Completers of Technology Center Full-Time Programs:

Lifetime Income Gains and the Impact on the Oklahoma Economy

Mark C. Snead
Center for Applied Economic Research
Spears School of Business
Oklahoma State University
E-mail: mark.snead@okstate.edu

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Introduction

This study seeks to estimate the income gains from training realized by completers of CareerTech full-time training programs and the resulting economic impact on the Oklahoma economy.[1] Understanding the economic impact of these programs is important because of the ongoing public investment in the CareerTech system and the increasingly important role of technical education in fulfilling the state's economic development mission.

The focus of the study is the development of a comprehensive framework for estimating the lifetime income gains due to vocational and technical training. The model takes into account existing approaches to the problem, the unique structure of the state's CareerTech system, differences in the student population and local labor market in each of the CareerTech districts, and the limitations of the data available for the analysis.

Using Oklahoma Employment Security Commission (OESC) employer reported wage data and Census Bureau survey data, the income model is applied to the 11,680 full-time program completers in fiscal year 2002 (FY02). The estimates indicate that the average 25 year old completer added more than $371,000 ($152,000 in current dollars) to their lifetime income stream relative to completing no additional education beyond high school. Approximately two-thirds of the lifetime income gain is due to faster growth in earned income over the working lifetime. The remainder of the income gain comes in the form of higher wages in the initial years following training, higher non-earned income over the work life, and higher earnings in retirement.

Across all FY02 completers, full-time training is estimated to add approximately $4.3 billion ($1.8 billion in current dollars) to their future lifetime income stream. Approximately 62 percent of the added income is expected to be earned within Oklahoma after adjusting for out-migration. In addition, the income gains from training are expected to produce sizeable annual economic ripple effects in the state economy into the extended future. The added income is also expected to generate a significant future stream of added sales and income taxes to state and local government.

The income model and estimated results are discussed in detail in the remainder of the paper. The next two sections examine the prevalence of technical training among workers in Oklahoma and provide an overview of CareerTech full-time programs. The following section provides a discussion of the findings in existing studies of the payoff to vocational and technical education and develops the methodology underlying the lifetime income gain model. Economic impact estimates of the ripple, or multiplier, effects in the state economy resulting from the estimated income gains are provided next. The paper concludes by discussing other potential benefits from vocational and technical training not captured by the income gain model.

Vocational Education and the Oklahoma Workforce

Vocational coursework is the primary source of education beyond high school for a large segment of the Oklahoma workforce. Based on Census survey data[2] in Figure 1, 17.2 percent of Oklahoma's population ages 18 years and over report having earned a credential from a vocational or technical school, versus 15.1 percent for the nation. Among Oklahoma workers ages 18 and over with earned income in the 12 months prior to the survey, 18.6 percent report a vocational or technical education, as compared to 16.2 percent nationally.

More than half of the state population has completed some education beyond high school, and more than one-third of those have completed vocational and technical school training. According to the survey data, more state workers have completed a vocational degree or certificate than a bachelor's degree. Currently, vocational and technical training is the most common level of educational attainment beyond high school among Oklahoma residents.

Figure 1. Educational Attainment of the Oklahoma Population 18 Years and Over (2004)

	Population			
	Ages 18+		Ages 18+ with Earned Income	
Educational Attainment	Total	% of Total	Total	% of Total
No high school diploma	427,930	16.7%	210,181	12.0%
High school graduate	822,167	32.1%	536,728	30.6%
Some college but no degree	197,532	7.7%	141,045	8.1%
Vocational/Tech./Bus. degree or certificate	440,332	17.2%	325,929	18.6%
Associate degree in college	150,339	5.9%	126,012	7.2%
Bachelor's degree	362,613	14.2%	285,469	16.3%
Master's degree	104,447	4.1%	81,906	4.7%
Professional school degree	35,779	1.4%	29,459	1.7%
Doctorate degree	17,801	0.7%	14,706	0.8%
Total	2,558,940	100.0%	1,751,435	100.0%

Source: Census Bureau 2004 American Community Survey (ACS) Public Use Microdata Samples (PUMS)

Survey data also indicate that the wage gains from education beyond high school can be sizeable. Figure 2 presents Census survey data on income by educational attainment for the Oklahoma labor force and indicates that the average worker who completes technical school training can expect to earn significantly higher wages over their working lifetime relative to those who complete no formal education beyond high school. Workers with vocational or technical training earn an average of $3,700 more in wage and salary income per year than workers with no additional education beyond high school. A slightly larger pay gap above a high school diploma exists for those who have completed an Associate degree, and even greater benefits accrue to those with a Bachelor's degree or higher.

Figure 2. Income of the Oklahoma Population 18 Years and Over by Educational Attainment (2004)

	Wage & Salary Income		Total Earned Income		Total Income	
Educational Attainment	Annual	Hourly	Annual	Hourly	Annual	Hourly
No high school diploma	$16,199	$10.43	$18,131	$11.68	$19,762	$12.73
High school graduate	22,004	12.26	24,134	13.44	25,784	14.36
Some college but no degree	23,863	13.75	25,627	14.76	26,848	15.47
Vocational/Tech./Bus. degree or certificate	25,746	14.30	27,789	15.44	29,875	16.60
Associate degree in college	28,407	15.44	29,257	15.91	31,161	16.94
Bachelor's degree	40,487	20.75	43,014	22.04	45,970	23.56
Master's degree	47,896	23.90	49,386	24.64	55,530	27.71
Professional school degree	66,232	28.35	81,843	35.03	90,687	38.81
Doctorate degree	54,182	24.19	63,018	28.13	74,326	33.18
Total	$28,512	$15.65	$30,824	$16.92	$33,234	$18.24

Source: Census Bureau 2004 American Community Survey (ACS) Public Use Microdata Samples (PUMS). Total earned income includes both wage & salary and self-employment income. Total income includes income from all sources collected in the Census Supplemental Survey form.

Hourly earnings by educational attainment in Oklahoma are also presented in Figure 2. The gains to vocational and technical training continue to hold when measured on an hourly basis, with earnings at least $2.00 per hour, or nearly 20 percent, higher than for high school graduates. The income gains are also insensitive to the measure of income, showing similar increases across the three measures reported in Figure 2. Based on total income, vocationally and technically trained workers earn nearly $4,100 more per year than those with no education beyond high school. Similar differences in income at the various levels of educational attainment are present at the national level as well.

Profile of Technology Center Full-Time Programs

The focus of this study is the group of technology center full-time program completers in fiscal year 2001-2002 (FY02). Figure 3 presents data on enrollment, average student age, and estimated post-training wages for each of the 29 CareerTech districts statewide. Students completing full-time programs receive preparation for a diverse set of occupations ranging from nursing to aviation maintenance. Most programs require attendance for at least one year, with up to 1,050 hours of classroom contact annually.

Students attending full-time programs tend to match one of two demographic profiles: 1) secondary school students age 16 to 18 in the final two years of high school and 2) adults over the age of 25 who have already completed high school. Approximately 40 percent of completers are high school students with an average age of 17.6 years; adults comprise the remaining 60 percent of completers and have an average age of 29.9 years. The average age across all completers is 24.7 years. Most secondary completers are approximately 18 years of age, however the average age of adult completers varies significantly across districts. Northwest Technology Center trained the youngest group of adults in the period (average age 25.5) while Central Technology Center trained the oldest group of adults (average age 35.1).

Figures 3 and 4 present estimated post-training hourly wage rates for completers by CareerTech district and program, respectively. The wage estimates are formed using a combination of employer reported earnings from the OESC Unemployment Insurance (UI) database and Census survey data. The wage rates reflect the average hourly earnings spanning the six quarters from the first quarter of 2003 to the second quarter of 2004. A detailed description of the underlying wage estimates is provided in the model framework section of the study.

As shown in Figure 3, the estimated average post-training wage rate is $10.47 for students completing full-time programs in FY02. Wage rates are significantly lower for secondary completers ($7.58) than for adult completers ($12.46), and wage rates differ by district as well, ranging from a high of $14.10 for Francis Tuttle Technology Center to a low of $7.72 at Northwest Technology Center. It is important to note that the wage rate alone is not an adequate gauge for measuring the training effectiveness of a district because it ignores differences in the mix of programs offered, the number of secondary versus adult students, and the overall level of wages in the local job market.

Table 4 details average estimated post-training wage rates by program, with responses ranging from approximately $5.00 per hour to more than $25.00 per hour. Programs offering the highest reported post-training hourly pay include MRI Technician ($26.78), Respiratory Care ($24.27), Radiology Technician ($22.17), Physical Therapist Assistant ($18.10), Database Administrator ($17.93), Law Enforcement Training ($16.45), Orthotics/Prosthetics Technician ($15.84), and Aviation Maintenance ($15.52). Programs with the largest enrollment include Business and Information Technology (1,330), Practical Nursing (890), Health Careers Certification (791), Truck Driver (743), Auto Service (698), Cosmetology (467), Welding (450), and Information Services (339).

Figure 3. Enrollment, Age, and Post-Training Wage by District (FY02)

	Completers			Average Age			Average Post-Training Hourly Wage		
District Name	Secon-dary	Adult	All	Secon-dary	Adult	All	Secon-dary	Adult	All
Autry	156	188	344	17.6	26.3	22.5	$7.58	$12.46	$10.47
Caddo-Kiowa	81	587	668	17.6	33.9	31.8	6.88	12.79	12.30
Canadian Valley	267	182	449	18.0	29.5	22.7	8.22	11.54	9.56
Central	217	882	1,099	17.3	35.1	31.6	8.05	14.31	12.65
Chisholm Trail	32	23	55	18.2	26.4	21.5	9.76	9.16	9.64
Eastern OK County	159	98	257	17.4	27.9	21.0	7.83	13.94	10.16
Francis Tuttle	255	595	850	17.6	31.6	27.3	8.08	16.58	14.10
Gordon Cooper	154	174	328	17.6	28.1	23.1	7.46	10.87	9.25
Great Plains	274	267	541	17.3	28.9	23.2	6.02	11.29	8.65
Green Country	72	37	109	17.4	28.0	21.0	6.48	12.92	9.24
High Plains	73	81	154	18.0	28.1	23.2	8.67	11.15	10.02
Indian Capital	300	290	590	17.4	26.1	21.7	7.59	10.62	9.11
Kiamichi	384	539	923	17.2	32.8	23.1	7.08	10.53	9.20
Meridian	94	168	262	17.3	27.3	23.7	7.88	12.21	10.70
Metro	179	504	683	17.4	27.0	24.6	7.13	11.98	10.70
Mid-America	202	93	295	17.5	27.7	20.6	9.11	11.13	9.79
Mid-Del	206	86	292	17.7	30.1	21.3	6.94	11.37	8.45
Moore Norman	166	295	461	17.5	26.9	23.6	7.66	12.15	10.49
Northeast	288	191	479	17.4	28.2	21.3	7.28	11.13	8.80
Northwest	35	46	81	17.6	25.5	21.9	6.77	8.38	7.72
Pioneer	86	141	227	17.3	28.7	24.3	7.86	10.61	9.65
Pontotoc	34	71	105	17.0	27.8	20.6	8.69	10.67	10.07
Red River	67	109	176	17.9	30.1	25.4	7.96	11.66	10.19
Southern Oklahoma	145	95	240	17.5	28.1	21.7	8.50	12.42	9.96
Southwest	50	84	134	18.0	28.6	24.6	6.70	10.92	9.15
Tri-County	141	123	264	17.4	27.2	21.9	7.19	10.80	9.00
Tulsa	511	671	1,182	18.1	27.9	23.6	7.19	13.85	11.08
Wes Watkins	44	93	137	17.5	27.2	24.0	6.50	9.50	8.66
Western	85	210	295	17.9	30.1	26.6	9.06	8.96	9.02
All Districts	4,757	6,923	11,680	17.6	29.9	24.7	$7.58	$12.46	$10.47

Source: Oklahoma CareerTech, Oklahoma Employment Security Commission, Census Bureau 2004 American Community Survey (ACS) Public Use Microdata Samples (PUMS)

Figure 4 - Full-Time Program Average Hourly Wage Rate (FY02)

Program	Completers	Average Hourly Wage	Program	Completers	Average Hourly Wage
Air Conditioning and Refrigeration	228	$11.88	Industrial Technology	94	$15.38
Apparel Design	22	5.70	Information Services	339	8.49
Applied Accounting	43	10.85	Institutional & Home Services	66	6.02
Automobile Collision Technology	271	9.10	Insurance Services	14	9.22
Automobile Service Technology	698	9.30	Internet Security	15	6.26
Aviation Maintenance Technology	285	15.52	Intranetworking	93	11.86
Building and Grounds Maintenance	197	6.35	Lab Technology	9	6.36
Business and Information	1,330	7.95	Law Enforcement Training	229	16.45
Cabinet Making	11	7.14	Magnetic Resonance Imaging	2	26.78
Carpentry	277	8.32	Major Appliance Technology	26	10.96
Certified Massage Therapist	7	9.55	Marine Service Technology	11	11.01
Commercial Art	48	6.90	Marketing E-Commerce	15	6.49
Commercial Photography	18	6.99	Marketing Management/Entrep.	73	7.12
Computer Repair/Networking Tech.	276	13.44	Masonry	98	8.05
Construction Trades Cluster	33	9.45	Meat Processing	9	8.30
Cosmetology	467	7.38	Medical Assisting	87	8.04
Culinary Arts	183	6.42	Medical Office Tech (Health)	34	8.46
Customer Service	34	7.59	Medical Office Technology	16	8.34
Database Administrator	18	17.93	Motorcycle Service Technology	13	6.97
Dental Assisting	94	8.44	Network Administrator	18	14.09
Dental Laboratory Technology	15	6.42	Network Technician	13	6.49
Diesel Service Technology	194	10.09	Networking Technology	81	10.61
Drafting	269	10.99	Nursing Assisting	154	8.89
Early Care and Education	202	6.49	Nursing Options	21	8.58
E-Commerce & Web Services	126	8.00	Occupational Therapy	12	11.95
Electrical Trades	201	10.44	Orthotics/Prosthetics	12	15.84
Electronics	287	11.51	Paralegal Studies	4	11.07
Emergency Medical Technician	160	14.93	Physical Therapist Assistant	16	18.10
Family & Consumer Sciences	26	4.82	Plumbing	21	11.76
Farm Equipment Repair	12	5.03	Power Products Technology	64	9.88
Firefighter Training	22	7.08	Practical Nurse	890	14.00
Graphic Communication	215	7.49	Precision Machining	205	15.12
Graphics & Video Production	53	7.21	Radiologic Technology	38	22.17
Health Careers Certification	791	7.49	Respiratory Care	40	24.27
Health Science Technology	12	6.87	Surgical Technology	123	13.75
Heavy Equipment Maintenance	46	9.13	Telecommunication Technician	194	11.77
Horse Production and Management	14	7.48	Truck Driver	743	15.60
Horticulture (T & I)	47	5.79	Upholstery	14	7.02
Hospitality	13	7.81	Welding	450	11.37
Individualized Cooperative	79	6.68			
			All Programs	11,680	$10.47

Source: Oklahoma CareerTech, Oklahoma Employment Security Commission, Census Bureau 2004 American Community Survey (ACS) Public Use Microdata
Samples (PUMS)

Issues in Estimating Gains to Vocational and Technical Education

Measuring the exact portion of the post-training wages reported in Tables 3 and 4 that is ultimately due to vocational and technical education presents several challenges. Among the more fundamental problems faced when evaluating income gains are two well-known sources of potentially serious bias that can result in an overstatement of the returns to education: 1) 'ability bias' - the tendency of those with more ability to seek more education and training, and 2) 'selectivity bias' - the tendency of trainees to choose a field for which they are 'naturally inclined.'

Other concerns when measuring the returns to vocational and technical education are that many of the skills can be learned either on the job or through self-training, and that acquired skills may diminish in value over time, some very quickly after program completion. Other factors such as the parent's income and education (Trost and Lee, 1984) and type of high school curriculum (Hollenbeck, 1992; Mane, 1999) are also believed to drive the decision to seek further education and thus affect wage rates over the work life cycle. Studies also find that some kinds of vocational and technical training – particularly programs for the disabled and disadvantaged that do not prepare trainees to enter the competitive job market and traditionally low-paying occupations such as child care (Grubb; 1997, 1999) – may provide no economic benefit at all.

Yet other issues hamper efforts to use empirical analysis to isolate the income gains due to education. For example, research shows that the returns to vocational and technical education are substantially higher for those who find employment related to their area of training as well as for those with prior work experience in the field of training (Grubb, 1997). Outcomes also differ based on the field of study and length of the training program, where better outcomes are observed for those obtaining training in health and technical fields (Grubb, 1996), and generally higher returns in all fields as the amount of training increases (Mane, 1999; Smith, 2001). Geography also matters, with program completers working in rural areas generally earning less than those finding jobs in metropolitan areas. There are also quantifiable differences in earnings outcomes based on the sex and race of the trainee (Couch, 1992; Grubb, 1997; Leigh and Gill, 1997; and Mane, 1999).

In short, the exact portion of the expected future increase in income that is ultimately due to education beyond high school is an empirical issue that is far from settled in the labor economics literature. Pascarella and Terenzini (1991) even argue that a portion of the wage gains realized through education are due to 'socialization' effects that develop personal skills and traits valuable to employers, and that these effects are not necessarily specific to any particular type of education but to formal education in general.

Recent Research on the Gains to Vocational and Technical Education

Despite the hurdles inherent in estimating the returns to education, recently renewed interest in measuring the effectiveness of education at all levels has resulted in numerous empirical studies attempting to isolate the effects of vocational education and training on labor market outcomes. A growing consensus within this body of research is that vocational education, as with other forms of post-secondary education, translates into higher income over the work life cycle. Recent empirical studies documenting statistically significant wage gains from vocational education and training include Kane and Rouse (1995a, 1995b), Lillard and Tan (1996), Grubb (1997), Leigh and Gill (1997), Rouse (1998), Mane (1999), Kornfeld and Bloom (1999), and Sanchez, Laanan, and Wiseley (1999).

The most convincing of these empirical studies use integrated databases combining state wage records and post-training employment surveys along with a demographic and academic profile of each program completer. Earnings functions are typically estimated comparing pre- and post-training wages in order to measure the change in wages attributable to training, while simultaneously holding other quantifiable influences on wages constant. Unfortunately, this comprehensive method of evaluation is not yet possible in Oklahoma because much of the data needed to complete the most rigorous form of study of the issue for full-time program completers is not available. These data include detailed demographic and academic profiles of program completers, pre-training work and wage history, and more detailed information on post-training occupation and hours worked. These data sets are not currently maintained by either the Oklahoma Employment Security Commission (OESC) or the Oklahoma Department of CareerTech.

Without access to these datasets, the next best approach to estimating wage gains is to construct a conservative framework for combining available data at the state level with applicable results from studies of wage gains at the national level. A concern with using wage gain models from national studies to make inferences about state programs is that it ignores any differences in performance across states, which tends to overstate the results of low performing states and understate the results of high performing states. Nevertheless, the approach of using available data at the state level in conjunction with certain national ratios should produce wage gain estimates that easily pass a 'reasonableness' test, but will undoubtedly leave ample uncertainty within the grasp of hard-nosed skeptics. However, even if a more comprehensive analysis were feasible, it would not fully eliminate the uncertainty surrounding the size of the estimated wage gains. This issue is addressed in comprehensive reviews by Bishop (1995), Stevens and Shi (1996), Grubb (1999), Grubb and Ryan (1999), and Smith (2001) along with a discussion of the complex empirical issues surrounding the measurement of wage gains from vocational and technical training and the results from existing research on earnings functions for vocational completers.

A Model of Lifetime Income Gains From Training

The lifetime income gain model used in this study allows completers to 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. The work life for each completer extends from the age of the completer at program completion to age 65, and a period of retirement is assumed for ages 66 to 75. The model also assumes that completers will periodically drop out of the labor force as well as experience periods of unemployment. Because the level of entry wages and the expected length of work life are significantly different for adult and secondary completers, income gains are estimated separately for the two groups of completers and then combined to derive district totals. The district results are then aggregated to produce CareerTech system results.

Again, due to data limitations, the basic approach used in this study is to combine available data at the state level with well-established results from existing studies at the national level. Oklahoma-specific datasets are used to determine the majority of the key parameters in the model, including post-training wage rates, annual hours worked, earnings growth over the work life, labor force participation rate, unemployment rate, out-migration rate, and retirement earnings. Studies at the national level are used to form estimates of two key assumptions: the initial wage gains

following training and the real growth rate of future earnings. These and other underlying model assumptions are discussed in the remainder of this section.

Study and Comparison Groups

The study group includes FY02 completers, or those completing technology center full-time programs, and excludes leavers, or those starting but not completing a full-time program. However, Sanchez, Laanan, and Wiseley (1999) find that completing additional coursework without completing the program adds to the future income stream of the student, though significantly less than for those completing the program. Hence, restricting the analysis to completers likely understates the overall income gains and economic impact of technology center full-time programs.

Specifically, the gains to training are modeled as the difference in the post-training income of full-time program completers relative to their expected income without completing education beyond high school. Secondary completers are compared to other recent high school graduates with no education beyond high school. Adult completers are compared to workers of a similar average age with no education beyond high school.

Entry Earnings Gains and the Expected Life-of-Training

National studies assessing entry wage gains for recent completers of vocational and technical training find statistically significant wage gains over several years but do not reach a consensus on the magnitude and expected life of the wage gains when a completer enters the workforce. For example, Bloom et.al. (1997) find no decay in the first 30 months of post training earnings gains. Couch (1992) finds that earnings gains from training do not decay in the 8 years following training. Lillard and Tan (1996) estimate earnings equations for various types of education and find an 11.9 percent income gain in the first year after vocational and technical training; however the income gains from training are statistically significant only over a 9-year horizon and diminish annually.

For this study, entry wage gains are modeled using the basic approach of Lillard and Tan by assuming that completers enjoy an 11.9 percent first year post-training gain in earnings, which then diminishes to zero after the ninth year following training. The Lillard and Tan framework is used because it allows for the simultaneous specification of two aspects of the expected lifetime earnings pattern: 1) an initial post-training wage increase and 2) and a finite life-of-training. This presents a logical framework for modeling the expected life cycle of earnings gains from vocational and technical training by allowing the gains to persist over several years but diminish to zero over time. Practical reasons suggesting a finite life to future wage gains are that some programs may produce no immediate wage gain, many program completers eventually move to careers for which their area of training is unrelated, and acquired vocational and technical skills may simply become obsolete over time.

The 11.9 percent estimated year 1 earnings gain is also representative of the range of findings in the literature for first year wage gains. A decade ago, the Census Bureau (1993) reported that those with a vocational certificate or degree earned on average $1,920 (or 14.9 percent) more per year than high school graduates. Using the 1996 Survey of Income and Program Participation (SIPP) Panel but different definitions for the workforce and for vocational training, the Census Bureau (2001) found that full-time workers ages 18 and over with a vocational degree earn $2,544 (or 9.3 percent) more per year than high school graduates. The first year increase in income is also

consistent with the assessment by Grubb (1997) that the income gains to those with a vocational certificate are "typically in the range of 12-16 percent." A similar result is found in Sanchez, Laanan, and Wiseley (1999) where students completing a vocational certificate in California community colleges realized a 14 percent gain in earnings in the one to three years after program completion.[3] In addition, the assumed 11.9 percent year one post-training wage increase is consistent with the Census survey data on income differentials between high school graduates and vocational completers shown in Figure 5. In the 2000 to 2004 period, vocational completers ages 18 to 65 earned an average hourly wage 16.8 percent higher than high school completers ($14.99 versus $12.83). The Lillard and Tan estimate is also conservative in the sense that it is near the low end of the range of estimates.

Figure 5. Hourly Wage Rate by Age and Educational Attainment

High School Graduate

Ages	2000	2001	2002	2003	2004	Average
18-20	$6.36	$7.15	$6.81	$8.54	$7.04	$7.18
21-25	8.74	8.35	9.75	9.22	9.65	9.14
26-30	10.04	10.81	11.17	11.49	12.33	11.17
31-35	12.13	11.94	11.78	13.32	12.11	12.26
36-40	13.26	13.05	14.96	12.85	13.94	13.61
41-45	13.39	14.59	13.61	13.87	14.64	14.02
46-50	11.82	14.25	13.79	13.53	15.48	13.77
51-55	12.23	15.20	12.02	13.82	14.70	13.60
56-60	16.27	16.32	15.50	14.63	15.82	15.71
61-65	15.72	11.80	16.40	13.94	12.77	14.13
All	$12.25	$12.78	$12.88	$12.80	$13.45	$12.83

Vocational/Technical/Business School Certificate or Degree

Ages	2000	2001	2002	2003	2004	Average
18-20	$7.01	$8.68	$7.05	$7.73	$6.74	$7.44
21-25	7.79	8.74	8.58	9.22	9.15	8.70
26-30	10.12	12.58	13.43	12.50	11.71	12.07
31-35	11.16	13.89	13.58	14.32	13.71	13.33
36-40	17.75	14.48	15.45	16.84	16.01	16.11
41-45	14.13	15.49	17.25	16.89	16.72	16.09
46-50	17.64	17.87	16.80	15.82	20.76	17.78
51-55	15.82	17.38	19.61	16.25	19.49	17.71
56-60	24.73	17.60	19.83	17.48	16.95	19.32
61-65	12.31	21.37	23.64	19.27	18.26	18.97
All	$14.22	$14.92	$15.54	$14.90	$15.34	$14.99

Source: Census Bureau American Community Survey (ACS)

Pre- and Post-Training Wage Estimates

Estimating the lifetime income gains from training requires an estimate of both the pre- and post-training wage rate of completers. The estimates are formed in two steps. First, the Census Bureau ACS wage survey estimates in the 2000 to 2002 period (see Figure 5) are used to establish the average level of pre- and post-training hourly wages for adult and secondary completers. The ACS survey contains both total wages and hours worked which provides the basis for establishing

an overall hourly rate. The average wage rate in the three year period from 2000 to 2002 is used because of the unusual volatility in wage rates for young workers during the economic cycle surrounding the 2001 national recession.

The UI employer-reported wage dataset is then used to adjust the overall wage rate by program and district. The UI dataset provided by OESC includes quarterly earnings in the period spanning the first quarter of 2002 to the second quarter of 2004 matching 74.5 percent of all FY02 program completers. Additionally, because the OESC wage database reflects employer reported wages, it avoids 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.[4] The most important limitation of the UI database is that it does not include the income of workers either not participating in the state Unemployment Insurance program (e.g. self-employed persons) or those working outside of Oklahoma. Advantages of the UI database include quarterly reporting and tracking of the county location and SIC industry sector reported by the employer.

For adult completers, the overall post-training wage is assumed to be the average hourly wage rate from the Census ACS survey in the 2000 to 2002 period for workers ages 26 to 35 with vocational and technical training. This reflects the expected wage for completers with an average age of 30 years. The resulting estimate is $12.46 per hour and is consistent with recent student-reported wage survey data in the period.[5] The overall pre-training wage for adults is estimated using the average wage for workers ages 26 to 35 but with only a high school degree. This reflects the wage that completers would have earned had they not pursued vocational and technical training. The estimated pre-training hourly wage is $11.31. The difference between the pre- and post-training wage is 10.2 percent, an amount slightly less than the Lillard and Tan first year wage gain estimate. The estimated post-training wage rate is then scaled using employer-reported UI wage data to form estimates of the hourly wage rate by both program and district.

For secondary completers, the overall post-training wage is based on the average hourly wage from the Census ACS survey for workers ages 18-20 with vocational and technical training. The resulting estimate is $7.58 per hour and is again consistent with student-reported wage rates in the period. The estimated pre-training hourly wage for secondary completers is $6.77, and is formed using the average wage for workers ages 18-20 with only a high school degree from the ACS survey. The wage differential for secondary students is 11.9 percent, which matches the estimate for the first year wage gain from Lillard and Tan. The overall estimated wage rate for secondary students is similarly scaled using employer-reported UI wage data to form estimates of the hourly wage rate by both program and district.

Although this approach to estimating pre- and post-training wages does not provide exact estimates of the overall level of wages, it nevertheless provides a very good estimate of the relative earnings across programs and districts. It also provides a reasonable first year wage gain based on the findings in existing studies of wage gains from vocational and technical training. This is desirable since the overall model estimates are much more sensitive to the difference between the pre- and post-training wage rates than to the overall level of wage rates used in the analysis. The implication for modeling income gains in Oklahoma is that the combination of Census survey data and the UI wage database provides the best available estimate of actual post-training earnings of full-time program completers.

Real Income Growth over the Work Life

The Bureau of Labor Statistics (2002) finds that all forms of formal education beyond high school translate into faster wage growth over a worker's career. Using the National Longitudinal Survey of youth from 1979 to 2000, BLS finds that for "every age category, growth rates in inflation-adjusted hourly earnings generally were higher for workers with more education." Specifically they find that those receiving education beyond high school but less than a bachelor's degree enjoyed inflation-adjusted wage growth in the 22-year period of between 0.4 percent and 1.4 percent per year higher than high school graduates. The lifetime income model assumes that vocationally trained workers experience an additional 1 percent in annual real income growth over the work life above what would be expected for workers with only a high school diploma.

Non-Earned Income over the Work Life

Completers are assumed to generate added non-earned income over their work life as a result of completing a full-time program. Non-earned income includes all forms of income other than wage and salary and self employment income (e.g. interest, dividends, and government transfer payments) and is derived from the Census Bureau's 2002 American Community Survey. Completers are assumed to gain an additional 1 percent annually in non-earned income above the level earned by the comparison group with no education beyond high school. Non-earned income is calculated as a fixed percentage of earned income and hence grows at the same rate as earned income over the work life. 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.

Entry into the Labor Force

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. 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. Any training gains are thus assumed permanent and realized immediately upon program completion rather than upon eventual entry into the workforce. This is merely a simplifying assumption for modeling purposes that does not materially alter the overall results from the model.

Migration Loss

The wage gain estimates further assume that some program completers will leave the state following training. The annual migration loss is equal to 2.7 percent annually until the percentage of completers remaining in the state reaches 55 percent. The annual out-of-state migration rate is derived from the Internal Revenue Service (IRS) County-to-County Migration Database in the 1996-97 to 2002-03 tax years, while the 55 percent floor on out-migration is derived from the Census Bureau's 2000-2004 American Community Surveys. It is important to note that this method of accounting for migration losses ignores workers who were trained in Oklahoma but by vocational

and technical schools other than those in the CareerTech system, as well as workers who received training at schools outside the state. While this narrow focus more accurately reflects the impact of training provided by the CareerTech system, it will substantially understate the overall impact of vocational and technical training in general on the wages of state workers.

Retirement Income

Retirement income is estimated using the ratio of average income between the ages of 66 and 75 (the retirement period in the model) to average income between the ages of 50 and 65 from the 2002 Census Bureau American Community Survey. No distinction is made between earned and non-earned income after age 65. Extending retirement income only to age 75 almost certainly understates the retirement income that will be received on average by FY02 completers.

Figure 6 illustrates the retirement income ratios for the various categories of educational attainment. Total income at the retirement age of 66 is 82.4 percent of average earned income from age 50 to age 65 for high school only, and 80.8 percent of average earned income from age 50 to age 65 for full-time program completers. Income declines 1.5 percent annually after age 66 for both groups.

Figure 6. Ratio of Retirement Income to Earned Income

Educational Attainment	Average Income		Retirement Income Ratio
	Ages 50-65	Ages 66-75	
No high school diploma	$17,112	$13,370	78.1%
High school graduate	22,104	18,220	82.4%
Some college but no degree	28,395	22,077	77.7%
Voc/Tech/Bus school degree	33,120	26,754	80.8%
Associate degree in college	33,901	26,537	78.3%
Bachelor's degree	44,729	43,404	97.0%
Master's degree	50,487	45,715	90.5%
Professional school degree	87,657	74,973	85.5%
Doctorate degree	77,407	48,148	62.2%
Total	$32,161	$23,229	72.2%

Source: Census Bureau 2002 American Community Survey

Summary of Model Assumptions

The model structure and underlying assumptions and parameters include the following:

1) The estimated full-time work life of completers extends to age 65. The average age for adults following training is 30 years; the average age for secondary completers is 18.
2) Completers receive both earned and non-earned income over the work life.
3) Completers receive both earned and non-earned income in a retirement period between ages 66 and 75.
4) The post-training wage for each program is determined using Census survey data by age and educational attainment along with OESC employer reported wage data.

5) The expected year-1 post-training wage increase upon entering the labor force is 11.9 percent for secondary completers and 10.2 percent for adult completers. The entry wage gains have an estimated 9-year life and decline at a uniform rate until they reach zero in year ten.

6) Training gains are either realized immediately or embodied in future earnings.

7) Real earned and non-earned income over the work life grows at a rate of 0.25 percent annually for high school only versus 1.25 percent annually for full-time program completers. The added 1.0 percent real growth in the income of completers each year is assumed to be due to training effects.

8) The underlying life path of real hourly wages reflects real growth rates that are highest in the early work years and become negative late in the work life. The estimated wage path is consistent with age-earnings profiles from the 2000-2004 Census Bureau American Community Surveys of Oklahoma residents ages 18 and over with earned income. Income is assumed to decline 1.5 percent annually after age 66 for both adult and secondary completers.

9) The labor force participation rate is 84.0 percent for workers with a high school diploma only and 88.2 percent for vocational and technical completers.

10) The unemployment rate is 5.5 percent for high school only and 5.0 percent for completers.

11) Completers are assumed to work an average of 1,855 hours per year, the average number of hours worked annually by Oklahoma workers with vocational and technical training in the 2000 to 2004 Census Supplemental Survey.

12) Total income at the retirement age of 66 is 82.4 percent of average earned income from age 50 to age 65 for high school-only completers, and 80.8 percent of average earned income from age 50 to age 65 for full-time program completers.

13) Annual migration loss is equal to 2.7 percent annually until the percentage of completers remaining in the state reaches 55 percent.

14) All present value calculations use a discount rate of 3 percent.

The results produced by the model can easily be evaluated for reasonableness by assessing the resulting percentage of added income that the model attributes to technical and vocational training. As discussed earlier, the added wage gains above those earned by high school completers following training that is observed in the data cannot be attributed in full to training. Across all completers, the income model suggests that approximately two-thirds (67.4 percent) of the income gain is a result of training and one-third is due to other factors, including selection bias.

It is also important to note that the model merely attempts to compute the gross income gains generated by the provision of full time training and does not integrate the operating costs of the CareerTech system in an attempt to determine a net benefit. Similarly, the model does not perform a cost/benefit analysis of the decision of an individual student to seek full-time training as it does not account for foregone income or any direct costs paid by students.

Lifetime Income Gains to a Typical Completer

The lifetime income gain model was applied to the set of FY02 completers in each of the 29 CareerTech districts, with separate estimates generated for adult and secondary students. The estimates are summarized in Figure 7 and indicate that a typical 25 year old completer will add more than $371,000 ($152,000 in current dollars) to their future earnings stream by completing a full-time training program. The gain is significantly larger in future dollars, however, the current dollar value, or present value, of the estimated gain is generally the most appropriate measure for assessing the gains to training because of the extended time frame over which income is earned.

For the two categories of completers, the current dollar expected lifetime income gain is 4 percent higher for secondary students than for adults. The typical secondary student completer is expected to add nearly $156,000 in current dollars to their future earnings, while an adult completer is expected to add more than $152,500 in current dollars. The small earnings gap 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 7 for both secondary and adult completers. The first component, the estimated entry wage gain in the nine years following training totals approximately $11,500 for the average completer, or 7.5 percent of the total gain. The entry wage gain makes up only 5.7 percent of the total gain for secondary students, but 8.8 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.

Faster growth in earned income over the work life is the second, and largest, component of the total gain in Figure 7, comprising slightly more than two-thirds of the added earnings over the work life for both adult and secondary completers. These gains reflect the assumed 1.0 percent increase in the real growth rate of earned income over the work life relative to those with no training beyond high school. Overall, FY02 completers can expect to add an average of $104,827 in current dollars to their lifetime earnings stream from this component alone - secondary students can expect to add $110,854, while adult completers add an estimated $100,686.

Non-earned income over the work life is the third component and comprises 12.4 percent of the expected income gain across all completers. This equates to nearly $19,000 in current dollars added to the expected future earnings of the typical completer. The gains are approximately equal in percentage contribution for both adult and secondary completers. The gains reflect the assumed 1.0 percent increase in the real growth rate of non-earned income over the work life as a result of training.

The fourth component, retirement earnings, makes up 11.3 percent of the total estimated gain for the typical completer, adding more than $17,000 in current dollars to their future income stream. 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 (11.3 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 completers. For all FY02 completers, CareerTech full-time training is estimated to add approximately $4.3 billion ($1.8 billion in current dollars) to their future income stream. Although secondary completers experience slightly greater individual gains, the $2.25 billion contribution to the total by adults ($1.04 billion in current dollars) is larger than the $2.1 billion total gain for secondary students ($743 million in current dollars) due to a larger number of adult completers.

The $1.8 billion total estimated current dollar income gain represents a significant addition to expected future income in Oklahoma. For comparison, it represents nearly 2 percent of the approximately $100 billion in annual personal income the Oklahoma economy presently generates. Given an average expected work life for the average FY02 completer of 40 years, the average

expected future contribution of this cohort group to state income is approximately $44.5 million annually in current dollars.

Figure 7. Estimated Income Gains From Training (FY02)

All *Career*Tech Districts

Total (11,680 Completers)	**Future Income Gain**		**PV of Income Gain***	
Entry Wage Gain (Years 1-9)	$12,774	3.4%	$11,478	7.5%
Earned Income over Work Life	245,696	66.1%	104,827	68.7%
Non-Earned Income over Work Life	44,334	11.9%	18,973	12.4%
Retirement Earnings (Ages 66-75)	68,637	18.5%	17,264	11.3%
Average per Completer	$371,441	100.0%	$152,542	100.0%
Total - All Completers	$4,338,429,480		$1,781,692,745	
Adult (6,923 Completers)	**Future Income Gain**		**PV of Income Gain***	
Entry Wage Gain (Ages 30-38)	$14,727	4.5%	$13,236	8.8%
Earned Income over Work Life (Ages 30-65)	210,712	65.0%	100,686	67.1%
Non-Earned Income over Work Life (Ages 30-65)	38,954	12.0%	18,614	12.4%
Retirement Earnings (Ages 66-75)	59,917	18.5%	17,548	11.7%
Average per Adult Completer	$324,309	100.0%	$150,084	100.0%
Total - All Adult Completers	$2,245,194,466		$1,039,032,737	
Secondary (4,757 Completers)	**Future Income Gain**		**PV of Income Gain***	
Entry Wage Gain (Ages 18-26)	$9,931	2.3%	$8,920	5.7%
Earned Income over Work Life (Ages 18-65)	296,610	67.4%	110,854	71.0%
Non-Earned Income over Work Life (Ages 18-65)	52,164	11.9%	19,496	12.5%
Retirement Earnings (Ages 66-75)	81,328	18.5%	16,850	10.8%
Average per Secondary Completer	$440,033	100.0%	$156,119	100.0%
Total - All Secondary Completers	$2,093,235,013		$742,660,008	

* Future income gains are discounted at 3% annually.

Lifetime Income Gains by District

The total current dollar lifetime income gain of $1.8 billion is apportioned to each district in Figure 8. The most significant determinant of the size of the impact by district is the number of students trained, with larger schools producing larger total gains. In the two largest districts as measured by number of completers, Tulsa Technology Center trained 1,182 students and added an estimated $200 million in current dollars to the lifetime earnings stream of these completers, while Central Technology Center trained 1,099 completers and added an estimated $156 million in lifetime earnings. Small districts such as Chisholm Trail Technology Center and Northwest

Technology Center trained fewer than 100 completers in FY02 and generated lifetime earnings gains of about $10 million in current dollars within each district. The average district trained about 400 students in FY02 and added an estimated $61.4 million in current dollars to the lifetime earnings stream of completers.

Figure 8. Estimated Lifetime Income Gains From Training by District (FY02)

		Total Income Gain From Training		Present Value of Income Gain Per Completer				
District	(1) Completers	(2) Future Value	(3)* Present Value	(4) Entry Wage Gain	(5) Earned Income	(6) Non-Earned Income	(7) Retirement Income	(8) Total
Autry	344	$136,637,643	$53,592,917	$10,363	$108,480	$19,629	$17,322	$155,793
Caddo-Kiowa	668	179,138,621	86,353,758	12,887	85,336	15,665	15,383	129,272
Canadian Valley	449	186,635,082	72,121,102	10,776	111,971	20,052	17,827	160,626
Central	1,099	330,861,887	155,625,670	14,015	93,708	17,113	16,770	141,607
Chisholm Trail	55	25,467,942	9,548,888	10,836	121,934	21,790	19,057	173,616
Eastern OK County	257	113,580,470	44,005,034	11,428	119,369	21,425	19,003	171,226
Francis Tuttle	850	342,753,955	151,189,937	15,189	120,187	21,897	20,597	177,871
Gordon Cooper	328	123,545,883	48,963,035	10,312	103,599	18,688	16,678	149,278
Great Plains	541	180,227,398	72,417,469	9,553	92,566	16,709	15,031	133,859
Green Country	109	41,516,826	16,027,078	9,758	102,581	18,397	16,301	147,037
High Plains	154	63,929,253	25,132,325	11,139	113,440	20,427	18,191	163,197
Indian Capital	590	238,623,500	92,160,106	10,174	109,083	19,655	17,292	156,204
Kiamichi	923	278,068,739	115,835,242	10,010	85,722	15,457	14,310	125,499
Meridian	262	108,944,888	43,960,630	11,740	116,131	21,095	18,822	167,789
Metro	683	267,901,419	110,674,150	11,690	111,662	20,395	18,294	162,041
Mid-America	295	138,398,809	51,909,932	11,139	123,487	22,003	19,337	175,966
Mid-Del	292	108,836,877	41,436,154	9,355	99,178	17,686	15,686	141,905
Moore Norman	461	189,038,550	76,345,155	11,601	114,603	20,821	18,582	165,608
Northeast	479	185,988,912	71,754,030	9,931	104,521	18,743	16,604	149,800
Northwest	81	27,994,520	10,800,272	8,580	93,176	16,837	14,743	133,337
Pioneer	227	81,108,449	32,982,022	10,554	100,234	18,135	16,372	145,295
Pontotoc	105	39,879,141	16,203,396	11,048	106,576	19,330	17,365	154,318
Red River	176	64,076,391	26,404,229	11,264	103,110	18,660	16,990	150,024
Southern Oklahoma	240	107,249,094	41,252,196	11,341	120,003	21,504	19,035	171,884
Southwest	134	45,103,961	18,583,112	10,265	95,421	17,309	15,685	138,680
Tri-County	264	101,809,319	39,559,863	9,946	104,467	18,804	16,632	149,848
Tulsa	1,182	492,409,133	199,925,233	12,097	116,830	21,186	19,029	169,141
Wes Watkins	137	44,998,093	18,250,623	9,385	92,114	16,752	14,965	133,216
Western	295	93,704,724	38,679,187	9,869	90,083	16,308	14,856	131,116
All Districts	11,680	$4,338,429,480	$1,781,692,745	$11,478	$104,827	$18,973	$17,264	$152,542

* Future income gains are discounted at 3% annually.

Nevertheless, there is a great deal of variability in the estimated income gains per completer among the districts (column 8), with a more than $52,000 difference between the highest gain

(Francis Tuttle, $177,871 gain per completer) and lowest gain (Kiamichi Technology Center, $125,499 gain per completer) districts. Again, the difference in gain per completer among the districts does not necessarily indicate a performance differential but instead may reflect differences in program offerings, the age of students, and the level of wages in the local job market.

The four components of the lifetime income gain for each district are shown in columns 4 through 7 in Figure 8. Entry wage gains (column 4) are determined in large part by the level of wages earned immediately following training; however, the level of wages is largely determined by the age of completers, with wages increasing along with age. Hence, districts with older completers, districts offering high wage programs, and districts located in job markets with higher overall wages tend to produce the largest entry wage gains.

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 tend to have high average post-training wages (e.g., Francis Tuttle) or tend to train students who have a low average age and consequently a longer expected work life (e.g., Chisholm Trail and Southern Oklahoma). Districts that train a large percentage of adults with a shorter expected work life following training (e.g., Caddo-Kiowa, Kiamichi, and Western) tend to have lower gains in earned income over the work life. Lower average post-training wages (e.g., Great Plains, Mid-Del, and Northwest) also tend to produce smaller 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 calculated as a percentage of income earned late in the work life and is similarly related to the gain in earned income over the work life.

Multiplier Effects of Direct Income Gains[6]

The direct income gains to students from vocational training will have a measurable impact on the expected future income level in the state economy. The income gains produce economic multiplier, or ripple, effects, which can be estimated using input-output analysis. An input-output model describes the mechanism through which the increased earnings of program completers indirectly support additional income and employment statewide.[7] The models can also be used to estimate increased income and sales tax collections at the state and local levels as a consequence of the new economic activity.

In estimating the economic impact, the added income of program completers is deemed the "direct" effect, which in turn generates what are referred to as "indirect" and "induced" effects. The indirect effect is the statewide inter-industry economic activity resulting from the direct impact, while induced effects reflect the economic activity resulting from new household spending out of employee compensation received as part of the direct and indirect effects. A state-level IMPLAN input-output model is used to estimate multiplier effects for each district, which are then aggregated to form an estimate of the economic impact generated by the CareerTech statewide.[8]

The economic impact estimates shown in Figure 9 are formed using the current dollar value income gains after adjustment for any expected future out-of-state migration by completers.[9] The

estimates assume an annual out-migration rate of 2.7 percent, with the total number of completers remaining in the state leveling out at 55 percent in approximately the twentieth year following the completion of training. The total migration adjusted current dollar income gain across all completers in FY02 is $1.1 billion. For the average completer, approximately 62 percent of the expected income gains are realized within Oklahoma and just over one-third are earned outside the state as completers migrate in and out of the state over their work life. Despite the reduction in potential income gains from out-migration, the results in Figure 9 suggest that added lifetime income gains of $1.1 billion received by FY02 completers remaining in-state result in future indirect and induced income gains at the state level totaling $991 million.

The total earnings impact (including direct, indirect, and induced effects) from the added lifetime earnings gains from training completers is nearly $2.1 billion. In other words, each dollar of direct income gain by FY02 completers working within the state supports an estimated $0.91 of additional indirect and induced income earned by other workers in the state economy.

Figure 9. Multiplier Effects – Indirect/Induced Income Gains and Tax Revenue (FY02)

		Income Impacts				Tax Impacts		
Group	Comple-ters	PV of Direct Income Gain From Training*	Migration Adjusted Direct Income Gain	Indirect and Induced Income Gain	Total Direct, Indirect, & Induced Income Gain	Direct Tax Revenue	Indirect and Induced Tax Revenue	Total Direct, Indirect, & Induced Tax Revenue
Adult	6,923	1,039,032,737	656,550,829	590,895,746	1,247,446,575	49,241,312	44,317,181	93,558,493
Secondary	4,757	742,660,008	444,958,680	400,462,812	845,421,491	33,371,901	30,034,711	63,406,612
Total	11,680	$1,781,692,745	$1,101,509,509	$991,358,558	$2,092,868,066	$82,613,213	$74,351,892	$156,965,105

* Future income gains are discounted at 3% annually.

The estimated wage gains to full-time program completers will also produce significant amounts of added income tax and sales tax revenues at the state and local levels.[10] FY02 completers are expected to pay additional direct sales and income taxes of $82.6 million in current dollars over their work life, or more than $7,000 in direct tax payments per completer. An additional $74 million in current dollar tax revenue is supported through indirect and induced multiplier effects generated by completers. Total estimated direct, indirect, and induced income tax and sales tax revenue generated by FY02 program completers totals $157 million in current dollars.

The 6,923 adult completers in FY02 produce approximately 60 percent of the migration adjusted income gain and consequently are responsible for approximately 60 percent of the resulting economic impact activity. In total, adult completers are expected to realize $656.5 million in future migration adjusted income gains and support the earnings of $590.9 million in future income for other state workers. Secondary completers will realize migration adjusted earnings gains of $445 million and support an additional $400 million in earnings for other state workers.

The expected economic impacts are shown for each district in Figure 10. Because the impacts are measured at the state level and not regionally, the economic impacts are proportional to the lifetime income gain estimates.

Figure 10. Multiplier Effects – Indirect/Induced Income Gains and Tax Revenue by District (FY02)

		Income Impacts				Tax Impacts		
District	Comple-ters	PV of Total Income Gain From Training*	Migration Adjusted Income Gain	Indirect and Induced Income	Total Direct, Indirect, & Induced Income Gain	Direct Tax Revenue	Indirect and Induced Tax Revenue	Total Direct, Indirect, & Induced Tax Revenue
Autry	344	$53,592,917	$32,389,773	$29,150,795	$61,540,568	$2,429,233	$2,186,310	$4,615,543
Caddo-Kiowa	668	86,353,758	54,596,463	49,136,817	103,733,280	4,094,735	3,685,261	7,779,996
Canadian Valley	449	72,121,102	43,586,800	39,228,120	82,814,920	3,269,010	2,942,109	6,211,119
Central	1,099	155,625,670	98,270,171	88,443,154	186,713,325	7,370,263	6,633,237	14,003,499
Chisholm Trail	55	9,548,888	5,733,496	5,160,147	10,893,643	430,012	387,011	817,023
Eastern OK County	257	44,005,034	26,586,698	23,928,028	50,514,725	1,994,002	1,794,602	3,788,604
Francis Tuttle	850	151,189,937	93,760,482	84,384,434	178,144,917	7,032,036	6,328,833	13,360,869
Gordon Cooper	328	48,963,035	29,687,138	26,718,424	56,405,562	2,226,535	2,003,882	4,230,417
Great Plains	541	72,417,469	44,045,216	39,640,694	83,685,910	3,303,391	2,973,052	6,276,443
Green Country	109	16,027,078	9,677,596	8,709,837	18,387,433	725,820	653,238	1,379,057
High Plains	154	25,132,325	15,219,109	13,697,198	28,916,306	1,141,433	1,027,290	2,168,723
Indian Capital	590	92,160,106	55,576,226	50,018,604	105,594,830	4,168,217	3,751,395	7,919,612
Kiamichi	923	115,835,242	71,248,798	64,123,918	135,372,715	5,343,660	4,809,294	10,152,954
Meridian	262	43,960,630	26,700,102	24,030,092	50,730,194	2,002,508	1,802,257	3,804,765
Metro	683	110,674,150	67,444,134	60,699,720	128,143,854	5,058,310	4,552,479	9,610,789
Mid-America	295	51,909,932	31,198,995	28,079,095	59,278,090	2,339,925	2,105,932	4,445,857
Mid-Del	292	41,436,154	24,994,830	22,495,347	47,490,177	1,874,612	1,687,151	3,561,763
Moore Norman	461	76,345,155	46,375,035	41,737,531	88,112,566	3,478,128	3,130,315	6,608,442
Northeast	479	71,754,030	43,322,785	38,990,506	82,313,291	3,249,209	2,924,288	6,173,497
Northwest	81	10,800,272	6,507,580	5,856,822	12,364,402	488,069	439,262	927,330
Pioneer	227	32,982,022	20,098,031	18,088,228	38,186,259	1,507,352	1,356,617	2,863,969
Pontotoc	105	16,203,396	9,861,687	8,875,518	18,737,205	739,627	665,664	1,405,290
Red River	176	26,404,229	16,142,951	14,528,656	30,671,606	1,210,721	1,089,649	2,300,370
Southern Oklahoma	240	41,252,196	24,894,821	22,405,339	47,300,159	1,867,112	1,680,400	3,547,512
Southwest	134	18,583,112	11,347,032	10,212,329	21,559,361	851,027	765,925	1,616,952
Tri-County	264	39,559,863	23,894,375	21,504,938	45,399,313	1,792,078	1,612,870	3,404,948
Tulsa	1,182	199,925,233	121,664,808	109,498,327	231,163,134	9,124,861	8,212,375	17,337,235
Wes Watkins	137	18,250,623	11,092,920	9,983,628	21,076,549	831,969	748,772	1,580,741
Western	295	38,679,187	23,654,115	21,288,703	44,942,818	1,774,059	1,596,653	3,370,711
All Districts	11,680	$1,781,692,745	$1,089,572,165	$980,614,948	$2,070,187,113	$81,717,912	$73,546,121	$155,264,033

* Future income gains are discounted at 3% annually.

Other Benefits to Vocational and Technical Training

While the primary benefit to those receiving vocational and technical training is a higher wage rate, many other documented benefits can accrue to program completers. For example, vocational and technical training provides faster entry into the labor force for young workers, with most existing studies finding that income gains occur very quickly, usually within 12 to 36 months of leaving a training program. 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.

Based on findings in the 2001 Census Supplemental Survey, vocationally trained workers also enjoy a longer and more sustained work life than workers completing only a high school education. In addition, workers with vocational training have a higher labor force participation rate, enjoy a widening of the earnings gap after the age of 50, and experience lower rates of unemployment.

The analysis also does not include any potential socioeconomic benefits resulting from reduced reliance on public services (e.g. unemployment compensation and welfare benefits), improved health benefits, reduced absenteeism, or other benefits of education beyond high school (Christopher and Robinson, 2001).

Summary of the Economic Impact for FY02 Full-Time Completers

- In fiscal year 2002, 11,680 students completed full-time programs at the state's technology centers.
- The average estimated post-training hourly wage for all FY02 completers is $10.47. Adults (average age 30) comprised 60 percent of completers and earned an average wage of $12.46 per hour versus $7.58 per hour for secondary completers (average age 18).
- Completers of full-time programs 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 (i.e. interest, dividends, and transfer payments) over the working lifetime, and 4) higher earned and non-earned income after the traditional retirement age of 65.
- The average FY02 completer added an estimated $371,000 ($152,500 in current dollars) to their lifetime earnings stream by completing a full-time training program. The typical secondary student completer is expected to add approximately $440,000 ($156,100 in current dollars) to their future earnings, while an adult completer is expected to add $324,000 ($150,100 in current dollars).
- Entry wage gains for the typical completer total nearly $11,500 in current dollars. The average reported hourly wage following training is $10.48. This equates to an estimated wage gain of $1.11 per hour, for a total gain of $2,068 in added first year income.
- More than two-thirds of the income gains from training are due to faster growth in earned income over the work life. FY02 completers can expect to add an average of $104,800 in current dollars to their lifetime earnings stream from faster wage growth over the work life.
- Non-earned income over the work life comprises 12.4 percent of the expected income gain, or nearly $19,000 in current dollars added to the expected future earnings of the typical completer.
- Added retirement earnings produce 11.3 percent of the total gain for the typical completer, adding more than $17,200 in current dollars to the future income stream.
- Across all 11,680 FY02 completers, full-time training is estimated to add approximately $4.3 billion ($1.8 billion in current dollars) to their future income stream. Approximately $1.1 billion in current dollars is expected to be earned within Oklahoma after adjustments for out-migration.
- Through multiplier effects, the migration adjusted income gains of FY02 completers will support an additional $990 million in current dollars in expected future earnings accruing to other workers statewide.
- FY02 completers are expected to pay added direct sales and income taxes of $82.6 million in current dollars over their work life, or more than $7,000 in direct tax payments per completer. An additional $74 million in current dollar tax revenue paid by other workers statewide is supported through multiplier effects generated by the income gains of FY02 completers.
- Vocationally trained workers enjoy faster entry into the workforce, faster rate of growth in future earnings, an extended work life, higher labor force participation rates, and lower rates of unemployment.
- Potential socioeconomic benefits to the state include a reduced reliance on public services such as unemployment compensation and welfare benefits, improved health benefits, and reduced absenteeism.

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Endnotes:

[1] This paper extends an earlier work (see Snead (2004)) evaluating entry wage gains for technology center completers.
[2] Summary tables are derived from the American Community Survey (ACS) Public Use Microdata Samples (PUMS), a comprehensive survey of more than 10,000 Oklahoma residents. Since 2000, the ACS survey has presented respondents with a broader set of educational attainment criteria, including the new category of a degree or certificate from a vocational/technical/business school.
[3] The estimated earnings increase is also consistent with existing findings in the labor economics literature for post-training wage increases across a variety of types of training programs. See for example Bloom, 1984; Trost and Lee, 1984; LaLonde, 1986; Eck, 1993; Lillard and Tan, 1996; and Smith, 2001.
[4] 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 (UI) data.
[5] Wage rates calculated from extensive student-reported surveys for Tulsa Technology Center (FY02, FY03, and FY04), Moore-Norman Technology Center (FY03 and FY04), and Francis Tuttle Technology Center (FY04) produce estimates very similar in magnitude to Census ACS-based hourly wage rates.
[6] The analysis focuses on the economic impact of wage gains on the state economy and does not consider the direct cost or opportunity cost of an individual student's decision to enroll in a technology center program, or the economic impact of the technology center operations.

[7] Caution must be exercised when using input-output multipliers to estimate the total economic activity 'supported' by an existing industry or firm. Input-output multipliers are intended to predict the change in region wide economic activity that results from an incremental change in a given industry within a regional economy.

[8] Minnesota IMPLAN Group, 1998. IMPLAN Professional: User's guide, analysis guide, data guide. Stillwater, MN.

[9] The Type 1 and Type 2 income multipliers are weighted averages of the multipliers by 1-digit SIC industry. The weights are calculated using the total income earned by industry by FY02 completers in the period spanning from the first quarter of 2003 to the second quarter of 2004. The distribution of income by SIC code are illustrated in the table below along with calculations for the weighted multipliers. The overall multiplier effect in FY02 equates to an average Type II labor income multiplier across industries of 1.91.

Weighted Economic Impact Multipliers

	Reported Income		Labor Income Multipliers		Employment Multipliers	
SIC Sector	2003Q1-2004Q2		Type 1	Type 2	Type 1	Type 2
1 Agriculture	$1,124,939	0.7%	1.94	2.64	1.48	1.77
2 Mining	4,469,245	2.6%	1.43	1.96	1.66	2.67
3 Construction	8,637,289	5.1%	1.64	2.24	1.69	2.40
4 Manufacturing	18,285,670	10.7%	2.06	2.81	2.66	4.07
5 TCPU	11,166,595	6.6%	1.63	2.22	1.92	3.01
6 Wholesale	8,445,722	5.0%	1.27	1.73	1.36	2.06
7 Retail	29,947,758	17.6%	1.20	1.64	1.12	1.41
8 FIRE	5,236,824	3.1%	1.57	2.14	1.53	2.12
9 Services	70,280,475	41.3%	1.32	1.80	1.28	1.75
10 Government	11,386,583	6.7%	1.04	1.42	1.04	1.59
Other	1,293,408	0.8%	1.51	2.06	1.57	2.29
All Industries	$170,274,508	100.0%	1.40	1.91	1.46	2.08

Source: Oklahoma Employment Security Commission, IMPLAN Input-Output Model

[10] 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 government of 4.5 percent and 3.25 percent, respectively. State income tax revenue is estimated as 2 percent of the income gains.