NATIONAL COLLEGE ATTAINMENT NETWORK

The Economics *Of* Postsecondary Attainment

2023

Authors Page

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We are grateful to the NCAN administration and staff that provided support, many conversations, and much of the data collection that made this report possible. Specific thanks go to Catherine Brown, Senior Director of Policy and Advocacy; Bill DeBaun, Senior Director of Data and Strategic Initiatives; and Louisa Woodhouse, Policy Associate. External Review and Quality Control was provided by Jake Wagner, Ph.D.

This study was prepared for and funded by NCAN and conducted by Recon Insight Group, LLC with assistance from Dr. Jake Wagner. The results and opinions in the study are those of the authors alone and do not reflect on any associated institutions. The author may be reached for questions or comments at recon.insight@gmail.com. The author bears no liability in the application or use of the study in any financial or policy decision making.

Executive Summary

The Purpose of this effort was to assess the average economic productivity, within each state, attributable to post-secondary graduates. This differs from assessing the return, or even the economic impacts, associated with education itself. Rather we want to know, on average, how a post-secondary graduate contributes to the economy's Gross Domestic Product (GSP), taxes, spending, etc, each year. Controls for known biases in the data are accounted for and conservative assumptions are made whenever clear data cannot be relied upon.

The economic activity associated with higher education graduates is compared with all non-college graduates. Regional data on earnings, occupation mix, etc. is used to control for various demographic factors. While this is first and foremost a data analysis, it includes methodology and economic theory consistent with the human capital and labor market literature. A primary component of the analysis depends upon the data crosswalks and career tracks. Lifetime measures depend on Mincer (1974) style lifetime earnings curves. Earnings are assumed to reflect marginal product of labor, which we correlate with measures of gross state product.

Data and Methodology

Data sources needed to be consistent across states to ensure the same methodology could be used. As such most sources were federal: the Bureau of Labor Statistics, Bureau of Economic Analysis, National Center for Education Statistics, and the Census Bureau. Some state level data on housing and taxes were utilized where consistent measures and sources were available: Zillow, the Tax Foundation, etc.

State Summary Results

The key metrics in the analysis focused on elements of gross state product (GSP), including earnings, effective tax contributions, housing, and transportation expenses. Lifetime contributions to GSP were included as well, though some caveats must be made to understand that metric correctly. We also included estimates on the payback period for state funds allocated to a post-secondary graduate's education to be repaid to taxpayers. What follows are the nationwide averages for these metrics based on the data and methodology described above. It is worth noting that the results for each state are positive, and though some states perform well above the national average, all states see gains to their GSP as a result of the post-secondary graduates in their respective state. Table E.1 shows the low, average, and high for each key metric. We also present the standard deviation from the mean.

Table E.1: Summary Statistics of State Findings for Key Economic Metrics

Economic Measure	Low	Average	High	Standard Deviation
Avg. Lifetime Contributions to GSP	$429,910	$1,377,313	$3,205,886	$517,271
Avg. Annual contributions to GSP	$38,999	$124,776	$286,927	$46,531
Avg. Annual higher Earnings	$19,254	$32,448	$52,070	$6,466
Avg. Annual Tax Contributions	$2,669	$4,418	$7,361	$1,011
Avg. Additional Housing Value	$49,452	$125,776	$266,499	$44,384
Avg. Annual Transportation Expenditures	$963	$2,691	$4,458	$725
Avg. Supporting Employment	3.8	6.0	9.7	1.3
Avg. State Payback Period	4.0	5.9	8.4	1.2

Conclusions

Every state sees average gains in productivity associated with their post-secondary graduates. These gains, even in the low case, represent positive net effects to the economy. Adding additional post-secondary graduates to these economies is likely to increase total GSP but at a diminishing rate. Those with the lowest contributions likely have room to grow their post-secondary returns at a lower cost. But even in the wake of a social movement against higher education, the data still show that GSP and wellbeing for all are improved by increased post-secondary graduation rates.

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1. Introduction

Higher education continues to be a primary driver of economic development and increasing human flourishing. In mid-2023 the National College Attainment Network (NCAN) set out to determine the economic consequences of post-secondary attainment within each state. Rather than seeking the economic impact or return on investment of the operations of each individual college or university, they sought to understand the role the graduates themselves play in the states' economies. What does education have to do with productivity as measured by gross state product (GSP)? To answer these questions NCAN approached Recon Insight Group LLC, a regional economic consulting firm with a history of human capital assessment.

The goal of the study was to measure economic productivity (gross state product) by education level. This required mapping post-secondary graduates in each state to their industries, occupations, and earnings. Recon took a heuristic modeling approach that could be replicated. A regression analysis was also done to corroborate the findings of the heuristic model while using a separate methodology. The modeling was compiled into three broad steps: 1) data collection by education level, 2) economic theory and literature to collate the data, and 3) analysis and results. This process uses the existing public facing data, combines it with published economic theory and findings, to construct a deterministic, rather than stochastic result. Standard economic assumptions were used, such as marginal productivity of an individual's labor being fully reflected wages. Average wage and employment data were used, as individual microeconomic data for each post-secondary graduate was not available.

What follows is the outline of the three steps used in constructing and assessing the data. Assumptions are discussed and where alternative assumptions might have been made, the rational for those chosen are provided. Chapter 1 will discuss the data collected and the data generating process from the bureaus or departments producing it. Data by industry employment, staffing matrices, and education level are discussed. Gross State Product, earnings, and taxes are shown by state. Data on educational attainment and educational output by state are provided as well as select household spending data from the consumer expenditure surveys. Chapter 2 covers the human capital theory and various adjustments made to the data to account for known biases in the data. This is also where we discuss the combining of data sets, and the formulas used to form the results. Chapter 3 reports the results and shows the national results as a weighted average of the individual state results.

2. Economic Data and Sources

All economic research begins with a question, in our case one regarding GSP that can be attributed to laborers based on their educational attainment. However, the next step in assessing that economic research requires data. The way we must answer economic questions is through economic data. Is there evidence, in the data, that can corroborate or refute the assumed economic theory? To assess this requires data, and in our case data categorized by education level.

Industry and Occupation Data

GSP is not broken down according to education levels, but it is broken down by industries. Industries are categorized by the North American Industry Classification System (NAICS) and the Bureau of Economic Analysis (BEA) is able to break out GSP by NAICS code according to their value added measures of production. Table 1 shows the national GSP broken down by 2-digit NAICS codes, what are often referred to as industry super sectors. Included in the table is employment by industry.

Table 1: GSP and Employment by 2-digit NAICS Code

NAICS Code	Industry Title	Employment	GRP
11	Agriculture, Forestry, Fishing and Hunting	1,986,638	$246,905,838,433
21	Mining, Quarrying, and Oil and Gas Extraction	567,378	$364,059,888,890
22	Utilities	563,126	$399,057,140,297
23	Construction	9,709,092	$1,051,507,432,447
31-33	Manufacturing	13,099,647	$2,749,227,198,792
42	Wholesale Trade	6,124,781	$1,605,645,307,732
44-45	Retail Trade	16,224,576	$1,444,122,453,599
48	Transportation and Warehousing	7,367,364	$785,932,053,248
51	Information	3,220,460	$1,354,942,288,578
52	Finance and Insurance	6,943,878	$2,252,500,000,868
53	Real Estate and Rental and Leasing	2,951,155	$942,007,672,985
54	Professional, Scientific, and Technical Services	12,017,236	$2,015,905,559,404
55	Management of Companies and Enterprises	2,506,723	$496,324,450,747
56	Administrative and Support and Waste Management and Remediation Services	10,600,646	$849,736,913,189
61	Educational Services	4,164,698	$293,988,503,422
62	Health Care and Social Assistance	21,493,291	$1,903,169,561,110
71	Arts, Entertainment, and Recreation	2,775,681	$262,610,627,163
72	Accommodation and Food Services	13,732,291	$810,864,189,801
81	Other Services (except Public Administration)	8,276,106	$468,372,698,260
90	Government	24,223,402	$2,673,588,661,028

We are also able to distribute employment by occupation and industry through staffing matrices provided by the bureau of labor statistics (BLS). Occupation data is categorized by Standard Occupation Classification (SOC) codes. An occupation-industry map provides us a link to distributing employment by

occupation. This gets us one step closer to our objective because we now have an approach for distributing GSP by occupation. Table 2 shows a simplified occupation-industry staffing matrix.

The last step in this process requires the occupation data to be broken down by education levels. This data is also provided by the BLS and shown in Table 3. This distribution of employment by occupation and education level, coupled with the earnings distribution allows us to determine the share of total occupational wages by education level. These shares directly translate to shares of GSP if we assume that wages reflect the individual's marginal productivity of labor.

Table 2: Industry-Occupation Staffing Matrix by 2-digit Codes

SOC Code	Occupation/Industry	11 Agriculture, Forestry, Fishing and Hunting	21 Mining, Quarrying, and Oil and Gas Extraction	22 Utilities	23 Construction	31-33 Manufacturing	42 Wholesale Trade	44-45 Retail Trade	48 Transportation and Warehousing
11-0000	Management occupations	310.8	41.4	40.3	540.3	752.1	510	536.8	199.3
13-0000	Business and financial operations occupations	0	23.9	47.2	402.4	564.8	348.6	206.3	130.8
15-0000	Computer and mathematical occupations	0	6.1	19.1	19.3	291.1	165.5	58.3	32.8
17-0000	Architecture and engineering occupations	0	25.5	49.2	94.3	763.2	60.6	4.5	23.8
19-0000	Life, physical, and social science occupations	23.4	12.2	10.4	17.6	142.9	20.1	1.3	9.9
21-0000	Community and social service occupations	0	0	0	0.2	0.2	1.2	1.2	0
23-0000	Legal occupations	0	1.4	1.2	2.1	6.4	4.2	2.6	1
25-0000	Educational instruction and library occupations	0	0	0.1	0.2	0.7	1.3	7.1	0.7
27-0000	Arts, design, entertainment, sports, and media occupations	0	0.3	2.1	10.8	84.7	93.1	149.2	6.6
29-0000	Healthcare practitioners and technical occupations	0	0	0.1	0.1	10.7	30.6	557.2	1.3
31-0000	Healthcare support occupations	0	0	0	0	1.7	1.2	39.9	0
33-0000	Protective service occupations	0	1.7	5.7	6.8	11.4	3.5	56.8	40.3

35-0000	Food preparation and serving related occupations	0	0.1	0	0.8	103.7	8.8	552.4	0
37-0000	Building and grounds cleaning and maintenance occupations	21.5	1	2.8	39.4	72.1	27.6	113.1	22.9
39-0000	Personal care and service occupations	0	0	0	0.5	1.2	1.2	86.2	9.1
41-0000	Sales and related occupations	14.2	10.1	7.4	156.3	420.9	1285.5	7889.5	75.7
43-0000	Office and administrative support occupations	68.6	41.6	78.9	687.6	995.4	935.4	1366.3	862.8
45-0000	Farming, fishing, and forestry occupations	822.7	0.1	0.4	1.1	32.8	42.2	26.6	0
47-0000	Construction and extraction occupations	8.1	201.7	33.4	4414.8	197.8	30	38.1	32.5
49-0000	Installation, maintenance, and repair occupations	29.6	47.3	157.6	665.3	625.2	403.5	719.4	318.6
51-0000	Production occupations	18.8	34.9	74.4	116.3	6160.6	296.8	367.6	79.8
53-0000	Transportation and material moving occupations	71.5	70.1	10.6	236.7	1107	1407	2615.4	4235.8

	NAICS Code	51	52	53	54	55	56	61	62
SOC Code	Occupation/Industry	Information	Finance and Insurance	Real Estate and Rental and Leasing	Professional, Scientific, and Technical Services	Management of Companies and Enterprises	Administrative and Support and Waste Management and Remediation Services	Educational Services	Health Care and Social Assistance
11-0000	Management occupations	320.9	686.4	359.1	1154	469.3	388.6	827.1	840.9
13-0000	Business and financial operations occupations	310.3	1834.2	150.5	1802.5	558.7	537.3	446.1	423.5
15-0000	Computer and mathematical occupations	675.1	515.6	16.6	1725.7	280.5	267.8	260.8	134.3
17-0000	Architecture and engineering occupations	39.2	4.3	5.3	933.8	65	79.5	23.3	4.5
19-0000	Life, physical, and social science occupations	3.6	3.5	1	367.6	24.2	36.7	203.8	118.5
21-0000	Community and social service occupations	0.8	22.8	2.7	14	22.4	0	423.1	1159.6
23-0000	Legal occupations	13.2	74.1	7.7	749.3	26.9	15	6.6	6.9
25-0000	Educational instruction and library occupations	17.2	0.7	0.4	10.5	5.3	30.1	7882.1	543.4
27-0000	Arts, design, entertainment, sports, and media occupations	429.6	22.6	17.5	352	44.8	53.6	281.5	36.5
29-0000	Healthcare practitioners and technical occupations	4.8	77.5	3.1	244.8	52.9	191.6	300	6998.8
31-0000	Healthcare support occupations	0.4	3.6	0	106.2	14.9	149.2	54.2	6106.4

33-0000	Protective service occupations	3.3	11	25.3	19.7	10.9	812.8	193.4	81.3
35-0000	Food preparation and serving related occupations	16.7	0.8	18.5	4.9	17.3	75.6	358.7	505.7
37-0000	Building and grounds cleaning and maintenance occupations	4.7	7.3	127.5	34.1	7.9	1902.7	473.6	409.7
39-0000	Personal care and service occupations	41.3	0.5	20.4	40.6	5.7	35.5	204.5	574.8
41-0000	Sales and related occupations	313.2	989.4	468.7	416.4	99.1	395.2	36	71.4
43-0000	Office and administrative support occupations	366	2244.8	411.2	1505.5	499	1580	1235.6	2750.1
45-0000	Farming, fishing, and forestry occupations	0	0.6	0	5.3	0	15.4	3.9	3.5
47-0000	Construction and extraction occupations	6.2	0.8	31.6	90.7	8.9	266.7	45.6	18
49-0000	Installation, maintenance, and repair occupations	218.6	13.7	445.1	87.9	41.1	268.6	191.2	157.3
51-0000	Production occupations	19.3	2.5	11.1	126.2	27.2	652.9	17.2	74.7
53-0000	Transportation and material moving occupations	27	2.9	130	91.2	53.8	1248	240.9	146.9

	NAICS Code	71	72	81	90
SOC Code	Occupation/Industry	Arts, Entertainment, and Recreation	Accommodation and Food Services	Other Services (except Public Administration)	Government
11-0000	Management occupations	131.2	436.8	408.7	672.3
13-0000	Business and financial operations occupations	85.6	80.8	390.5	1185.5
15-0000	Computer and mathematical occupations	9.2	4.7	62.6	293.5
17-0000	Architecture and engineering occupations	1.1	0.8	12.7	306.3
19-0000	Life, physical, and social science occupations	2.7	0.4	18.4	351.2
21-0000	Community and social service occupations	1.1	0.5	512.5	535.9
23-0000	Legal occupations	0.9	0.1	11	279.3
25-0000	Educational instruction and library occupations	47.9	1.4	212.3	200.4
27-0000	Arts, design, entertainment, sports, and media occupations	159	10.2	210.4	76
29-0000	Healthcare practitioners and technical occupations	6.4	5.3	27.8	478.7
31-0000	Healthcare support occupations	3.6	5.6	185.3	141.9
33-0000	Protective service occupations	84.1	55.5	41.5	1997.6
35-0000	Food preparation and serving related occupations	252.6	9559.9	95.2	100.5

37-0000	Building and grounds cleaning and maintenance occupations	159.8	468.4	476.6	240.5
39-0000	Personal care and service occupations	573.3	94.2	1047.2	219.1
41-0000	Sales and related occupations	131.7	463.5	166.1	70
43-0000	Office and administrative support occupations	200.6	399.7	877.9	2138.1
45-0000	Farming, fishing, and forestry occupations	2.3	1.9	3.1	21.4
47-0000	Construction and extraction occupations	5.8	4.1	15.9	457
49-0000	Installation, maintenance, and repair occupations	80.2	134.8	728.9	447.7
51-0000	Production occupations	4.1	98.2	223.2	174.6
53-0000	Transportation and material moving occupations	35.9	294.8	386.4	414.5

Table 3: Distribution of Employment by SOC and Education Level

SOC Code	Occupation Title	Less than high school diploma	High school diploma or equivalent	Some college, no degree	Associate's degree	Bachelor's degree	Master's degree	Doctoral or professional degree
11-0000	Management occupations	2%	12%	16%	8%	37%	20%	5%
13-0000	Business and financial operations occupations	1%	10%	17%	8%	44%	17%	3%
15-0000	Computer and mathematical occupations	1%	5%	13%	8%	44%	24%	6%
17-0000	Architecture and engineering occupations	2%	11%	15%	14%	39%	16%	4%
19-0000	Life, physical, and social science occupations	1%	6%	7%	5%	36%	25%	20%
21-0000	Community and social service occupations	2%	8%	12%	7%	32%	35%	5%
23-0000	Legal occupations	1%	6%	10%	6%	17%	6%	54%
25-0000	Educational instruction and library occupations	1%	4%	6%	4%	23%	34%	29%
27-0000	Arts, design, entertainment, sports, and media occupations	2%	13%	19%	10%	42%	12%	2%
29-0000	Healthcare practitioners and technical occupations	1%	6%	10%	11%	17%	14%	42%
31-0000	Healthcare support occupations	5%	23%	28%	23%	17%	3%	2%
33-0000	Protective service occupations	3%	22%	29%	14%	25%	6%	1%
35-0000	Food preparation and serving related occupations	21%	38%	23%	8%	9%	1%	0%
37-0000	Building and grounds cleaning and maintenance occupations	24%	39%	19%	7%	10%	1%	0%
39-0000	Personal care and service occupations	7%	29%	27%	11%	21%	4%	1%
41-0000	Sales and related occupations	5%	23%	24%	9%	30%	7%	1%
43-0000	Office and administrative support occupations	3%	26%	30%	12%	22%	5%	1%
45-0000	Farming, fishing, and forestry occupations	36%	34%	14%	5%	9%	1%	0%
47-0000	Construction and extraction occupations	24%	44%	20%	5%	5%	1%	0%
49-0000	Installation, maintenance, and repair occupations	10%	38%	28%	13%	9%	1%	0%
51-0000	Production occupations	18%	42%	23%	8%	8%	2%	0%
53-0000	Transportation and material moving occupations	11%	40%	25%	8%	13%	3%	0%

GSP, Earnings, and Taxes

Table 4 shows the GSP, Earnings, and Tax receipts for each state. These measures are all broken down according to the Industry, Occupation, and Education Levels discussed above, and in the state model they are broken down according to state as well.

Table 4: GSP, Earnings, and Taxes by State

FIPS	State Name	GRP	GRP Earnings	Taxes
1	Alabama	$254,246	$168,568	$14,416
2	Alaska	$54,051	$32,445	$4,168
4	Arizona	$419,481	$281,836	$24,125
5	Arkansas	$147,744	$98,107	$10,491
6	California	$3,245,899	$2,128,471	$194,690
8	Colorado	$445,764	$301,215	$26,081
9	Connecticut	$300,191	$197,935	$18,860
10	Delaware	$78,258	$45,696	$4,561
11	District of Columbia	$154,304	$114,973	$5,112
12	Florida	$1,285,958	$877,915	$91,603
13	Georgia	$686,574	$444,482	$37,880
15	Hawaii	$90,533	$59,582	$8,259
16	Idaho	$98,438	$66,817	$5,746
17	Illinois	$925,265	$605,039	$67,336
18	Indiana	$399,906	$255,097	$22,556
19	Iowa	$214,377	$130,077	$12,676
20	Kansas	$189,174	$117,708	$12,513
21	Kentucky	$238,870	$157,894	$16,354
22	Louisiana	$257,644	$157,703	$18,531
23	Maine	$78,538	$53,630	$6,854
24	Maryland	$422,308	$286,223	$25,110
25	Massachusetts	$634,281	$443,810	$29,376
26	Michigan	$572,321	$387,035	$35,058
27	Minnesota	$413,134	$278,487	$25,717
28	Mississippi	$127,554	$83,241	$10,049
29	Missouri	$360,839	$245,820	$19,110
30	Montana	$61,876	$41,814	$3,474
31	Nebraska	$140,343	$84,544	$8,538
32	Nevada	$202,822	$134,282	$16,772
33	New Hampshire	$98,694	$68,663	$6,044
34	New Jersey	$694,569	$469,858	$60,037
35	New Mexico	$105,179	$66,281	$8,538
36	New York	$1,849,404	$1,178,412	$124,350
37	North Carolina	$651,350	$424,558	$36,730
38	North Dakota	$65,176	$37,665	$5,357
39	Ohio	$732,735	$468,149	$46,507
40	Oklahoma	$214,761	$133,522	$13,200
41	Oregon	$269,290	$186,554	$13,075
42	Pennsylvania	$831,632	$559,561	$51,333
44	Rhode Island	$65,258	$45,075	$4,984
45	South Carolina	$268,209	$178,163	$18,805
46	South Dakota	$62,140	$37,365	$4,097
47	Tennessee	$433,876	$283,291	$28,386
48	Texas	$2,137,544	$1,334,644	$163,009
49	Utah	$225,420	$147,421	$11,869
50	Vermont	$38,288	$26,506	$3,474
51	Virginia	$588,529	$406,110	$36,396
53	Washington	$650,173	$410,861	$47,904
54	West Virginia	$82,419	$51,034	$6,092
55	Wisconsin	$362,332	$244,088	$22,207
56	Wyoming	$42,797	$25,667	$3,403

Human Capital

Gary Becker is credited with the development of Human Capital as a sub discipline of economics, identifying the importance of investment in education as a means to increases labor productivity, and ultimately GDP. Contributions to GDP vary across education levels, though it is a mistake to assume the productivity generated by each education level is exclusively the consequence *of* the education alone. Ability, for example, may explain some of the gains in productivity generated by more highly educated individuals. Table 5 shows the proportion of population with each level of education by state.

Table 5: 2022 Educational Attainment by State

State	Less Than 9th Grade	9th Grade to 12th Grade	High School Diploma	Some College	Associate's Degree	Bachelor's Degree	Graduate Degree and Higher
Alabama	3%	8%	30%	21%	9%	17%	11%
Alaska	2%	4%	29%	25%	9%	19%	12%
Arizona	5%	7%	23%	24%	9%	20%	12%
Arkansas	4%	7%	34%	21%	8%	16%	9%
California	9%	7%	21%	20%	8%	22%	14%
Colorado	3%	4%	20%	20%	9%	27%	17%
Connecticut	4%	5%	26%	16%	8%	23%	19%
Delaware	3%	5%	30%	19%	8%	20%	15%
District of Columbia	3%	4%	15%	12%	3%	26%	37%
Florida	4%	6%	28%	19%	10%	20%	12%
Georgia	4%	7%	27%	20%	8%	21%	13%
Hawaii	3%	4%	27%	20%	11%	23%	13%
Idaho	3%	6%	26%	25%	10%	20%	10%
Illinois	4%	5%	25%	20%	8%	22%	15%
Indiana	3%	6%	32%	20%	9%	18%	11%
Iowa	3%	4%	30%	20%	12%	21%	10%
Kansas	3%	5%	25%	22%	9%	22%	13%
Kentucky	4%	7%	32%	20%	9%	16%	11%
Louisiana	4%	9%	33%	21%	7%	17%	10%
Maine	2%	4%	30%	19%	11%	22%	13%
Maryland	4%	5%	23%	18%	7%	22%	20%
Massachusetts	4%	4%	23%	15%	8%	25%	21%
Michigan	2%	5%	28%	22%	10%	19%	12%
Minnesota	3%	4%	23%	20%	12%	25%	13%
Mississippi	4%	9%	29%	22%	11%	15%	10%
Missouri	3%	6%	30%	21%	8%	20%	12%
Montana	1%	4%	27%	23%	10%	23%	12%
Nebraska	4%	5%	25%	22%	11%	22%	12%
Nevada	5%	8%	28%	24%	9%	17%	9%
New Hampshire	2%	4%	27%	17%	10%	24%	15%
New Jersey	4%	5%	26%	16%	7%	26%	17%
New Mexico	5%	8%	26%	23%	9%	16%	13%
New York	6%	6%	25%	15%	9%	22%	17%
North Carolina	4%	6%	25%	20%	10%	22%	13%
North Dakota	2%	4%	26%	21%	14%	23%	9%
Ohio	3%	6%	32%	20%	9%	19%	12%
Oklahoma	4%	7%	31%	22%	9%	18%	10%
Oregon	3%	5%	22%	24%	9%	22%	14%
Pennsylvania	3%	5%	33%	16%	9%	21%	14%
Rhode Island	4%	6%	28%	18%	8%	22%	15%

South Carolina	3%	7%	28%	20%	10%	19%	12%
South Dakota	3%	5%	30%	20%	12%	21%	10%
Tennessee	4%	7%	31%	20%	8%	19%	11%
Texas	7%	7%	24%	21%	8%	21%	12%
Utah	2%	4%	23%	24%	10%	24%	12%
Vermont	2%	4%	27%	16%	9%	25%	17%
Virginia	3%	5%	24%	18%	8%	23%	18%
Washington	3%	5%	22%	22%	10%	23%	15%
West Virginia	3%	8%	39%	19%	8%	14%	9%
Wisconsin	2%	4%	29%	20%	12%	21%	11%
Wyoming	2%	4%	28%	25%	12%	18%	11%
U.S. Total	***5%***	***6%***	***26%***	***20%***	***9%***	***21%***	***14%***

Household Spending

In order to show how the earnings and GDP translate into human flourishing we want to show how expenditures by education level translate into marginal propensities of consumption. That is to say how increased earnings, which stem from increased productivity, results in increased spending. Table 6 shows the key variables of transportation and housing expenditures by education level. These averages come from the national consumer expenditure survey.

Table 6: Select Consumer Expenditure Survey data by Education level

Item	Less than college graduate			College graduate		
	Less than high school graduate	**High school graduate**	**High school graduate with some college**	**Associate's degree**	**Bachelor's degree**	**Master's, professional, doctoral degree**
Number of consumer units (in thousands)	7,887	24,527	24,297	14,701	35,328	27,350
Mean Income	38,719	48,947	60,780	71,740	100,369	130,620
Mean Housing Expense	13,736	16,276	19,365	21,071	27,862	35,996
Mean Transportation Expense	6,538	8,942	10,383	11,918	14,548	15,947

3. Theory and Methodology

The theory and methodology surrounding educational assessment is robust and has been influenced by many economists prior to Becker's (1964) Human Capital Theory, and those economic investigators have only grown since Becker's time. Robert Lucas (Nobel 1995) has developed models of knowledge transfer through interactions. James Heckman (Nobel 2000) developed one of the largest RCT assessments of the Perry Preschool assessments. Raj Chetty (2011) has conducted a value-added assessment of teacher quality and student outcomes, including student earnings in adulthood. Virtually every rigorous analysis from researchers, on either side of the isle, has shown that educational attainment is causally linked with improved outcomes of human flourishing. These theories are consistent with the data and allow us to extract the consequences of education on the economy in aggregate.

Human Capital Theory

Broadly speaking Human Capital addresses any investment into labor productivity gains. Most recently that has taken on the form of health economics, though the original focus was education. Gary Becker wrote the seminal *Human Capital: A theoretical and Empirical Analysis* as an answer to why income has grown. Economists were, prior to Becker, only able to encapsulate a small portion of earnings growth through increases in capital assets and labor itself. Becker believed that if education specifically, and human capital generally, were contributing factors to earnings growth, it would be found in the rates of return to education.

At the core of all of the human capital theory is that workers are paid, in some measure, according to their marginal productivity. That productivity is a function of their innate abilities, their workforce experience, their knowledge, and skills. Education represents a reasonable instrumental variable in predicting an individual's knowledge, skills, and abilities, which is why education is so well correlated with earnings. Investments in education will persist until the marginal returns to education, via workforce productivity, are met by the marginal costs of that education. On the main, the first dollars spent on education will have higher marginal returns, than subsequent dollars. However, if a dollar invested in educational attainment increases worker productivity by more than a dollar, continued investment is warranted and will be incurred.

Jacob Mincer

Jacob Mincer was nearly as influential in human capital's founding as Becker. In his discussions of earnings, Mincer explained the lifetime earnings cycle of individuals as a log linear function of labor (w_0), years of schooling (s), experience (x), and experience squared.

$$\ln(w) = \ln(w_0) + \beta_1 s + \beta_2 x + \beta_3 x^2$$

Researchers since Mincer have refined this model, but it still holds today and is utilized in forecasting earnings, albeit with modifications for cohort effects, inflation etc. We use a form of the Mincer equation, discussed later on, in estimating the lifetime contributions to GSP of post-secondary graduates based off the relationship we derived between earnings and GSP.

Garry Becker

Becker's Human Capital (1964) is to that branch of economics what Keynes's General Theory was for macroeconomics. Not only did he reiterate and synthesize the theory, he formalized it mathematically. Becker models the student as both a producer and consumer. The student's time may be allocated to labor force participation, t_{wi}, or consumption activities, t_{ci}, the sum of which equals total available time, t, in period i. The variable C_i is the amount of the commodity consumed during period i, and x_i represents the composite market good used. Thus, $C_i = f_i(x_i, t_{ci})$ where f_i is a production function in period i. Becker formulates the student's real income (labor and non-labor) in period i as the wage rate multiplied by time $w_i t_{wi}$ and endowment income v_i. The basic student model developed in Human Capital is as follows:

$$\max U = U(C_i, \dots C_n) \text{ s.t. } \sum_{i=1}^{n} \frac{p_i x_i + w_i t_{ci}}{(1+r)^{i-1}} = \sum_{i=1}^{n} \frac{w_i t + v_i}{(1+r)^{i-1}}, \qquad 0 \le t_{ci} \le t,\ x_i \ge 0\ \forall i \in (1, n)$$

Where the constraint is a standard expenditure-income equality. The interest rate, r, is assumed to be equal in all time periods.

Timming is a critical issue in this investment narrative. The students today are not likely the producers of today's output. So the earnings and productivity seen in the data is a reflection of the learning, on the job training, and education of previous cohorts of people. Becker notes at the end of his book that,

> "A large dispersion makes it difficult for any individual to anticipate his gain from education, a difficulty that is compounded by a pay-off period of some twenty to twenty-five years. This long pay-off period provides an economic justification for flexible or "liberal" education, since most of the benefits would be received when the economic environment was greatly different from that prevailing at the time of entry into the labor force."

Becker is essentially arguing that educational outcomes are not known at the time of the investment. Thus, knowing whom should be invested in or that appropriate magnitude of that investment is uncertain. The opportunity cost of not making the investment is likely larger than broadly investing in everyone.

James Heckman

Heckman et al. (2010) assessed the rates of return sought by Becker, but in the context of early childhood educational interventions. Many researchers have studied the Perry Program but few accounted for standard errors or adjusted for data and design flaws. The authors also accounted for the deadweight losses of taxation necessary for financing the program. Because the study ended at age 40, earnings post 40 needed to be estimated and Heckman et al. developed and implemented new econometric techniques for extrapolating those future earnings. Lastly, they used local data rather than national averages for estimating cost variables e.g., crime, welfare, and education costs.

While our research is not focused on preschool interventions and treatment effects, this study showed that education, particularly early education, had sizable influence on economic outcomes. And substantially linked the causal influence of education to earnings and other socioeconomic factors. We lean on these findings, asserting that such causal relationships are the drivers behind the productivity discussed in our data analysis.

Simply looking at the descriptive statistics reported helps to ground the reader as to the relationships between economic factors and education. Table 7 shows the descriptive statistics of select outcomes for the treatment and control groups by gender and age.

Table 7: Excerpts of Perry Preschool Descriptive Statistics Heckman et al. (2010)

Outcome	Age	Female		Male	
		Control	Treatment	Control	Treatment
Sample Size		**26**	**25**	**39**	**33**
HS Graduation (%)	27	31%	84%	54%	48%
Currently Employed (%)	27	55%	80%	56%	60%
Currently Employed (%)	40	82%	83%	50%	70%
Yearly Earnings	40	$20,345	$24,434	$24,730	$32,023
Ever on Welfare (%)	26-40	41%	50%	38%	20%
Ever Arrested (%)	≤ 40	65%	56%	95%	82%

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3145373/

Methodology

The data used in our process is based on state totals. The only situation where national data is used is in the BLS staffing matrices. We are comfortable using this assumption as within-industry staffing is likely to be consistent across states. That is, those industries that are similar across states, grocery stores for example, are likely to have similar occupational mixes. A grocery store in LA is likely to have the same mix of bookkeepers, clerks, bakers, butchers, etc. as a comparably sized grocery store in Chicago or Austin. In situations where industries are highly concentrated, vacuum cleaner manufacturing is such an example, we are not worried about the national occupational mix because it is very close to the mix of the concentrated regions and that mix is not being attributed to a state where the industry does not exist.

Moving from Industry to Occupation and Educational Earnings Distributions.

The methodology for the core of this analysis is based on taking the GSP by industry data and allocating it to the various occupations within the industry. To do this we begin with employment and the BLS staffing matrices. The mix of occupations within the industry are identified by the staffing matrix and multiplied by the average earnings for each occupation. That provides the share of industry earnings allocated to each occupation within the industry.

The earnings distribution calculated above are weighted by the education level for the industry and occupation of interest. If the average education level for the industry is a high school diploma, but the average education level for the occupation within the state is a master's degree, we use those two education levels to weight the earnings allocated to that occupation within that industry and state. This captures the variation in earnings between an accountant in a construction firm with that of an accountant at a water bottling plant, etc. Once earnings are fully allocated by industry, occupation, and education level we ensure the state data balances with the aggregate of our estimates. This ensures our distribution of earnings dollars does not report something different than the reported earnings totals by industry from the BEA.

Moving from Earnings to GSP and Taxes

As stated in the Human Capital Theory section, earnings tend to reflect the marginal product of labor after controlling for various shift parameters that account for on-the-job training investments etc. This implies that earnings are a sound instrumental variable for contributions to the industries GSP because earnings are correlated with output. Several of the authors discussed above, as well as other empiricists have shown the causal relationship that is assumed here. Multiplying each industry's GSP by the weighted earnings distribution of occupation and education level, allows GSP to be spread to occupation and education level, essentially assuming GSP will follow the same distribution across occupations and education levels as that of earnings.

Total taxes collected for each state are distributed in the same fashion as GSP. This is a somewhat weaker assumption than that of GSP because states have quite different taxing regimes. While this is a simplifying assumption, we believe it to be a conservative assumption as most states have a progressive taxing structure wherein higher earning individuals pay a higher proportion of the tax. Our model is somewhat closer to a flat tax regime. Because we are inherently underestimating the taxes paid by the post-secondary graduates, and overstating those paid by non-graduates, we are minimizing the true contributions of the graduates. This suggests our assumption is understanding the true gains provided by the post-secondary graduates. Even with this conservative assumption we will see that the contributions to state coffers are still substantial.

Differentials Across Education Levels

Once the GSP and Taxes are allocated to each occupation and education level across industries, we can sum the earnings, GSP, and Taxes by the education level. We compare the earnings by education level with the published data by state and found the results were within the published margins of error. The next step is to compare the average GSP, taxes, and earnings of the post-secondary graduates with non-graduates. Again, to make our results conservative, we include the "some college" averages with the non-graduate averages to reduce the gaps between graduates and non-graduates.

Adjusting for Biases

Having estimated the earnings, GSP, and Taxes by education level we further discount those earnings by education level to account for known "ability biases." That is, individual's education levels are highly correlated with their knowledge, skills, and abilities. Because post-secondary graduates are likely to have higher productivity (ability) unrelated to their level of education, the marginal increase in earnings from education must be adjusted downward as to not conflate the gains from education with their persistent but unobserved ability. This downward adjustment scales with education, predominantly affecting post-secondary graduates (see Verhaest and Omey 2011).

Lifetime Measures

In order to account for lifetime contributions, we utilize the mincerian earnings functions by education level and convert those earnings into GSP using the current earnings to GSP ratios. There is a newer branch of literature in the forensic economics journals that discusses the non-static nature of these earnings ratios across temporal cohorts. However, we are looking at the current mix of labor moving forward and not looking at the entrance of new cohorts. Adjusting for the dynamics of the labor market, including entrepreneurship and capital enhancements to labor productivity (AI for example) exceeded the scope of this work.

These lifetime metrics also allow us to estimate the rate at which public educational funds strictly to graduates might be paid back to the state. These payback periods were estimated using a retirement age of 65 and the current average age within each state's respective labor market.

4. Results

The results of the analysis are consistent with the current state of the economic literature and illustrate the gains each state and the nation as a whole realize through the activities of the post-secondary graduates. There is diversity across states in regard to their various metrics. That is likely due to feedback loops in the market. Thick labor markets such as those in California and New York create large knowledge spillovers, job matching improvements, etc., which increase worker productivity above those in other states. As such, comparison across states is unreliable as a robust data comparison. The objective of our analysis was not to control all such endogenous factors, but rather to show how the states benefit given their idiosyncratic economic structures. Table 4.1 summarizes the measures across the states.[1]

Table 4.1: Summary Statistics of State Findings for Key Economic Metrics

Economic Measure	Low	Average	High	Standard Deviation
Avg. Lifetime Contributions to GSP	$429,910	$1,377,313	$3,205,886	$517,271
Avg. Annual contributions to GSP	$38,999	$124,776	$286,927	$46,531
Avg. Annual higher Earnings	$19,254	$32,448	$52,070	$6,466
Avg. Annual Tax Contributions	$2,669	$4,418	$7,361	$1,011
Avg. Additional Housing Value	$49,452	$125,776	$266,499	$44,384
Avg. Annual Transportation Expenditures	$963	$2,691	$4,458	$725
Avg. Supporting Employment	3.8	6.0	9.7	1.3
Avg. State Payback Period	4.0	5.9	8.4	1.2

[1] It is important to note that the marginal effects of each additional graduate will influence these averages and may serve to lower the averages, which is consistent with diminishing marginal returns to productivity. We do not ignore this reality but recognize that each state will experience different marginal effects depending on where they are in the human capital investments.

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