The Impact of Foothill-De Anza on Earnings in the Local Community

Prepared for the Foothill-De Anza Community College District

November 2014



In this report, Hanover Research estimates the number of Foothill-De Anza Community College District credits embedded in the San Jose Metropolitan Statistical Area and the increase in earnings that a college education provides to workers and their communities.

HANOVER RESEARCH

TABLE OF CONTENTS

Executive Summary

The Foothill-De Anza Community College District (FHDA) educates thousands of students each year. This education increases students' productivity and wages, which in turn provides benefits for local employers, retailers, and governments. In this report, Hanover Research estimates the amount of increased wages that is generated in the local community by FHDA.

This analysis is largely an update of work previously conducted by Kevin Stange on behalf of FHDA in October 2005. In Stange's previous work, he estimates the total credits in the workforce by summing the credits earned by each student cohort and making adjustments for labor force participation, migration, and mortality. Stange further estimates the dollar value of each credit earned by FHDA alumni and subsequently determines the total value to the workforce. We follow similar procedures and produce similar estimates in most areas of our current analysis.

We expand on Stange's analysis in four ways. First, we use updated data through 2013, which adds nine years to his original analysis. Second, we project the number of embedded credits in the local population and workforce through 2024. Third, we analyze FHDA alumni wage data to present a picture of what typical FHDA graduates earn and whether they are employed in well-paying careers. Finally, we conclude our report by using Census wage data to estimate the increase in earnings a college education provides in the San Jose-Sunnyvale-Santa Clara Metropolitan Statistical Area (San Jose MSA) and noting whether this increase in earnings is constant or varied among different demographic groups.

The key findings from our analysis are presented below.

Key Findings

- **FHDA contributed 8.9 million instructional credits to the regional workforce in 2013.** This represents the accumulated educational impact FHDA provided to the San Jose MSA in just one year. This figure has grown by approximately 2.7 million credits since 1993 and 1.3 million since 2003. We estimate that there will be nearly 10.5 million FHDA credits embedded in the local workforce by 2024.
  - **With respect to the 2013 figure, about 2/3 of these credits are from De Anza College students, and 1/3 from Foothill College students.**[1] De Anza College has contributed approximately 5.9 million credits, while Foothill College has contributed roughly 3.0 million.
- **FHDA credits in the San Jose MSA workforce are estimated to be worth more than $356 million in increased earnings in 2013.** In his previous analysis, Stange had drawn from existing research studies to estimate that one year of community college instruction is worth a 6 percent increase in annual earnings. Applying this to estimate in our current analysis, this translates to an average per-credit annual earnings increase of between $20 and $84, depending on the worker's age.

[1] The Foothill credits did not include apprenticeship, performing arts alliance, primary care and noncredit courses.

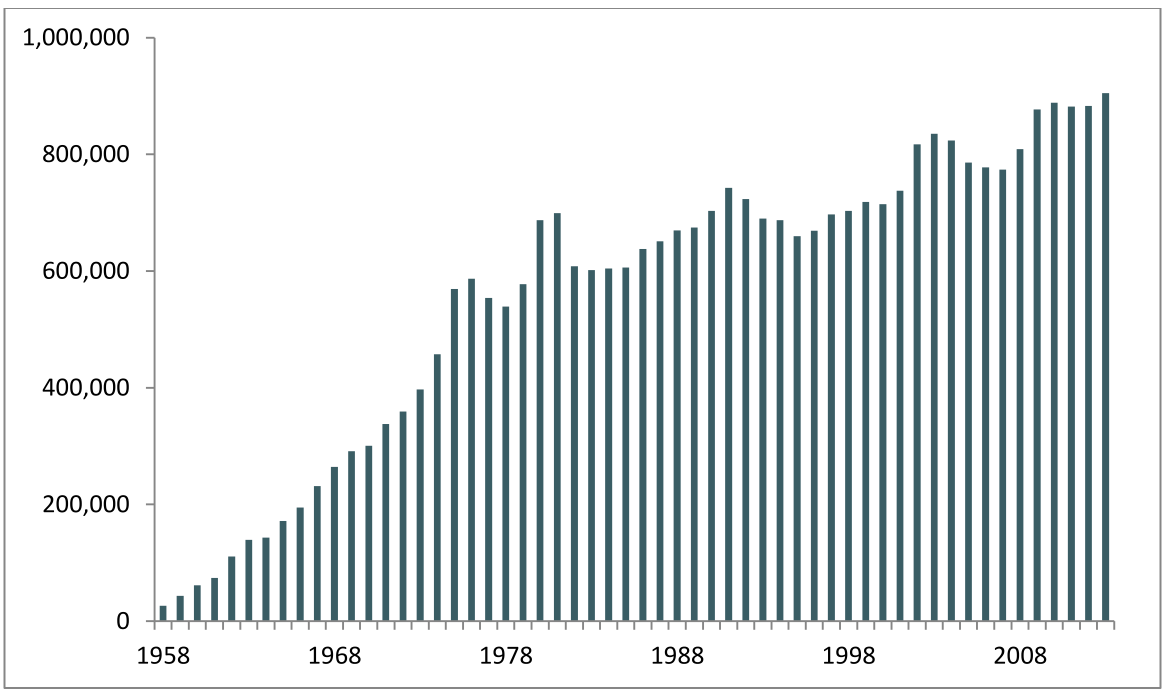
- **FHDA produces individuals equipped to follow several career paths that earn much more than the typical associate's degree holder.** FHDA graduates from eight of the 20 most popular programs earn more three years after graduation than the average person in the San Jose MSA with an associate's degree.
    - **Many Foothill College students pursue degrees or certificates in the medical field, with five of the top 10 most popular academic programs in this area.** Further, among the top 10 most popular programs, those in the medical field (e.g., Physician's Assistant, Diagnostic Medical Sonography, and Radiation Therapy Technician) generally attract wages that are much higher than the average wage of a San Jose MSA associate's degree holder. Other Foothill College programs leading to well-paying jobs include Sheet Metal and Structural Metal, Radiologic Technology, Respiratory Care/Therapy, and Plumbing, Pipefitting, and Steamfitting.
    - **The top programs pursued by De Anza College students are somewhat more diverse.** Although the most popular program is Registered Nursing, most of the other programs are not in the medical field, (e.g., Paralegal, Accounting, and Computer Networking). Graduates of De Anza College's Registered Nursing and Computer Networking programs earn more than the typical associate's degree holder in the San Jose MSA. Many of the other top 10 programs have attracted wages below this level three years after graduation, though we note that this may be a function of worker experience and/or the type of award (degree versus certificate) De Anza College graduates have earned.
- **Residents in the San Jose MSA who received at least some college instruction earn significantly more than their counterparts who just have a high school diploma.** Completing some college courses (i.e., less than an associate's degree) is linked to an 18 percent increase in wages in the San Jose MSA. An associate's degree increases wages by 31 percent. However, our data also show that this earnings advantage does not tend to appear until workers reach their mid-20s.

SECTION I: CUMULATIVE INVESTMENT IN WORKFORCE PRODUCTIVITY

Each year, Foothill College and De Anza College educate thousands of students. When those students join the workforce, they take their college experience with them. Thus, one measure of FHDA's impact on the local economy is the total number of credits embedded in the local community. In this section, we estimate the number and dollar value of FHDA credits embedded in the San Jose-Sunnyvale-Santa Clara Metropolitan Statistical Area (San Jose MSA) population and workforce from 1958 to 2013.

In order to contextualize our findings, Figure 1.1, below, plots the total number of credits earned each year at FHDA. Total credits have generally risen since 1958, with a steep rise from 1958 through the 1970s. While the number of credits has increased from 1980 through today, the increase has not always been linear. For example, annual credits dipped at various points in the 1980s, 1990s, and 2000s. In 2013, FHDA delivered 904,934 credits among 55,051 students, the highest number of total credits delivered to date.

Figure 1.1: Total Credits Earned per Year at FHDA



Source: Stange 2005[2] and Foothill-De Anza Community College District

[2] Stange, Kevin. 2005. "The Economic Impact of the Foothill-De Anza Community College District and its Students." Prepared for Foothill-De Anza Community College District. http://fhdafiles.fhda.edu/downloads/homefhda/FHDAEconImpact.pdf

NUMBER OF EMBEDDED CREDITS IN THE COMMUNITY

Of course, not all of these credits stay in the local population or workforce. Some graduates leave the area to attend a four-year university, or start a job elsewhere after finishing their coursework at FHDA. Further, even if an FHDA graduate stays in the area after graduation, there is still a chance that he or she will move years later for either personal or professional reasons. There is also some attrition of credits in the community due to mortality, particularly when graduates reach their 70s and 80s. Using data from the Centers for Disease Control (CDC) and the American Community Survey (ACS), we account for these mortality and migration considerations by applying population multipliers to our estimates.[3]

Probability of mortality and migration vary considerably by age group. For example, out-migration is much higher among younger adults, who tend to have more flexibility in their careers and personal lives. Thus, we apply age-specific multipliers to each cohort as they progress over time. In other words, credits earned in 1960 are treated differently in 1961 than they are in 1985, due to the progressing age of that cohort. The table below displays the survival and non-migration rates used in this analysis (i.e., the inverse of mortality and migration). Note that as these rates typically correspond to five-year age groups (e.g., 20 to 24), before applying them to the credit data, we "annualize" the rates so that they correspond to discrete ages (e.g., age 20). We further combine the annualized survival and non-migration rates to achieve an overall population multiplier. These steps are discussed in greater detail in the appendix.

Figure 1.2: Population Multipliers (Mortality and Migration)

AGE GROUP	% SURVIVING OVER FIVE YEAR PERIOD (SURVIVAL RATE)	% STAYING IN COUNTY OVER FIVE YEAR PERIOD (NON-MIGRATION RATE)
Less than 20	100%	53%
20 to 24	100%	58%
25 to 29	99%	66%
30 to 34	99%	77%
35 to 39	99%	81%
40 to 44	98%	85%
45 to 49	97%	87%
50 to 54	96%	86%
55 to 59	94%	84%
60 to 64	91%	86%
65 to 69	87%	89%
70 to 74	80%	87%
75+	70%	90%

Source: Stange 2005; Centers for Disease Control and the American Community Survey

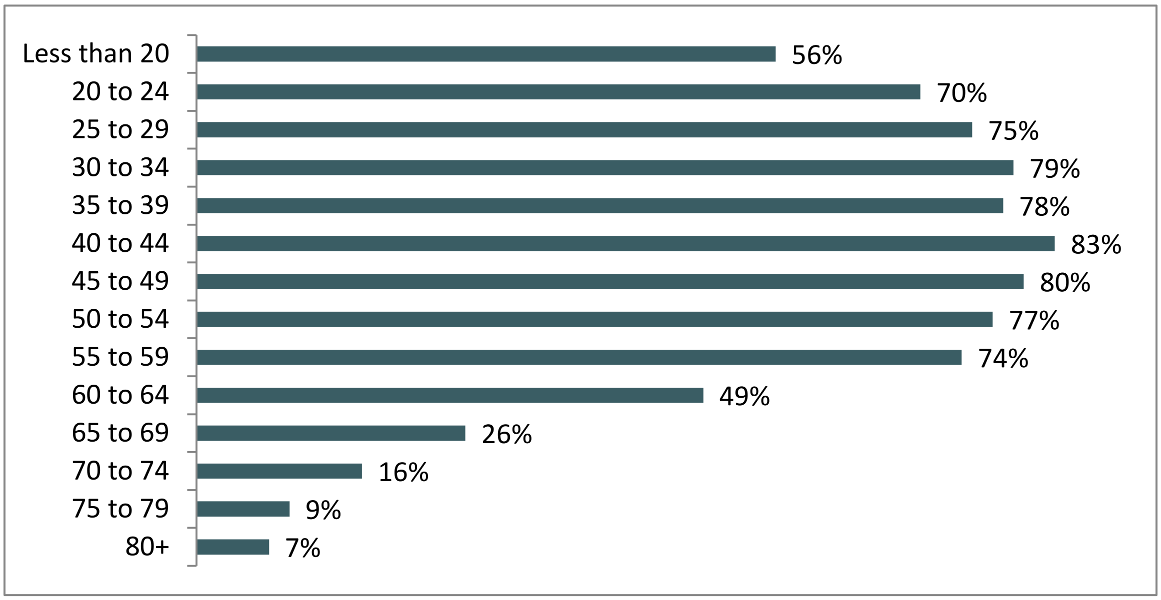
[3] Note that in order to replicate Stange's previous study as closely as possible, our current analysis uses the same CDC and ACS multipliers.

We must also account for labor force participation to arrive at estimates for FHDA credits embedded in the local workforce, as even if a graduate stays within the area, there is no guarantee that he or she is employed. Labor force participation rates also vary considerably by age, so we apply age-specific multipliers for these estimates, as well.

Our method of calculating workforce credits is to multiply the population multipliers shown in Figure 1.2 by the labor force participation rates in Figure 1.3. As the graph shows, participation in the local labor force peaks when individuals are in their early 40s and then slowly declines before dropping suddenly in the mid-to-late 60s.

Figure 1.3: Labor Force Participation by Age Group

San Jose MSA



Source: Stange 2005; U.S. Census Bureau

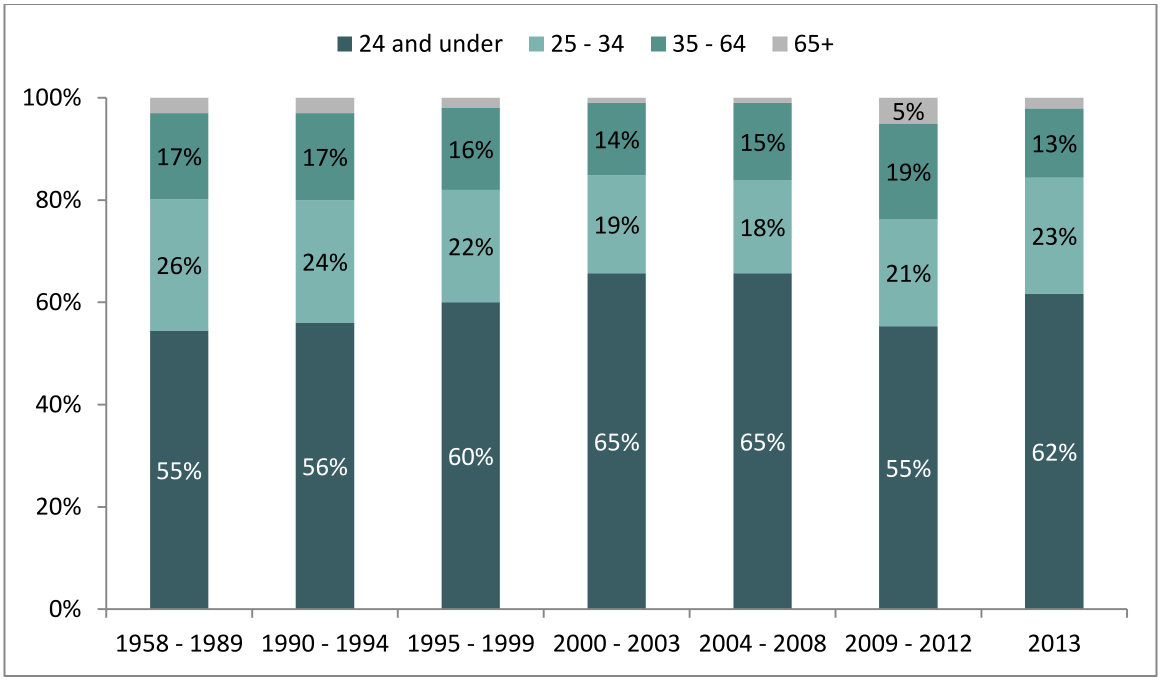
To use such narrow age-specific multipliers requires us to estimate the credit distribution by age for each cohort from 1958 to 2013. Using estimates from Stange 2005[4] and FHDA, we use the distributions presented in Figure 1.4. These distributions enable us to estimate the age of every person who earned a credit over this 56-year period, which in turn allows us to apply age-specific mortality, migration, and labor force participation multipliers to each credit as time goes by. Given that the age groupings in Figure 1.4 are larger than the ones we use with respect to the multipliers (see Figure 1.3), we assume that credits are equally distributed between each discrete age within the larger age group.

These estimates vary somewhat over time. For instance, following Stange's numbers, we estimate that 55 percent of credits earned each year between 1958 and 1989 went to students under the age of 25. However, this percentage is noticeably higher from 2004 to 2008, during which we estimate that students under 25 earned 65 percent of credits each year.

[4] Stange 2005. Op. cit.

Note that the age groups for the 2009 academic years onward are based on data provided by FHDA which corresponded to slightly different ranges than earlier years: they are grouped by 24 and under, 25-34, *35-59*, and *60+*.[5] For the purpose of this report, we consider the 35-59 age group to be 35-64 and the 60+ age group to be 65+. As this change only corresponds to the last four years of the data and the two smallest age groups, few students are affected by this regrouping.

Figure 1.4: Composition of Credits by Age Group by Academic Year



Source: Stange 2005 and Foothill-De Anza Community College District

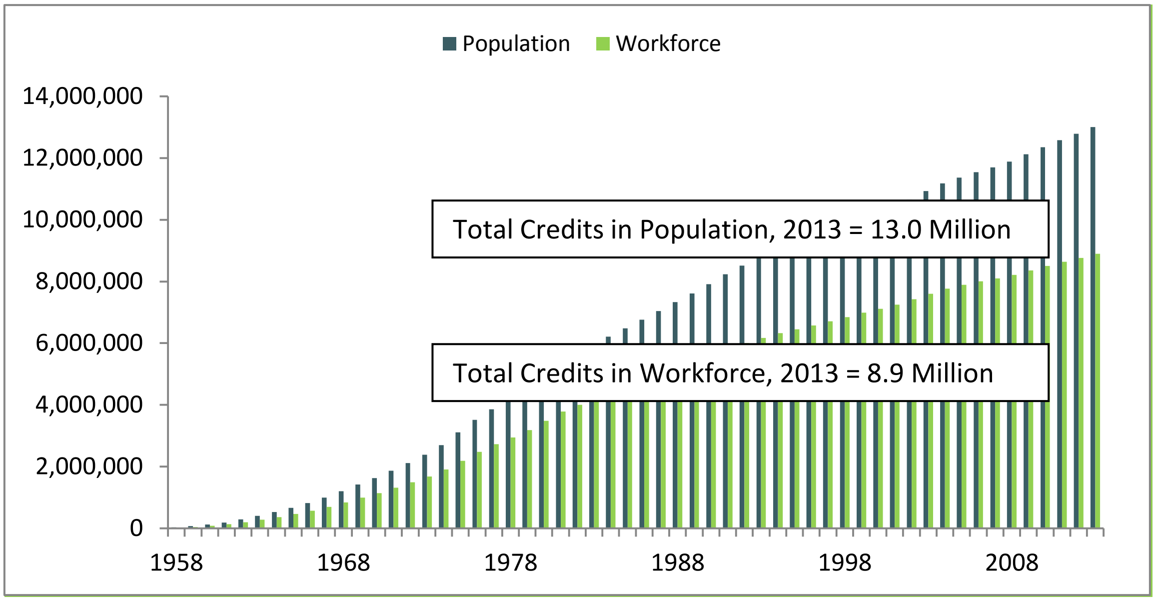
As Figure 1.5 shows, we estimate that there were 13.0 million FHDA credits embedded in the San Jose MSA in 2013. Of these 13.0 million credits in the population, we estimate that almost 70 percent (8.9 million) were active in the local workforce in 2013.

Hanover's estimates track closely with Stange's study, which provided estimates through 2004. In that report, the author estimated that there were approximately 10.0 million embedded credits in the San Jose MSA population in 2004 and 7.0 million in the workforce. Our replication produces similar numbers – 11.2 million in the population and 7.8 million in the workforce. Thus, using our figures, we find that there have been approximately 1.8 million additional credits added to the local population and roughly 1.1 million credits added to the local workforce since 2004.

[5] The age distributions provided by FHDA for 2009 and 2013 were presented separately for De Anza College and Foothill College. As Stange's age distribution data were only available for FHDA overall (i.e., for the two colleges combined), we combined the De Anza College and Foothill College distributions for each of these more recent years as well.

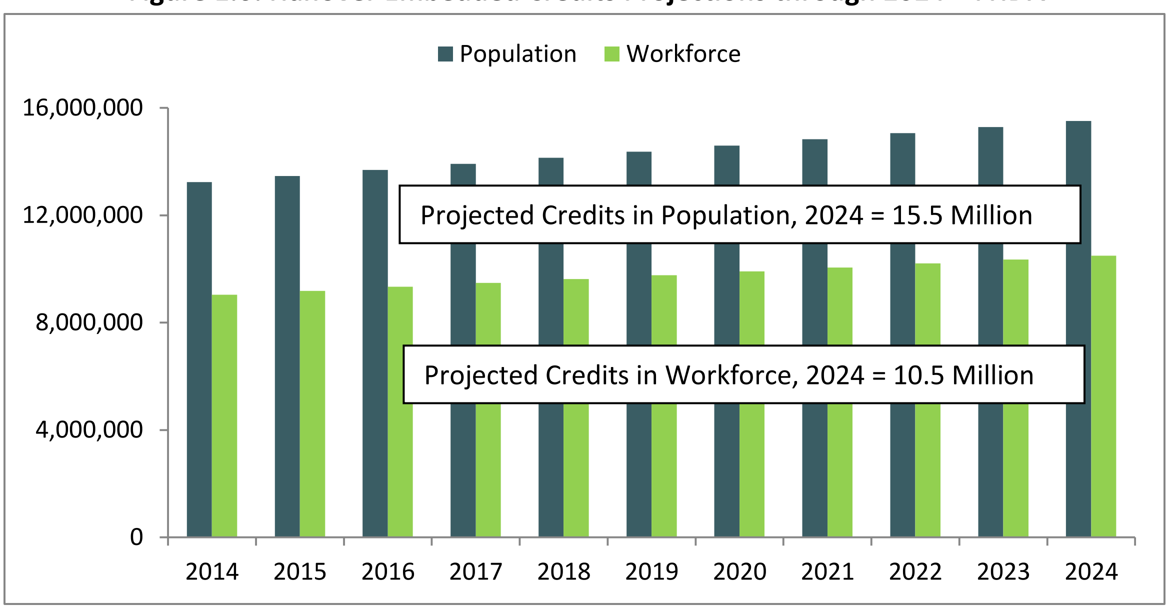
Using the historical estimates presented in Figure 1.5, we use ARIMA modeling to make embedded credit projections through 2024 (see Figure 1.6).[6] By 2024, we expect there to be roughly 15.5 million credits embedded in the local population and 10.5 million credits embedded in the workforce.

Figure 1.5: Total FHDA Credits Embedded in Local Population and Workforce



Source: Estimated by Hanover Research, using data from Foothill-De Anza and methodology from Stange 2005.

Figure 1.6: Hanover Embedded Credits Projections through 2024 – FHDA



Note: Projections generated using historical estimates from 1958 to 2013 in a (0,2,1) ARIMA model.

[6] Note that autoregressive integrated moving-average (ARIMA) modeling allows the analyst to "predict a value in a response time series as a linear combination of its own past values, past errors (also called shocks or innovations), and current and past values of other time series." See: "The ARIMA Procedure." SAS OnlineDoc: Version 8. 1999. p. 193. http://www.dms.umontreal.ca/~duchesne/chap7.pdf

EARNINGS VALUE OF FHDA CREDITS

We now turn to estimating the actual dollar value these embedded workforce credits bring the local community in terms of extra earning power. In his earlier analysis, Stange drew on several studies to "estimate that each year of community college instruction increases earnings by 6 percent at every point in individuals' working careers,"[7] a point we explore further in Section II and III. Applying this point to FHDA students' experience, it is reasonable to argue that FHDA's instruction provides significant earnings increases for its students and graduates.[8] In turn, this generates additional spending within the local community.

To estimate the average earning increase each FHDA credit provides, we multiply each age group's average annual earnings by 6 percent and then divide by 45, which is the number of credits for a full year of instruction at FHDA. We use PUMS data from the 2008-2012 American Community Survey to estimate average wages.[9] Note that we restricted the sample on which we based these wage estimates to employed individuals living in the San Jose MSA with at least a high school diploma but less than a bachelor's degree.[10]

Figure 1.7: Value per Credit by Age Group (2013)

AGE GROUP	AVERAGE ANNUAL EARNINGS	ESTIMATED ANNUAL $ VALUE OF EACH FHDA CREDIT EARNED
Less than 20	$14,888	$19.85
20 to 24	$21,004	$28.01
25 to 29	$37,476	$49.97
30 to 34	$46,136	$61.51
35 to 39	$53,681	$71.57
40 to 44	$58,339	$77.79
45 to 49	$62,990	$83.99
50 to 54	$62,207	$82.94
55 to 59	$59,642	$79.52
60 to 64	$56,877	$75.84
65+	$45,456	$60.61

Source: Estimated by Hanover Research, using data from American Community Survey and methodology from Stange 2005.

[7] Stange. 2005. Op. cit.

[8] Sources:

Jacobson, L., Robert LaLonde, Daniel G. Sullivan. "Estimating the returns to community college schooling for displaced workers." *Journal of Econometrics,* 125:1-2, March-April 2005, p. 271-304.

Kane, Thomas J., Cecilia Elena Rouse. "Labor-Market Return to Two- and Four-Year College." *The American Economic Review,* 85:3, Jun 1995. p. 600-614.

Kane, Thomas J., Cecilia Elena Rouse. "The Community College: Educating Students at the Margin between College and Work." *Journal of Economic Perspectives,* 13:1, Winter 1999, p. 63-84.

Leigh, Duane E., Andrew M. Gill. "Labor Market Returns to Community Colleges." *The Journal of Human Resources,* 32:2, Spring 1997, p. 334-353.

[9] "American Community Survey: 2008-2012 PUMS." United States Census Bureau. http://www.census.gov/acs/www/data_documentation/public_use_microdata_sample/

[10] These specifications are based on Stange 2005.

The estimates in Figure 1.7 represent the amount of money each FHDA credit adds to an individual's annual salary. Among individuals under 20 years old, each credit results in $19.85 more in earnings per year. This increases rapidly as workers age, because older workers earn more money, on average, than their younger counterparts. In turn, the dollar value of education tends to increase along with age. Most age groups earn more per year from a single credit than the current cost of a credit unit at FHDA ($31 per unit[11]). Additionally, this increase in earnings is applicable for every year in which an individual is employed, compared to a one-time fee for a credit hour of instruction. In other words, instruction at FHDA and other community colleges is an excellent investment.

To determine the impact that these earnings have on the entire community, we estimate the number of embedded credits within each age group in 2013 and multiply those estimates by the estimated per-credit value of FHDA credits presented in Figure 1.7.

As Figure 1.8 shows, FHDA credits embedded in the workforce in 2013 resulted in an aggregate increase in earnings of $356.2 million that year. This is an increase of almost $4 million since this was estimated by Stange in 2005.[12]

Figure 1.8: Total Value of Credits by Age Group (2013)

AGE GROUP	TOTAL EMBEDDED CREDITS	EMBEDDED $ VALUE OF EMBEDDED CREDITS ($ MILLIONS)
Less than 20	2,461,038	$48.9
20 to 24	2,820,696	$79.0
25 to 29	1,173,293	$58.6
30 to 34	1,213,703	$74.7
35 to 39	296,291	$21.2
40 to 44	268,213	$20.9
45 to 49	225,758	$19.0
50 to 54	179,092	$14.9
55 to 59	126,882	$10.1
60 to 64	75,389	$5.7
65+	56,299	$3.4
Total	***8,896,655***	***$356.2***

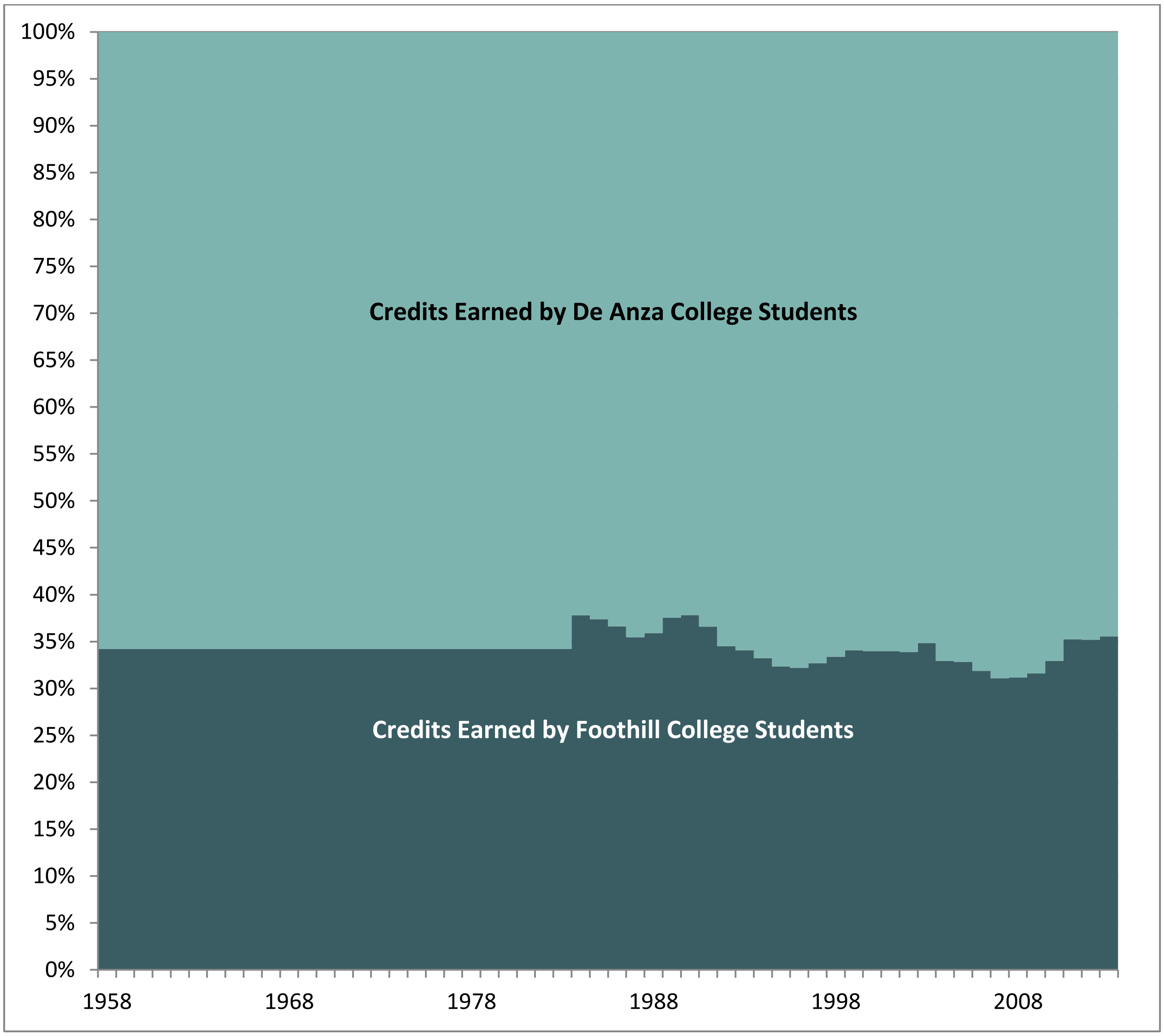
[11] "Student Fees." Foothill College. http://www.foothill.edu/reg/fees.php

[12] See Stange 2005. In that report, Stange estimated a total value of $352.8 million, with most of the impact coming from middle-aged workers. Our models produce a similar total figure as Stange, but we estimate that most of the value is actually coming from younger workers. This is because our models show that the majority of embedded credits in the workforce are with those under 30 years old. If our distribution of embedded credits skewed older, like Stange's, then our total embedded value estimate would be much higher than $356.2 million – as older workers make more money and thus have a higher per-credit dollar value. We do not have access to Stange's exact methodology, so we cannot currently explain why our estimates differ in this regard.

SEGMENTATION BY COLLEGE

In this subsection, we repeat the above analysis separately for Foothill College and De Anza College.[13] While Stange did not make such a distinction in his earlier analysis, FHDA provided the number of credits for each college for the period 1984-2013. For years 1958-1983, we assume that credits are earned in the same proportion as 1984-2013. On average 65.8 percent of the credits in each year were earned by De Anza College students and 34.2 percent by Foothill College students, with very little year-to-year variation (Figure 1.9).

Figure 1.9: Proportion of Credits by College per Year



One notable limitation to this segmented analysis is a lack of age distribution data by college for the observed timeframe. In preparation for this project, FHDA provided age distributions

[13] The Foothill credits did not include apprenticeship, performing arts alliance, primary care and noncredit courses.

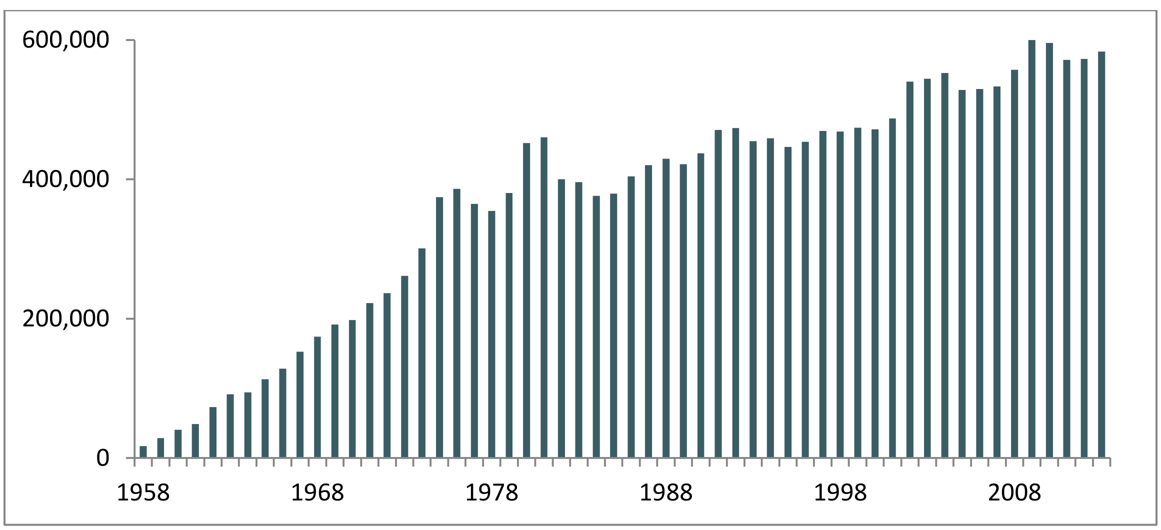
for the two colleges for the period 2009 onward. However, as this represented only a very small portion of the observed timeframe, and as Stange's analysis used District-wide age distributions (see Figure 1.4), our current analysis also relied on District-wide age distributions. This is an important point to keep in mind, as if the age makeup of the two colleges differed throughout the observed timeframe, this would affect the final embedded credit estimate. As we saw in our discussion of population and labor force multipliers, the probability that a credit is embedded in the workforce in any given year is largely determined by the age of the student who attained it.

We also note that the sum of the number of embedded credits for the two colleges does not precisely equal the number of credits reported for both colleges as a whole, although these numbers are very close. This is due to rounding that is necessary at various stages of the analysis. These differences are extremely minor – on the order of less than 0.03 percent of the credits in the workforce in any given year – and do not affect the conclusions presented in this report.

De Anza College

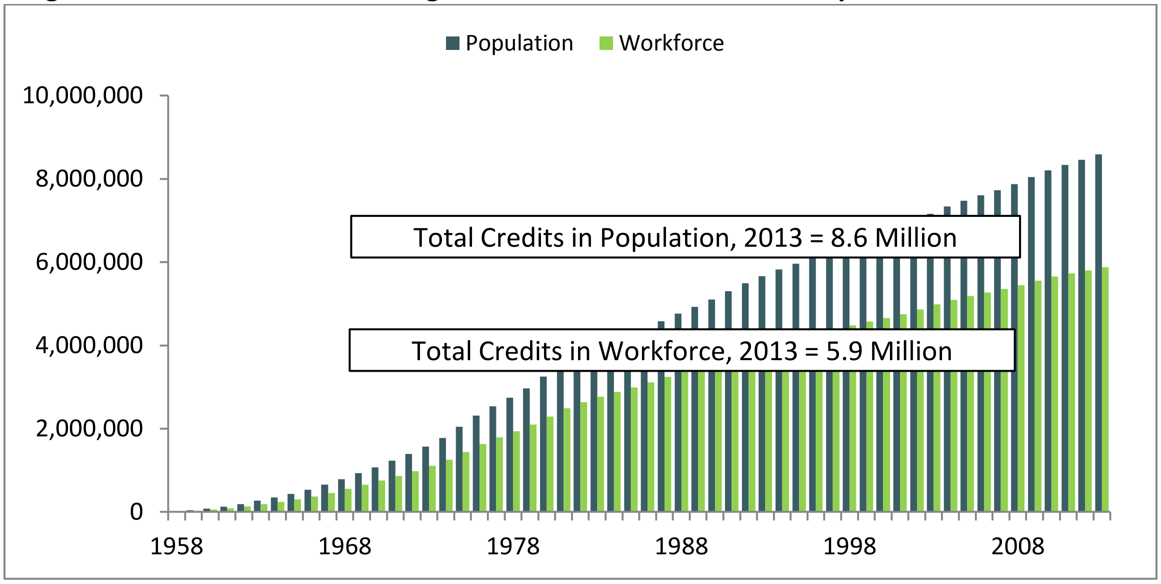
Figure 1.10 below shows the total credits earned by De Anza College students in each year since 1958. The pattern generally follows that seen with respect to FHDA's credits overall – they have generally increased, albeit somewhat unsteadily. As of 2013, De Anza College students had earned a total of 20.6 million credits, including more than half a million in 2013 alone.

Figure 1.10: Total Credits per Year – De Anza College



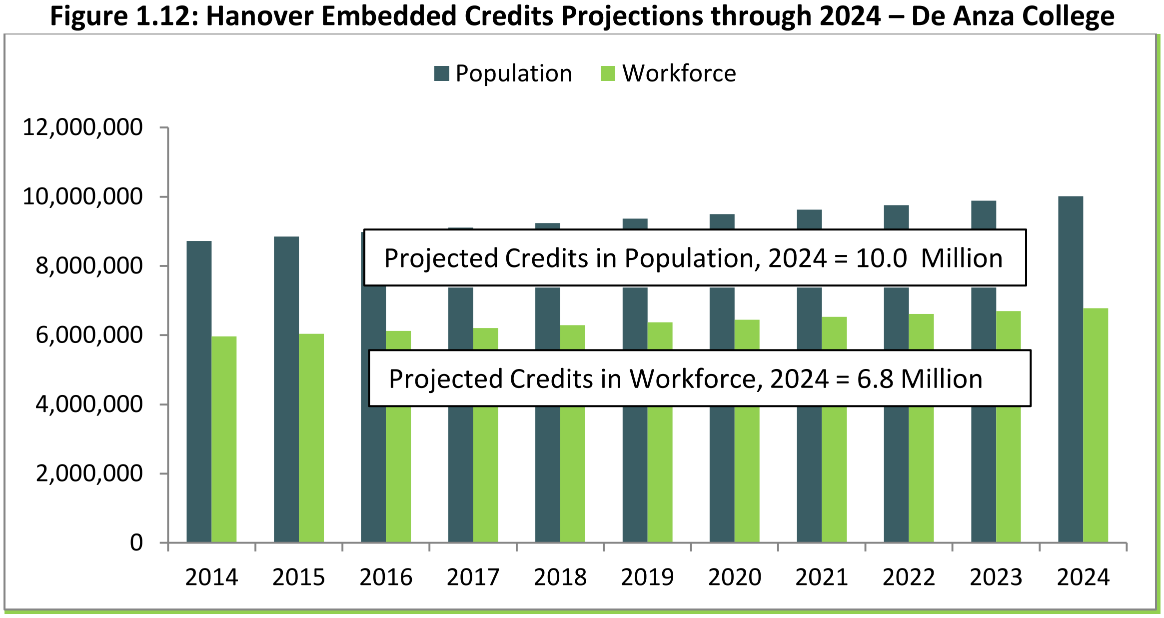
In Figure 1.11 below, we calculate the cumulative investment in the population and workforce by De Anza College. We estimate that De Anza has contributed about 8.6 million of FHDA's total 13.0 million credits in the population, and 5.9 million of FHDA's total 8.9 million credits in the workforce, as of 2013.

Figure 1.11: Total De Anza College Credits Embedded in Local Population and Workforce



Using the historical estimates presented in Figure 1.11, we use ARIMA modeling to make embedded credit projections through 2024 (see Figure 1.12). By 2024, we expect there to be roughly 10.0 million credits embedded in the local population and about 6.8 million credits embedded in the workforce.

Figure 1.12: Hanover Embedded Credits Projections through 2024 – De Anza College



Note: Projections generated using historical estimates from 1958 to 2013 in a (0,2,1) ARIMA model.

We use the same methodology as before to determine the value of the credits embedded in the workforce. As Figure 1.13 shows, De Anza College credits embedded in the workforce in 2013 resulted in an aggregated increase in earnings of $235.6 million that year.

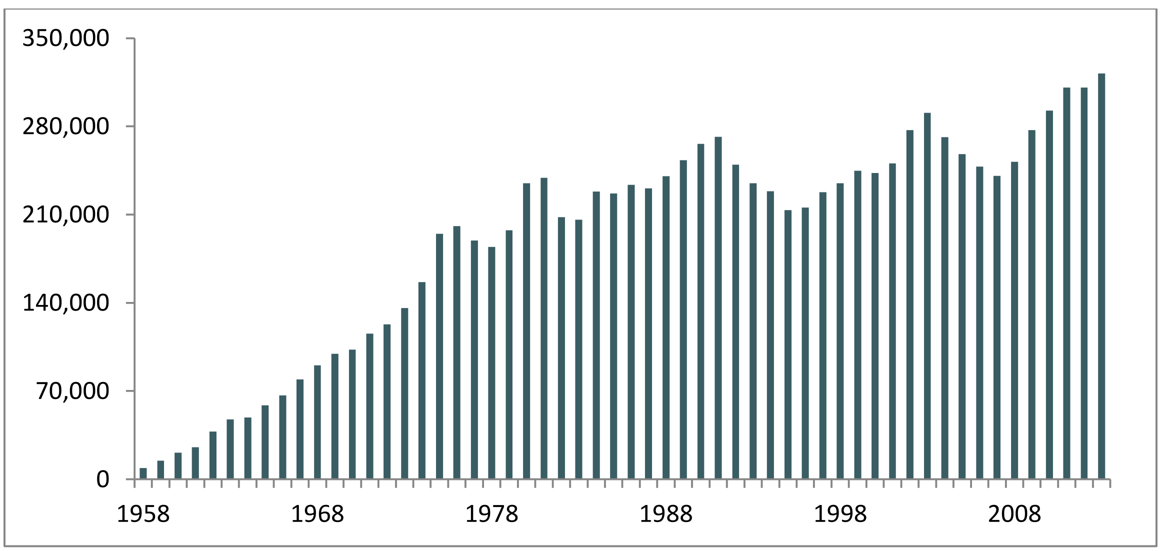
Figure 1.13: Total Value of Credits by Age Group (2013) – De Anza College

Age Group	Total Embedded Credits	Embedded $ Value of Embedded Credits ($ millions)
Less than 20	1,627,334	$32.3
20 to 24	1,864,469	$52.2
25 to 29	773,563	$38.7
30 to 34	800,889	$49.3
35 to 39	196,342	$14.1
40 to 44	178,051	$13.9
45 to 49	150,041	$12.6
50 to 54	119,086	$9.9
55 to 59	84,158	$6.7
60 to 64	49,909	$3.8
65+	37,201	$2.3
Total	***5,881,044***	***$235.6***

Foothill College

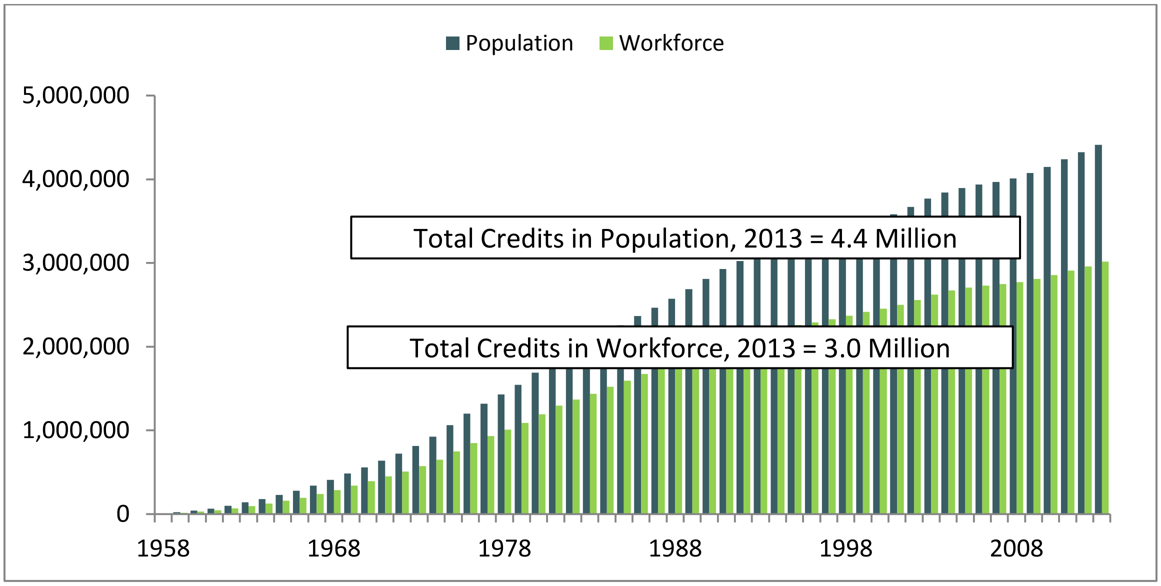
Figure 1.14 below shows the total credits earned in each year since 1958 by Foothill College students. Again, the pattern tracks closely with total FHDA credits and De Anza College credits over this period. As of 2013, Foothill College students had earned a total of 10.7 million credits over the period observed and approximately 320,000 credits in that year alone.

Figure 1.14: Total Credits per Year – Foothill College



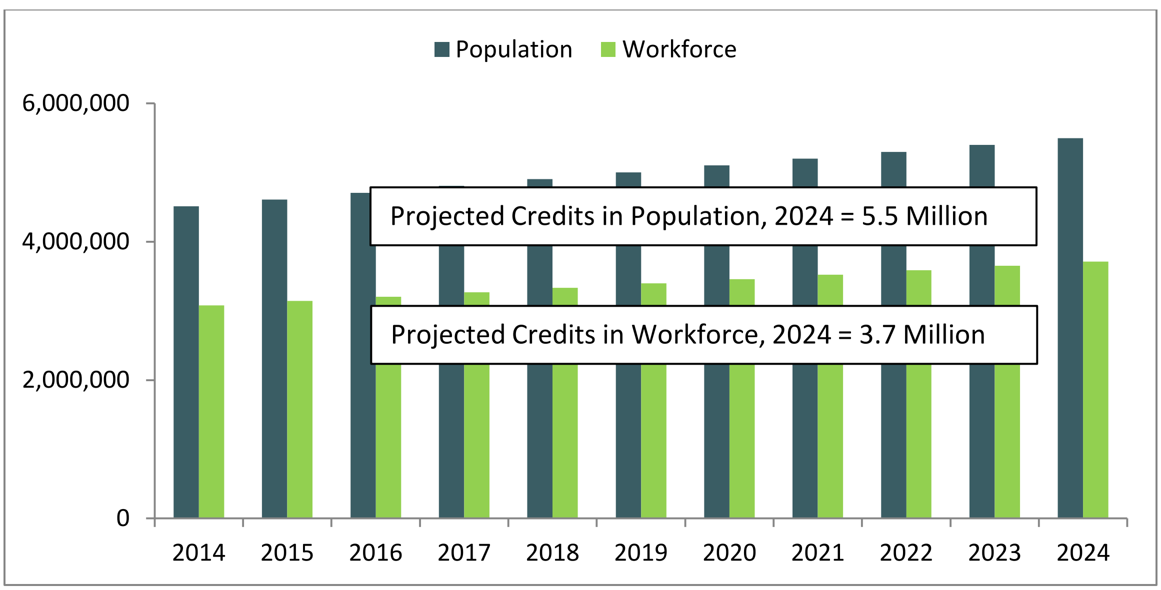
In Figure 1.15, we calculate the cumulative investment in the population and workforce by Foothill College. We estimate that Foothill College has contributed roughly 4.4 million of FHDA's total 13.0 million credits in the population, and 3.0 million of FHDA's total 8.9 million credits in the workforce, as of 2013.

Figure 1.15: Total Foothill College Credits Embedded in Local Population and Workforce



Using the historical estimates presented in Figure 1.15, we use ARIMA modeling to make embedded credit projections through 2024 (see Figure 1.16). By 2024, we expect there to be about 5.5 million credits embedded in the local population and 3.7 million credits embedded in the workforce.

Figure 1.16: Hanover Embedded Credits Projections through 2024 – Foothill College



Note: Projections generated using historical estimates from 1958 to 2013. Number of credits in the population was estimated using a (1,1,1) ARIMA model, and number of credits in the workforce was estimated using a (0,2,1) ARIMA model.

We use the same methodology as before to determine the value of the credits embedded in the workforce. As Figure 1.17 shows, Foothill College credits embedded in the workforce in 2013 resulted in an aggregated increase in earnings of $120.7 million that year.

Figure 1.17: Total Value of Credits by Age Group (2013) – Foothill College

Age Group	Total Embedded Credits	Embedded $ Value of Embedded Credits ($ millions)
Less than 20	833,692	$16.5
20 to 24	956,228	$26.8
25 to 29	399,733	$20.0
30 to 34	412,817	$25.4
35 to 39	99,948	$7.2
40 to 44	90,162	$7.0
45 to 49	75,718	$6.4
50 to 54	60,009	$5.0
55 to 59	42,727	$3.4
60 to 64	25,483	$1.9
65+	19,088	$1.2
Total	***3,015,605***	***$120.7***

SECTION II: WAGES BY DEGREE PROGRAM

In this section, we examine the specific jobs obtained by FHDA graduates, as well as typical wages of these occupations. This provides insight into the types of jobs that FHDA graduates have obtained in recent years, and whether or not these jobs offer competitive wages.

The data used in this analysis are drawn from the College Wage Tracker[14] and the State of California's Employment Development Department.[15] The College Wage Tracker, administered by the California Community Colleges Chancellor's Office, provides award totals from 2001-02 to 2008-09 for all community colleges in California, as well as average earnings of alumni three years after the graduates receive their awards. We compiled data for the 20 most popular programs at FHDA over this period and compare it to average wages for similar occupations in the San Jose MSA area.

Figure 2.1 comprises two main sections. In the three left-hand columns (green header), we provide the wages of the most popular programs at FHDA from 2001-02 to 2008-09 (not counting students who transferred or are unemployed). In the three right-hand columns (red header), we show titles, wages, and employment estimates for occupations that correspond to FHDA programs in the same row.

With 495 total awards conferred from 2001-02 to 2008-09, the most popular program over this time period was Sheet Metal and Structural Metal, followed by Electrical (367 awards) and Registered Nursing (345 awards). Eight out of the 20 programs are medical-related. The two most popular programs are skilled trade occupations (Sheet/Structural Metal and Electrical).

The average wage of these 20 programs varies considerably, though graduates of several of these programs currently earn more than the average associate's degree holder in the San Jose MSA. In 2012, an individual in the area with an associate's degree averaged $59,000,[16] which is significantly lower than the earnings associated with several of FHDA's popular programs, including Physician's Assistant ($107,785), Diagnostic Medical Sonography ($106,707), and Registered Nursing ($97,858). In fact, graduates of five out of the eight medical-related programs earn, on average, *significantly* more than the average person with an associate's degree in the region (Registered Nursing, Physician's Assistant, Radiologic Technology, Respiratory Care/Therapy, and Diagnostic Medical Sonography).

---

[14] "College Wage Tracker." California Community Colleges Chancellor's Office . http://datamart.cccco.edu/Outcomes/College_Wage_Tracker.aspx

[15] "OES Employment and Wages by Occupation." California Employment Development Department. 1Q 2014. http://www.labormarketinfo.edd.ca.gov/LMID/OES_Employment_and_Wages.html

[16] Calculated by Hanover Research. Data come from: "American Community Survey: 2008-2012 PUMS." United States Census Bureau. http://www.census.gov/acs/www/data_documentation/public_use_microdata_sample/

Figure 2.1: FHDA Graduate Wages, Sorted by Most Popular Programs

FHDA Awards and Graduate Wages			San Jose MSA Jobs and Wages		
Program	**Wage**	**Awards**	**Occupation**	**Wage**	**Jobs**
Sheet Metal and Structural Metal	$78,073	495	Sheet Metal Workers	$69,014	1,030
Electrical	$60,727	367	Electrical and Electronics Engineering Technicians	$66,014	4,240
Registered Nursing	$97,858	345	Registered Nurses	$124,633	14,230
Physician's Assistant	$107,785	294	Physician Assistants	$106,938	330
Paralegal	$51,002	228	Paralegals and Legal Assistants	$66,207	2,610
Accounting	$43,997	201	Bookkeeping, Accounting, and Auditing Clerks	$49,252	9,000
Child Development/Early Care and Education	$21,915	159	Childcare Workers	$29,565	2,800
Veterinary Technician (Licensed)	$39,522	147	Veterinary Technologists and Technicians	$44,161	290
Clinical Medical Assisting	$38,442	133	Medical and Clinical Laboratory Technicians	$55,209	810
Other Business and Management	$46,285	122	N/A		
Travel Services and Tourism	$39,294	122	Travel Agents	$41,745	730
Social Sciences, General	$36,189	118	N/A		
Radiologic Technology	$90,207	115	Radiologic Technologists and Technicians	$86,552	710
Respiratory Care/Therapy	$91,922	105	Respiratory Therapists	$87,635	760
Computer Networking	$67,535	99	Computer Network Support Specialists	$91,823	3,040
Business Administration	$52,636	89	N/A		
Diagnostic Medical Sonography	$106,707	78	Diagnostic Medical Sonographers	$111,440	200
Administrative Medical Assisting	$37,064	69	Medical Secretaries	$44,938	2,990
Biological and Physical Sciences (and Mathematics)	$33,288	68	N/A		
Transfer Studies	$31,615	63	N/A		

Sources: College Wage Tracker and California Employment Development Department
Notes: (1) N/A marked when award category is too broad; (2) Awards figures are from 2001-02 to 2008-09 academic years, while FHDA graduate wage data are for three years after award granted. San Jose MSA data are from 2013-14; (3) Award totals and wages for FHDA count only those who did not transfer to a 4-year institution and were employed in the San Jose area; and (4) Awards include both AA/AS degrees and certificates.

Wage by Degree Program and College

Similar to Section I, we further examine wages by academic program through a segmentation of the analysis by college. This is of particular interest because some of the programs listed in the first part of this section were only offered at one college or the other. For each college, we report the wages for the 10 most popular programs.

De Anza College

Figure 2.2 presents the wages of the 10 most popular programs at De Anza College compared to the average for the San Jose MSA. The most popular program over the sample period was the Registered Nursing program, which earned all of FHDA's 345 awards listed in Figure 2.1 above. Although some of the programs are clearly aligned with an occupational field (e.g., Registered Nursing, Paralegal, Computer Networking, etc.), others are fairly broad (e.g., Social Sciences and Other Business/Management) and could prepare students to enter a wide variety of fields.

Only two programs' average wages are above the 2012 San Jose MSA average of $59,000 for associate degree holders – Registered Nursing ($97,858) and Computer Networking ($67,535). However, it is important to keep in mind that the De Anza College graduate wages represented in this chart include individuals who attained a variety of awards. For example, programs like Accounting, Paralegal, Child Development, Computer Networking, and Automotive Technology have both graduates who earned associate's degrees and those who earned certificates. The figures for programs such as Administrative Medical Assisting and Clinical Medical Assisting exclusively represent individuals who earned certificates.

Further, we observe that the average wage of De Anza College graduates in all of the top 10 programs that are matched to an occupation is lower than the average wage in San Jose. However, these MSA wages are not restricted to individuals who have only an associate's degree, and some of these fields exhibit high variation in their wages (e.g., Registered Nurses and Medical and Clinical Laboratory Technicians). Additionally, while the wage figures for De Anza College graduates were recorded three years after graduation, workers with higher and lower levels of experience are represented in the San Jose MSA wage data. In most cases, as De Anza College graduates gain more experience, we would expect their wages to increase.

Figure 2.2: FHDA Graduate Wages, Sorted by Most Popular Programs – De Anza College

De Anza Awards and Graduate Wages			San Jose MSA Jobs and Wages		
Program	**Wage**	**Awards**	**Occupation**	**Wage**	**Jobs**
Registered Nursing	$97,858	345	Registered Nurses	$124,633	14,230
Paralegal	$51,002	228	Paralegals and Legal Assistants	$66,207	2,610
Accounting	$41,087	166	Bookkeeping, Accounting, and Auditing Clerks	$49,252	9,000
Child Development/Early Care and Education	$21,915	159	Childcare Workers	$29,565	2,800
Clinical Medical Assisting	$38,442	133	Medical and Clinical Laboratory Technicians	$55,209	810
Other Business and Management	$46,285	122	N/A		
Computer Networking	$67,535	99	Computer Network Support Specialists	$91,823	3,040
Social Sciences, General	$31,736	76	N/A		

De Anza Awards and Graduate Wages			San Jose MSA Jobs and Wages		
Program	**Wage**	**Awards**	**Occupation**	**Wage**	**Jobs**
Administrative Medical Assisting	$37,064	69	Medical Secretaries	$44,938	2,990
Automotive Technology	$39,119	55	Automotive Service Technicians and Mechanics	$51,582	2,860

Sources: College Wage Tracker and California Employment Development Department
Note: N/A marked when award category is too broad

Foothill College

Figure 2.3 presents the wages of the 10 most popular programs at Foothill College compared to the average for the San Jose MSA. The most popular program over the sample period was the Sheet Metal and Structural Metal program, which accounted for all of FHDA's 495 awards listed in Figure 2.1 above. We also see that many of the programs are medical-related, such as Physician's Assistant, Radiologic Technology, and Respiratory Care/Therapy.

The 2012 average wage of an individual holding an associate's degree in the San Jose MSA of $59,000 is significantly lower than several of Foothill's popular programs, including Physician's Assistant ($107,785), Diagnostic Medical Sonography ($106,707), and Radiation Therapy Technician ($99,402). In fact, graduates of eight out of the 10 most popular programs earn, on average, more than the average person with an associate's degree in the region. Further, graduates of several of the programs earn more than the average individual in related occupational fields in the San Jose MSA (e.g., graduates of the Sheet Metal and Structural Metal, Radiologic Technology, and Respiratory Care/Therapy programs).

Figure 2.3: FHDA Graduate Wages, Sorted by Most Popular Programs – Foothill College

Foothill Awards and Graduate Wages			San Jose MSA Jobs and Wages		
Program	**Wage**	**Awards**	**Occupation**	**Wage**	**Jobs**
Sheet Metal and Structural Metal	$78,073	495	Sheet Metal Workers	$69,014	1,030
Electrical	$60,727	367	Electrical and Electronics Engineering Technicians	$66,014	4,240
Physician's Assistant	$107,785	294	Physician Assistants	$106,938	330
Veterinary Technician (Licensed)	$39,522	147	Veterinary Technologists and Technicians	$44,161	290
Travel Services and Tourism	$39,294	122	Travel Agents	$41,745	730
Radiologic Technology	$90,207	115	Radiologic Technologists and Technicians	$86,552	710
Respiratory Care/Therapy	$91,922	105	Respiratory Therapists	$87,635	760
Diagnostic Medical Sonography	$106,707	78	Diagnostic Medical Sonographers	$111,440	200
Plumbing, Pipefitting and Steamfitting	$76,890	62	Plumbers, Pipefitters, and Steamfitters	$80,317	1,560
Radiation Therapy Technician	$99,402	51	Radiation Therapists	$115,649	70

Sources: College Wage Tracker and California Employment Development Department

Section III: Wages by Demographic Characteristics

We now turn to Census data to investigate the average earning increase an individual in the San Jose MSA can expect from completing college coursework or earning an associate's degree. Additionally, we examine earnings by various demographic groups to determine whether a college education provides an added advantage to certain demographic groups.

We estimate average annual wages for varying education levels using PUMS data from the 2008-2012 American Community Survey,[17] which is administered by the U.S. Census Bureau. We include an individual's wages in our analysis only if they: 1) live in the San Jose MSA; 2) are 18 or older; 3) worked at least 50 weeks in the last year; and 4) reported wages greater than $0.[18] This ensures that we are not including unemployed individuals or volunteers in our wage estimates.[19] While we do not use data directly from FHDA, our exclusive focus on the San Jose MSA makes the findings highly relevant to the District.

The average high school graduate with no college credits in the San Jose MSA earns approximately $45,000. In comparison, an individual with some college experience but no degree earns $53,000 – an increase of around $8,000 (18 percent) compared to the high school graduate. Similarly, an individual with an associate's degree earns roughly $14,000 more than a high school graduate (an increase of 31 percent). This clearly shows that individuals with at least some college experience earn significantly more than their counterparts who hold only a high school diploma.

All races and ethnicities experience an increase in earnings by attending college. Blacks and African Americans experience the largest average salary increase by having "some college" (+28 percent), compared to Asians (+18 percent), Hispanics (+21 percent), and Whites (+18 percent). All races and ethnicities experience a further salary bump for holding an associate's degree except Blacks/African-Americans. Curiously, this group reports a lower average salary than their counterparts who have college experience but do not hold an associate's degree.

Males experience a slightly higher increase in earnings after completing a college education compared to their female counterparts. The average male in the San Jose MSA who has some college experience earns 29 percent more than a male with just a high school diploma. In comparison, a female with some college earns 25 percent more than a female with just a high school diploma. This gap generally holds when examining earnings at the associate's degree level (45 percent vs. 40 percent).

[17] "American Community Survey." Op cit.
[18] This follows the methodology used by Stange 2005 in his reporting of wage data.
[19] After these restrictions, our final data set includes 11,720 surveyed individuals, representing a population size of 249,602 in the San Jose MSA.

Perhaps the most interest findings come from an examination of wages by age groups. On average, individuals under 25 experience no immediate increase in earnings from a college education. In fact, younger people with some college earn 9 percent less than their counterparts with just a high school diploma. Individuals under 25 with some college earn roughly the same as those with just a high school education. However, the scenario quickly changes as workers get older. For instance, the wage increases for some college and an associate's degree in the 25 to 34 age bracket are 20 percent and 29 percent, respectively. These wide margins continue at all age brackets past 25.

Thus, it might be necessary to encourage young people to view their education as an investment that takes some time to realize. While their peers who do not attend college might earn more than them at 19, this is unlikely to continue into the mid-20s and beyond.

Figure 3.1: Average Annual Income by Educational Attainment

San Jose MSA

	Less than HS Diploma	High School Diploma	Some College	Assoc. Degree	% Increase From HS to Some College	% Increase from HS to Associate's
All						
All	$35,748	$45,156	$53,116	$59,110	*18%*	*31%*
Race/Ethnicity						
Asian	$36,028	$36,537	$44,246	$56,360	*21%*	*54%*
Black or Af. Am.	$39,196	$39,368	$50,507	$44,580	*28%*	*13%*
Hispanic	$32,445	$36,299	$44,009	$49,348	*21%*	*36%*
White	$46,951	$54,663	$64,749	$67,629	*18%*	*24%*
Gender						
Male	$38,838	$46,248	$59,531	$66,899	*29%*	*45%*
Female	$30,752	$36,477	$45,695	$51,199	*25%*	*40%*
Age						
Under 25	$23,473	$21,050	$19,217	$21,145	*-9%*	*0%*
25 to 34	$31,210	$36,710	$44,041	$47,280	*20%*	*29%*
35 to 44	$36,489	$46,932	$63,505	$61,553	*35%*	*31%*
45 to 54	$44,352	$51,878	$66,711	$74,828	*29%*	*44%*
55 to 64	$38,350	$47,008	$65,852	$63,675	*40%*	*35%*
65+	$37,874	$38,958	$50,289	$52,079	*29%*	*34%*

Note: Amounts are in 2012 dollars

APPENDIX: DETAILED METHODOLOGY

As discussed at the outset of this report, at the request of FHDA, Hanover Research sought to replicate a methodology employed by Kevin Stange in his October 2005 report. While we did not have access to all of the details of Stange's methodology, we were successful in approximating his results for the period 1958 through 2004. We then extended this replicated methodology to produce estimates of the number of embedded FHDA credits in the community and the earnings value of these credits for an additional nine years through 2013. We also projected the number of credits embedded in the local community through 2024.

In this appendix, we provide a detailed discussion of the steps we took to develop these estimates. Note that this is intended as an extension of the discussion presented in Section I of this report. Further, while we developed estimates for FHDA overall, as well as separate estimates for its two colleges, in this appendix we primarily focus on the overall FHDA calculations to illustrate the methodology.

DATA SOURCES

The data supporting this analysis were gathered from multiple sources. First, we were able to obtain some of the data Stange used in his report from a presentation he developed for FHDA in 2005.[20] We compiled these data into a spreadsheet and delivered it to FHDA for review. The District then updated some of these numbers and provided more detailed credit figures for Foothill College and De Anza College separately (for the period 1984-2013).[21]

ESTIMATING NUMBER OF EMBEDDED CREDITS IN THE COMMUNITY

As illustrated in Figure 1.1 in Section I of this report, we began our analysis by examining total credits earned per year at FHDA. These data were drawn from Stange's report, as well as the data provided by FHDA, noted above. Figure 1.1 in Section I shows that overall, students earned a total of 26,198 credits through FHDA in 1958, a number which rose dramatically to 904,934 credits in 2013.

MORTALITY, MIGRATION, AND LABOR FORCE PARTICIPATION MULTIPLIERS

In keeping with Stange's goal of estimating how many of these credits are cumulatively embedded in the local community, it was necessary to apply appropriate migration, mortality, and labor force participation multipliers. In other words, we needed to factor in the likelihood that a student may leave the area (in effect taking the credits out of the

[20] To obtain a spreadsheet containing the data for a given chart, right-click the chart, select "Chart Object," and select edit. See: Stange, K. "The Economic Impact of the Foothill-De Anza Community College District and its Students." Foothill-De Anza Community College District. October 17, 2005. http://research.fhda.edu/research-reports/_economic-impact/economic-impact-oct-17-2005-board-presentation-102005.ppt

[21] "Hanover Data Template – Foothill De Anza Community College District." Delivered to Hanover Research by email on July 28, 2014.

region), passing away, or dropping out of the workforce (no longer directly contributing to the local labor force).

As noted in Section I, mortality, migration, and labor force participation rates vary considerably by age group. For example, as shown in Figure A1 below, while the *survival rate* (the inverse of mortality rate) of individual ages 25 to 29 is 99 percent, this rate decreases to 80 percent for individuals ages 70 to 74. By contrast, younger individuals are generally more mobile than their older counterparts, so we observe that individuals ages 25 to 29 have a 66 percent *non-migration rate* (inverse of migration rate), while the rate for those ages 70 to 74 is 87 percent.

The survival and non-migration rates for each age group are then converted to *annual* survival and non-migration rates. This is done because of the process of simulating how students age over time, which is described in the subsection *Aging Students and Applying Multipliers* below. For example, the migration rate for the 25-29 age group is 34 percent, which is annualized to 34/5 = 6.8 percent. This translates to a 93.2 percent non-migration rate for each year an alumnus is in the 25-29 age group. For the purposes of annualizing multipliers, we treat the less than 20 age group as a five-year age group.

We combined the *survival* and *non-migration* rates for each age group into a single population multiplier, depicted in the rightmost column below.

Figure A1: Population Multipliers (Mortality and Migration)

Age Group	% Surviving over Five-Year Period (Survival Rate)	Annualized Survival Rate	% Staying in County over Five-Year Period (Non-Migration Rate)	Annualized Non-Migration Rate	Population Multiplier (Annual Survival % X Annual Non-Migration %)
Less than 20	100%	100%	53%	91%	91%
20 to 24	100%	100%	58%	92%	92%
25 to 29	99%	100%	66%	93%	93%
30 to 34	99%	100%	77%	95%	95%
35 to 39	99%	100%	81%	96%	96%
40 to 44	98%	100%	85%	97%	97%
45 to 49	97%	99%	87%	97%	97%
50 to 54	96%	99%	86%	97%	96%
55 to 59	94%	99%	84%	97%	96%
60 to 64	91%	98%	86%	97%	95%
65 to 69	87%	97%	89%	98%	95%
70 to 74	80%	96%	87%	97%	94%
75+	70%	94%	90%	98%	92%

Source: Stange 2005; Centers for Disease Control and the American Community Survey

Next, in order to factor in variation in labor force participation by age group, we obtained age-specific participation rates and multiplied them by the corresponding population multipliers to achieve a final multiplier. Figure A2 displays these calculations.

Figure A2: Labor Force Participation and Final Multipliers

Age Group	Labor Force Participation Multiplier (% Participating in Labor Force)	Population Multiplier (Survival % X Non-Migration %)	Final Multiplier (Population Multiplier X Labor Force Participation Multiplier)
Less than 20	56%	91%	51%
20 to 24	70%	92%	64%
25 to 29	75%	93%	70%
30 to 34	79%	95%	75%
35 to 39	78%	96%	75%
40 to 44	83%	97%	80%
45 to 49	80%	97%	77%
50 to 54	77%	96%	74%
55 to 59	74%	96%	71%
60 to 64	49%	95%	47%
65 to 69	26%	95%	25%
70 to 74	16%	94%	15%
75+	9%	92%	8%

Share of Credits by Age Group

In order to apply the final multipliers to FHDA's credits earned data, we needed to estimate the age of the students (at time of instruction) earning these credits. Stange's report included a figure titled "Share of Total Foothill-De Anza Credit Hours Earned by Age Group,"[22] providing such data for the years 1985, 1990, 1995, 2000, and 2004. FHDA provided us with more recent estimates for 2009 and 2013. As the shares of credits earned by age were available for discrete years, we spread these estimates over the intervening years (e.g., assuming that the 1990 figure remained consistent for the period 1990-1994; as a figure was not available prior to 1985, we used the same share of credits earned for the period 1958-1989).

Figure A3: Share of Credits by Age Group by Academic Year

Age Group	1958-1989	1990-1994	1995-1999	2000-2003	2004-2008	2009-2012	2013
24 and Under	55%	56%	60%	65%	65%	55%	62%
25-34	26%	24%	22%	19%	18%	21%	23%
35-64	17%	17%	16%	14%	15%	19%	13%
65+	3%	3%	2%	1%	1%	5%	2%

Source: Stange 2005 and Foothill-De Anza Community College District

Next, as illustrated in Figures A1 and A2 above, the mortality, migration, and labor force participation multipliers are available for narrower age ranges (typically five-year age groups

[22] Stange. 2005. Op. cit.

such as 25-29) than the share of credits data shown in Figure A3 (which correspond to broader age groups, such as 25-34). We therefore segmented the broader age groups in Figure A3 into five-year increments, assuming that each five-year increment earned the same number of credits. For example, the age group 25-34 covers two five-year increments: 25-29 and 30-34. From 1958-1989, our approach assumes that students age 25-34 accounted for 26 percent of the total credits earned at FHDA colleges each year. Breaking this apart into the associated five-year increments, we assume that students age 25-29 accounted for 13 percent of credits each year (26 percent/2) and students age 30-34 accounted for another 13 percent.

Similarly, as the available data are reported for age *groups* (e.g., 25- to 29-year-olds), rather than discrete ages (e.g., 25-year-olds), we further assume that age groups are uniformly distributed across discrete ages. For example, with respect to students age 25-29, we assume that there are an equal number of 25-year-olds, 26-year-olds, 27-year-olds, 28-year-olds, and 29-year-olds. Applying this assumption to the share of credits by age data in Figure A3, we estimate that students at each discrete age earned an equal number of credits. This is illustrated for the 25-29 age group in 1958 in the table below.

Figure A4: Calculating the Distribution of Credits within Age Groups, 25- to 29-Year-Olds, 1958

Share of FHDA Credits for 25-to 34-Year-Olds in 1958	Share of FHDA Credits for 25-to 29-Year-Olds in 1958	Share of FHDA Credits for Each Discrete Age (e.g., 25-Year-Olds)
26%	26%/2 = 13%	13%/5 = 2.6%

Note that we took a slightly more nuanced approach for the youngest age group of students. Treating the "24 and under" age group as 18- to 24-year-olds, we assume that half of the credits earned by this group are accounted for by 18- to 19-year-olds, while the other half is accounted for by 20- to 24-year-olds. We took this step because, as depicted in Figures A1 and A2, the available multipliers data correspond to two groups: "less than 20" and "20 to 24." Figures A5 and A6 illustrate how we calculated the distribution of credits for 18- to 19-year-olds and 20- to 24-year-olds in 1958.

Figure A5: Calculating the Distribution of Credits within Age Groups, 18- to 19-Year-Olds, 1958

Share of FHDA Credits for "24 and Under" in 1958	Share of FHDA Credits for 18- to 19-Year-Olds in 1958	Share of FHDA Credits for Each Discrete Age (e.g., 18-Year-Olds)
55%	55%/2 = 27.5%	27.5%/2 = 13.75%

Figure A6: Calculating the Distribution of Credits within Age Groups, 20- to 24-Year-Olds, 1958

Share of FHDA Credits for "24 and Under" in 1958	Share of FHDA Credits for 20- to 24-Year-Olds in 1958	Share of FHDA Credits for Each Discrete Age (e.g., 23-Year-Olds)
55%	55%/2 = 27.5%	27.5%/5 = 5.5%

AGING STUDENTS AND APPLYING MULTIPLIERS

As the goal of this exercise is to estimate the number of credits embedded in the local workforce *cumulatively* over time, our approach allows students to "age" from the time they earn their credits through the end of our timeframe for analysis (2013). This is critical, as while these students age, the multipliers applied to the credits they earned change over time (as illustrated in Figures A1 and A2).

Using 22-year-old FHDA students in 1958 as an example, we estimate that these students accounted for 5.5 percent of the total 26,198 credits earned that year (i.e., 1,441 credits). In his 2005 analysis, Stange did not apply population multipliers to any age group for the first year in which they appeared in the sample. This is likely due to an assumption that during the year in which students complete their FHDA credits, they both survive and reside in the community. Therefore, only a labor force participation multiplier (0.7 for individuals age 20-24) is applied to the 1,441 credits earned by 22-year-olds in 1958. This results in an estimated 1,009 FHDA credits earned by 22-year-olds that are embedded in the local workforce in 1958.

As these students age one year (i.e., turn 23 in 1959), their population multipliers are included. The population multiplier for the 20-24 age group is 0.916, and they retain the labor force participation multiplier for the 20-24 age group of 0.7, resulting in a final multiplier for 1959 of 0.916 * 0.7 = 0.641. Multiplied by the 1,441 credits they earned, the result is 0.641 * 1,441 = 924 credits contributed to the workforce in 1959.

For subsequent years, their population multiplier compounds upon itself but the labor force participation multiplier does not. For example, in 1960 (i.e., our example 22-year-old is now 24), their population multiplier is 0.916 * 0.916 = 0.839, but the labor force participation multiplier remains 0.7, thus their contribution to the credits embedded in the workforce in 1960 is 0.839 * 0.7 * 1,441 = 846.

The reason that population multipliers compound upon themselves is that they reflect more or less permanent conditions. The survival rate is the inverse of the mortality rate, which is absolutely a permanent condition. Although migration is less permanent, it is generally a long-term condition. Thus, multiplying the population multipliers year over year results in the probability that a given credit was earned by a student who is both alive and residing in the San Jose MSA, given that she was both alive and residing in the San Jose MSA in the previous year.

If we did not compound these multipliers, we would find that the population multipliers for relatively young students would increase greatly as they age into the 35-64 age groups, in which migration rates are at their lowest while mortality is also still relatively low. Intuitively, the data would appear to indicate that many of the students who migrated away from the San Jose area between the ages of 18 and 34 had migrated back to the San Jose area between the ages of 35 and 64 – an unrealistic scenario. By compounding the multipliers, the intuitive explanation becomes that younger alumni who remain in the San Jose area until age 35 are substantially more likely to continue living in the San Jose area.

The labor force participation multiplier is not compounded year over year because it is a much less permanent condition than mortality or migration, and in general is much more likely to change from year to year. The labor force participation multiplier for our example 22-year-old is 0.7 in both the first and second years she appears in the dataset. If we were to compound this multiplier, it would instead be 0.7 in the first year and 0.91 in the second, because this represents the probability that the credit was earned by a student who is in the labor force given that they were in the labor force in the previous year.[23] Although it is well-documented that the condition of being a member of the labor force in one year does increase the probability of being in the labor force in subsequent years, Stange does not address this in his analysis. In keeping with his methodology, we therefore do not compound labor force participation multipliers.

Figure A7 below provides a concrete example of this process for our example 22-year-old for her first four years in sample.

Figure A7: Credits Contributed by a Starting 22-Year-Old for Four Years

YEAR	AGE (AGE GROUP)	POPULATION MULTIPLIER		LABOR FORCE PARTICIPATION MULTIPLIER		FINAL MULTIPLIER	TOTAL CREDITS
1	22 (20-24)	1.000	*	0.70	=	0.700	0.700 * 1,441 = 1,009
2	23 (20-24)	1.000 * 0.916 = 0.916		0.70		0.641	0.641 * 1,441 = 924
3	24 (20-24)	0.916 * 0.916 = 0.839		0.70		0.587	0.587 * 1,441 = 846
4	25 (25-29)	0.839 * 0.930 = 0.780		0.75		0.585	0.585 * 1,441 = 843

Figure A8 summarizes the process for an example 22-year-old, 23-year-old, and 24-year-old. Notice that all three start with the same multiplier in the first year because they are all in the same age group in the first year.

In the second year, the 22-year-old and 23-year-old have both been in the same age group for two years but the 24-year-old has aged into the 25-29 age bracket. Thus, the 22-year-old and 23-year-old have the exact same final multiplier, which is different from that of the 24-year-old.

[23] In this hypothetical situation, labor force participation (LFP) is conditioned on the LFP of previous years, in which case it is mathematically correct to calculate the probability of continued labor force participation as the inverse of non-participation. That is, the probability of labor force participation in the second year *given that the alumnus was in the labor force for the first year* is 1-((1 – 0.7)*(1 – 0.7)) = 0.91. Using the LFP of the given year is correct when the probability of participation is not conditioned on participation in the previous year, which is the actual methodology used in this study. Simply compounding the labor force participation rate would result in 0.7 * 0.7 = 0.49, indicating that labor force participation in the second year is actually reduced, given that the students was in the labor force in the first year. It is for this same reason that we analyze the probability of survival and non-migration, rather than mortality and migration.

In the third year, the 23-year-old has aged into the 25-29 age bracket and no longer has the same multiplier as the 22-year-old. In the fourth year, all of our example students have aged into the 25-29 age bracket, but their multipliers are all different because of their staggered entrances into this bracket.

Figure A8: Comparison of Contributions by Different Age Cohorts

Year	Starting 22-Year-Old			Starting 23-Year Old			Starting 24-Year Old		
	Age Group	Final Multiplier	Total Credits	Age Group	Final Multiplier	Total Credits	Age Group	Final Multiplier	Total Credits
1	20-24	0.700	1,009	20-24	0.700	1,009	20-24	0.700	1,009
2	20-24	0.641	924	20-24	0.641	924	25-29	0.698	1,005
3	20-24	0.587	846	25-29	0.639	921	25-29	0.649	935
4	25-29	0.585	843	25-29	0.594	856	25-29	0.604	870

Calculation of Embedded Credits

Below we describe the process we used for calculating embedded credits. Please note that this is a somewhat more technical explanation than was provided for the steps above. The earlier discussion was intended to illustrate how the credits earned data from FHDA (and Stange's previous report) were combined with population and labor force participation multipliers to achieve an estimate of embedded credits. The discussion below shows, from a practical standpoint, how we executed these operations on the credits earned data for 56 cohorts of FHDA students (i.e., students earning credits each year from 1958 to 2013), a computationally challenging procedure.

Because of the shifting multipliers and aging cohorts, multiplying a number of credits for an age group by the appropriate multiplier is technically difficult. Instead, we perform the following steps for each cohort.

1) Create a blank dataset with the number of records equal to the number of credits earned in the given cohort year. This dataset contains a column for each year from the cohort year until 2013. In this manner, each credit is represented by its own record, with a column to store its contribution to the workforce (or population) in a given academic year. For example, in 1958, FHDA students earned 26,198 credits. Students who earned these credits will remain in the dataset for a period of 56 years (i.e., 1958-2013). Therefore, the 1958 dataset starts with 26,198 blank records and 56 columns.

Step 1: Create a blank dataset with 26,198 records and 56 columns.

Row Number	Col. 1
1	-
2	-
3	-
…	…
26,197	-
26,198	-

2) Create a variable to indicate the age of each record. For each age from 18 to 65,[24] impute the number of records with age *a.* For example, for 1958, we estimated that 18-year-olds accounted for 13.75 percent of the total FHDA credits earned that year (0.1375 * 26,198 = 3,602 credits). Therefore, in 1958, 3,602 records are imputed for age 18. For age 19, impute 3,602 records (as 19-year-olds also accounted for 3,602 records in 1958). Continue extending this out to age 65.

Step 2: Create a variable to indicate the age of the record. For each age from 18 to 65, impute a number of records equal to the number of credits earned by that age cohort.

Row Number	Age	Col. 1
1	18	-
2	18	-
…	…	-
3,601	18	-
3,602	18	-
3,603	19	-
3,604	19	-
…	…	-
7,203	19	-
7,204	19	-
7,205	20	-
7,206	20	-
…	…	-
26,198	65	-

3) Using the method for determining the correct multiplier for each age (described above), apply the appropriate multiplier for each credit for each year.

Step 3: Mark each record with the correct multiplier for that year.

Row Number	Age	1958 Multiplier
1	18	0.56
2	18	0.56
…	…	…
3,601	18	0.56
3,602	18	0.56
3,603	19	0.56
3,604	19	0.56
…	…	…
7,203	19	0.56
7,204	19	0.56
7,205	20	0.70
7,206	20	0.70
…	…	…
26,198	65	0.26

[24] Note that 65 represents individuals age 65 and over.

4) Sum the credits for each year by age by collapsing the dataset down to the age level, producing a dataset with 48 rows (i.e., one row for each age cohort from 18-65) and a column for each year from the cohort year to 2013. For example, for the 1958 cohort, the 3,602 records representing 18-year olds receive a multiplier of 0.56 in 1958. When collapsed down to the age level, we calculate 2,017 credits contributed by 18-year olds from the 1958 cohort in 1958. Summing 3,602 units of 0.56 is mathematically equivalent to multiplying 3,602 by 0.56, however this method is a simpler procedure.

Step 4: Sum the credits by collapsing each age group

Row Number	Age	1958 Multiplier Collapsed to Final Credits		
1	18	0.56 + 0.56 + … + 0.56 = 0.56 * 3,602		2,017
2	19	0.56 + 0.56 + … + 0.56 = 0.56 * 3,602		2,017
3	20	0.70 + 0.70 +… + 0.70 = 0.70 * 1,441	=	1,009
…	…	…		…
48	65	0.26 + 0.26 + … + 0.26 = 0.26 * 786		204

Once this process has been completed for all cohorts from 1958 to 2013, all files are appended together. The above collapsing procedure is repeated, summing the credits for all age levels across all cohorts. This produces a final dataset of credits contributed by each age level in each year, allowing us to sum the number of credits in each year to produce the totals reported in Section I of this report, and allowing us to calculate how many credits were contributed by each age group in 2013 to produce the value of those credits.

PROJECT EVALUATION FORM

Hanover Research is committed to providing a work product that meets or exceeds partner expectations. In keeping with that goal, we would like to hear your opinions regarding our reports. Feedback is critically important and serves as the strongest mechanism by which we tailor our research to your organization. When you have had a chance to evaluate this report, please take a moment to fill out the following questionnaire.

http://www.hanoverresearch.com/evaluation/index.php

CAVEAT

The publisher and authors have used their best efforts in preparing this brief. The publisher and authors make no representations or warranties with respect to the accuracy or completeness of the contents of this brief and specifically disclaim any implied warranties of fitness for a particular purpose. There are no warranties which extend beyond the descriptions contained in this paragraph. No warranty may be created or extended by representatives of Hanover Research or its marketing materials. The accuracy and completeness of the information provided herein and the opinions stated herein are not guaranteed or warranted to produce any particular results, and the advice and strategies contained herein may not be suitable for every partner. Neither the publisher nor the authors shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages. Moreover, Hanover Research is not engaged in rendering legal, accounting, or other professional services. Partners requiring such services are advised to consult an appropriate professional.

HANOVER RESEARCH

1700 K Street, NW, 8th Floor
Washington, DC 20006

P 202.559.0500 F 866.808.6585
www.hanoverresearch.com