# CHAPTER 7

# HIGH-TECH INDUSTRIES IN CALIFORNIA: PANACEA OR PROBLEM?

STEVE RAPHAEL, CLAIR BROWN, AND BEN CAMPBELL

## I. Introduction

Since the mid-1990s, the California economy has been growing at a rate rivaled only by the strong growth associated with the military buildups of the mid-1980s. Since 1996, growth in state personal income has exceeded 4 percent annually (adjusting for inflation) and reached nearly 5.5 percent during 1999. In addition, the current state unemployment rate, hovering around five percent, is at its lowest level in three decades.

Many observers believe that employment growth in high-tech industries, such as computer services and telecommunications, is a major force responsible for the state's current good fortune and that job growth in these industries is the future of the California economy. Industry proponents point to the high wages of this sector and speculate that as the high-tech sector expands, wages will increase rapidly. Such sentiments are similar to arguments heard in the 1980s about the growth effects attributed to high-tech industries, which were fueled by federal military contracts. During the mid-1980s defense build-up under the Reagan Administration, California's defense-related industries grew rapidly and were responsible in part for a strong recovery from the deep 1982 recession. In 1984 real personal income grew at an annual rate of over 8 percent. Moreover, the 1984 unemployment rate (7.8 percent) had declined nearly two full percentage points from the previous year.

This chapter compares and contrasts the employment and wages in California's high-tech industries during these two important periods. Specifically, we analyze the employment and earnings patterns among high-tech firms for two years, 1984 and 1999. Both years represent periods of strong growth, when key high-tech industries were expanding rapidly. In addition, in both years, high-tech employment accounts for similar proportions of the state's jobs base. At this point, however, the similarities cease. The current composition of high-tech employment is dramatically different from the composition of high-tech employment during the 1980s. Moreover, we have observed substantial changes in the education requirements of high-tech employers, the racial and ethnic composition of their workforce, and weekly earnings.

We compare these two periods when high-tech industries were strong in California in order to ask if high-tech industries are a panacea for the California economy or if high-tech industries present special problems. In order to answer this question, we must first know:

- How important has employment in high-tech been for California's workers over the past fifteen years?
- What types of workers, in terms of education and skills, are hired and what are their earnings in high-tech industries? How well do different racial and ethnic groups do in high-tech industries?
- How do wages and employment in California's high-tech industries compare to other industries? What is the rate of unionization in high-tech industries compared to other industries?

- To what extent are high-tech jobs driving the labor market in California, and what can we expect in the future?

The answers to these questions should help California policy-makers understand how high-tech industries affect the California labor market, for better or worse.

## II. High-tech industries in 1984 and 1999

In order to compare California's high-tech industries in 1984 and 1999, we first identify the top ten high-tech industries in California, defined by the number of scientists, engineers, and technicians as well as the percent of workforce who are scientists, engineers, and technicians (called high-tech workers).[1] Based on this definition, the high-tech industries employed approximately one-in-nine California workers in both years. They also employed approximately 60 percent of all high-tech workers in California. While only 6 percent of all California workers were scientists, engineers, or technicians in 1999, 31 percent of the workers in the high-tech industries were high-tech workers. To analyze the characteristics and earnings of workers in high tech and other industries, we analyze California data for 1984 and 1999 from the Current Population Surveys published by the Bureau of Labor Statistics. For a description of our data sources, see appendix A.

Figure 1 presents employment levels for 1984 and 1999 for all industries that are among the top ten high-tech industries for either year. The industries are ordered in descending order according to the number of net new jobs added in the industry between 1984 and 1999. Although the sum of employment in these industries is comparable across the two time periods, the distribution of high-tech workers across industries changed substantially. In the mid-1980s defense-related industries (missiles, aircraft, national security, and electrical equipment) accounted for 60 percent of high-tech employment and computer equipment and services accounted for 20 percent. In late 1990s defense-related industries fell to 34 percent of high-tech employment, and computer equipment and services rose to 31 percent plus an additional 11 percent in the rapidly expanding telecommunications industry, which supports the Internet infrastructure. In addition the R&D and Engineering services industry grew from 10 percent of high-tech employment in 1984 to 19 percent in 1999 as it shifted from supporting defense-related industries to supporting Internet-related industries.

Overall we see that high-tech industries are equally important to the California labor market in the mid-1980s and the late 1990s, yet the industrial composition has shifted from being driven by defense-related industries to being much more reliant upon Internet-related industries. What implications does this shift in the driver of high-tech employment have for the types of workers hired and their earnings?

## III. High-tech workers in 1984 and 1999

The education of California workers rose slightly from 1984 to 1999, and the education of workers in the top ten high-tech industries rose more rapidly than in the rest of the California economy. In 1984 high-tech industries hired only 9 percent of workers with a high school diploma or less, and this fell to 6 percent in 1999, when only one-in-five workers in high-tech industries did not go to college (see figure 2a). The importance of workers with college and advanced degrees in high-tech industries grew with the shift from defense- to Internet-related industries. The top ten high-tech industries increased their reliance on highly-educated workers as the percent of high-tech workers with college and advanced degrees rose from 40 percent in 1984 to 50 percent in 1999. The other industries continued to rely mainly on workers *without* college degrees as their percent of workers *with* college and advanced degrees remained slightly under 30 percent in 1984 and 1999 (see figure 2b). College-educated workers in high-tech industries were much more likely to be working with other college-educated workers than were their counterparts in other industries. Workers with a high school education (or less) in other industries remained over 40 percent of the workforce, and so were much more likely to work with other non-college goers that were their counterparts in the top ten high-tech industries.

If we look at ethnic breakdown of employment, we see in figure 3a that Hispanics were underrepresented in the top ten high-tech industries in 1984, and the disparity grew in 1999 when only 5 percent of Hispanics were employed in high-tech industries, which employ 11 percent of all California workers. Blacks were not underrepresented in the top ten in 1984, but they were underrepresented in 1999 when 9 percent of Blacks worked in high-tech industries. Asian workers were over represented in both periods with 17 percent working in high-tech industries. The importance of Asian workers to the top ten high-tech industries grew with the shift from defense- to Internet-related industries. In the mid-1980s Asians were 12 percent of high-tech industries workers, and in the late-1990s, they were 21 percent. Since the population of California became more Hispanic and Asian during this period, we see that the proportion of Hispanics in other industries almost doubled from 16 percent to 30 percent, while the Asian proportion grew from 8 percent to 12 percent (see figure 3b). As the population of California became less white (non-Hispanic) during this period, the percent of white workers in other industries fell from 69 percent to 52 percent, while the percent in high-tech industries remained 12 percent. These data show that as the Hispanic population of California grew, the additional workforce found jobs in other industries and not in high-tech industries, and partly this reflects the high education requirements of the high-tech sector.

The top ten high-tech industries have unionization rates that are much lower than unionization rates for workers employed in other industries, especially for workers with college and advanced degrees. Workers with only a high school degree (or less) had the highest representation rate among high-tech employees in 1984, with one in five of them represented (see figure 4a). Only 15 percent of high-tech employees with some college were represented in 1984. Unionization rates are even lower for workers with Bachelors degrees (7 percent) and workers with advanced degrees (3 percent). The unionization rate for workers in other industries was considerably higher in 1984, with approximately one-in-four workers being represented across all educational groups (see figure 4b).

In 1999, union representation of workers with less than a college degree has become more comparable between high-tech and other industries. However, the disparity in union representation among workers with college and advanced degrees has grown. Overall the unionization rate of 7 percent for high-tech industries was only a fraction of the 19 percent rate for other industries. While much of this difference among highly-educated workers is accounted for by high unionization rates among teachers, unionization rates excluding teachers are still higher among more educated workers outside of the high-tech industries.

Unionization rates for high tech workers with a high school degree (or less) nearly equals the representation rate for high-tech employees without some college (13 percent). The rate of representation of workers with high school degrees (or less) in other industries fell much more than the rate for those with some college, while the representation rate for workers with college and advanced degrees in other industries rose slightly between 1984 and 1999. The disparity in unionization between top ten high-tech industries and other industries in California today is especially noticeable among the highest educated workers, while the unionization rate among the least educated workers has become equal in high-tech and other industries. However since the proportion of workers without a college degree in high-tech industries is less than one-half, the decline in representation rates of workers with college and advanced degrees is especially noticeable.

Overall we see that as the top ten high-tech industries have shifted from a focus on defense to the Internet, the workforce has become relatively more educated, more white and Asian, and less unionized compared to other industries in California. Now let us ask how wages in high-tech industries have changed by education since 1984 compared to other industries, and how this has affected wages by ethnicity and union status.

Over the past two decades, wage growth in both California and the nation as a whole followed dramatically different paths depending upon whether one looks at the high end or the low end of the wage distribution. Real median earnings (the earnings level at which half the workforce earns less and half earns more) stagnated through much of the 1980s and 1990s for both California and the nation. Earnings of workers in the bottom half of the wage distribution actually fell after adjusting for inflation. Meanwhile, earnings for workers in the upper half of the distribution grew in real terms. The difference in

earnings between workers with high and low education and between younger and older workers grew. Moreover, research by Reed et al. (1996) indicates that this widening of the earnings distribution was much greater in California than elsewhere in the nation.

Growth in high-tech employment and changes in the composition of high-tech employment can either aggravate or partially assuage these trends. To the extent that high-tech employers provide relatively high paying employment opportunities for some low-skilled workers, the erosion of earnings observed during much of the 1980s and 1990s may be partially counterbalanced. Alternatively, if high-tech provides employment opportunities for the relatively educated only (and at levels of pay that exceed compensation that such workers would receive from other employers), growth in high-tech employment may further aggravate the gap between California's haves and have-nots.

In this section, we analyze the relative earnings trends between 1984 and 1999 for workers employed in the high-tech sector compared to workers employed in other firms. This analysis will provide information that can be used to assess how employment in high tech is affecting the state's wage structure.

Table 1 presents estimates of the median earnings in 1984 and 1999 for California workers in top ten high-tech employment and other employment. The first three columns present information for high-tech employment, while the second three columns present information for other employment. For both sets of workers, we first present median earnings for all workers and by education for 1984. We next present comparable figures for 1999. Finally, we present the change in median earnings between 1984 and 1999. All of the figures are adjusted for inflation (constant 1999 dollars).

Across all education levels, high-tech workers earn substantially more than other workers. The median high-tech earnings in 1984 of $753 exceed median earnings of other employers by $176 (a 31 percent earnings premium). By 1994, this difference in real earnings increases to $350.

If we compare only workers with similar education, we still observe earnings premiums for working at high-tech employers. For example, workers with a high school degree or less employed at high-tech firms in 1984 earn $61 more (or 12 percent) per week than workers at other firms. By 1999, this earnings premium increased to $179 (or 48 percent more). Hence, these comparisons indicate that workers of all education levels earn substantial premiums by working for high-tech employers. Moreover, the figures in table 1 indicate that these premiums widened over the past 15 years.

Looking at the figures in the first three columns, we see that median weekly earnings have increased in real terms for high-tech workers overall, and for high-tech workers in each education category. Overall, median weekly earnings increased by $146 from 1984 to 1999. The largest increases were realized by workers with advanced degrees ($264), while the smallest increases were realized by workers with a high school education or less ($17). In contrast, median earnings declined overall in real terms for workers in other industries by approximately $27. This earnings decrease, however, was not constant across education categories. The least educated workers experienced the largest real wage decline, while the workers with the most education experienced increases in their real wages.

Let us look at the relative advantage of being employed in a high-tech industry by computing the change in median earnings for high-tech workers relative to the change for other workers. (See final column, which subtracts the change in earnings for other workers from the comparable change in earnings for high-tech workers). All high-tech workers gained relative to other workers with similar education, and the earnings gains for high-tech workers were greatest for the least educated workers. Specifically, for workers with a high school degree or less, earnings in high-tech increased by $173 relative to workers in other employment. For workers with advanced degrees, high-tech workers experienced a relative increase in earnings of $89.

To assess whether high-tech employment contributes to, or lessens, earnings inequality, Figure 5 plots 1999 earnings at the ninetieth percentile, the fiftieth percentile, and the tenth percentile for workers in high-tech and other industry by education. Several patterns stand out. Overall earnings inequality (as measured by the difference in earnings at the ninetieth and tenth percentiles) looks similar for high-tech employment and other employment. Within educational categories, however, there are a few notable differences. Among workers with high school degrees or less, earnings inequality is much greater among

high-tech workers, while the reverse is true for workers with Bachelors degrees and advanced degrees. This latter finding, however, should be tempered by the fact the Bureau of Labor Statistics top-codes earnings for high earnings workers in order to preserve confidentiality.[2]

To assess changes in inequality, table 2 presents the ratio of earnings at the ninetieth percentile to earnings at the tenth percentile (higher ratios indicate greater inequality) for workers in high-tech and other employment by year and education. Here we see some striking patterns. Overall, earnings inequality increased less in top ten high-tech industries (from 3.99 to 4.16, a change of 0.17) than in the other industries (from 4.24 to 5.21, a change of 0.97). Within educational categories, however, earnings inequality among workers in high-tech industries increased relative to earnings inequality among workers in other industries. These conflicting patterns indicate that the wage distributions of workers of different education levels in other industries overlapped less and pulled further apart between 1984 and 1999.

The pattern for high-tech workers was considerably different. The slight increases in overall inequality coincided with larger increases in inequality among workers of similar education. These patterns indicate more overlap of the wage distributions of low- and high-educated workers in 1999 relative to 1984, accompanied by slight increases in earnings inequality within an education category.

## IV. Conclusion

This chapter asks if high-tech industries are a panacea for the California economy or if high-tech industries present special problems. The answer is both. The high-tech industries in the late 1990s have created jobs with higher wages and less overall inequality than the other industries in California. However high-tech industries employ only a small proportion of California workers, and over one-half of their workers have college and advanced degrees. For California workers, high-tech industries present both good news and bad news.

The good news is that high-tech jobs pay more. This fact is true for both workers with advanced degrees and high school dropouts. Wage premiums for working at a high-tech employer are nothing new. In fact, our findings indicate that there were substantial earnings premiums between high-tech and other California workers in 1984. The premiums grew during the intervening 15 years.

Overall, earnings inequality is less among top ten high-tech workers than among workers in other industries. This was true in 1984 and is true today. Within education categories, however, we observe greater inequality in the high-tech sector. These patterns indicate a greater degree of overlap between the earnings distributions of low-skilled and high-skilled workers in high-tech industries than is observed in other industries. A decrease in overall inequality may also be attributed to a shift in the underlying skill distribution of the workforce. The high-tech industries employ a relatively more homogeneous and higher educated workforce which leads to a compression of the wage distribution.

The bad news is that the top ten high-tech industries hire fewer than 11 percent of California workers, and only 6 percent of California workers are scientists, engineers or technicians. Furthermore high-tech industries do not create many jobs for workers with no college: only 20 percent of workers in high-tech industries have a high school degree (or less), while 50 percent of them have college and advanced degrees. Blacks and Latinos are relatively under-represented at high-tech jobs. The top ten high-tech industries have a very low unionization rate (7 percent in 1999), and representation of workers with college and advanced degrees is almost nonexistent (2.5 percent). As high-tech industries shifted from being defense-related to being Internet-related, the trends toward high educational requirements, under-representation of blacks and Hispanics, and low unionization rates accelerated.

So even though high-tech industries create "good" jobs and serve as an engine of economic growth, California cannot depend upon high-tech industries to create large numbers of jobs, especially for workers with no college. Workers who are lucky enough to land a job in a high-tech industry will earn a substantially higher income than their counterparts who are excluded from the high-tech industries, and workers with only a high school degree will benefit the most. However California must depend on other industries to provide eight-out-of-nine jobs. For this reason policy-makers must focus on what is happening outside the high-tech sector, where real wages for non-college goers have declined and wage inequality has increased.

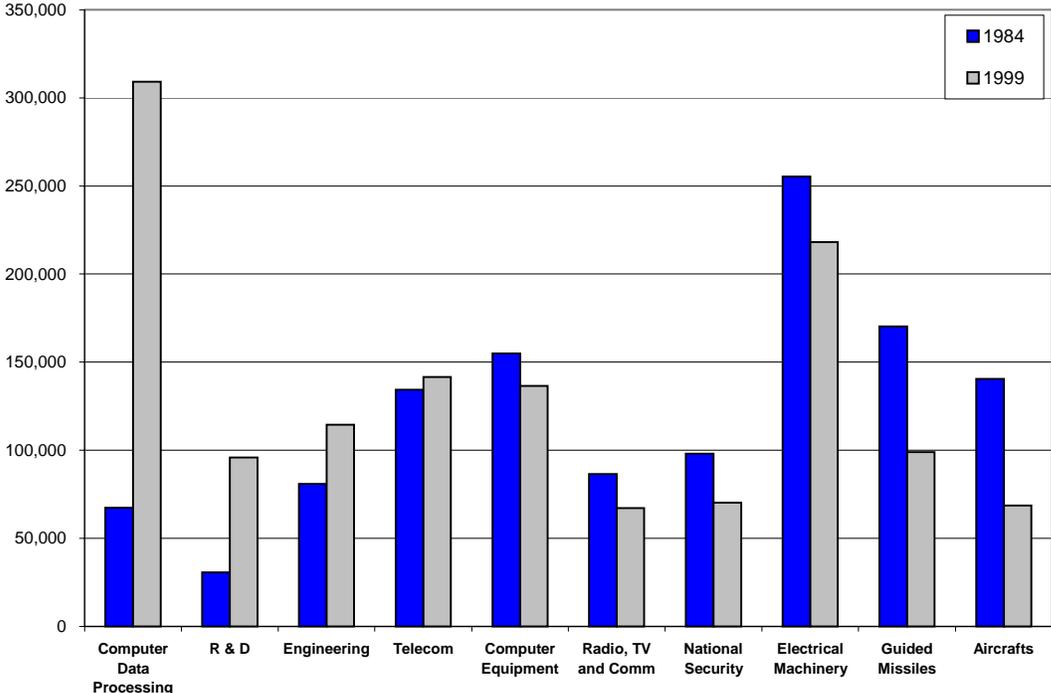**Figure 1: Total Employment in Specific High Tech Industries, 1984 and 1999**



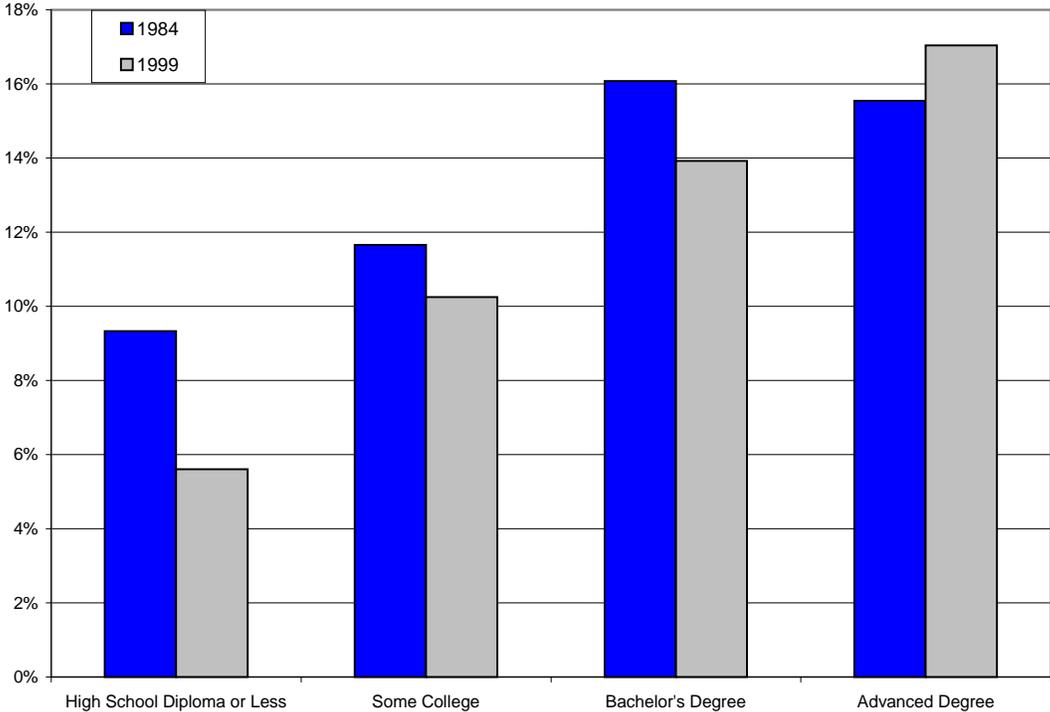**Figure 2A: Percent of Education Group Employed in High Tech Industries, 1984 and 1999**

**Figure 2B: Distribution of Employment in High Tech Industries by the Education of Employees, 1984 and 1999**
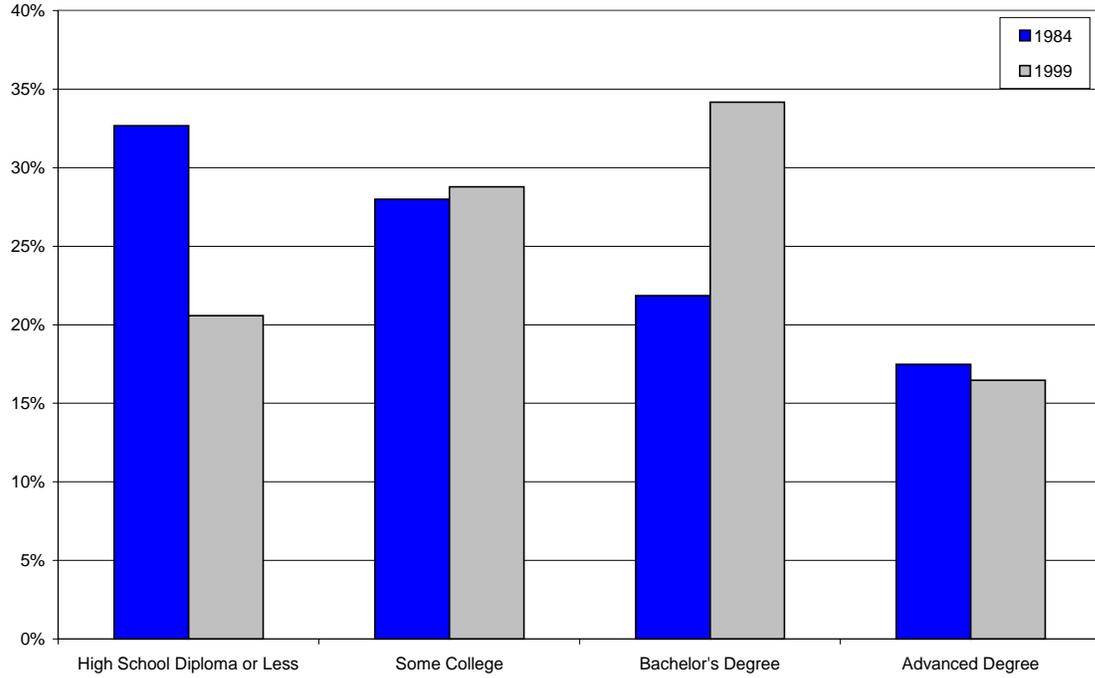


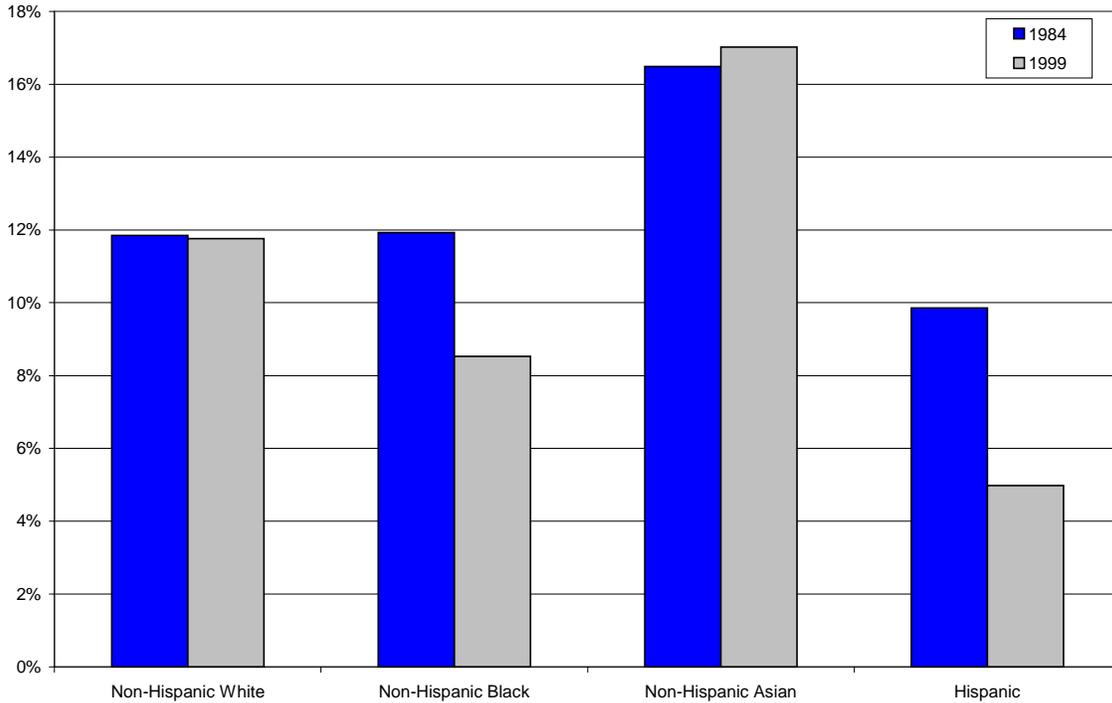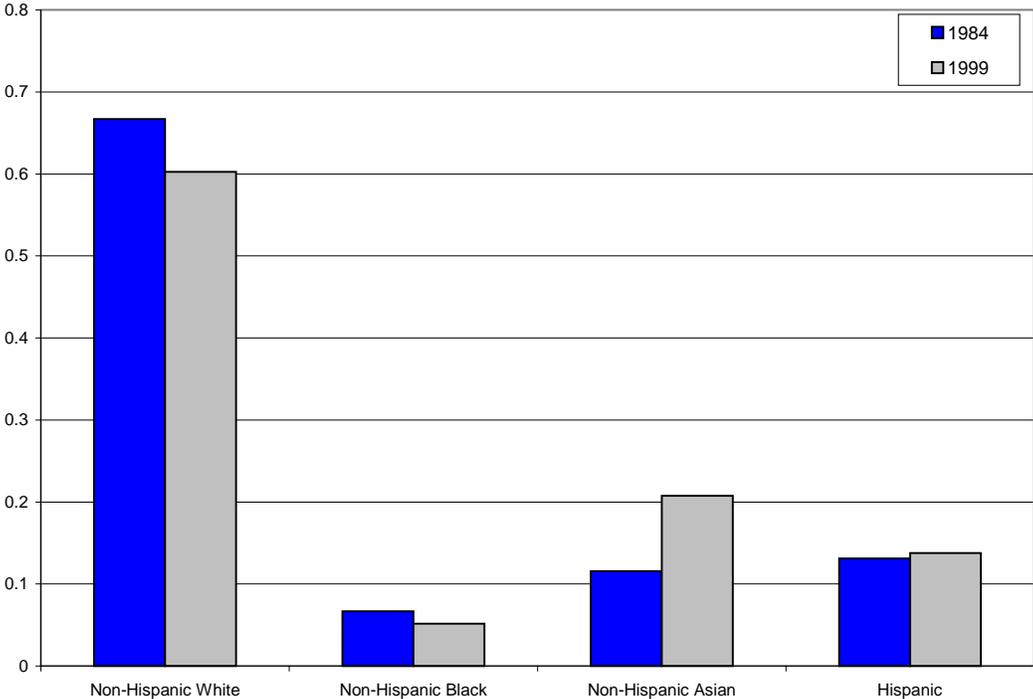**Figure 3A: Percent of Racial/Ethnic Group Employed in HighTech Industries, 1984 and 1999**

**Figure 3B: Distribution of Employment in High Tech Industries by Racial/Ethnic Group, 1984 and 1999**



**Figure 4A: Percent Unionized Workers in High-Tech Industries by Educational Attainment, 1984 and 1999**
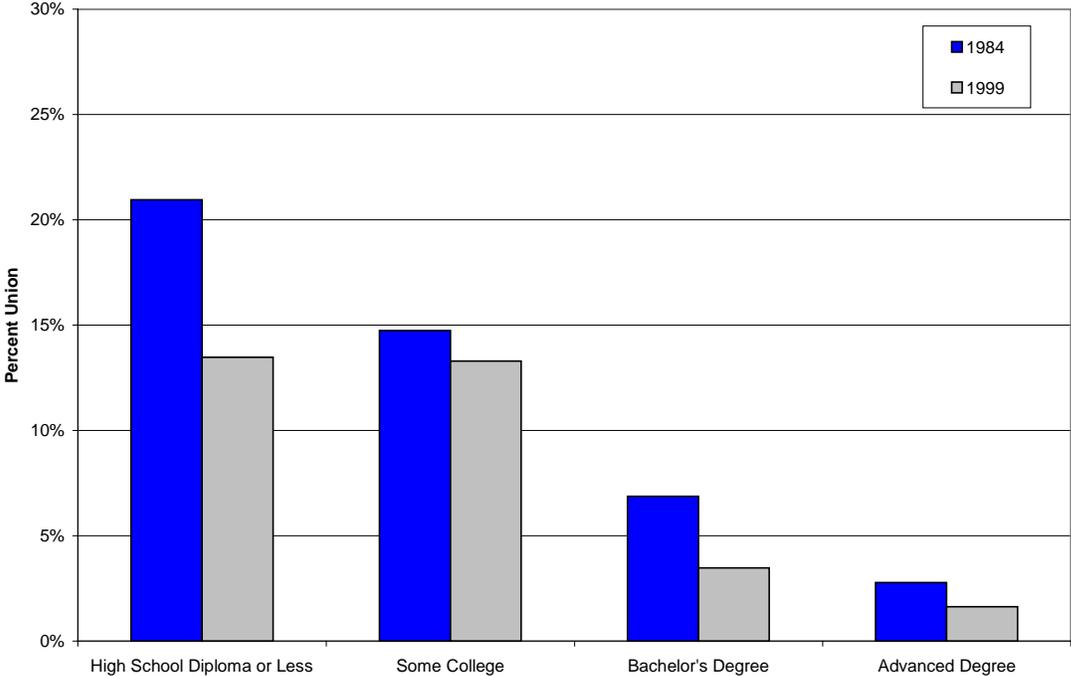
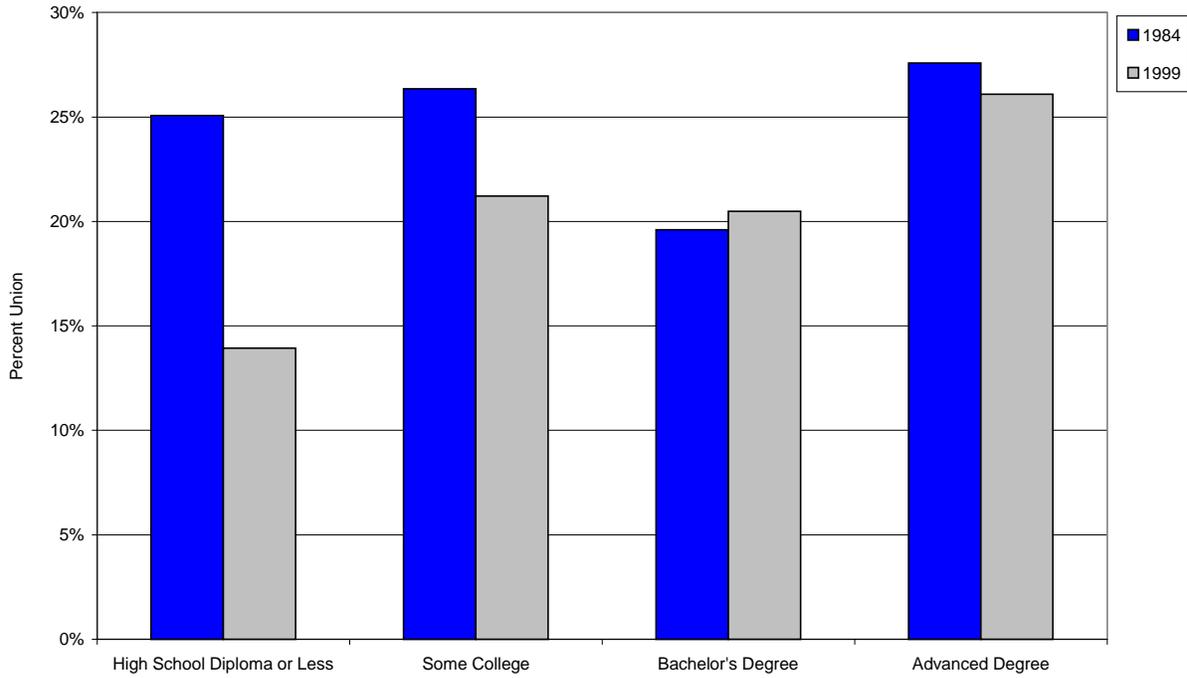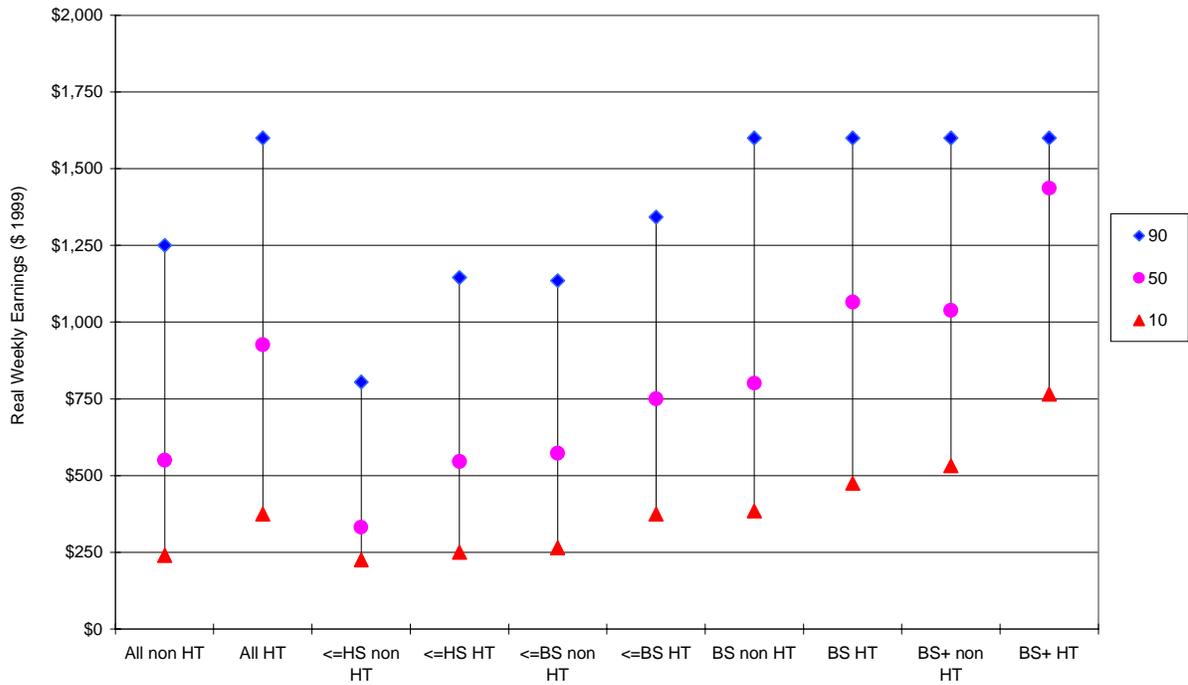**Figure 4B: Percent Unionized Workers in Non-High-Tech Industries by Educational Attainment, 1984 and 1999**



**Figure 5: Wage Distribution in High Tech Industries in 1999**

## Endnotes

[1] We select the top ten employers of scientists, engineers, and technicians whose workforce is composed of more than three times the state average of percent high-tech workers for all industries, which is 5-6 percent. The construction industry employs the largest number of scientists, engineers, and technicians of any industry, but only 3-4 percent of the workers are high-tech. Colleges and universities also employ large numbers of scientists and engineers (1999), but only 10 percent of its employees are high-tech.

[2] We should also note that to compare the 1984 and 1999 samples, we impose the 1984 top-code (in 1999 dollars) on the 1999 sample. While this does not affect our estimates of median earnings, this reduces the variation in earnings among higher-wage workers in 1999.

## References

Reed, Deborah; Glenn Haber, Melissa; and Laura Mameesh. 1996. *The Distribution of Income in California*. Public Policy Institute of California: San Francisco.