in 2012. In section 4 we discuss the methodology that we use to estimate the economic impact of these graduates on the state. In section 5 we present our results, and section 6 offers concluding thoughts and a discussion of important caveats and other considerations. Ultimately, this research should help policymakers design better policies toward higher education.

2 Background on West Virginia Higher Education System

In this section we review recent trends in higher education in West Virginia with regards to the number of graduates of public colleges and universities and spending patterns. In Figure 1 we depict the location of the 13 public college and universities in West Virginia. In Figure 2 we depict the location of the nine public technical and community colleges in the state.[8] This research incorporates graduates of all of these institutions in the aggregate and does not differentiate among graduates from the various institutions.

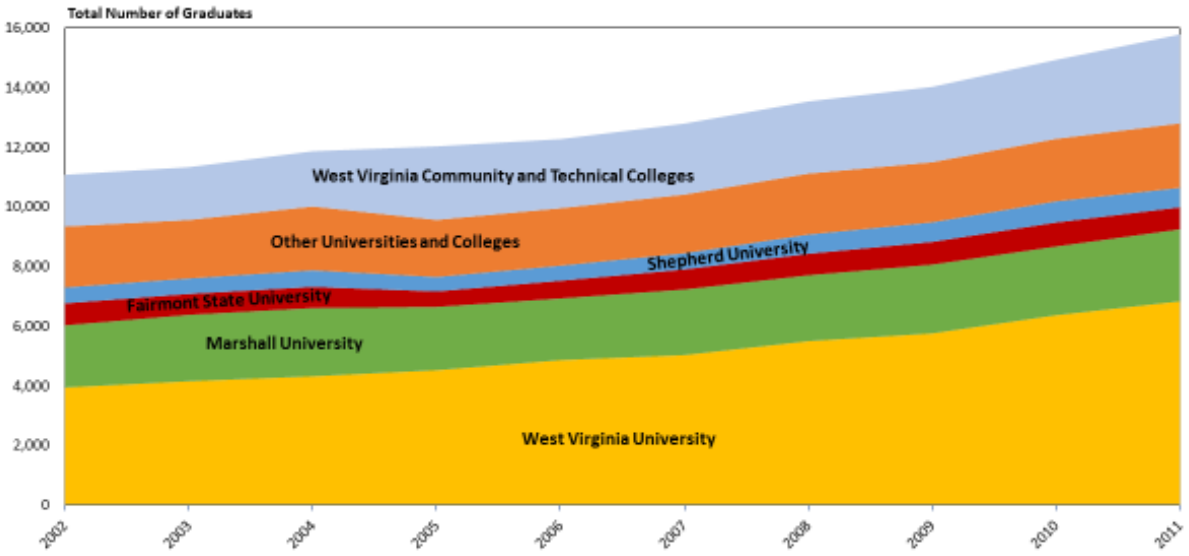
Figure 1: West Virginia Public Colleges and Universities

[8] At the time of this analysis, Bridgemont Community and Technical College and Kanawha Valley Community and Technical College were separate institutions. The two colleges completed a merger in the fall of 2014, becoming BridgeValley Community and Technical College.

Figure 2: West Virginia Public Technical and Community Colleges

In Figure 3 we depict the number of graduates for each West Virginia public college and university over the past decade or so. As illustrated, the total number of graduates annually in the state rose from just over 11,000 in 2002 to 16,000 by 2011, an increase of approximately 45 percent over the decade. Of the 16,000 that graduated in 2011, approximately 85 percent graduated from a four-year college or university, with the remainder graduating from a community or technical college. West Virginia University is the largest of the various institutions by a significant margin, accounting for 46 percent of the total graduates and approximately 55 percent of the graduates of the four-year colleges and universities in 2011. Marshall University was second largest in 2011, with 16 percent of total graduates, followed by Fairmont State University, Shepherd University and West Liberty State College with 5.0 percent, 4.4 percent, and 3.0 percent of total graduates respectively.

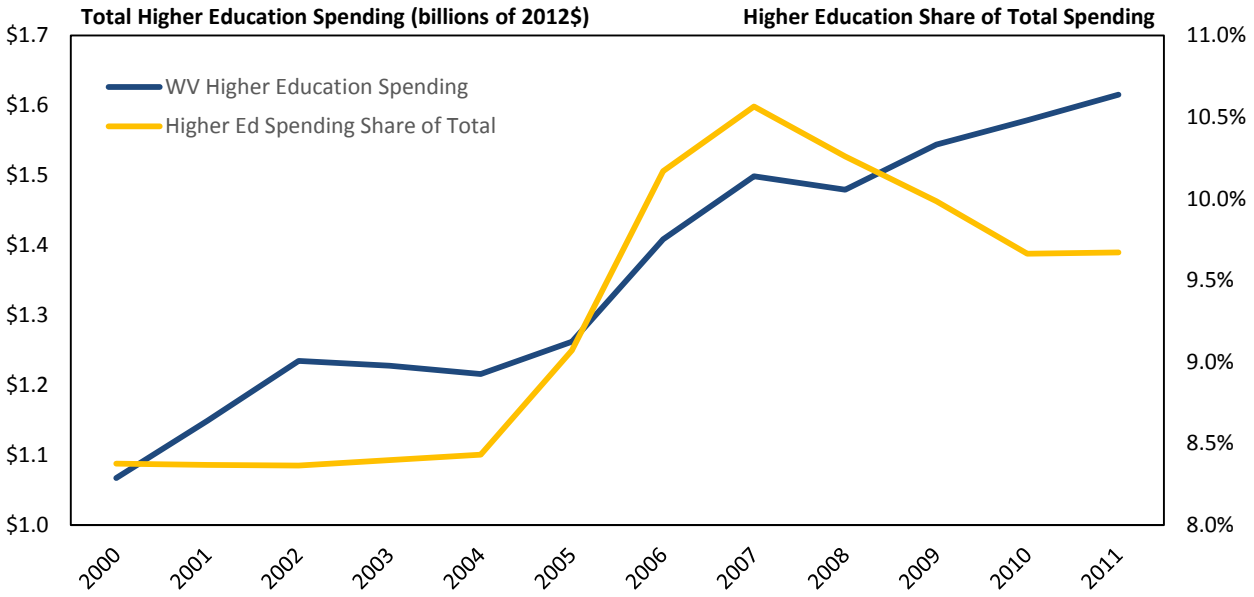
Figure 3: West Virginia Public College and University Graduates, by Institution



Source: West Virginia Higher Education and Policy Commission (www.wvhepc.org). Note: The calculation for West Virginia University contains graduates from WVU, WVU Parkersburg, and Potomac State College. WV Community and Technical Colleges contain graduates from WV Northern Comm. College, Marshall Comm. and Tech. College, Comm. and Tech. College of Shepherd, Fairmont State Comm. and Tech. College, WV State Comm. and Tech. College, Southern WV Comm. and Tech. College, Comm. and Tech. College at WVU Tech., WVU Institute of Technology, New River Comm. and Tech. College, Eastern WV Comm. and Tech. College. Other Universities include West Liberty University, Concord University, WV State University, Bluefield State College, WV School of Osteopathic Medicine, and Glenville State College.

In Figure 4 we depict total higher education spending in West Virginia over the years 2000 through 2011. As illustrated by the blue line in the figure, total spending on higher education in the state stood at approximately $1.6 billion in 2011,[9] which represents a rise of 51 percent over the level in 2000, after accounting for inflation. Higher education spending in the state as a share of total state and local government spending, as represented by the yellow line in the figure, was stable at around 8.4 percent of total spending from 2000 through 2004, but rose to 10.5 percent by 2007 and fell to 9.7 percent by 2011.

Figure 4: West Virginia Higher Education Spending

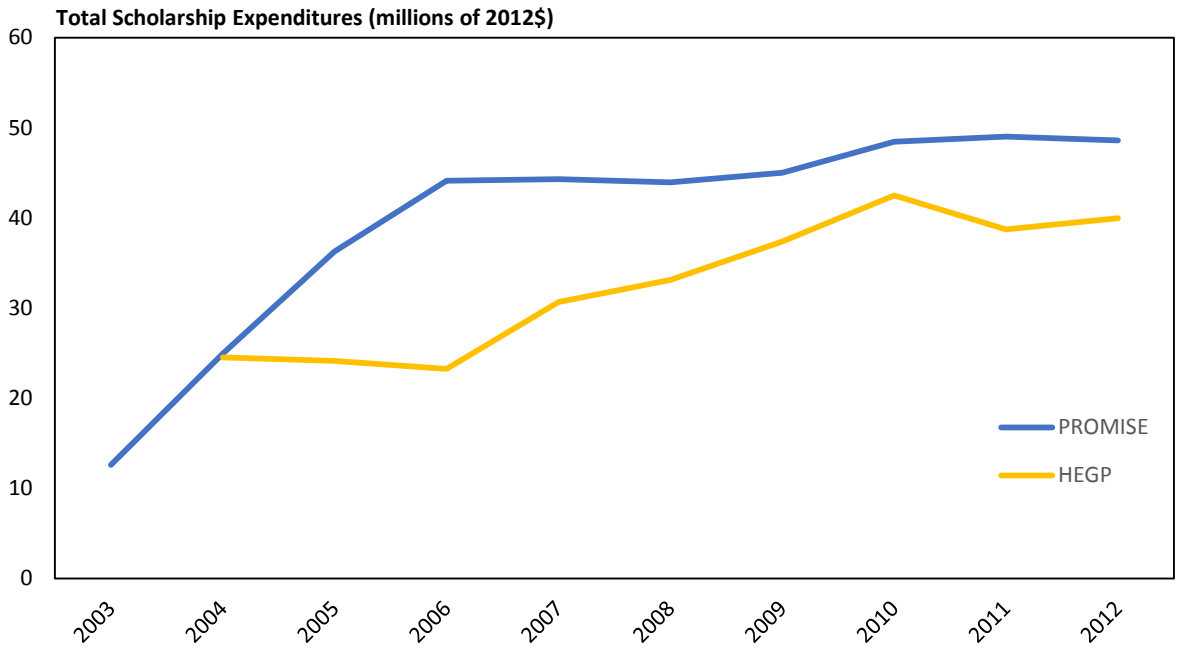


Source: US Census Bureau (www.census.gov)
Note: Data for 2001 and 2003 were not available and are averages of the previous and following year. Data are adjusted for inflation, presented here in 2012$.

[9] This total includes spending for the Providing Real Opportunities to Maximize In-state Student Excellence (PROMISE) scholarship program.

In Figure 5 we present data on the Providing Real Opportunities to Maximize In-state Student Excellence (PROMISE) and Higher Education Grant Program (HEGP) scholarship programs, the two largest state financial aid programs. Total spending on the PROMISE scholarship was $48.6 million in the 2012 academic year. This amount increased from $12.6 million in the 2003 academic year, when the program started, a 286 percent increase, after accounting for inflation. We see a similar trend when we examine spending on the HEGP. Inflation-adjusted spending on the HEGP rose from $24.5 million in the 2003 academic year to $40 million in the 2012 academic year, an increase of 63 percent.

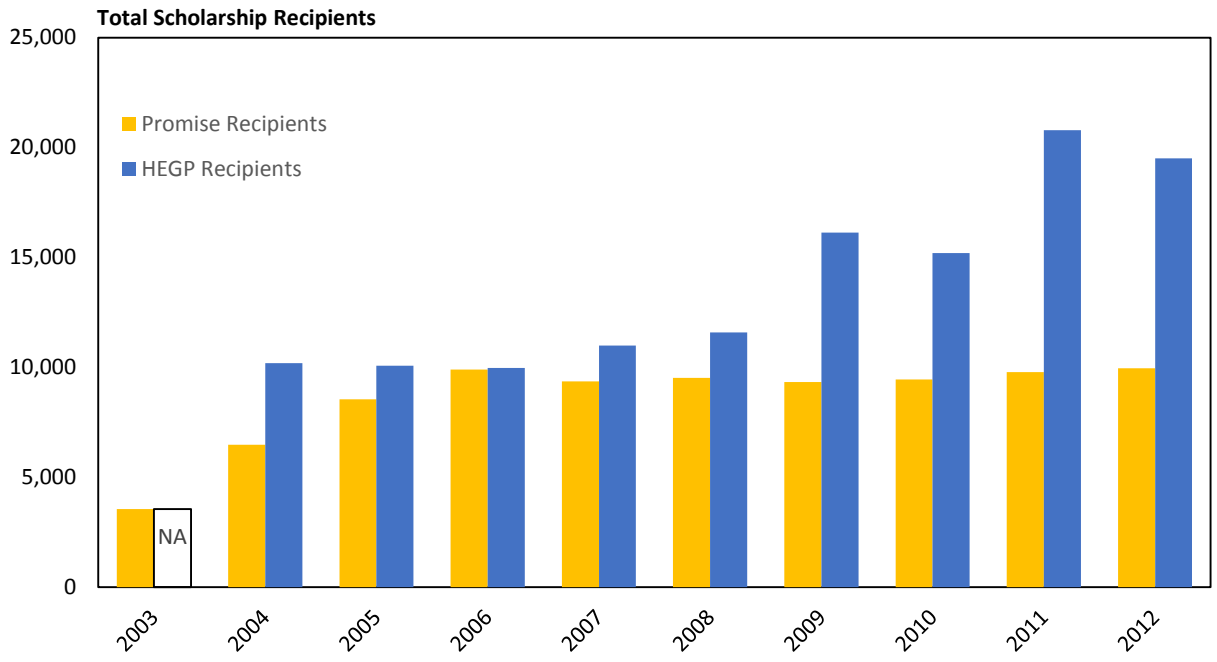
Figure 5: West Virginia PROMISE and HEGP Scholarship Spending by Year



Source: West Virginia Higher Education Policy Commission (www.wvhepc.org). Note: Figure is adjusted for inflation, presented here in 2012$. HEGP represents the West Virginia Higher Education Grant Program

Figure 6 depicts the number of PROMISE and HEGP scholarships awarded from 2003-2012. PROMISE scholarships increased dramatically from 2003-2006 rising from 3,555 to 9,904, an increase of 179 percent. However, from 2006 to 2012, the number of PROMISE scholarships remained relatively steady, ranging from a low of 9,362 in 2007 to a high of 9,954 in 2012. HEGP scholarships remained stable from 2003-2008, ranging from roughly 10,000-11,500 scholarship awards. In 2008, that number shot up to roughly 16,000 and by 2012 had risen to 19,500.[10] Total HEGP scholarships grew over the period 2004-2012 by 91 percent.

Figure 6: West Virginia PROMISE and HEGP Scholarship Recipients by Year

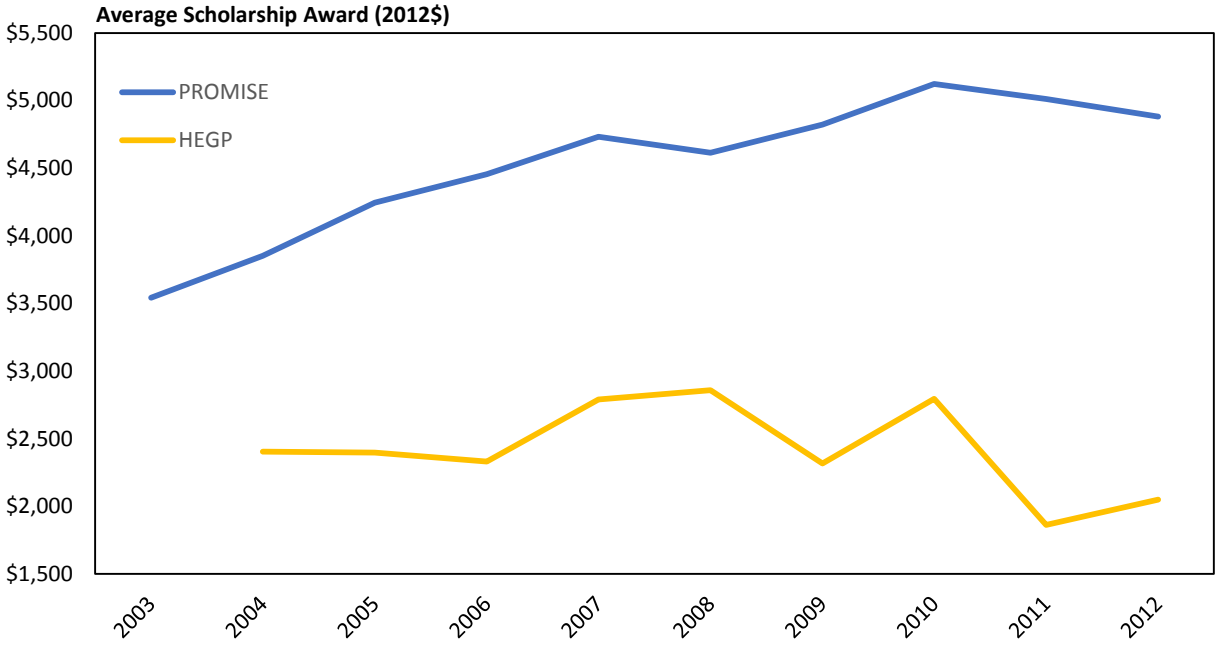


Source: West Virginia Higher Education Policy Commission (www.wvhepc.org)
Note: HEGP Schoarlship represents the West Virginia Higher Education Grant Program. Data for 2003 HEGP recipients wre not availabale.

[10] This increase was primarily due to West Virginia's linking the application of HEGP grants with the Free Application for Federal Student Aid, which had the effect of increasing the number of recipients in the HEGP program.

In Figure 7 we report the average scholarship award for PROMISE and HEGP recipients. The inflation-adjusted average PROMISE scholarship award in 2003 was roughly $3,500, which was the first year of the program. The figure rose to a high in 2009 of roughly $5,100, before decreasing slightly by 2012 to roughly $4,900.[11] Overall, the average PROMISE scholarship award grew by 38 percent over the period 2003-2012, after accounting for inflation. The average HEGP grant grew from roughly $2,400 in 2004 to nearly $2,900 in 2009. However, driven by the increase in total HEGP scholarships awarded, by 2012 the average inflation adjusted HEGP scholarship award had fallen to roughly $2,000. The average HEGP scholarship award fell by 15 percent from 2004-2012.

Figure 7: Average Award for PROMISE and HEGP Scholarship Recipients by Year



Source: West Virginia Higher Education Policy Commission (www.wvhepc.org). Note: Figure is adjusted for inflation, presented here in 2012$. HEGP represents the West Virginia Higher Education Grant Program.

[11] This decline is likely due to a change in the law that set a maximum scholarship of $4,750 for all new recipients after 2010.

3 Profile of 2009-2010 Graduating Class

The economic impact estimates below are based on members of the 2009-2010 graduating class from West Virginia's public colleges and universities who worked in the state in 2012. In this section we provide a brief profile of these individuals, which include graduates from public two-year community and technical colleges, as well as four-year colleges and universities. Of the 13,821 members of the 2009-2010 graduating class in total, we consider 6,309 – those who worked in the state in 2012 and earned an income of more than $10,000 that year.[12] These individuals received an average income for the year of $38,276. Among these individuals, 5,802 (92 percent) were classified as in-state students when starting college, and the remainder were classified as out-of-state. Table 1 reports the breakdown of our sample by gender. As illustrated, approximately 38 percent of our sample were men. The data also show a significant salary premium for men: in our sample men earned 13.2 percent more than women on average in 2012, without controlling for area of study, industry of occupation, or any other factor.

Table 1: Income by Gender

Gender	Number of Graduates	Share of Total Graduates	Average Annual Income
Female	3,939	62.4%	$36,467
Male	2,370	37.6%	$41,284

In Table 2 we report the distribution of our sample by degree type and average earnings across degree type. Bachelor's degree recipients – the most common degree category at over 51 percent of our sample – report an average annual income of $32,893. With an average income of $48,274, master's degree recipients reported significantly higher earnings in 2012 compared to bachelor's degree recipients. Doctoral degree recipients report the highest overall income, at $72,198, but doctoral degrees represent by far the smallest share of our sample (5 percent). Those who have earned an associate's degree (23.6 percent of our sample) report an average income of $34,141, which is, perhaps surprisingly, higher than those with a bachelor's degree. However, data (presented below) show that this pattern evolves as the time from graduation increases such that bachelor's degree recipients earn an average income that is substantially higher than that of associate's degree graduates several years after graduation.

[12] A total of 7,277 members of the 2010 graduating class worked in the state in 2010. We exclude those individuals from our analysis who earned less than $10,000 for the year because those individuals were likely working part-time.

Table 2: Number of Graduates and Average Income by Degree Type

Degree Category	Number of Graduates	Degree Type Share	Average Annual Income
Associate	1,487	23.6%	$34,141
Bachelor	3,235	51.3%	$32,893
Master	1,265	20.0%	$48,274
Doctoral	322	5.1%	$72,198

In Table 3 we report the distribution and average earnings of our sample by age at graduation in 2012. As illustrated, 2012 income was substantially higher for individuals who were older at graduation, as age at graduation increases through the age 46-50 grouping. Income for those aged 46-50 at graduation was $46,366 on average in 2012, compared to $34,117 for those aged 21-25, at graduation, representing a premium of 36 percent. After the 46-50 age-at-graduation group, however, reported 2012 income does decline with age. These figures do not control for the type of degree earned, however.

Table 3: Income by Age at Graduation

Age at Graduation	Number of Graduates	Average Annual Income
<=20	58	$24,919
21-25	3,221	$34,117
26-30	1,325	$40,874
31-35	540	$42,840
36-40	432	$44,833
41-45	273	$46,011
46-50	192	$46,366
51-55	158	$44,125
56-60	68	$47,293
61-65	21	$41,936
65+	7	n/d

n/d indicates the salary is not disclosed for privacy reasons.

In Table 4, we report the range of salaries in our sample across areas of study as well as 2012 income across area of study. As reported, the largest number of people in our sample focused on study in the health professions while at college or university (1,401). Education also accounts for a large portion of our sample (1,065), followed by business (896). Average earnings for 2012 varies widely across the sample. Earnings were highest on average for those who studied engineering while at college or

university ($54,752), followed closely by law ($54,359). Health professions also reports an average income that is significantly above average ($49,305).

Table 4: Income by Area of Study

Area of Study	Number of Graduates	Average Annual Income
Agriculture, agriculture operations	40	$31,585
Architecture and related services	3	n/d
Biological and biomedical sciences	120	$28,058
Business, management, marketing	896	$37,835
Communication, journalism	240	$30,975
Communications technologies/technicians	11	$18,918
Computer and information sciences	120	$36,540
Education	1,065	$37,232
Engineering	136	$54,752
Engineering technologies	166	$47,760
English language and literature/letters	69	$25,879
Family and consumer sciences/human sciences	48	$21,267
Foreign languages, literatures, and linguistics	22	$24,250
Health professions and related programs	1,401	$49,305
History	73	$26,662
Homeland security, law enforcement, firefighting	176	$30,069
Legal professions and studies	101	$54,359
Liberal arts/sciences, general studies, humanities	665	$32,933
Library science	23	$36,001
Mathematics and statistics	16	$31,944
Mechanic and repair technologies/technicians	116	$33,287
Multi/interdisciplinary studies	57	$34,376
Natural resources and conservation	73	$28,288
Parks, recreation, leisure, and fitness studies	12	$23,853
Personal and culinary services	7	n/d
Philosophy and religious studies	42	$35,670
Physical sciences	21	$28,832
Precision production	161	$27,811
Psychology	102	$30,177
Public administration and social service professions	52	$35,223
Science technologies/technicians	184	$28,471
Social sciences	91	$25,813
Visual and performing arts	40	$31,585

n/d indicates the salary is not disclosed for privacy reasons.

As illustrated in Table 5, members of the 2010 graduating class in our sample worked in a wide variety of industries in 2012. The largest number of graduates worked in health care and social assistance (2,065 graduates), which was followed by educational services (1,699). Retail trade was a distant third in terms of industry placement with 653 graduates, followed by professional services (562) and public administration (653). Income also varies widely by industry. Those who worked in the mining, quarrying, and oil and gas extraction industry earned the highest income with an average of over $62,000. Utilities was next, where workers earned an average of over $54,000. Income varies widely across industries. Workers in the accommodation and food services industry earned an average of $14,619, which represents only 23 percent of average earnings in the highest-earning industry.

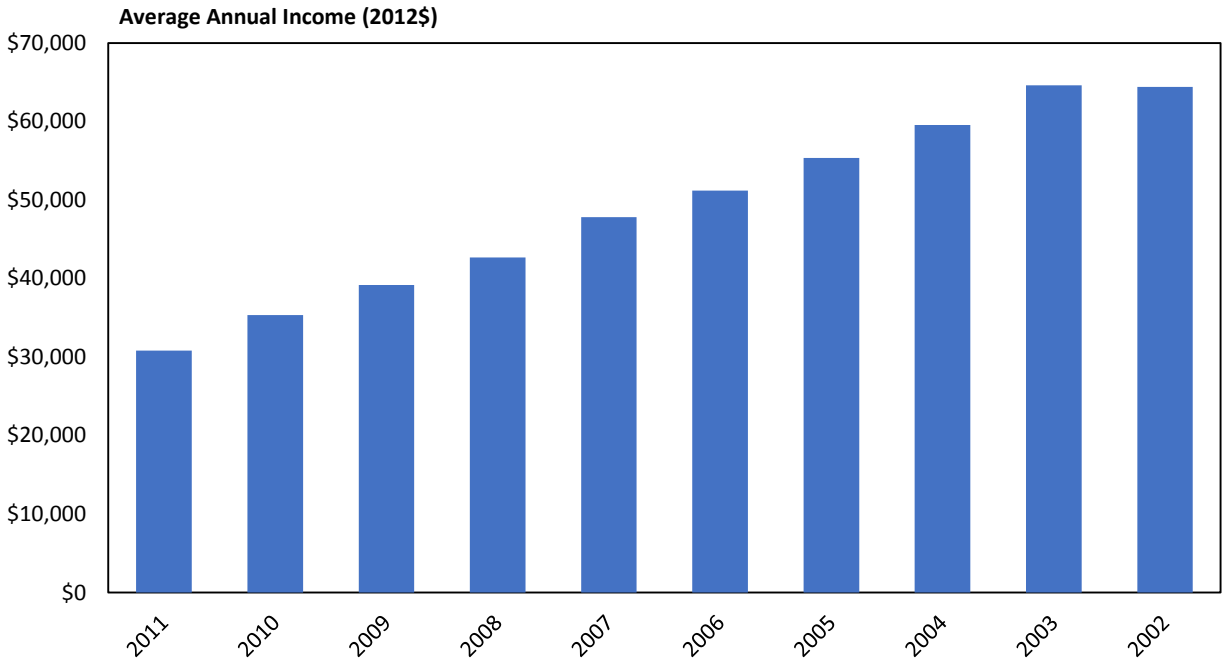
Table 5: Income by Industry

NAICS Industry	Number of Graduates	Average Annual Income
Accommodation and Food Services	394	$14,619
Administrative Support and Waste Management	336	$23,802
Agriculture, Forestry, Fishing and Hunting	4	n/d
Arts, Entertainment, and Recreation	89	$12,389
Construction	115	$30,992
Educational Services	1699	$33,771
Finance and Insurance	247	$26,809
Health Care and Social Assistance	2,065	$37,600
Information	144	$30,551
Management of Companies and Enterprises	36	$42,498
Manufacturing	242	$46,502
Mining, Quarrying, and Oil and Gas Extraction	117	$62,918
Other Services (except Public Administration)	157	$20,667
Professional, Scientific, and Technical Services	562	$36,821
Public Administration	469	$29,783
Real Estate and Rental and Leasing	55	$32,051
Retail Trade	653	$25,168
Transportation and Warehousing	51	$37,211
Unclassifiable	14	$24,070
Utilities	43	$54,583
Wholesale Trade	142	$35,920
Total*	7,634	$32,815

n/d indicates the salary is not disclosed for privacy reasons.
*** Note: The total here is larger than the number of graduates from above because some graduates may have multiple jobs.**

Our approach below relies on projecting how income will change over time for our sample. As such, in Figure 8 we report average income in 2012 for every public college and university graduate in West Virginia, by graduating class, for those who graduated between the 2001-2002 academic year and the 2010-2011 academic year. As illustrated, income is substantially higher for those who graduated in earlier years, and presumably have greater work experience, compared to those who graduated in recent years. Overall, 2012 average income rises from just over $30,000 for members of the 2011 graduating class to around $65,000 for members of the 2001 graduating class. Our income projections below will be based on this pattern of income growth over time.

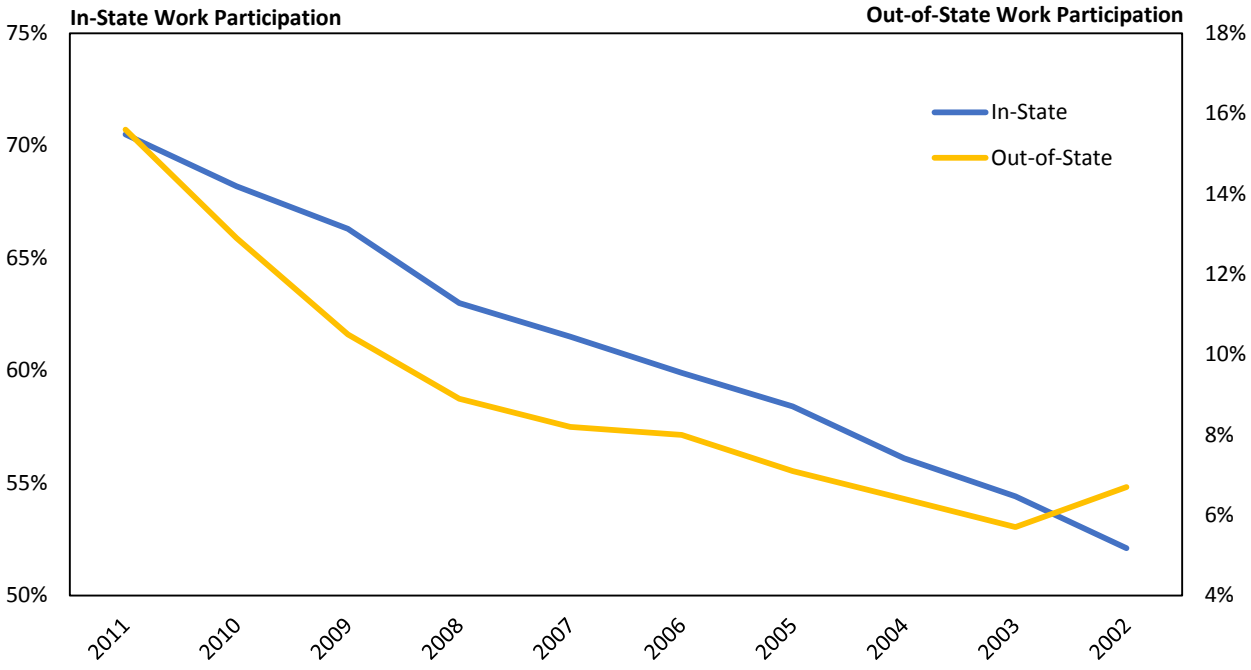
Figure 8: 2012 Income by Graduation Year



Source: Author Calculations based on data from the West Virginia Higher Education Policy Commission (www.wvhepc.org). Note: Figure is adjusted for inflation, presented here in 2012$.

Our methodology also relies on how the proportion of graduates who work in the state changes as time from graduation increases. As such, in Figure 9, we depict the share of graduates from each graduating class between the 2001-2002 academic year through the 2010-2011 academic year who worked in the state in 2012. As illustrated, the work participation rate falls as the time from graduation increases. For in-state students (blue line), the 2012 work participation rate falls from around 70 percent for the 2011 graduating class to around 52 percent for the 2002 class. For out-of-state students, the rate diminishes from nearly 16 percent for the 2011 class to around 7 percent for the 2002 class. This labor force attrition occurs for various reasons: graduates may leave the state to work elsewhere; they may become homemakers; they may quit work because of health; etc. As with the income trends presented in Figure 8, we use this pattern of diminishing work participation in our economic impact estimates below.

Figure 9: 2012 Work Participation Rate by Graduation Year



Source: Author calculations based on data from the West Virginia Higher Education Policy Commission (www.wvhepc.org).

4 Economic Model and Data

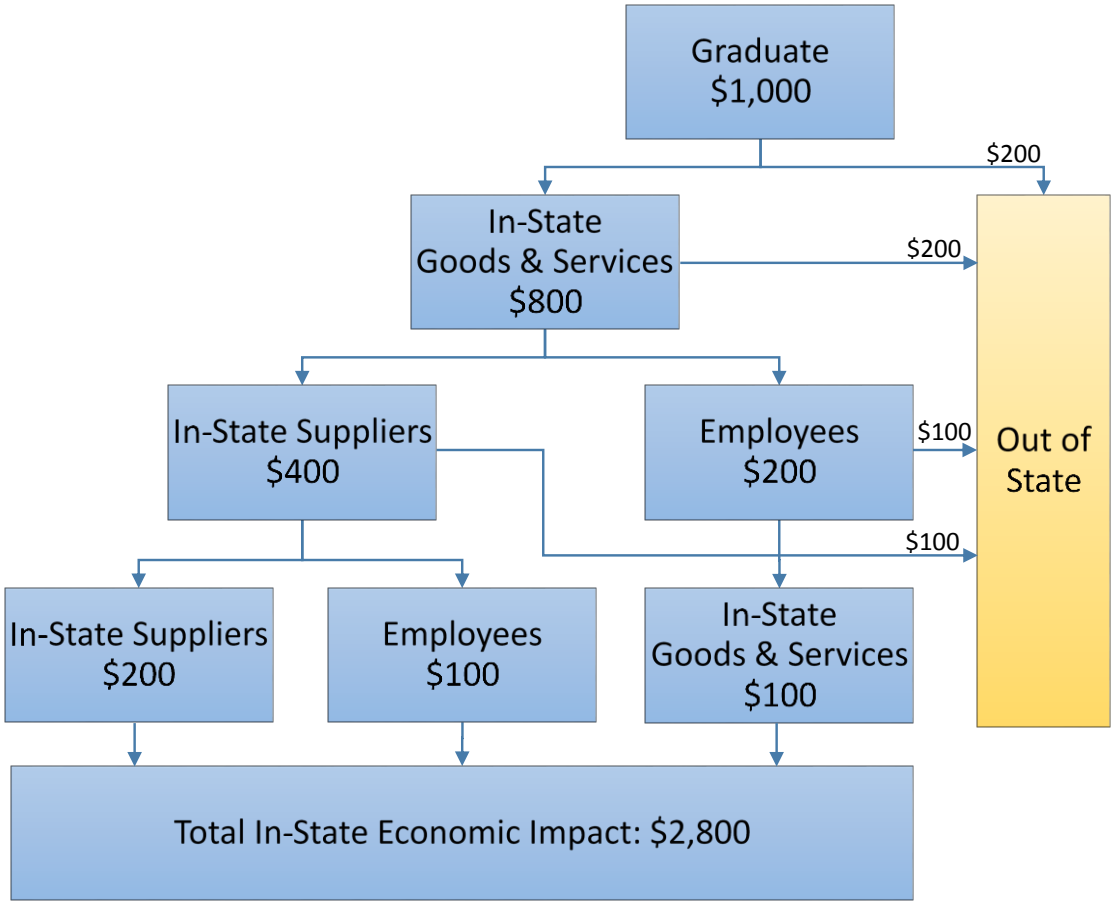
In this study we estimate the economic impact that graduates of West Virginia's public higher educational institutions in the 2009-2010 academic year will generate in the state's economy over their careers. We consider two components of the graduates' overall impact. First, we consider the additional demand for goods and services in the state that result from the higher incomes that college graduates typically earn, compared to those with only high school diplomas. This effect is termed the "demand-side effect" below. Second, we consider increased levels of productivity that firms accrue as a result of having employees with higher levels of skill that result from higher education – termed "supply-side effect." We discuss these two components of the study in turn.

4.1 Demand-side Effect

It is well known that those with a college degree typically receive a higher income than those without such degrees, as discussed above. This additional income is a direct boost to the state's economy. However, the overall economic impact of this additional income does not end with this initial income premium, but instead will have broader economic benefits to the state's economy to the extent that the premium is spent in the state.

As illustrated in Figure 10, suppose that a representative college graduate spends $1,000, of which $800 is spent at businesses in the state and the rest out of the state. The money spent locally represents an additional economic benefit to the state. In the second round of spending, these businesses pay their suppliers and employees, who in turn purchase goods and services from local businesses. Lastly in the third round, the suppliers from the second round also pay their suppliers and employees. At each stage, some of the additional money will be spent outside of the state, and thus does not have impacts within West Virginia. Overall, if we combine these successive rounds of spending we arrive at the total economic impact of the initial income premium. In the example below we would sum the blue boxes to arrive at the total impact of $2,800. This general idea that the overall economic impact of an economic event may be much larger than the event directly is termed the "multiplier effect."

Figure 10: Multiplier Effect Illustration



The first step in our estimation process is to estimate the additional income that graduates of West Virginia's colleges and universities who work within the state receive, compared to those possessing only a high school diploma. We estimate this income premium over a 20-year period. Once we obtain this estimate, which will represent the direct economic impact of the graduates' income, we then use a sophisticated economic model to estimate the overall economic impact in West Virginia of these graduates over a 20-year period, based on the multiplier effect theory discussed above.[13] For our analysis we consider graduates of public colleges and universities for the 2009-2010 academic year, assuming that they are representative of typical graduating classes of recent years.[14] Our basic dataset

[13] Our analysis uses the REMI economic modeling system, which is discussed in more detail below. For more detail on this system see www.remi.com.

[14] A cursory examination of work participation, income, field of study, field of work, etc. of graduating classes over the past decade does not reveal any obvious indication that the 2010 class is atypical.

includes information on all West Virginia public college and university graduates who worked in the state in 2012 and was provided by the West Virginia Higher Education Policy Commission. These data were then matched with records maintained by WorkForce West Virginia on earnings and the industry in which each graduate worked.

In order to estimate the income premium that college graduates receive, we begin with actual earnings for each graduate in our sample for 2012, a total of 6,309 men and women as discussed above. We then project earnings based on patterns reflected in a broader set of data that includes graduates from West Virginia public colleges and universities between the years 1996 and 2011, who were observed to be working in the state between 2003 and 2012. Our projections are based on three key individual characteristics, all of which were statistically determined to be important explanatory factors of income and the probability that a graduate works in West Virginia: the industry in which the graduate worked in 2012; the type of degree earned (Associate, Bachelor, Master, Doctoral); and current age. See the Appendix for more detailed information on our data and on the statistical approach behind our income projections.

Once we project the income that each individual in our sample will receive over the 20-year period of analysis, we then estimate what they would have earned if they had only received a high school diploma.[15] Here we simply rely on the average wage earned statewide by those with only a high school diploma, accounting for age. In Figure 11 we report our projected average income levels over our 20-year period of analysis for each degree category. The figure also includes our projection for the average income for those with only a high school diploma over the period of analysis, which serves as the counterfactual in our analysis below. As illustrated, the projected premium associated with any college degree over a high school is substantial. Those with only a high school diploma are projected to earn around $22,000 in the first year of our period of analysis,[16] which is around 40 percent lower than the beginning wages for those with a bachelor's degree. Further, this income gap widens substantially over time as estimated income for those with a high school diploma is projected to remain mostly flat, in contrast to healthier estimated growth for those with any college degree.

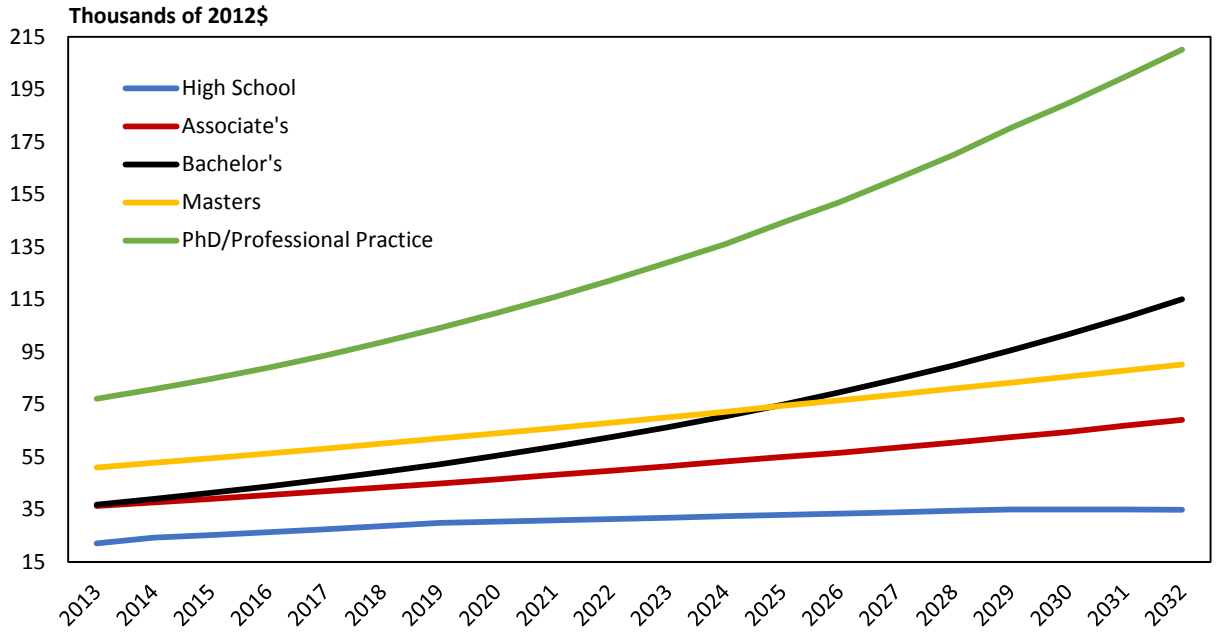
In addition, our estimates illustrate a sizeable variation among degree types. Those with a bachelor's degree are projected to earn roughly the same as those with an associate's degree during the first four years after graduation. However, after four years, those with a bachelor's degree are projected to earn substantially more. Individuals with a master's degree are projected to earn around $14,000 more than those with a bachelor's degree in the first year after graduation; however income for bachelor's degree recipients is projected to rise faster than that of master's degree recipients, such that by the 14th year

[15] Data for earnings by those with only a high school diploma provided by US Census Bureau, American Community Survey.

[16] For the sake of this analysis, we assume high school earnings begin at age 24.

after graduation, bachelor's degree recipients are projected to earn more.[17] Those with doctoral or professional degrees are projected to earn substantially more than those with the next highest income throughout the period of analysis, and the doctoral-degree-premium is projected to increase over time.

Figure 11: Projected Average Annual Income, by Degree Type

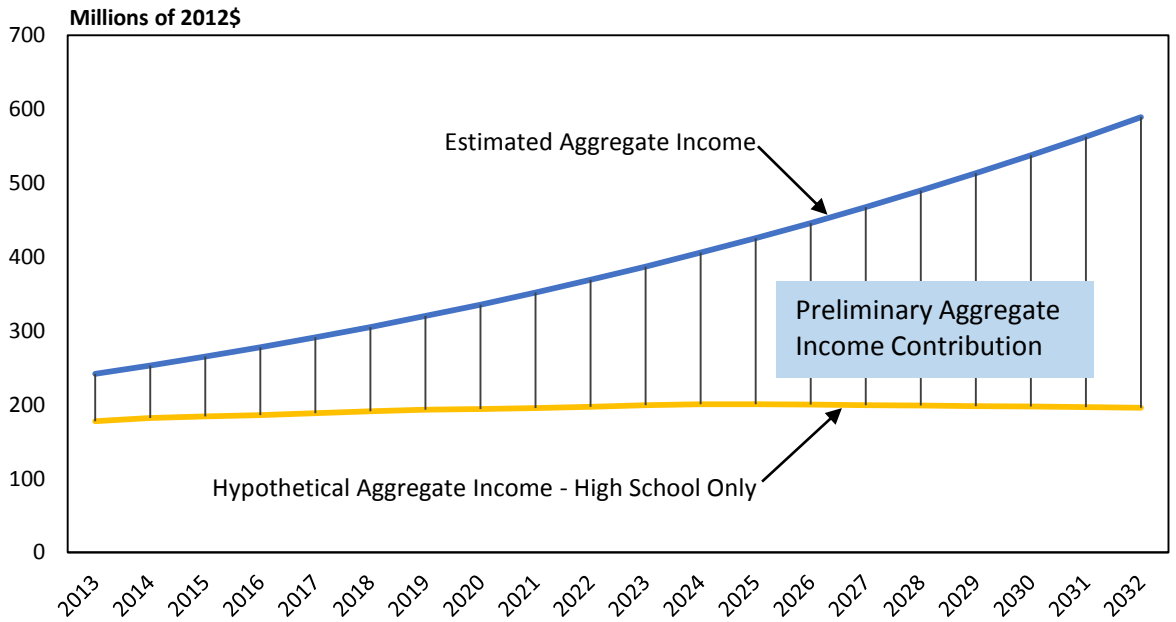


Source: Author calculations based on data from the West Virginia Higher Education Policy Commission (www.wvhepc.org). High School wages were calculated based on the 2012 American Community Survey PUMS.

[17] The difference in growth rates is likely due to the fact that a large proportion of master's degrees are awarded in education, indicating these workers are primary- and secondary-school teachers. Potential earnings growth is somewhat limited in this field.

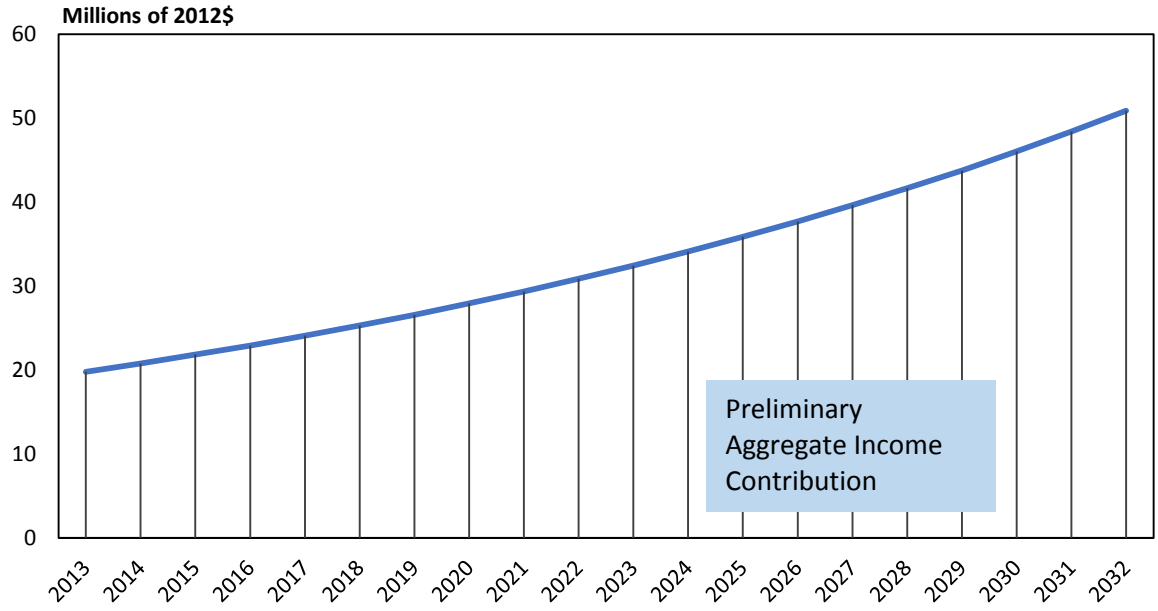
Our next step is to aggregate the projected earnings of all of the individuals in the sample by year. As discussed above, for in-state students, we simply assume that these individuals would work in the state and earn an income based on that of the typical individual with only a high school diploma if they had not received higher levels of education. Therefore, in order to consider the economic impact of their earnings premium, we subtract their estimated aggregate earnings, based on the averages presented in Figure 11, and subtract from them their earnings that they would have likely earned in our counterfactual scenario – if they had only a high school diploma. For out-of-state students, however, we assume that they would not have migrated to West Virginia to work if not for first coming here for higher education. Therefore, for these individuals we consider their entire income as an addition to the state's economy, not just the premium that they earn over their likely earnings with only a high school diploma. Overall, our approach is illustrated in Figure 12 for in-state students and in Figure 13 for out-of-state students.

Figure 12: Preliminary Projected Gross Income Contribution, In-state Students



Source: Author calculations based on data from the West Virginia Higher Education Policy Commission (www.wvhepc.org) and the US Bureau of Labor Statistics.

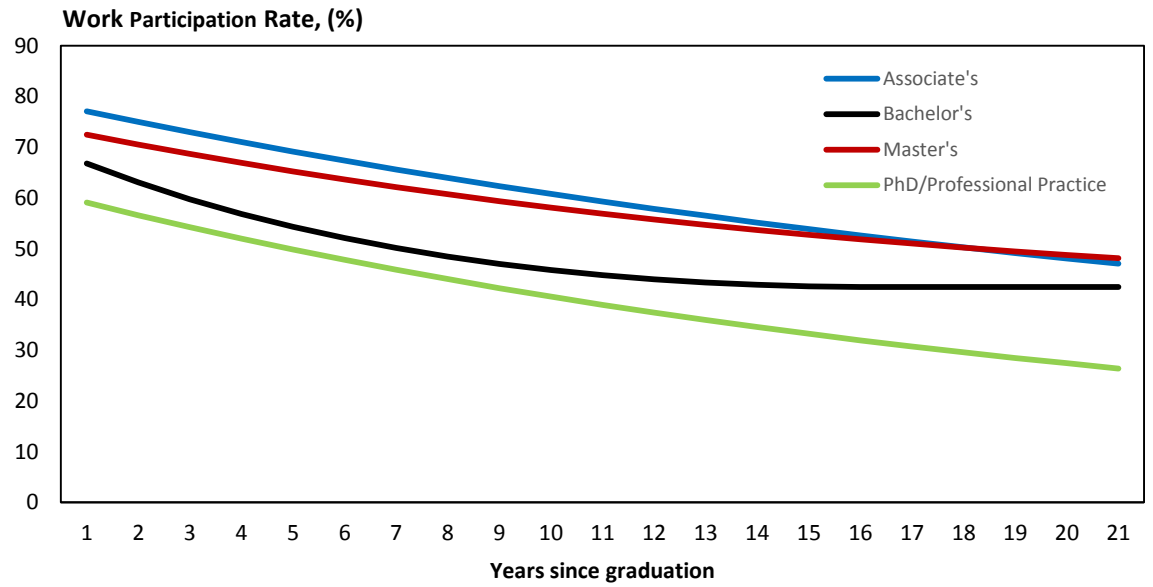
Figure 13: Preliminary Projected Gross Income Contribution, Out-of-state Students



Source: Author calculations based on data from the West Virginia Higher Education Policy Commission (www.wvhepc.org) and the US Bureau of Labor Statistics.

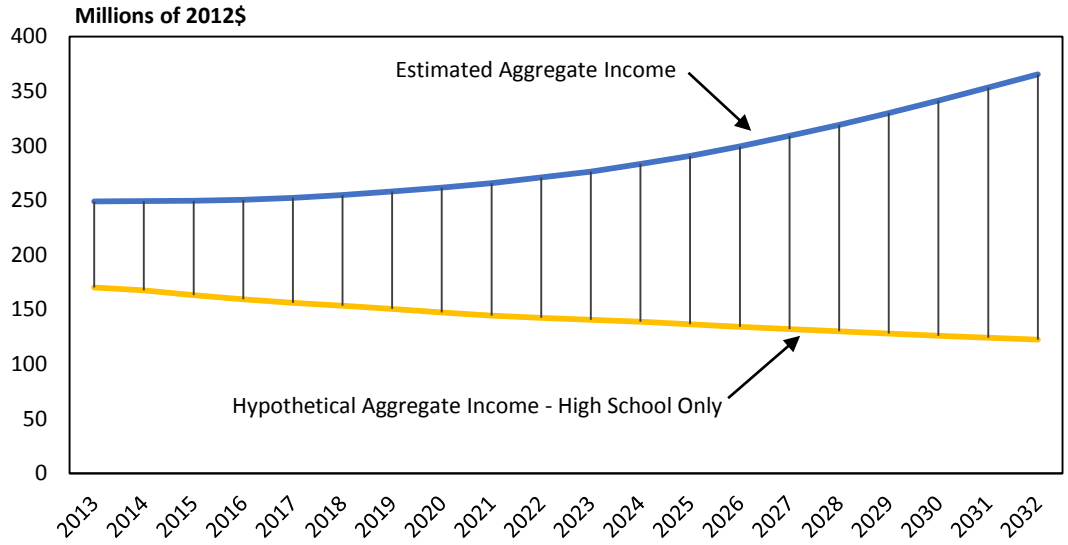
After aggregating projected income across individuals, our next step is to account for the fact that individuals will likely leave the West Virginia work force over time due to various reasons, such as retirement, caring for family members, or leaving the state for economic opportunities elsewhere. These exits from the local labor force reduce the overall economic impact of the men and women who compose our sample. As such, we reduce our projected earnings over time based on work participation patterns observed over the past decade. Our work participation rate adjustments account for degree type and for whether each individual was an in-state or out-of-state student. In Figure 14 we report forecast work participation rates for in-state students by degree type over the study period. Consistent with Figure 9, the projected work participation rate falls substantially over the time-frame of this study. In-state bachelor's degree holders, for example, start at a work participation rate of more than 67 percent, but that rate falls by more than one-third by the end of period. In Figures 15 and 16 and we report revised versions of Figures 12 and 13, after accounting for projected labor force attrition.

Figure 14: Projected Work Participation Rate, In-state Graduates, by Degree Type



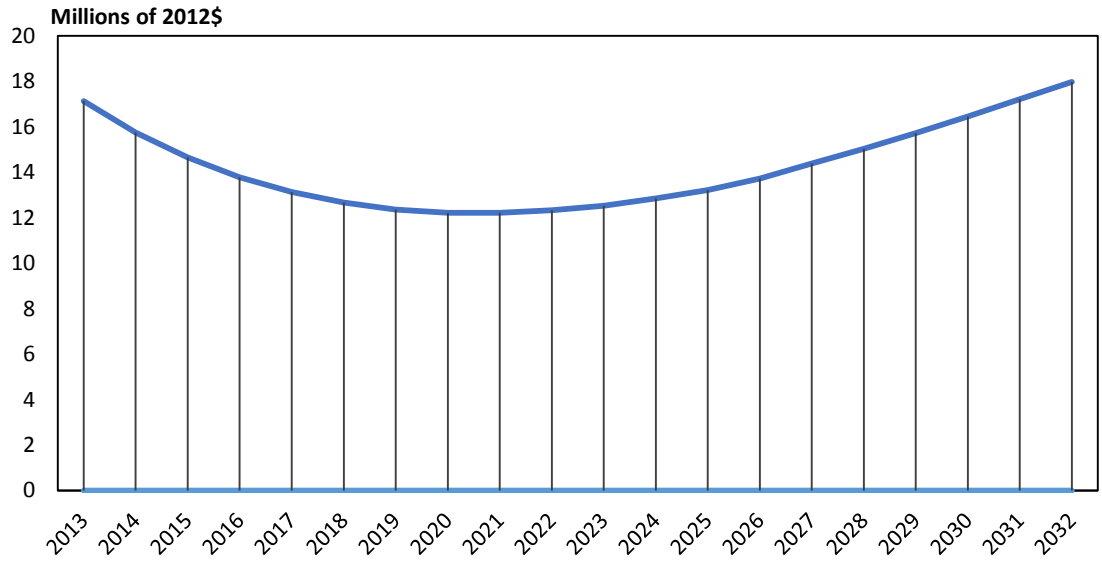
Source: Author calculations based on data from the West Virginia Higher Education Policy Commission (www.wvhepc.org).

Figure 15: Projected Gross Income Contribution, In-State Students



Source: Author calculations based on data from the West Virginia Higher Education Policy Commission (www.wvhepc.org).

Figure 16: Projected Gross Income Contribution, Out-of-State Students



Source: Author calculations based on data from the West Virginia Higher Education Policy Commission (www.wvhepc.org).

Our final adjustment to the demand-side component of our analysis concerns what is commonly referred to as "ability bias." This is based on the premise that individuals who choose to obtain a college

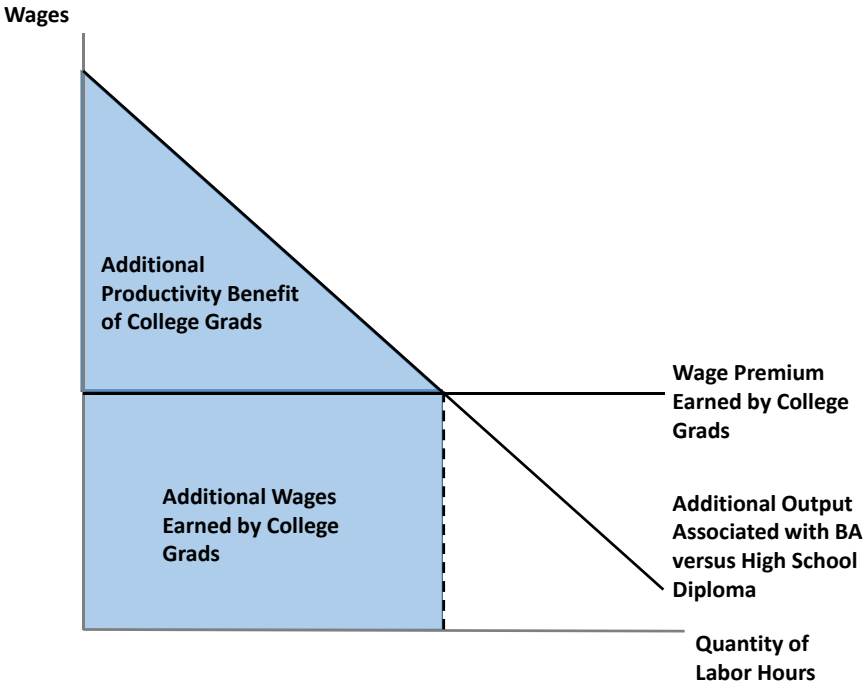
degree tend to have a greater initial ability, compared to those who do not choose to do so. As a result, since a higher initial ability would tend to lead to a higher wage, part of the income premium that is observed for college graduates is a result of inherent ability, in addition to the enhanced skills and ability that result from higher education. To account for ability bias, we adjust our estimated aggregate income premium reported in Figures 15 and 16 down by 10 percent for both in-state and out-of-state students.[18] This results in final direct income contribution levels of $2.6 billion for in-state students and $257 million for out-of-state students for the overall forecast period.

4.2 Supply-Side Effect

In the second part of our analysis we incorporate the way in which higher education enhances worker productivity in an economic system more broadly. Our general approach is illustrated in Figure 17. The higher level of skills that college graduates typically possess, relative to those with only a high school diploma, is illustrated in the figure by the line labeled "Additional Output Associated with BA versus High School Diploma." We expect that the additional output associated with a college degree diminishes as labor increases, as illustrated by the downward sloping line. The area under that line, up to the level of labor employed, illustrates the total output gain resulting from the higher skill level enjoyed by college graduates. However, a portion of that productivity gain is transferred to the college graduates themselves in the form of wages and salaries, the economic impact of which is accounted for in our discussion above as a demand-side effect on the state's economy. This portion – labeled "Additional Wages Earned by College Grads" – is accounted for in section 4.1 above. We use our economic modeling system to estimate the additional output gains that firms enjoy, net of the higher wages paid – labeled "Additional Productivity Benefit of College Grads."

[18] Ability bias has been estimated at between 6 and 13 percent of wages, with a mean of approximately 10 percent. See McMahon, Walter W. "Higher Learning, Greater Good: The Private and Social Benefits of Higher Education." Baltimore, MD: Johns Hopkins University Press, 2009.

Figure 17: Dual Effects That Are Considered



4.3 The REMI Model

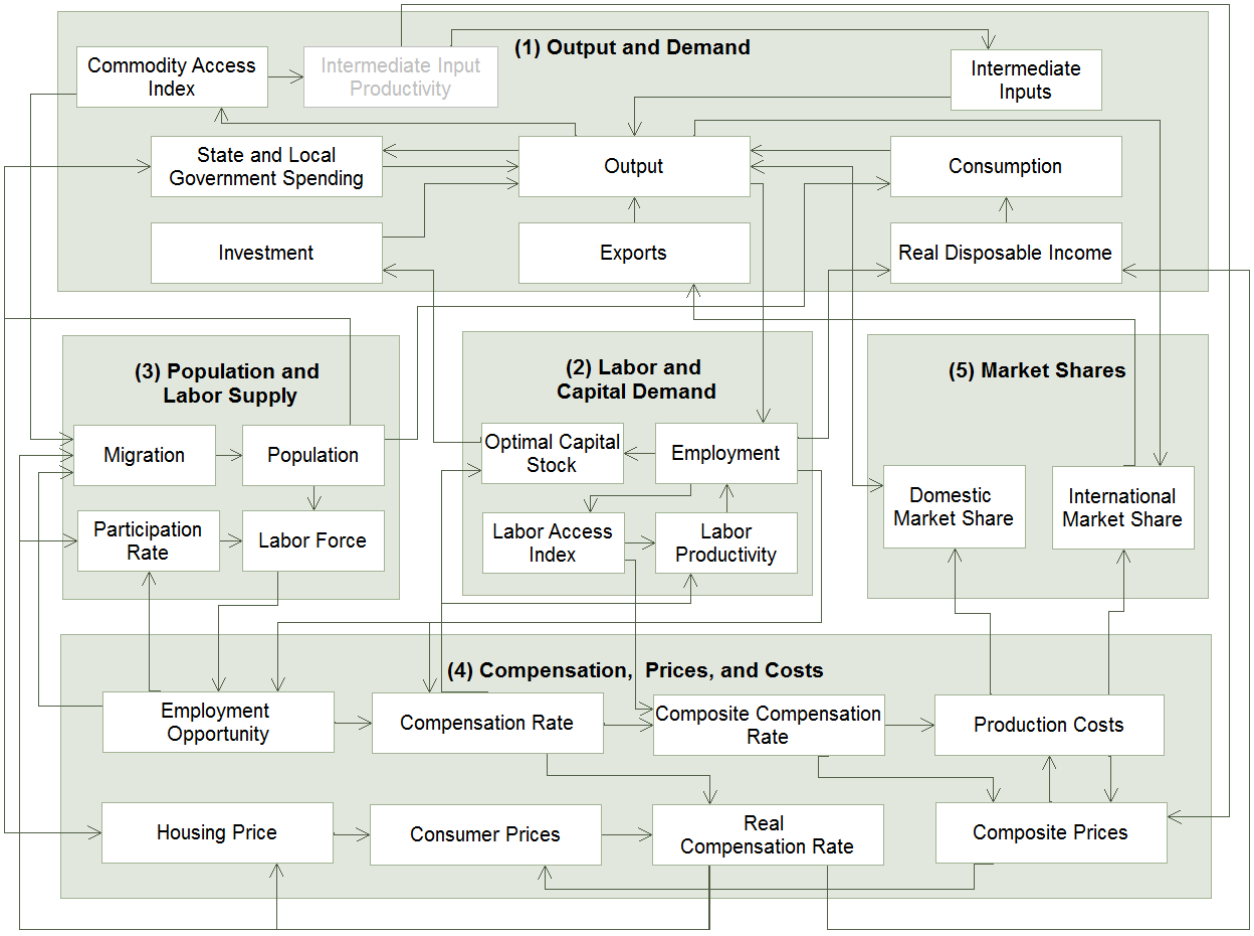
To estimate the impact of the West Virginia's college graduates, we apply the REMI PI+ model, a widely used structural economic forecasting and policy analysis model. This model integrates input-output, computable general equilibrium, econometric analysis, and economic geography methodologies. The input-output components define the inter-industry relationships, which specifies what and how many inputs are required to produce one unit of certain output. The model takes into account the feedback effects that come from the market once the initial impact runs through the goods-services market and resources (capital and labor) market. This dynamic aspect of the model allows the impact to evolve over time as it responds to market forces. The model also takes into account the agglomeration effect, which recognizes the effect of output or firm size on accessibility to resources. This will affect the average production costs, and in turn the amount of outputs produced. In short this model offers a more comprehensive, and accordingly more realistic, method of measuring an economic impact than the stand-alone model such as input-output, general equilibrium, or econometric model.

This REMI PI+ model consists of five major blocks including: (1) Output and Demand (2) Labor and Capital Demand, (3) Population and Labor Supply, (4) Wages, Prices, and Profits, and (5) Market Shares, which are illustrated in Figure 18. The Output and Demand block represents the total output or aggregate demand, which is the sum of consumption, investment, government spending, and exports minus imports. This block contains the input-output equations. The Labor and Capital Demand block represents the total demand for labor and capital, and contains labor intensity and labor productivity equations. The Population and Labor Supply block represents the labor supply, and contains labor supply

or labor participation rate and migration equations. Wages, Prices, and Profits block contains composite prices, determinants of production costs, price deflator, housing prices, and compensation equations. The Market Shares block includes equations that compute the share of inputs provided locally and the share of output consumed locally or exported.

These five blocks interact simultaneously and their interactions are governed by numerous equations contained in each of those blocks. A new economic event or new policy will initially affect one of these five blocks, which will then respond simultaneously. The model estimates the magnitude of the impact by solving those simultaneous equations.

Figure 18: Overview of the REMI Model



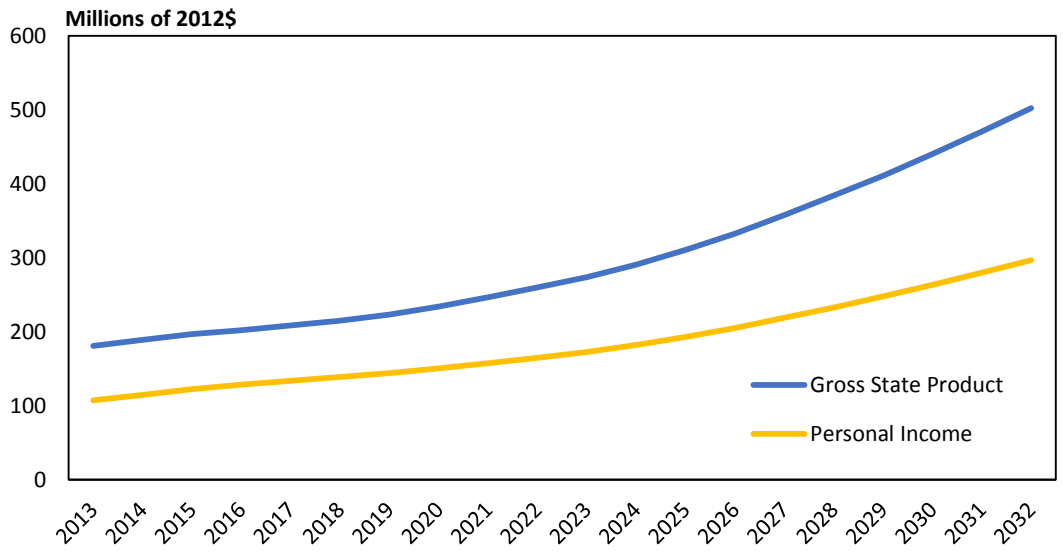
5 Economic Impact Estimates

In this section we present the results of our estimation process described above. In Figure 19 we report the estimated total economic impact of our sample of college graduates in terms of two alternate measures of economic activity: gross state product (GSP) and personal income. We consider these alternate measures for added robustness. GSP captures total economic output. Personal income captures all forms of household income. The two metrics differ to the extent that businesses retain earnings and capital assets depreciate. Our estimates are reported by year over our 20-year period of analysis. Our calculations account for inflation, but not for discounting future dollars to the present value.

As illustrated, we estimate that the state will enjoy a level of personal income that is around $100 million higher in the first year of our analysis as a result of the college graduates in our sample than it would have if these men and women had only a high school diploma. That figure rises to nearly $300 million for the 20th year of our period of analysis, as the individuals gain more experience, become more productive, and earn higher incomes. Overall, we estimate that personal income in the state will be approximately $3.6 billion higher over the entire 20-year period analysis as a result of the men and women in the 2010 graduating class who compose our sample.

Also reported in the Figure, GSP is estimated to be approximately $180 million higher in the first year of our analysis, rising to more than $500 million by the final year. Overall, we estimate an addition to GSP of $5.9 billion to the state's economy over the 20-year period as a result of the 2010 graduating class who compose our sample.

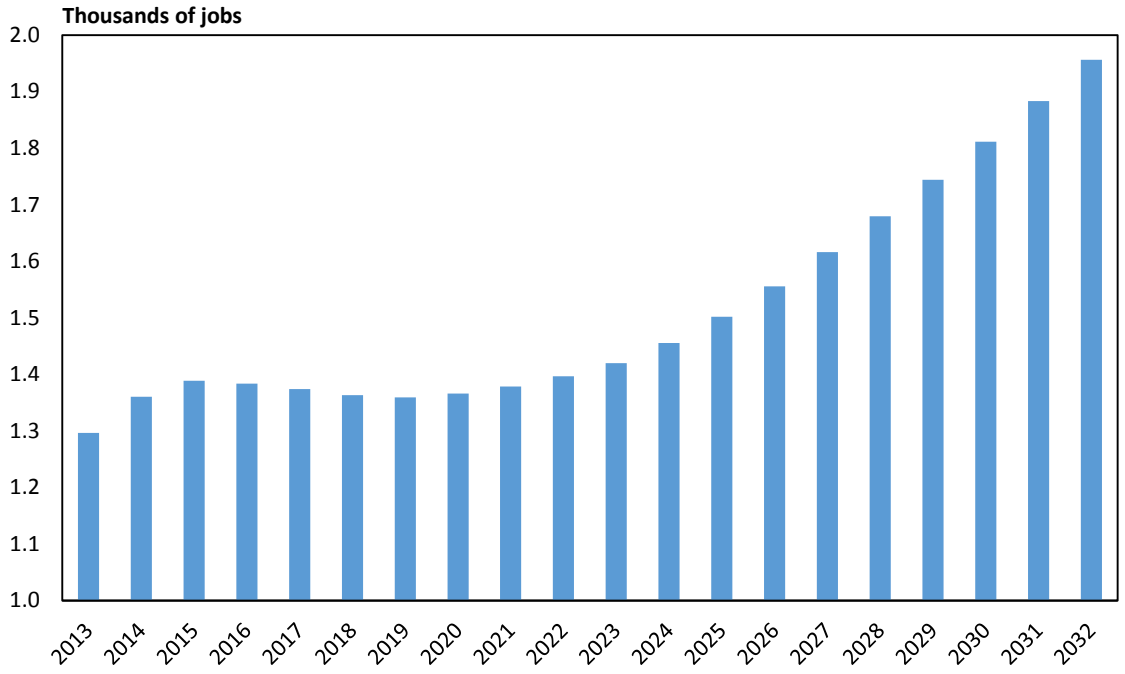
Figure 19: Estimated Impact of 2010 Graduates: GSP and Personal Income



Source: Author calculations based on REMI model results.

In Figure 20 we present the estimated boost to statewide employment generated by our sample of graduates. To be clear, the jobs reported in this figure represent additional jobs that are supported as a result of the income and productivity gains associated with our sample of graduates, and this figure does not represent the jobs held by the graduates themselves. As illustrated, the number of jobs supported by this spending totals almost 1,300 jobs in the first year after graduation, rising to almost two thousand jobs in the 20th year. Thus the additional spending of this graduating class is projected to support nearly one-third of their numbers in additional jobs over the course of their working lives.

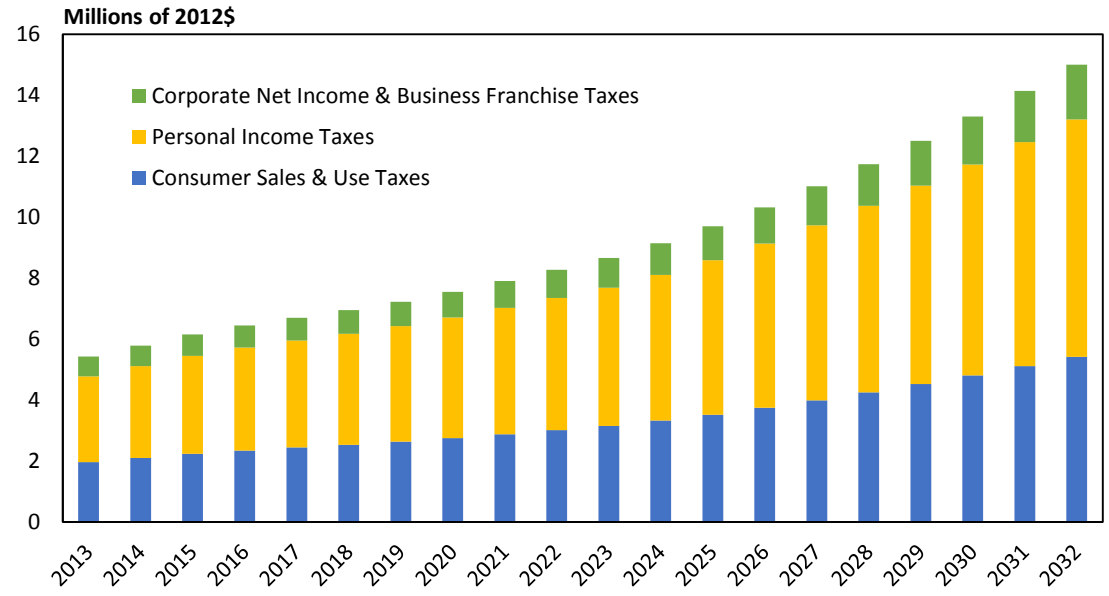
Figure 20: Estimated Impact of 2010 Graduates: Employment



Source: Author calculations based on REMI model results.

In Figure 21 we report the estimated tax impact of our sample of graduates. Over 20 years, these graduates are projected to generate $184 million in taxes. These taxes include personal income taxes, and sales and use taxes that the individuals will pay, as well as additional corporate net income taxes generated from additional economic activity. This tax impact is estimated as a direct result of the additional economic activity reflected in Figure 18 and effectively assumes the same tax rates and tax base that were in effect in 2012.

Figure 21: Estimated Impact of 2010 Graduates: Tax Revenue



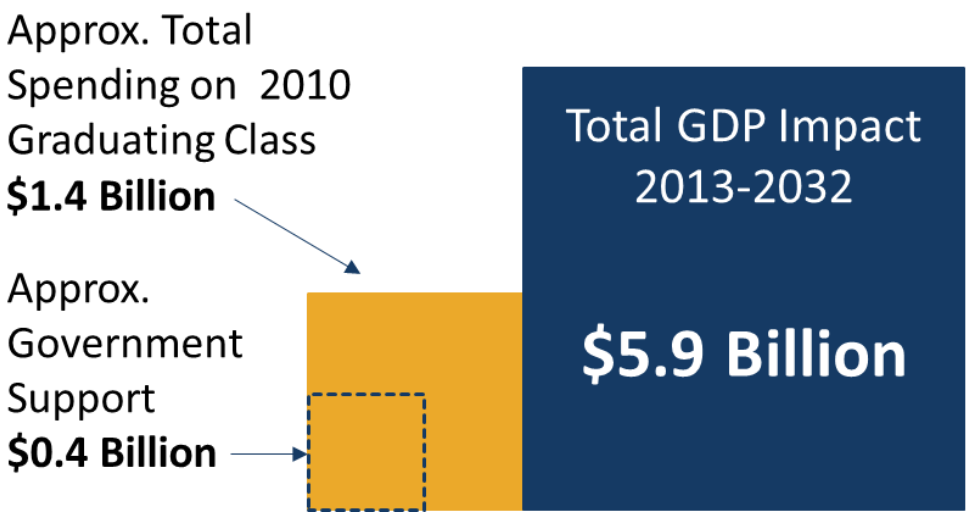
Source: Author calculations based on REMI model results.

6 Conclusions and Caveats

In this report we estimated the economic impact of 2009-2010 graduates of West Virginia's public colleges and universities on the state's economy. Overall, after accounting for likely labor force attrition, our research estimates that the men and women who compose this graduating class will likely lead to the addition of nearly $6 billion in economic output to the state's economy over our 20-year period of analysis.

In Figure 22 we illustrate the magnitude of the overall economic impact that we estimate. The yellow area represents our estimate of the resources devoted to educating the 2009-2010 public college and university graduating class, which amounts to $1.4 billion.[19] Of this, $400 million is derived from direct state appropriations, which are funded by taxpayer dollars, whereas the remainder is derived from college and university tuition, gifts to higher education institutions, etc. The blue portion of the figure represents our overall estimated GSP impact of our sample of graduates over their working career, which, as stated above, amounts to $5.9 billion. Overall, with this approach we estimate that the economic benefits of our sample of graduates amounts to 4.3 times that of the resources devoted to educating these men and women beyond high school.

Figure 22: Estimated 20-year GDP Impact versus Cost of Higher Education



Throughout this research we made several simplifying assumptions that are important to consider in interpreting these findings. Some of the key assumptions are outlined as follows:

[19] For this figure we started simply with total public higher education spending in the state for one year ($1.6 billion for 2011). We then subtract from that figure our estimate of spending that occurs at the state's larger institutions that is easily identifiable as being related to research activities, leaving a total of $1.4 billion.

- We assume that the wage gains for college graduates can be entirely attributed to having gone to public colleges in West Virginia. In practice, in the absence of these public colleges, private colleges will likely replace some of these college graduates. For that reason, the economic impacts estimated in this study represents the economic impact of college education in general rather than the impact of college graduates of certain college institutions.
- We assume that none of the West Virginia public college graduates who were from out-of-state would have worked in the state after graduation if they had not come to West Virginia for higher education. This assumption implies that all of these graduates' income can be counted as a net gain for the state's economy.
- Our economic impact estimates exclude nearly 1,000 public college and university graduates from 2010 who worked in the state but made less than $10,000 because these individuals were likely working part-time. This omission places downward pressure on our economic impact estimates.
- Although we do account for inflation in our economic impact estimates, we do not account for discounting future dollar amounts to the net present value today. That is, we consider a (inflation adjusted) dollar earned in 2032 as valuable as a (inflation adjusted) dollar earned in 2013. This omission places upward pressure on our economic impact estimates.

7 Appendix: Detailed Description of the Data in this Report

The data used in this study come from the matching of demographic information on graduates from West Virginia public institutions of higher education, which were compiled by the West Virginia Higher Education Policy Commission (HEPC) with employment records maintained by Workforce West Virginia.

Education data are gathered from HEPC records of graduates from the state's public higher education institutions. The data reflect graduates' highest degree earned at the time of measurement. Graduation years follow a July to June educational year, meaning that graduates in the last six months of one year are combined with those of the first six months of the next year.

Employment data are gathered from West Virginia unemployment compensation records. This is a well-known dataset that measures employment by place of work. It covers jobs and wages reported by firms participating in the West Virginia Unemployment Compensation system and is often referred to as covered employment. As a general rule, any firm which employs one or more workers for some part of a day in at least 20 different weeks of a calendar year is required to contribute to the state's unemployment insurance system. Major exceptions are railroad companies and the federal government, which contribute to separate systems. The self-employed, student workers, most church workers, and unpaid family workers are also generally not covered. Additional employment data come from WorkForce West Virginia.

7.1 Calculating the earnings differentials for college graduates

Earnings projections for college graduates are based on a dataset of college graduates from West Virginia's public institutions of higher education. The full data sample includes more than 194 thousand individuals who graduated from a West Virginia public university or college between the 1993-1994 school year and the 2010-2011 school year. Individuals were observed in each year between 2003 and 2012. For each person who was working in the state in each observation year, the HEPC collected data on wages and industry of work, along with education records of the graduate. Each observation year generally includes graduates from the previous 10 years. The observation years were then combined to create an unbalanced panel dataset. The total sample size contains over 1 million observations.

To conduct the forecast, we performed a multivariate regression analysis of the graduates in the HEPC dataset. We modeled an individual's annual wage as a function of their degree earned, the industry in which they worked, the graduate's age at time of observation, and the number of years since graduation (a proxy for work experience). Using the coefficient estimates from the regression analysis, we projected each individual's earnings over the next 20 years. For graduates with in-state residency, we then subtracted the average earnings for high school graduates of the same age from each individual's earnings to get the wage differential. Graduates who were out-of-state residents were assumed to migrate to West Virginia only because they attended college here, and thus their entire salary was considered additional economic impact in the state. We forecast work participation rates by performing a multivariate regression relating work participation rate to time since graduation, broken down by

degree type and residency. We then forecast work participation rates over the next 20 years and adjusted each individual's wage by the lower work participation rates over time.

Productivity was calculated using multipliers provided in the REMI model. We calculated the share of wages relative to value added, then multiplied our projected wage gains by this multiplier.[20] Both the wage differential and productivity gains were adjusted to account for differences in an individual's innate ability, which has become seen as a significant factor in gains to education. An individual's choice to go to school may be related to their ability to do work that requires more human capital, and thus wages are not entirely due to increased education. To adjust for this "ability bias," we subtracted 10 percent of graduates' salaries.

To calculate the economic impact in the REMI model, we input wage differentials as additional household income in the "Wage Bill" variable broken down by REMI-equivalent NAICS sector. Productivity was input by NAICS sector in category "Industry Sales / Exogenous Production without Employment, Investment, and Compensation." We did not consider the additional productivity impact of government workers, as government output is determined by tax revenues and spending and not worker productivity. In addition, we added additional jobs for those graduates working in West Virginia who were originally non-residents, then subtracted their wages and output to avoid double counting their impact.

[20] This procedure is similar to that in Rephann, Terance J., Knapp, John L., Shobe, William M. 2009. "Study of the Economic Impact of Virginia Public Higher Education." University of Virginia Weldon Cooper Center for Public Service.

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