Oklahoma Department of Career and Technology Education (ODCTE)

The Economic Contribution of CareerTech to the Oklahoma Economy

Cost-Benefit Analysis of Career Majors (FY11)

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Cost-Benefit Analysis of Career Majors

Introduction

This report is part of an ongoing effort to assess the economic contribution of the CareerTech System to the Oklahoma economy. The specific objective of the study is to prepare a comprehensive cost-benefit assessment of the system's career major programs. Career majors are commonly viewed as the flagship program of the CareerTech System because of the large number of students enrolled and the extensive training received by students.[1] The demand for these training programs continues to be driven by the desire of both employers and workers to match job skills over the work life more efficiently than is possible through access to common and higher education alone.

The study examines the cohort of career major completers in fiscal year 2010-2011 (FY11). The study seeks to identify and estimate the range of private and public benefits and costs associated with delivering training to this cohort and then assess the expected net economic contribution to the Oklahoma economy.[2] Policymakers generally support the subsidization of public education and training programs on the grounds that the resulting wage and productivity effects enhance economic activity over time.

Estimates are formed for benefits accruing to students, government, and the broader state economy. As with all forms of formal education, the primary economic benefit generated by career major training is work life income gains realized privately by students. A model of earnings gains is constructed to explain the composition of the expected future income gain for completers. Estimates are similarly formed for the direct costs to deliver the programs, tuition costs for students, forgone wages and economic activity as students undertake training, and spillover costs from taxation to fund these services through the public sector.

Estimates indicate that training the FY11 cohort of career major completers produced direct benefits totaling $1.93 billion in excess of direct costs. The largest direct benefit accrues to career major completers in the form of an estimated $1.8 billion in added future income earned within the state. When potential indirect spillover benefits and other indirect costs are considered, total net benefits to the Oklahoma economy are $3.5 billion in current dollars. The net benefit consists of $3.94 billion in direct and indirect benefits offset by $445 million in direct and indirect costs associated with delivering the programs.

The first two sections of the report provide an overview of the role of career and technology education in Oklahoma and a profile of the current structure of career majors. The next section provides a discussion of the economic payoff to occupation-based education and develops the methodology underlying the work life income gain estimates. Estimates of the economic spillover effects in the state economy resulting from the income gains of completers are provided next. Cost-benefit estimates are then formed and the paper concluded by discussing other potential benefits from career and technology training not captured by the cost-benefit analysis.

The Economic Return to Education

Students continue to pursue education beyond high school in large part because the economic returns can be sizeable. Figure 1 illustrates the general positive relationship between educational attainment and average income levels for workers with earned income in Oklahoma and nationally.[3] These income differentials have persisted for decades and underlie many of the policy efforts within Oklahoma and other states to raise the overall level of education of the workforce.

High school completion traditionally produces a substantial economic payoff, with income more than 50 percent higher than for workers without high school diplomas.[4] High school completers in the workforce in Oklahoma currently earn an average of $32,700 annually, versus only $20,700 for those without diplomas. The same income differential is present at the national level. An ongoing concern for Oklahoma relative to the nation is the state's higher share of workers with only a high school education or less relative to the nation (39.3 percent versus 36.5 percent). It is primarily these workers that CareerTech seeks to aid through the provision of career majors and other training programs.

Figure 1. Income of the OK and U.S. Population Ages 18-65 by Educational Attainment *(2011/2012 avg.)*

	Oklahoma			U.S.		
Educational Attainment	Workers with Earned Income	Labor Force Share	Average Total Income	Workers with Earned Income	Labor Force Share	Average Total Income
No high school diploma	122,222	7.1%	$20,655	12,705,933	8.8%	$22,057
High school graduate/diploma	551,883	32.2%	32,669	40,240,547	27.7%	33,669
Some college but no degree	390,662	22.8%	35,602	29,112,199	20.1%	35,163
Associate degree-occupational/vocational	68,698	4.0%	42,748	6,634,894	4.6%	42,161
Associate degree-academic program	114,619	6.7%	42,951	8,465,654	5.8%	44,224
Bachelor's degree	310,369	18.1%	62,123	31,567,122	21.8%	62,891
Master's degree	104,276	6.1%	64,156	11,951,079	8.2%	80,645
Professional school degree	28,792	1.7%	136,370	2,178,613	1.5%	137,340
Doctorate degree	22,566	1.3%	97,122	2,178,469	1.5%	114,490
Total	1,714,084	100.0%	$43,412	145,034,507	100.0%	$46,959

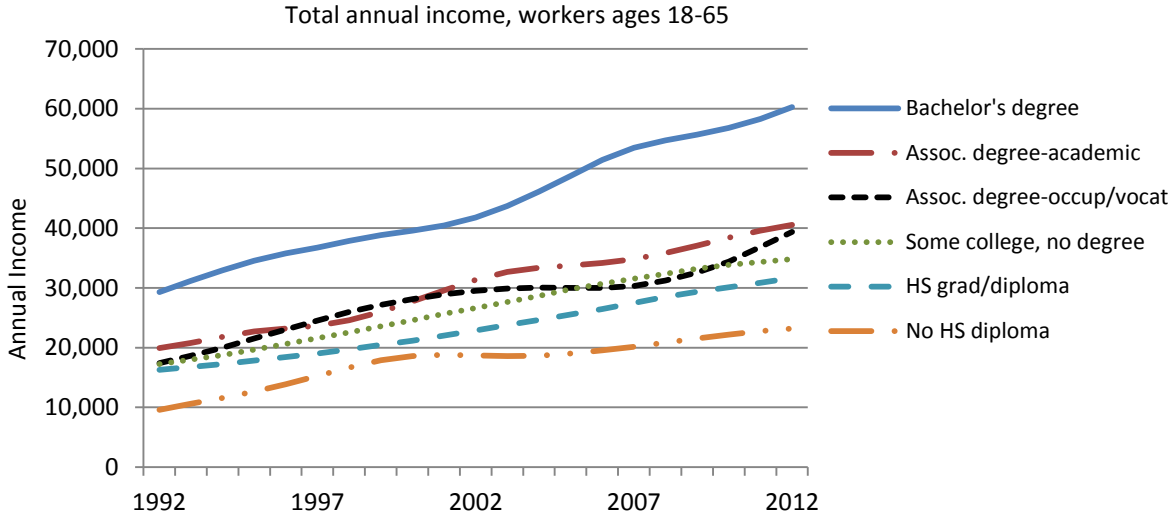
Source: Census Bureau, 2011 and 2012 Current Population Survey, March Supplement.
Notes: Average of survey estimates for 2011 and 2012. Includes only workers with earned income in the period.

As shown in Figure 1, the potential economic payoff to the state of moving workers into the various education tracks beyond high school can be substantial. Workers who have earned college credit but have not completed degrees currently earn almost $3,000 more per year than high school graduates. Completing a college degree or choosing a two-year program that leads to a recognized degree or certification provides even greater economic payoff.[5] Workers in Oklahoma with the equivalent of an associate degree with an occupational or vocational emphasis earn roughly $10,000 (30 percent) more per year than high school graduates. This category of educational attainment captures current career major completers in Oklahoma as well as students who completed a CareerTech full-time training program in prior years.[6] Workers completing an associate degree with an academic emphasis also earn roughly $10,000 more annually than workers completing only high school.

The significant payoff to obtaining a bachelor's degree or higher is also evident in Figure 1. The annual earnings premium for a four-year college degree relative to high school is currently about $30,000, both in Oklahoma and nationally. The state continues to trail the nation in the share of workers with bachelor's degrees, but the gap has closed. In 2012, 18.1 percent of workers with earned income had completed bachelor's degrees, versus 21.8 percent nationally. The state has made similar progress in raising the share of workers with education beyond the bachelor's degree but still trails the nation (9.1 percent versus 11.2 percent). The reported income gain for workers with master's degrees is currently only about $2,000 per year in Oklahoma versus $18,000 nationally. The income of workers with professional or doctoral degrees is roughly 50 percent to 100 percent higher than for those with bachelor's degrees at both the state and national levels.

Figure 2 illustrates income profiles for Oklahoma workers with bachelor's degrees or less the past two decades.[7] The payoff to each form of formal education beyond high school has remained relatively consistent, both in Oklahoma and nationally. The long-standing payoff to high school completion is the foundation of the process for raising overall education levels, and the payoff to a high school diploma has only widened in recent years. The relative payoff to each form of education between high school and a bachelor's degree has fluctuated over time but continues to produce a significant income premium relative to high school completion. The much-discussed acceleration in the payoff to a bachelor's degree in recent years relative to other forms of education beyond high school is clearly evident as well.

Figure 2. Income Profile for Oklahoma Workers by Educational Attainment



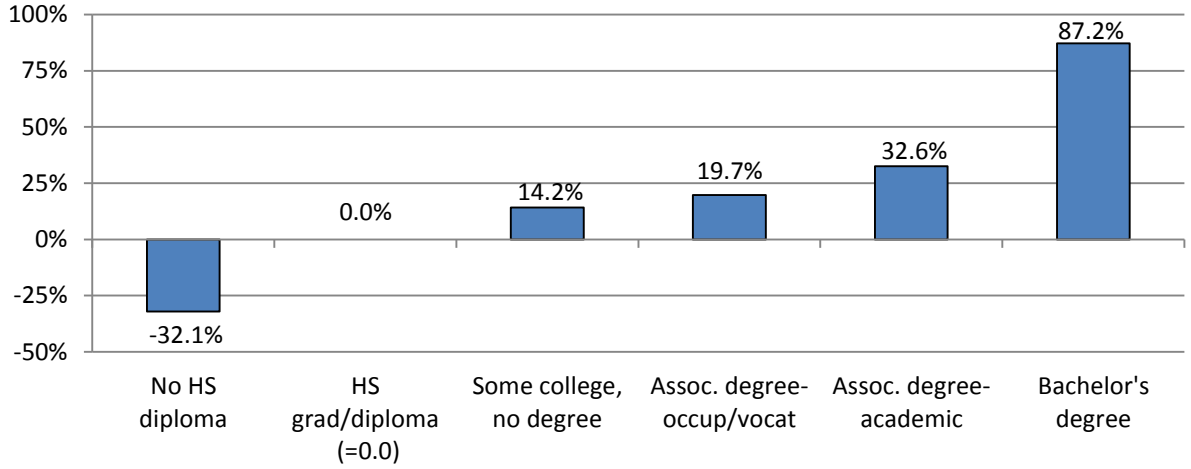
Source: Current Population Survey, March 2012 Supplement
Note: Profiles are estimated using a Hodrick-Prescott filter with a smoothing parameter of 10.

Figure 3 summarizes the average annual income differential in the 1992 to 2012 period for educational attainment levels up to the bachelor's degree in Oklahoma. Across all age groups, workers not completing high school earned one-third less than high school graduates in the period. Workers with college credit but no degree earned 14 percent more on average than high school graduates. Oklahoma workers with the equivalent of an associate degree with occupational or vocational training (which includes career majors) earned an average of 20 percent more than workers with no education beyond high school. Workers with associate degrees with an academic

emphasis earned an average of one-third more income than high school completers. The income differential for a bachelor's degree relative to high school in the period was 87 percent.

Figure 3. Annual Income Differential for Oklahoma Workers by Educational Attainment

Relative to high school graduate/diploma, 1992-2012 average, workers ages 18-65



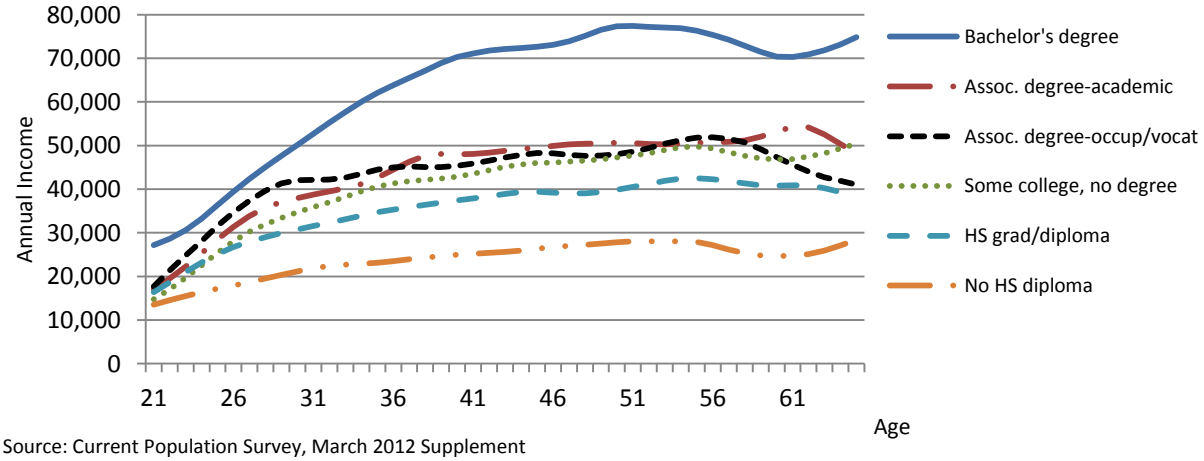
Source: Current Population Survey, March Supplements 1992-2012

Earnings Profile Estimates of the Return to Education

Earnings profiles by age and educational attainment provide a general indication of the potential work life earnings gain expected from obtaining additional education.[8] Figure 4 illustrates the current earnings profile by age for U.S. workers ages 21 to 65 by education level up to the bachelor's degree. Because Oklahoma closely matches the national earnings profile for education levels between high school and a bachelor's degree, the national profiles provide a useful proxy for the state.[9]

Figure 4. Income Profile for U.S. Workers by Educational Attainment

Total income, workers ages 21-65, 2012



Source: Current Population Survey, March 2012 Supplement
Note: Profiles are estimated using a Hodrick-Prescott filter with a smoothing parameter of 10.

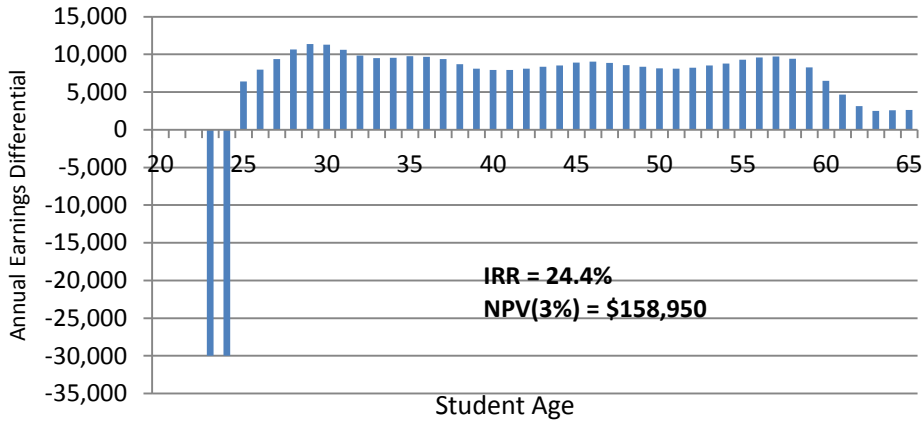
The above profiles illustrate the differing expected work life income paths across the various categories of education. A four-year college degree suggests much higher earnings early in the work

life and much faster earnings growth through age 55. The three education options between high school and a bachelor's degree all follow a similar work life trajectory and suggest a consistent positive earnings premium over the work life relative to high school completion. Two-year degrees with a vocational or technical emphasis offer the largest income differential early in the work life but tend to diminish the fastest after age 60.[10]

These earnings profiles are similar to those used by the Census Bureau to construct synthetic estimates of the total work life income gain received by pursuing additional education.[11] Census estimates generally describe expected earnings gains during a 40-year period for workers who maintain full-time year-round employment. These cumulative wage differentials over the work life can be substantial and are routinely used as summary estimates of the potential returns to education. Recent Census estimates suggest that completing some college but not receiving a degree adds $260,000 (in future dollars) to work life earnings above completing high school. An associate degree adds an estimated $440,000 relative to completing high school, while a bachelor's degree adds slightly more than $1 million to future earnings relative to a high school diploma. These estimates are based on dollars received in the future and are not discounted for inflation effects. They further ignore the cost to the student of obtaining training or education. When adjusted to present dollars and used along with estimates of tuition costs and forgone wages during training, the internal rate of return and net present value of the stream of earnings gains provide a basic measure of the private return to education.

For example, Figure 5 illustrates the expected annual differential in work life earnings for a typical 23-year-old student entering a two-year program with an occupational or vocational emphasis. The student is assumed to incur annual costs of $16,500 for both tuition and forgone income during training and will complete the program at age 25. Over the course of training and through age 65, the student receives an estimated $303,850 in added earnings (in future dollars minus costs). The expected internal rate of return is 24.4 percent and produces a net present value of about $159,000 when discounted to the present at 3 percent.[12]

Figure 5. Example Assoc. Deg-Voc/Tech Work Life Earnings Profile



Example: Hypothetical student who is age 25 at completion of a 2-year program. Tuition and forgone income are $16,500 annually during training. Annual income gains after age 25 are estimated using U.S. earnings functions for associate degree-occupational/vocational versus high school graduate.

For a two-year associate degree with an academic emphasis, and assuming the same tuition costs and forgone income, future work life earnings after upfront costs increase by $350,500. The

internal rate of return is 18.3 percent and produces a current net present value of $162,300 using a 3 percent discount rate. Similarly, the typical student who takes college credit but does not complete a degree can expect to add $213,200 to future earnings through age 65. This equals an internal rate of return of 11.4 percent and net present value of about $88,000 discounted to the present at 3 percent. All three education tracks beyond high school but less than a bachelor's degree produce an expected internal rate of return above 10 percent over the work life and a net present value between $88,000 and $162,300.[13]

While these relationships have persisted for decades, estimates of the return to education based on earnings functions necessarily imply that future workers will benefit from education to the same degree as current and past workers. Earnings functions also ignore other aspects of labor force participation and lifetime earnings including unemployment, periodic labor force entry and exit, and changes in retirement income.

Profile of Technology Center Career Majors

The expected payoff to education beyond high school continues to generate strong demand for career majors in Oklahoma. In FY11, more than 28,200 students were enrolled in a career major and 16,075 students completed the requirements. In comparison, Oklahoma's higher education system had enrollment of approximately 195,000 students and awarded more than 30,000 degrees and certificates in FY11. Students choose from more than 300 career majors within 15 broad career clusters, receiving preparation for a diverse set of career fields ranging from information technology to health sciences. Most students are enrolled for two academic years and complete an average of approximately 1,000 hours of classroom contact.[14]

Career majors are increasingly focused on academics and have been realigned to better reflect industry identified knowledge, skills, and credentials.[15] Career major courses are also more closely aligned with academic offerings at two- and four-year colleges and universities within the state to promote multiple channels for degree completion. Additional efforts are under way to increase the share of majors devoted to fields related to science, technology, engineering, and mathematics to meet the future workforce needs of targeted industry sectors such as aerospace, energy, advanced manufacturing, health care, and biotechnology.[16]

Career majors also play a major role in bolstering the career success of Oklahoma students who are either at risk of not completing high school or who choose not to immediately pursue bachelor's degrees following high school. Career majors further provide a vital education option for many students who are considered among the most likely to struggle to enter and remain in the labor force and who are unlikely to pursue education beyond high school outside the CareerTech system. Disabled students constituted 13 percent of enrollment in FY11, and more than half of disabled students are adults over the age of 18 and in their prime working years.[17] Fully one-third of students enrolled in career majors are considered economically disadvantaged, a group traditionally underrepresented in higher education.[18] And 16.5 percent of entrants are considered academically disadvantaged and in need of significant academic remediation upon entering a career major.[19]

Students enrolled in career majors tend to match one of two demographic profiles: 1) secondary school students age 16 to 18 in the final two years of high school or 2) adults over the

age of 20 who have already completed high school and are pursuing additional training and education. Approximately 10 percent of entering students have completed some college credit but have no degree; 3.8 percent have either a technical/vocational diploma or an associate degree; and approximately 1.5 percent have a bachelor's degree or higher.

Figure 6 details the number of FY11 completers along with post-completion wage survey data for each career cluster.[20] Clusters with the largest enrollment include health science (4,562); transportation, distribution, and logistics (2,331); information technology (1,499); architecture and construction (1,445); and manufacturing (1,269).

Figure 6. Post-Training Wage of Career Major Completers by Career Cluster *(FY11)*

Instructional Program	Completers	Average Hourly Wage
Agriculture, Food, and Natural Resources	190	$8.50
Architecture and Construction	1,445	13.18
Arts, Audio/Video Technology, and Communications	576	12.82
Business, Management, and Administration	1,103	10.09
Education and Training	8	11.13
Finance	239	10.55
Health Science	4,562	13.27
Hospitality and Tourism	465	8.41
Human Services	1,254	11.20
Information Technology	1,499	14.19
Law, Public Safety, Corrections, and Security	227	11.70
Manufacturing	1,269	17.74
Marketing, Sales, and Service	111	12.65
Science, Technology, Engineering, and Mathematics	796	11.84
Transportation, Distribution, and Logistics	2,331	13.53
All Career Clusters	16,075	$13.01

Source: ODCTE

A post-completion wage survey is administered by each technology center six months after the close of each academic year. Reported hourly wages across career clusters averaged $13.01 and ranged from approximately $8.50 to nearly $18.00.[21] Career clusters offering the highest reported post-training hourly wage were manufacturing ($17.74); information technology ($14.19); transportation, distribution, and logistics ($13.53); health science ($13.27); and architecture and construction ($13.18). The lowest reported hourly wages were reported in hospitality and tourism ($8.41) and agriculture, food, and natural resources ($8.50).

Figure 7 details the reported employment status of FY11 completers six months after completion. Nearly 88 percent of completers reported either being employed or continuing their education. Forty percent of all completers reported continuing their education - about 60 percent of secondary completers and 18 percent of adults.[22] Among completers who entered the labor force on a full-time basis (excluding those continuing their education, entering the military, or not in the labor force), 87 percent were employed six months after the close of the academic year, and more than 75 percent reported employment in a related field. Approximately 2 percent of completers entered military service, and 7.1 percent were either unemployed or their status unknown.

Figure 7. Career Major Post-Completion Employment Status

Employment Status	Completers	Percent
Employed - Related Field	6,651	41.4%
Continuing Education	6,375	39.7%
Employed - Unrelated Field	1,059	6.6%
Unemployed & Seeking Work	716	4.5%
Not in Labor Force	532	3.3%
Military	328	2.0%
Unknown	414	2.6%
All Completers	16,075	100.0%

Source: ODCTE

Note: Survey is completed six months after the close of the academic year of completion.

Figure 8 presents data on enrollment, average student age, and wage survey data for completers at each of the 29 technology centers statewide. Total enrollment tends to reflect local population levels, with the Tulsa and Oklahoma City metro districts producing the most completers.

Figure 8. Career Major Completers, Age, and Post-Training Wage by District *(FY11)*

	Completers			Average Age (Years)			Hourly Wage		
District	Secon-dary	Adult	Total	Secon-dary	Adult	Total	Secon-dary	Adult	Total
Autry	177	266	443	17.9	26.8	23.3	$10.84	$13.88	$13.21
Caddo-Kiowa	110	216	326	17.9	25.7	23.0	11.15	15.12	14.29
Canadian Valley	378	331	709	17.9	28.8	23.0	11.25	13.57	12.76
Central	439	446	885	17.9	32.9	25.5	10.77	13.62	12.21
Chisholm Trail	39	71	110	18.3	28.6	24.9	10.81	12.54	12.38
Eastern OK County	174	174	348	17.9	25.1	21.5	9.94	12.82	11.29
Francis Tuttle	464	832	1,296	17.8	29.5	25.3	10.15	16.63	15.83
Gordon Cooper	253	245	498	17.9	27.4	22.6	11.22	15.52	14.28
Great Plains	430	257	687	18.0	28.7	22.0	9.77	12.93	12.04
Green Country	119	42	161	17.4	31.2	21.0	9.85	17.92	15.16
High Plains	57	75	132	18.1	26.7	23.0	11.98	15.28	14.33
Indian Capital	439	392	831	17.8	28.4	22.8	10.01	13.53	12.11
Kiamichi	836	711	1,547	17.7	28.9	22.8	11.22	13.86	12.95
Meridian	172	202	374	18.0	26.5	22.6	11.83	14.08	13.44
Metro	238	522	760	16.9	30.8	26.4	10.46	14.51	14.22
Mid-America	335	145	480	18.0	24.2	19.9	10.77	12.52	11.58
Mid-Del	199	57	256	17.8	25.8	19.6	10.33	13.68	11.53
Moore Norman	291	346	637	17.4	27.2	22.7	10.11	13.55	12.53
Northeast	418	370	788	17.8	28.7	23.0	12.18	13.86	13.15
Northwest	67	71	138	17.9	25.3	21.7	10.45	17.15	15.47
Pioneer	168	100	268	18.0	25.3	20.7	11.26	10.54	10.95
Pontotoc	34	88	122	17.8	27.2	24.6	12.50	13.32	13.14
Red River	150	98	248	18.0	28.9	22.3	10.10	12.58	11.55
Southern Oklahoma	248	65	313	17.7	27.6	19.8	11.57	14.11	12.47
Southwest	89	89	178	17.8	26.7	22.3	8.38	14.62	12.72
Tri County	200	126	326	17.9	26.5	21.2	10.44	14.87	13.31
Tulsa	1,706	1,049	2,755	17.6	28.8	21.8	11.04	14.99	14.22
Wes Watkins	73	108	181	18.1	31.6	26.2	9.48	12.51	11.98
Western	120	158	278	18.1	26.2	22.7	10.43	13.94	12.84
All Districts	8,423	7,652	16,075	17.8	28.5	22.9	$10.88	$14.26	$13.01

Source: ODCTE

Among the 16,075 completers in FY11, a little more than half (52 percent) are high school students with an average age of 17.8 years; adults constitute the remaining 48 percent and have an average age of 28.5 years. While nearly all secondary completers are approximately 18 years old upon completion, the average age of adult completers varies significantly across technology centers. The average reported hourly wage rate is significantly higher for adult completers ($14.26) than for secondary completers ($10.88) because of both age and experience effects. These wages compare favorably to wage estimates for workers with only high school degrees. For comparison, the average hourly wage derived from the March Supplements of the 2010 and 2011 Current Population Survey for workers ages 26-33 with only high school degrees is $10.86. The estimated hourly wage for adult workers ages 18-20 with only high school degrees is $8.68.

Average wage rates differ significantly by technology center as well, ranging from a high of $15.83 (Francis Tuttle) to a low of $10.95 (Pioneer). The highest average reported hourly wage for secondary completers is $12.50 (Pontotoc) and for adult completers is $17.92 (Green Country). It is important to note that the wage rate alone is not a robust measure of the training effectiveness of a district because it ignores differences in the mix of programs offered and the number of secondary versus adult students at each technology center. It further ignores differences in the overall level of wages, industry mix, and volatility of economic conditions in the local job market served by each technology center.

Model of Work Life Income Gains

To evaluate the economic impact of career majors on the state economy, a model of work life income gains is applied to the cohort of FY11 completers. The approach builds upon prior estimates of the returns to career and technology education developed in Snead (2006) and Snead (2008). The model is based upon established empirical findings in the research literature on the returns to vocational and technical education along with Oklahoma-specific wage survey data and historical earnings profiles.

Based on past empirical findings, the model assumes that completers realize work life income gains in four ways: 1) a wage increase upon entry into the workforce, 2) faster growth in earned income over the work life, 3) additional non-earned income (e.g., interest, dividends, and transfer payments) over the work life, and 4) higher earned and non-earned income after the traditional retirement age of 65. The model also allows for other known differences affecting work life earnings for vocational completers including lower rates of unemployment and more hours worked per year. Breaking down the income gains in this micro fashion provides a more intuitive explanation of the underlying source of the expected gains.

Work life income estimates are then derived for completers relative to their expected income without completing education beyond high school. Adult and secondary completers at each technology center are compared to workers of a similar average age but with no education beyond high school. Estimates are produced in a bottom-up fashion for adult and secondary completers at each technology center. This reflects the considerable difference in wage rates across technology centers as well as the difference in expected length of work life for adult and secondary completers. The technology center-level estimates are then aggregated to form statewide estimates.

For adult completers, the initial entry wage is based on earnings for Oklahoma workers ages 26 to 33 with vocational and technical training derived from the March Supplements of the 2010 and 2011 Current Population Survey (CPS). Number of hours worked is used to generate an estimate of an hourly wage rate. The resulting estimate is $12.05 per hour, or approximately $1 per hour lower than the student-reported average hourly wage reported in Figure 3. In comparison, the average reported wage in the CPS for workers ages 26 to 33 with only high school degrees is $10.86. The estimated hourly entry wage gain for adults is $1.19 (10.9 percent), an amount slightly less than the 11.9 percent entry gain for vocational completers predicted by Lillard and Tan (1996).

For secondary completers, the overall post-training wage is estimated using the average hourly wage reported in the CPS survey for workers ages 18 to 20 with vocational and technical training. The resulting estimate is $9.61 per hour, or $1.17 per hour less than the student-reported average wage rate in Figure 3. The estimated pre-training hourly wage for high school completers is $8.68, and is formed using the average wage for workers ages 18 to 20 with only high school degrees from the CPS. The wage differential for secondary students is 10.7 percent, which is also roughly equal to the estimate for the first-year wage gain predicted by Lillard and Tan (1996).

The average level of wages used in the model for each technology center is then established using employer-reported wage data from the Quarterly Census of Employment and Wages provided by the Oklahoma Employment Security Commission (OESC).[23] The OESC dataset includes quarterly earnings data matching 70 percent of all FY11 program completers in the period spanning the third quarter of 2008 to the second quarter of 2012.[24]

Growth in income over the work life is further adjusted to reflect historically faster growth for vocational and technical completers relative to the comparison group of high school completers. Based on historical earnings profiles, real earned income over the work life is expected to increase 0.25 percent annually for high school completers versus 0.75 percent annually for career major completers. The added 0.5 percent growth in the real income of completers each year is assumed to be due to training effects. This real wage premium is consistent with wage gain differentials observed over many decades. The expected wage gains are spread evenly over the work life rather than largely front-loaded as suggested by historical earnings profiles in order to discount the effect.

Implementing the Income Gain Model – Structure and Assumptions

A summary of the structure of the income gain model and key underlying assumptions follow:

1) The estimated work life of completers extends from the age at completion to age 65. The average age across all adult completers following training is 29 years; the average age for secondary completers is 18. The actual ages used for both adult and secondary completers for each technology center are shown in Figure 8.
2) Completers receive both earned and non-earned income over the work life. Non-earned income includes all forms of income other than wage and salary and self-employment income. Non-earned income is calculated as a fixed percentage of earned income using ratios derived from multiple years of the Current Population Survey. For adults, non-earned income is equal to 13.6 percent of earned income for completers and 12.5 percent of earned income for the

comparison group. For secondary students, non-earned income is equal to 12.7 percent of earned income for completers and 11.7 percent of earned income for the comparison group.

3) Based on survey data, the expected entry wage increase upon entering the labor force is 10.7 percent for secondary completers and 10.9 percent for adult completers, relative to high school completers. The entry wage gains have an estimated nine-year life and decline at a uniform rate until they reach zero in year 10.

4) Completers receive retirement income in a period between ages 66 and 75 equal to 80.8 percent of average income earned between ages 50 and 65. The comparison group of high school completers receives retirement income of 82.4 percent of income earned between ages 66 and 75. Income is not tracked beyond age 75. These estimates are derived over multiple years from the Current Population Survey

5) Training gains are either realized immediately or assumed to be embodied in future earnings. Future income gains are not forfeited if additional education is sought or military service entered.[25] Hence, there is no settling-in period or time lag required for completers of the program to find either employment in a related field or suitable employment in another field.

6) The labor force participation rate is assumed to be 84.0 percent for workers with high school diplomas versus 88.2 percent for career major completers. These ratios are averages derived over multiple years from the Current Population Survey.

7) Completers will incur less cumulative unemployment over their work lives. The assumed unemployment rate is 5.5 percent for high school only and 5 percent for career major completers. The 0.5 percent differential is an average derived over multiple years from the Current Population Survey.

8) All future income received is discounted to the present using a discount rate of 3 percent.

Estimated Lifetime Income Gains to a Typical Completer

The lifetime income gain model is applied to the full set of 16,075 FY11 career major completers across each of the 29 technology center districts. The estimates are summarized in Figure 9 and indicate that the average FY11 completer will add almost $475,000 in future dollars ($188,000 in current dollars) to his or her work life earnings. The expected gain per completer is similar in magnitude to the Census synthetic income gain estimate derived earlier for workers with two-year degrees with a vocational or occupational emphasis after adjusting for upfront costs.

The average gain should not be viewed as a specific prediction for any individual student, career major, or technology center, but is best viewed as an estimate for either a typical completer or the average effect across all completers. Hence, a typical secondary completer is expected to add more than $193,300 in current dollars to their future earnings stream, while an adult completer is expected to add more than $181,500 in current dollars. The slightly higher earnings estimate favoring secondary completers is attributable mainly to a longer work life.

The four components of the current dollar lifetime income gain are detailed in Figure 9 for both secondary and adult completers. The first component, the estimated entry wage gain in the nine years following training totals approximately $13,200 in current dollars for the average completer, or 7.0 percent of the total gain. The entry wage gain makes up only 5.4 percent of the total gain for

secondary students, but 8.9 percent of the expected gain for adults. Entry gains are more important for adults because their market wages are significantly higher upon entry into the labor force following training.

Figure 9. Estimated Income Gain From Training *(FY11 Completers)*

Total (16,075 Completers)	**Future Income Gain**		**PV of Income Gain***	
Entry Wage Gain (Years 1-9)	$14,716	3.1%	$13,222	7.0%
Earned Income over Work Life	317,456	66.5%	130,764	69.3%
Non-Earned Income over Work Life	56,949	11.9%	23,524	12.5%
Retirement Earnings (Ages 66-75)	88,218	18.5%	21,102	11.2%
Average per Completer	$477,338	100.0%	$188,612	100.0%
Total - All Completers	$7,673,213,825		$3,031,945,266	
Adult (7,652 Completers)	**Future Income Gain**		**PV of Income Gain***	
Entry Wage Gain (Ages 29-37)	$18,103	4.5%	$16,272	8.9%
Earned Income over Work Life (Ages 29-65)	261,166	65.0%	123,067	67.1%
Non-Earned Income over Work Life (Ages 29-65)	48,281	12.0%	22,751	12.4%
Retirement Earnings (Ages 66-75)	74,412	18.5%	21,350	11.6%
Average per Adult Completer	$401,961	100.0%	$183,440	100.0%
Total - All Adult Completers	$3,075,807,953		$1,403,682,498	
Secondary (8,423 Completers)	**Future Income Gain**		**PV of Income Gain***	
Entry Wage Gain (Ages 18-26)	$11,639	2.1%	$10,451	5.4%
Earned Income over Work Life (Ages 18-65)	368,594	67.5%	137,757	71.3%
Non-Earned Income over Work Life (Ages 18-65)	64,824	11.9%	24,227	12.5%
Retirement Earnings (Ages 66-75)	100,760	18.5%	20,876	10.8%
Average per Secondary Completer	$545,816	100.0%	$193,312	100.0%
Total - All Secondary Completers	$4,597,405,872		$1,628,262,768	

* The present value (PV) of future income gains are discounted at 3 percent annually

Faster growth in earned income over the work life is the second, and largest, component of the total gain in Figure 9, constituting slightly more than two-thirds of added earnings over the work life for both adult and secondary completers. These gains reflect faster growth in earned income over the work life relative to those with no training beyond high school. Overall, FY11 completers can expect to add approximately $130,000 in current dollars to their lifetime earnings streams from this component alone - secondary students can expect to add $137,800, while adult completers add an estimated $123,100.

Non-earned income over the work life is the third component and constitutes 12.5 percent of the expected gain across all completers. This equals more than $23,500 in current dollars for the typical completer. The gains are roughly equal in percentage contribution for both adult and secondary completers. The fourth component, retirement earnings, makes up 11.2 percent of the

total estimated gain for the typical completer, adding about $21,100 in current dollars to their future income streams. The substantial number of years between program completion and the realization of retirement income results in only a modest contribution to the current dollar earnings of completers. Adult completers receive a slightly larger percentage of the total gain (11.6 percent) from higher retirement income than do secondary completers (10.8 percent).

The income gains become more impressive when extrapolated across the full set of FY11 completers in Figure 9. In total, training is estimated to add approximately $7.7 billion to the future income streams of career major completers, or $3.0 billion in current dollars. Secondary completers constitute a larger share of the total current dollar gain than adults - $1.63 billion for secondary students versus $1.4 billion for adults – because of both slightly larger individual gains and more completers. The gains will be realized slowly over the work life of the average completer, but cumulatively represent nearly 2 percent of the approximately $150 billion in annual personal income the Oklahoma economy currently generates. Given an average expected work life for FY11 completers of approximately 40 years, the added future income gain of this cohort group is equivalent to $75 million annually in current dollars, or nearly $4,700 annually per completer.

Lifetime Income Gains by District

The $3 billion in estimated current dollar lifetime income gains across completers is partitioned across the technology centers in Figure 10. The most significant determinant of the size of the impact by district is the number of students trained, with the largest districts generally producing the largest total future income gain. The three largest technology centers by number of completers (Tulsa, Kiamichi, and Francis Tuttle) jointly trained almost 5,600 students and added an estimated $983 million in current dollars to the lifetime earnings streams of completers. This is equivalent to roughly one-third of both the number of students trained and the total income impact. For comparison, the two smallest districts by number of completers (Pontotoc and Chisholm Trail) trained about 100 career major completers in FY11 and generated lifetime earnings gains of $25 million or less in current dollars. On average, each district trained about 550 students in FY11 and added an estimated $105 million in current dollars to the lifetime earnings stream of completers.

The four components of the estimated lifetime income gain for each district are shown in columns 4 through 7 in Figure 10. There is tremendous variability in the estimated income gain per completer among the districts (column 8), with a nearly $100,000 difference between the largest (High Plains, $247,405 gain per completer) and smallest gain (Caddo-Kiowa, $151,873 gain per completer). Again, the difference in gain per completer among the districts does not necessarily indicate a performance differential but will reflect differences in program offerings, the age of students, and the level of wages in the local job market. The estimates also do not reflect the share of the income gain realized within a given technology center's labor market area.

The most important of the four factors in determining the difference in total gain per completer among the districts is added earned income over the work life (column 5). Districts that score well on this measure typically have either a high average post-training wage (e.g., High Plains) or train mostly secondary students who have a longer expected work life (e.g., Mid-America and Southern Oklahoma). Districts that train a large percentage of adults with a shorter expected work life following training (e.g., Caddo-Kiowa and Kiamichi) tend to have lower gains in earned

income over the work life. Since non-earned income (column 6) is calculated as a percentage of earned income in the model, differences among the districts in non-earned income are explained by the same set of factors driving earned income and reflect similar differences across the districts. Retirement income (column 7) is similarly calculated as a percentage of income earned late in the work life and is related to the gain in earned income over the work life.

Figure 10. Estimated Lifetime Income Gains From Training by District *(FY11)*

		Total Income Gain From Training		Present Value of Gain Per Completer*				
District	(1) Comple-ters	(2) Future Value	(3) Present Value*	(4) Entry Gain	(5) Earned Income	(6) Non-Earned	(7) Retirement Income	(8) Total
Autry	443	$230,977,001	$91,417,421	$14,021	$143,332	$25,996	$23,011	$206,360
Caddo-Kiowa	326	116,656,963	49,510,458	12,828	102,994	18,591	17,460	151,873
Canadian Valley	709	358,639,031	138,875,977	13,099	136,542	24,464	21,771	195,876
Central	885	428,042,397	180,143,345	17,217	138,100	24,866	23,370	203,552
Chisholm Trail	110	47,316,128	18,836,673	11,794	118,753	21,570	19,124	171,242
Eastern OK	348	184,091,667	73,139,983	14,630	145,726	26,301	23,515	210,172
Francis Tuttle	1,296	505,809,763	218,286,292	14,231	114,082	20,714	19,404	168,431
Gordon Cooper	498	259,675,359	103,039,215	14,385	143,490	25,890	23,141	206,906
Great Plains	687	329,581,172	126,654,763	12,137	128,747	23,032	20,444	184,359
Green Country	161	81,532,913	31,134,726	12,485	135,304	24,209	21,386	193,383
High Plains	132	84,334,183	32,657,473	16,419	172,543	30,967	27,476	247,405
Indian Capital	831	392,701,059	151,635,051	11,862	127,439	22,961	20,211	182,473
Kiamichi	1,547	609,845,421	242,463,859	11,482	108,238	19,381	17,631	156,732
Meridian	374	215,267,606	85,005,067	15,530	157,873	28,526	25,357	227,286
Metro	760	328,400,170	134,560,648	12,881	121,986	22,234	19,953	177,053
Mid-America	480	283,687,407	106,581,582	13,838	155,967	27,804	24,435	222,045
Mid-Del	256	119,043,620	45,041,794	11,260	123,293	21,963	19,429	175,945
Moore Norman	637	293,532,119	115,627,689	12,378	126,128	22,777	20,237	181,519
Northeast	788	400,732,632	156,192,592	13,318	138,033	24,809	22,054	198,214
Northwest	138	58,885,917	22,682,673	10,584	114,863	20,746	18,174	164,367
Pioneer	268	134,448,648	51,183,217	12,307	133,688	23,870	21,117	190,982
Pontotoc	122	59,737,480	24,477,368	14,729	138,161	25,100	22,643	200,634
Red River	248	139,379,943	54,087,820	14,739	151,891	27,186	24,280	218,096
Southern	313	178,205,544	65,602,264	12,506	147,920	26,248	22,918	209,592
Southwest	178	95,537,160	38,056,608	15,107	148,052	26,677	23,966	213,801
Tri County	326	147,915,812	56,290,184	11,011	120,939	21,658	19,061	172,669
Tulsa	2,755	1,352,013,597	523,974,590	12,652	132,609	23,804	21,126	190,190
Wes Watkins	181	83,038,279	33,017,547	12,606	126,522	22,899	20,391	182,417
Western	278	154,184,834	61,768,386	16,022	153,547	27,644	24,975	222,188
All Districts	16,075	$7,673,213,825	$3,031,945,266	$13,222	$130,764	$23,524	$21,102	$188,612

* Future income gains are discounted at 3 percent annually

Migration-Adjusted Income Gains Realized Within Oklahoma

Not all of the estimated earnings gains will be realized within the state of Oklahoma. A substantial share of workers will migrate in and out of Oklahoma over their work lives. To restrict the estimated income gains to only those realized within Oklahoma, the wage gain estimates in Figures 9 and 10 are adjusted using historical migration rates. The estimates assume an annual out-migration rate of 2.7 percent for the FY11 cohort, with the total number of completers remaining in

the state leveling out at 55 percent in approximately the 20th year following the completion of training.[26] The annual out-migration rate is derived from the Internal Revenue Service County-to-County Migration Database. The 55 percent floor on out-migration is based on the percentage of native born residents at least 18 years of age residing in Oklahoma and is an average derived from multiple years of data from the American Community Survey.

Under these assumptions, the total migration-adjusted current dollar income gain across all completers in FY11 is $1.84 billion, as shown in Figure 11. For the average completer, only approximately 61 percent of the expected future income gain is realized within Oklahoma as completers migrate in and out of the state over their work lives.

Figure 11. Migration-Adjusted Work Life Income Gains

Student Group	Comple-ters	PV of Total Income Gain From Training*	Migration Adjusted Direct Income Gain
Adult	7,652	1,403,682,498	872,630,728
Secondary	8,423	1,628,262,768	967,762,290
Total	16,075	$3,031,945,266	$1,840,393,019

* Future income gains are discounted at 3 percent annually; assumes an out-migration rate of 2.7 percent annually.

Educational Attainment, Public Education Expenditures, and Economic Growth

The estimated migration-adjusted $1.84 billion current dollar income gain for completers represents a significant potential addition to future income for students, and potentially for the state economy. These added earnings are largely the embodiment of future education-driven productivity gains in output in the state economy that will support added future income payments to workers. There is also a long-held belief that education-generated income gains such as these play a key role in determining overall income levels in an economy. Especially for a given individual, the private return to education can be quite large, as described earlier in the report.

Determining the exact size of any broader economic spillover to society is an empirical question not fully answered by existing research, however. The outcome is especially difficult to predict when public funds are used to provide the educational benefits. Theoretically, the cost of taxation can offset the benefits of education in part or in whole. Disentangling the effects of education on future economic growth will always be complicated by the fact that economic growth contributes to education spending and education spending contributes to economic growth.

More recently, a range of studies using modern macroeconomic growth models provide evidence of a significant net positive link from education levels to economic growth, both within and across countries. One thread of this research views education as a critical source of human capital that contributes to long-run growth. Recent works providing an overview of the issues surrounding the links between human capital and long-run growth include Glomm et. al. (1997), Eckstein and Zilcha (1994), and Blankenau (2005).

Other recent studies describe a more formal theoretical framework and provide empirical evidence supporting a positive link between public education expenditures and economic growth. Krueger and Lindahl (2001) demonstrate that the social return from rising educational attainment

and income growth closely resembles the private returns to education commonly found in studies of wage gains. Similarly, Blankenau et. al. (2007) find positive links from education to economic growth across a range of developed countries. Blankenau (2005) finds that increased government spending on higher education is more likely to cause economic growth when tuition is subsidized and the market cost of education lowered. Moretti (2004) provides evidence of a broader social benefit from publicly funded education as higher wages for college graduates pull up market wages for high school graduates and dropouts.

Bose et. al. (2007) examine several types of public expenditures and find that education is the only major category of government spending that can produce positive growth effects across a range of developing countries. Basu and Bhattarai (2012) find a positive link from education to growth but also find that added government involvement in education can lead to less educational attainment and consequently lower growth. Annabi et. al. (2011) suggest that public education expenditures on higher education might act as a potential solution to future growth constraints from aging populations and slowing labor force growth. What is also clear in these studies is that the realized outcome will differ based upon the efficiency of the educational delivery system, the amount of public funding available, the tax structure in place, and the overall level of taxation in the economy.

A recent study of future income gains for higher education graduates in Oklahoma produced using the REMI model, a widely-used dynamic general equilibrium model, predicts large productivity-driven spillover effects for two-year associate degree and certificate holders. The results suggest that added earnings by higher education graduates will increase consumption in the state by an average of $8.825 billion annually in current dollars during the 40 years following completion. The total contribution in the first year following graduation is $228 million in current dollars and reaches $18 billion in current dollars 40 years later. The spillover estimates necessarily assume that spillover economic growth as identified by a growing segment of the economics literature takes place following training.

Given the likelihood of stimulative growth effects from added income gains, we provide input-output model estimates of the potential economic spillover effects. Input-output models are commonly used to describe the mechanism through which increased earnings can indirectly support additional income and employment statewide.[27] These models reflect the interrelationships among the various sectors of the economy and provide estimates of spillover economic activity generated, as well as increased income and sales tax collections at the state and local levels as a consequence of new economic activity. In estimating the spillover impacts, the added income of program completers is deemed the direct effect, which in turn generates what are referred to as indirect and induced effects.[28] The indirect effect is the statewide inter-industry economic activity resulting from the direct impact, and induced effects reflect the economic activity resulting from new household spending out of employee compensation received as part of the direct and indirect effects.

Input-output models are well known to have the potential to overstate future spillover benefits.[29] Several adjustments are made to the model inputs to minimize potential overstatement. First, the wage gains are reduced to reflect any expected out-migration of completers and the potential leakage of earnings outside the state. Second, the initial estimate of the economic impact from the instructional delivery of the career majors through the technology centers is similarly

reduced by the amount of expected out-of-state leakage of purchases. Third, deadweight loss estimates are included in the overall cost-benefit analysis to explicitly account for potential private sector economic losses resulting from public expenditures on the programs.

A custom state-level input-output model is used to estimate multiplier effects for each district. The district-level impacts are then aggregated to form an estimate of the statewide impact. Estimates of spillover impacts to state wages and related tax revenue are detailed in Figure 12.

Figure 12. Multiplier Effects - Indirect/Induced Income Gains and Tax Revenue *(FY11 Completers)*

		Income Impacts			Tax Impacts		
Student Group	(1) **Comple-ters**	(2) **Migration Adjusted Direct Income Gain**	(3) **Indirect and Induced Income Gain**	(4) **Total Direct, Indirect, & Induced Income Gain**	(5) **Direct Tax Revenue**	(6) **Indirect and Induced Tax Revenue**	(7) **Total Direct, Indirect, & Induced Tax Revenue**
Adult	7,652	872,630,728	785,367,656	1,657,998,384	65,447,305	58,902,574	124,349,879
Secondary	8,423	967,762,290	870,986,061	1,838,748,352	72,582,172	65,323,955	137,906,126
Total	16,075	$1,840,393,019	$1,656,353,717	$3,496,746,736	$138,029,476	$124,226,529	$262,256,005

* Future income gains are discounted at 3 percent annually

Overall, the estimated $1.84 billion income gain from training supports an additional $1.66 billion in income gains across other state industries. The estimated combined direct and spillover income gain generated by the FY11 cohort of completers is $3.5 billion in current dollars. Secondary completers account for slightly more than half of the migration-adjusted income gain and consequently are responsible for just over half of the resulting economic impact activity.

The estimated income gains are also expected to produce significant amounts of added income tax and sales tax revenue at the state and local levels.[30] FY11 completers are expected to pay added direct sales and income tax of $138 million in current dollars over their work lives, or more than $8,500 in direct tax payments per completer. An additional $124 million in estimated current dollar tax revenue paid by other workers statewide is supported through spillover effects generated by the income gains of completers. Total estimated direct and spillover income tax and sales tax revenue generated by FY11 completers totals $262 million in current dollars.

Cost-Benefit Framework and Analysis – Career Majors

This section of the report integrates the estimated work life income gains of completers and economic spillover estimates into an overall cost-benefit assessment of career majors. Evaluating the overall contribution of these programs to the Oklahoma economy is challenged by the fact that the benefits of education extend beyond the private return to the student and accrue to several parties, including employers and the public. Benefits also tend to accrue over many years and in differing forms based on the type of training undertaken. The costs of education are also borne by multiple parties and are generally incurred upfront as education and training is delivered.

Figure 13 details the direct and indirect costs and benefits believed to be generated from the provision of career majors for the FY11 cohort of completers. Estimates for most of the direct and indirect benefits are detailed in earlier sections of the report. In current dollars, these benefits

include $1.84 billion in current dollar future wage gains to completers, $138 million in added tax revenue to state and local government, estimated spillover income gains to the broader state economy of $1.66 billion, and spillover tax revenue of $124 million.

The final benefit considered is the impact of the direct spending of $241 million for the delivery of the career major instructional programs statewide. This generates a public cost but also exerts a direct positive economic impact statewide. Based on historical spending patterns, only 76.6 percent, or $185 million, of the expenditures to operate the programs is considered spent within Oklahoma for the cost-benefit analysis.[31]

Figure 13. Cost-Benefit Analysis of Career Major Programs *(FY11 Completers)*

Benefits		Costs	
Direct		**Direct**	
PV of Direct Income Gains to Completers	$3,031,945,266	Cost of Career Major Instruction	$241,310,000
- Out-migration adjustment	-1,191,552,247	- Tuition, Fees, & Other Adjustments	-12,275,000
Net Direct Income Gains to Completers	1,840,393,019	Net Cost of Program Operations	229,035,000
Direct Tax Revenue to State/Local Govt. (Migration adjusted, present value)	138,029,476		
Instruction Expenditures (76.6% of cost)	184,843,460		
Total Direct Benefits	$2,163,265,955		
Indirect		**Indirect**	
Spillover Income Gains (Migration adjusted, present value)	1,656,353,717	Forgone Wages During Training (Adults)	94,502,200
		Forgone Tax Rev. During Training (Adults)	7,087,665
Spillover Tax Revenue	124,226,529	Deadweight Loss (50% of net Prog. Costs)	114,517,500
Total Indirect Benefits	$1,780,580,246		
Total Benefits	$3,943,846,201	**Total Costs**	$445,142,365
Net Benefit	$3,498,703,836		

Along with the direct cost to administer the programs, additional costs include opportunity costs borne by students while in school, the direct costs borne to taxpayers to operate the programs, and any deadweight loss indirectly imposed on the state economy from the hidden cost of taxation to fund education and training.[32] Direct operating costs for career major instruction in FY11 totaled $241.3 million, or $229.3 million after adjusting for tuition, fees, and other income received.[33] Each cohort of completers takes approximately two academic years to complete a career major. Hence each cohort accounts for roughly half the annual cost to operate the program over two years, or about one full year's cost to operate the program. The full cost to operate career majors in FY11 is

used to estimate the cost to train FY11 completers over two years. Program costs over two years totaled approximately $14,250 per completer, or $7,125 per completer per year of instruction.

The cost-benefit assessment considers the potential for deadweight loss that may be generated as a result of funding the programs with public expenditures.[34] Deadweight loss is a theoretical concept used by economists to describe the inefficiencies and losses incurred by the private sector when competitive market forces do not fully determine the outcome in a market for goods or services. The use of taxation to fund public expenditures can result in significant deadweight loss and reduction in output that may offset a part or all of the expenditures.[35] Empirical estimates of deadweight loss in the economics literature suggest that each dollar of government spending funded with taxes reduces private sector activity by roughly $1 to $1.50. The cost-benefit analysis uses a 1.5 to 1 ratio of deadweight loss to public expenditures, the upper end of the range from a series of empirical studies. This ratio is consistent with a broad range of findings in the economics literature and believed to be a significant hurdle in the view of most policymakers and empirical economists. For FY11 career majors, the 1.5 to 1 rule suggests that the $229 million in direct net program costs will produce an estimated $114.5 million in deadweight loss, or reduced state output. Hence, career majors should produce total benefits of at least $343.5 million to fully offset the impact of both the costs of the program and any deadweight loss imposed on the private sector.

There are also losses associated with the time spent by students on education rather than work. The estimates assume that the FY11 cohort incurs a cost of $94.5 million in total forgone income during two years of training. Adult students are assumed to forgo 950 potential work hours each year for two years at a cost of $13 per hour. The estimated lost tax revenue associated with the forgone income is $7.1 million.[36] The estimates assume that only adult students will suffer an income loss. Secondary students do not sacrifice either leisure time or work opportunities to complete career majors but are merely substituting specialized career major training and its foundational academic coursework for traditional high school coursework.

The estimated overall net economic benefit of career majors to the state economy is sizeable. As detailed in Figure 13, estimated direct benefits ($2.16 billion) are roughly 10 times the direct cost ($229 million) to deliver career majors and produce an estimated net direct benefit to the state of nearly $2 billion. Income gains realized directly by completers constitute most of the net direct benefit. State and local government receive $138 million in added tax revenue. Even when the full range of direct and indirect costs ($445 million) are considered, the direct benefits alone cover these costs almost five times and produce a net benefit of $1.7 billion in current dollars.

Considering the indirect benefits pushes total gross benefits to the Oklahoma economy to nearly $4 billion in current dollars. The total gross benefit is nearly nine times the size of the total direct and indirect costs required to administer the programs. The estimated net benefit to the state economy, assuming all direct and indirect costs and benefits are realized, is $3.5 billion in current dollars. State and local government would receive an estimated $309 million in current dollars in added tax revenue. The broader economy would receive more than $1.8 billion in added earnings in current dollars.

Other Benefits to Career and Technology Training

While the primary benefit to those receiving career and technology training is higher work life earnings, many other documented benefits can accrue to program completers and the broader economy. Hence, the estimates provided in this report likely understate the full range of benefits resulting from the provision of career majors in Oklahoma. Excluded benefits include potential socioeconomic benefits resulting from reduced reliance on public services (e.g., unemployment compensation and welfare benefits), improved health benefits, reduced absenteeism, or other potential benefits of education beyond high school (see Christopher and Robinson, 2001) that are realized by both employees and employers across the state. Grubb (1996) finds that undertaking vocational and technical training also increases a worker's likelihood of becoming a professional or manager relative to those with no training beyond high school.

Another source of potential benefit is traced to the group of students who started but did not complete career majors. Sanchez, Laanan, and Wiseley (1999) and Meer (2007) document that completing additional coursework without completing a program adds to the future income stream of the student, though significantly less than for completers. Hence, restricting the analysis only to completers may severely understate realized income gains and the total economic impact of career major programs.

The analysis also ignores workers in Oklahoma who were trained by public and private career and technology schools in the state other than CareerTech, as well as those trained by schools outside the state. While the report's narrow focus more accurately reflects the impact of training provided by the CareerTech System, it will substantially understate the overall impact of career and technology training in general on the wages of state workers and the broader state economy.

Summary of the Economic Impact for FY11 Career Major Completers

- More than 28,200 students were enrolled in career majors and 16,075 students completed the requirements at the state's technology centers in FY11.
- A little more than half (52 percent) of completers are high school students with an average age of 17.8 years; adults constitute the remaining 48 percent and have an average age of 28.5 years.
- Career clusters with the largest enrollment are health science (4,562); transportation, distribution, and logistics (2,331); information technology (1,499); architecture and construction (1,445); and manufacturing (1,269).
- Career majors provide a vital education option for many at-risk students. Disabled students constitute 13 percent of enrollment, one-third are considered economically disadvantaged, and 16.5 percent of entrants are considered academically disadvantaged.
- Reported post-completion hourly wages averaged $13.01 and ranged from approximately $8.50 to nearly $18. The average reported hourly wage rate is significantly higher for adult completers ($14.26) than for secondary completers ($10.88) because of both age and experience effects.
- Career clusters offering the highest reported post-training hourly wage are manufacturing ($17.74); information technology ($14.19); transportation, distribution, and logistics ($13.53); health science ($13.27); and architecture and construction ($13.18).
- The largest benefit of career major training is added income over the work lives of completers. During the past two decades, Oklahoma workers with the equivalent of two-year degrees with an occupational or vocational emphasis earned 20 percent more annually than high school graduates.
- Completers of career majors realize post-training income gains in four ways: 1) a wage increase upon entry into the workforce, 2) faster growth in earned income over the working lifetime, 3) faster growth in non-earned income (e.g., interest, dividends, and transfer payments) over the working lifetime, and 4) higher earned and non-earned income after the traditional retirement age of 65.
- Using a model of lifetime income gains, the average FY11 completer added an estimated $477,000, or $188,000 in current dollars, to his or her lifetime earnings stream. The estimated gains are similar to Census Bureau synthetic estimates of expected lifetime earnings gains. The typical secondary student completer is expected to add approximately $193,300 in current dollars to his or her future earnings, while an adult completer is expected to add $183,400 in current dollars.
- Across all 16,075 FY11 completers, training is estimated to add approximately $3.0 billion in current dollars to their future income streams. After adjusting for out-migration, approximately $1.84 billion in current dollars is expected to be earned within Oklahoma.
- Economic research suggests that public investment in postsecondary education can have a large positive spillover effect on long-run economic growth rates through future productivity gains. Estimated spillover effects suggest that the $1.84 billion income gain of FY11 completers will support an additional $1.66 billion in current dollars in expected future earnings accruing to other workers statewide.
- FY11 completers are expected to pay added direct sales and income tax of $138 million in current dollars over their work lives, or more than $8,500 in direct tax payments per completer.

An additional $124 million in current dollar tax revenue paid by other workers statewide is supported through spillover effects generated by the income gains of FY11 completers.

- Other direct benefits include the impact generated through expenditures made within the state to provide the instruction of career majors at the technology centers ($185 million).
- The estimated direct cost after tuition to operate the career majors for a cohort group of completers over two years is $229 million. Other indirect costs include $101.6 million in forgone earnings and tax revenue as students engage in training rather than work. The indirect costs also include a potential deadweight loss of $114.5 million (50 percent of the net public cost of the programs).
- Overall, estimated direct benefits ($2.16 billion) are roughly 10 times the direct cost ($229 million) to deliver career majors and produce an estimated net direct benefit to the state of nearly $2 billion.
- Considering indirect benefits pushes total gross benefits to the Oklahoma economy to nearly $4 billion in current dollars. The total gross benefit is nearly nine times the size of the total direct and indirect costs required to administer the programs.
- The estimated net benefit to the state economy, assuming all direct and indirect costs and benefits are realized, is $3.5 billion in current dollars. State and local governments would receive an estimated $309 million in current dollars in added tax revenue. The broader economy would receive more than $1.8 billion in added earnings in current dollars.

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Endnotes

[1] Beginning in fiscal year 2008, career majors replaced the former structure of full-time programs offered for many years through the CareerTech System. These two occupational programs represent the highest level of educational attainment for many Oklahoma residents.

[2] A 2008 study conducted by REMI similarly evaluated the impact of the higher education system in Oklahoma. See "The Economic Impact of The Higher Education System Of the State of Oklahoma." Available online at http://www.okhighered.org/econ-dev/econ-impact-remi-9-08.pdf

[3] See Julian and Kominski (2011) for detailed earnings profiles by educational attainment and various demographic factors.

[4] See Heckman et. al. (2008) for recent evidence on the returns to high school and a college degree. They find that Mincer-type earnings functions historically understate the returns to completing high school and a college degree.

[5] A number of explanations have been forwarded for observed Sheepskin effects within higher education, including the role of degrees and certifications in serving a sorting-out role and providing evidence of accumulated human capital. See Weiss (1995) and Card (1999).

[6] The educational attainment classifications used in federal statistical programs have been redefined in recent years. Prior surveys contained a category for vocational/technical/business degree or certificate, but this category is no longer tracked in current surveys. See Chan and Moore (2003) for a discussion of the issues surrounding the inclusion of vocational and technical education in a continuum of educational attainment.

[7] Census Bureau began asking a detailed question on educational attainment in the Current Population Survey in 1992.

[8] Studies evaluating the returns to education have historically focused on the early work of Mincer, which estimated the impact of education on future earnings and the private return to education realized by the student. See Mincer (1974) and more recently Card (1999) and Card (2001).

[9] The area where state earning profiles differ substantially from national data remains education levels above the bachelor's degree.

[10] One potential explanation for the relative weakness in vocational/occupational earnings beyond age 60 may be the relatively small number of completers in this age range and the reduced academic focus of the programs at the time the training was received.

[11] Julian and Kominski (2011) details the role of education versus demographic factors in determining earnings over the work life. Julian (2012) details synthetic work life earnings estimates by degree type and by field for bachelor's degrees.

[12] The concept of an internal rate of return to education is not directly applicable to secondary students completing a career major. The problem is that there are effectively no upfront costs or added opportunity costs incurred by the student. There is also no sacrifice of additional leisure time or work opportunities to complete a career major. The student largely chooses to substitute specialized career major training and its foundational academic coursework for traditional high school coursework.

[13] Krueger and Lindahl (2001) find that the private return to education in the United States is generally around 10 percent for each additional year of schooling when costs and benefits are fully accounted for.

[14] A typical 1,000-hour career major requires six hours of daily classroom instruction for two academic years.

[15] This approach to demand-driven workforce training originated at the federal level as the U.S. Department of Education shifted its funding focus to private-public partnerships that are responsive to the needs and requirements of employers. Funding is also being provided to states to develop more fully the academic, vocational, and technical skills of career and technology education students by promoting the integration of academic and vocational/technical instruction. See Jacobs and Grubb (2003) for a discussion of the policy environment surrounding the future path of career and vocational education, particularly future funding mechanisms.

[16] For an overview of CareerTech STEM-related efforts in FY12 see http://www.okcareertech.org/educators/science-technology-engineering-and-mathematics-stem-1/stem-accountability-2012

[17] Individual disabilities include mental retardation, hearing impairments including deafness, speech or language impairments, visual impairments including blindness, serious emotional disturbances, orthopedic impairments, other health impairments, a specific learning disability, autism, or head injury.

[18] Economically disadvantaged individuals include any person who is eligible for or receiving Aid to Dependent Children under Part A of Title IV of the Social Security Act or benefits under the Food Stamp Act of 1977; is counted

for purposes of Section 1005 of Chapter 1 of Title 1 of the Elementary and Secondary Education Act of 1965; is participating in a program assisted under Title II of JTPA; is receiving a PELL grant or assistance under a comparable state program; or is determined as low-income according to the Department of Commerce or the Department of Health and Human Services' Poverty Guidelines.

[19] Academically disadvantaged individuals are those who score at or below the 25th percentile on a standardized achievement aptitude test or whose secondary school grades are below 2.0 on a 4.0 scale (where the grade "A" equals 4.0) or who fail to obtain minimal academic competencies. This definition does not include individuals with learning disabilities.

[20] The post-completion wage survey provides data on approximately 5,500 of the 9,700 FY11 completers who are not continuing their education.

[21] While self-reported wages are well-known to overstate actual wages, they nonetheless provide a useful gauge of the range of market wages received by a large sample of completers across industries. The earnings gain model used in the cost-benefit analysis uses wage data from the Current Population Survey and employer-reported wages from the OESC database.

[22] Of completers continuing their education, 52 percent pursued further education at a technology center and 48 percent pursued education at a public college or private school. Many health-related career majors including dental hygienist and radiology technician are clinical programs affiliated with four-year bachelor degree programs at comprehensive universities.

[23] The OESC database provides quarterly pre- and post-training wage data on approximately 11,800 of the 16,075 FY11 completers.

[24] Because the OESC wage database reflects employer reported wages, it avoids some known survey biases. However, it is not without limitations of its own and does not necessarily provide definitive evidence of the actual wages earned by program completers. The most important limitation of the OESC database is that it does not include the income of workers either not participating in the state Unemployment Insurance program (e.g., self-employed workers) or those working outside of Oklahoma. Advantages of the OESC database include quarterly reporting and tracking of the county location and SIC industry sector reported by the employer. See Stevens and Shi (1996) for an overview of the issues underlying the process of estimating the post-training earnings gains from state unemployment insurance-based data.

[25] This is merely a simplifying assumption for modeling purposes that does not materially alter the overall results from the model. It is well known that many completers do not find immediate employment, while others either pursue higher education or join the Armed Forces. In the case of those not immediately entering the workforce, the model follows the finding in Sanchez and Laanan (1998) that vocational earnings are not forfeited but are instead embodied in future earnings. Any training gains are thus assumed permanent and realized immediately upon program completion rather than upon eventual entry into the workforce.

[26] This approach is consistent with overall out-migration rates for Oklahoma but may potentially overstate the rate given recent findings on the out-migration rate of higher education graduates with associate degrees or certificates in Oklahoma as detailed in OSRHE (2012).

[27] More specifically, input-output multipliers are intended to predict the indirect and induced changes in region-wide economic activity that result from an incremental change in a given industry within a regional economy.

[28] The Type I and Type II labor income multipliers used in the estimates are weighted averages of industry-level multipliers at the 2-digit NAICS level. The weights are calculated using the total income earned by industry by FY11 completers in the period spanning from the third quarter of 2010 to the third quarter of 2012. The assumed overall multiplier effect in FY11 equates to an average Type II labor income multiplier of 1.90.

[29] This is in addition to other well-known criticisms of input-output (I-O) models. I-O models are essentially demand-driven and assume a fixed structure for prices and wages across industries. They further do not allow for flexible labor market supply or industry-level productivity changes. I-O models are applied most appropriately to scenarios in which a small marginal change in a regional economy is not expected to influence the overall structure of prices or wages or require a meaningful adjustment in overall labor supply. Our estimates merely illustrate the potential impact of the wage gains on the state economy under these circumstances.

[30] The sales tax estimates assume that 50 percent of the income gains are spent within the state on taxable goods and services, with applicable sales tax rates for state and local governments of 4.5 percent and 3.25 percent, respectively. State income tax revenue is estimated as 2 percent of the income gains.

[31] The operations of the career major programs generate further spillover economic benefits, primarily through the payment of labor income to employees, but are excluded from the analysis.

[32] Heckman et. al. (2010) similarly apply a broad cost-benefit framework to the benefits of early childhood education for disadvantaged children.

[33] Total publicly funded revenue used to operate the full CareerTech system in FY11 was approximately $500 million. Hence, nearly half of systemwide funding is devoted to career majors. Historically, approximately two-thirds of CareerTech revenue is raised at the local level through property tax levies, 25 percent through state appropriations, and five percent from federal funding. CareerTech funding at the state level is approximately four percent of total state education spending.

[34] In the case of using taxes to support government activities such as CareerTech training and education, deadweight loss reflects the loss to society of forgone production in the private sector as a result of levying a tax to pay for public services. The loss reduces potential output in the economy and distorts the allocation of goods and services away from a purely market solution. These costs can potentially be quite large and are recognized by economists as a significant factor in determining the long run growth path of an economy. The following table is reproduced from "Hidden Costs of Government Spending." Joint Economic Committee, United States Congress, Jim Saxton (R-NJ), Chairman. December 2001, a 2001 Joint Congressional Committee report providing guidance on the hidden costs of government along with a representative sample of estimates of the size of deadweight loss found in the economics literature:

Table 1. Studies estimating deadweight losses from taxation

Author (year)	*What studied*	*Deadweight loss as % of tax collected*
Harberger (1964)	Taxes affecting U.S. labor	2.5
Browning (1976)	Taxes affecting U.S. labor	8-16
Findlay and Jones (1982)	Australian income, excise, sales taxes	11-160
Stuart (1984)	U.S. payroll, income, excise taxes	21-100
Ballard and others (1985a)	All major U.S. taxes	17-56
Browning (1987—revision of 1976 estimates)	Taxes affecting U.S. labor	8-100
Jorgenson and Yun (1993)	All major U.S. taxes after 1986 reforms	18 (average) 38 (marginal)
Feldstein (1996)	All major U.S. taxes	165
Gravelle and Smetters (2001)	U.S. cigarette and energy taxes	92-861

Sources: References given at end of paper.

Across a broad range of taxes, these studies suggest that government taxation tends to create a deadweight loss of something less than one dollar for each dollar of tax revenue raised. Estimates of deadweight loss have been revised upward over time but even the most aggressive estimates suggest that taxation reduces private sector activity by at most around $1.50 per dollar of tax revenue. Conover (2010) provides an accessible survey of prior estimates of deadweight loss and highlights the findings from Ballard, Shoven, and Whalley (1985) using a range of taxes and shown in the chart above. Ballard, Shoven, and Whalley conclude that the average deadweight loss burden of taxation is 44 percent of the tax raised. The choice of 50 percent deadweight loss follows from this finding. While little evidence is available specifically for deadweight loss generated by local area property taxes, there is no readily available theory suggesting they should be any more burdensome than direct income taxes.

[35] Blankenau et. al. (2007) develop a model illustrating the necessity of considering the offsetting cost of taxation in funding public education expenditures. Deadweight loss can also result from less than perfect competition in a market (as in the case of an oligopoly or a monopolist), from various forms of governmental or legal interference in markets (e.g., binding price floors and ceilings), and from taxes or subsidies originating in the public sector.

[36] The same tax assumptions detailed in note 30 are used to form the estimates of forgone income and taxes.