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California's Future Workforce

Will There Be Enough College Graduates?

Deborah Reed

with research support from Qian Li

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SUMMARY

In PPIC's *California 2025* report, a potential mismatch was highlighted between the level of education the future population is likely to possess and the level of education that will be demanded by the future economy. This study provides further evidence of the future workforce skills gap and discusses the causes, magnitude, and likely consequences of the gap.

The workforce skills gap is already a reality in California. In recent decades, the demand for workers with a bachelor's degree has grown. The share of workers with a college degree increased from 28 percent in 1990 to 34 percent in 2006. Over the same period, the wages of college-educated workers grew substantially, whereas the wages of less-educated workers were relatively stagnant. These conditions characterize an increase in demand for college-educated workers for which growth in supply has not kept pace.

Since 1990, there have been relatively small shifts in employment toward industries and occupations that employ higher shares of workers with bachelor's degrees. More important, the employment of college-educated workers has increased within most industries and occupations. Our analysis shows that if past trends in worker education within and across industries and occupations were to continue, the demand for college-educated workers in 2025 would be equivalent to 41 percent of California workers.

We are not projecting a change in demand trends for college-educated workers but rather a change in supply trends. Workers who are currently ages 50 to 64 have the highest levels of college education and these workers will reach retirement age by 2025. Furthermore, the share

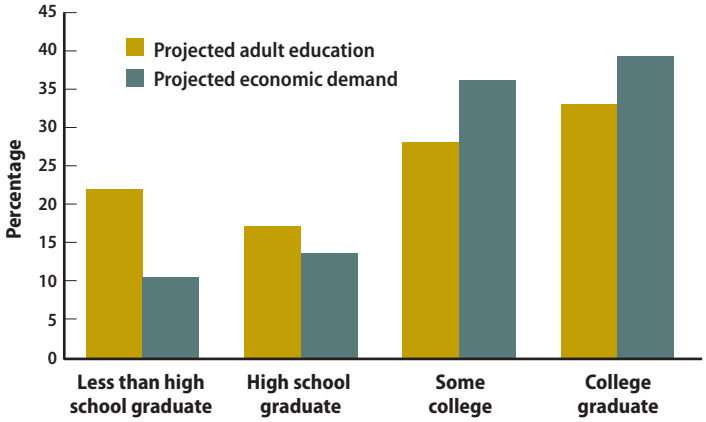
of Latinos in the working-age population is increasing, and this group has relatively low levels of educational attainment. Also, the migration of college-educated workers from other states and other countries is unlikely to increase future supply growth to levels comparable with past growth.

In the coming decades, slower growth in the supply of college-educated workers will be a limiting factor that changes the path of the state's economic growth.

In sum, our analysis shows that the supply of college-educated workers will not meet projected demand. The economic growth of recent decades occurred in a period of substantial growth in the number of workers with a college education. In the coming decades, slower growth in the supply of college-educated workers will be a limiting factor that changes the path of the state's economic growth. At the same time, the supply of workers with a high school diploma or less is projected to *exceed* demand. These workers will see an erosion of their compensation and a decline in job opportunities, leading to reduced economic resources for low-income families.

Although it would take unprecedented increases in the number of young adults earning bachelor's degrees to fill the gap, California should look for ways to reduce the size of the gap. Effective reforms and investments today will improve opportunities for California's workers and create a workforce that will help fuel future economic growth.

California's troubled future: too many workers without a college education, too few with a college degree in 2020



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Introduction

PPIC's *California 2025* report identified the potential gap between the skills that will be demanded by the future economy and the education levels of the future population (Hanak and Baldassare, 2005). In this study, we examine recent trends in the California labor market and show that these projections for the future are a continuation of past labor market conditions. Since 1980, the demand for college-educated workers in the California labor market has grown substantially; so has the supply of such workers, although not as much as demand. (Throughout this report, we use the term "college-educated" to mean people who have completed a bachelor's degree.)

In this report, we revisit and update demand projections, showing that they are not substantially changed by taking into account changes in the labor market since 2000 or by analyzing occupational projections in addition to industry projections. We compare our approach with an alternative approach that uses estimates of employer education requirements by occupation.

We also examine supply responses to growth in the demand for college-educated workers. We find that recent trends in supply growth are not likely to continue. We conclude with a discussion of the potential consequences of the skills mismatch and the importance of investing in improving workforce skills.

Economic Demand for College-Educated Workers Has Grown

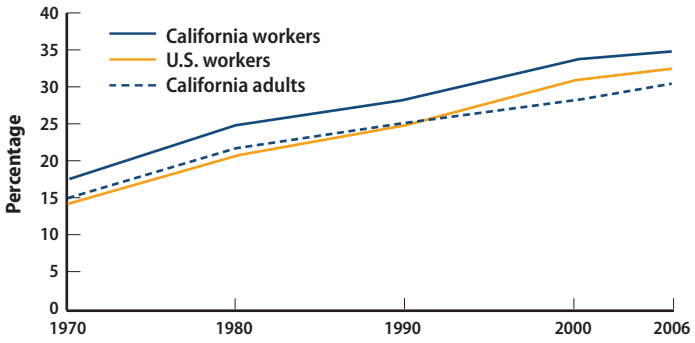
For the last quarter century, the California labor market has experienced rising demand for college-educated workers. This growth in demand has driven up the earnings of such workers, whereas the earnings of workers with a high school diploma or less have remained fairly stagnant. In this section, we describe the growth in labor market demand for college-educated workers in the state and nationally by examining trends in the education and wages of workers.

Despite the recent period of economic instability and the occasional recessions that have plagued the economy, California has experienced substantial economic and population growth over the past several decades. The state population increased by 57 percent, from 23.8 million people in 1980 to 37.4 million in 2006 (California Department of Finance, 1998, 2007). Over the same period, the number of adult workers grew by 48 percent, from 9.3 million to 13.7 million.[1] The number of workers with a college education grew much faster, more than doubling from 2.4 million to 4.7 million.

With the rapid growth in the number of college-educated workers, their share in the California economy grew from 25 percent to 34 percent between 1980 and 2006 (Figure 1). Because of changes in the surveys, measured educational attainment in 1980 and earlier is not strictly comparable with that in 1990 and later. Other analysis suggests that growth in the share of workers with a college education between 1980 and 1990 may have been lower than depicted in Figure 1.[2]

Relative to the United States as a whole, California workers are slightly more likely to have a college education. However, the growth trends are similar in the state and the nation with a slight closing of the gap in recent years. College education among all adults in California is less than among workers in California, reflecting the reality that

Figure 1. College education has grown substantially in California and the nation



Sources: Author's calculations based on the decennial Census and the 2005 and 2006 American Community Surveys (combined).
Notes: The figure shows the share with a bachelor's degree (including those with a graduate degree) among workers ages 25 and older and all adults ages 25 to 64. Statistics for 1980 are not strictly comparable to statistics for 1990 (see note 2).

adults with a college education are more likely to work. College education among California adults shows a growth trend since 1970, but the gap between workers and all adults has increased somewhat and was particularly large in 2000 (mainly because adults with less education were less likely to be working in that year than in other years). The trends shown in Figure 1 for college education can also be seen when bachelor's degrees and graduate degrees are examined separately (Table 1).

Growth in the share of workers with a bachelor's degree, from 25 percent to 34 percent between 1980 and 2006, was not primarily driven by improvements in college attainment for California's youth. In 1980, 22 percent of young adults who were born in California held a bachelor's degree. By 2006, this share had increased to only 25 percent. Migration from other states and other countries was the primary source of growth in the college-educated workforce. Among California workers who held a bachelor's degree in 2006, 33 percent were born in other states and 31 percent were born in other countries.[3] In addition, over this time period Californians reaching retirement age had very low levels of college education. (In 1980, only 22 percent of workers ages 40 and older held a bachelor's degree.) As these workers retired, they were replaced by young workers and migrants with higher levels of college education.

Since 1980, even as the share of workers with a bachelor's degree or more education grew, the wages of college-educated workers relative to the wages of workers with only a high school education also grew (Figure 2).[4] The greatest wage growth occurred in the 1990s; the decade concluded with a tremendously strong labor market during the "dot com" boom. In recent years, workers with a bachelor's degree have earned wages similar to the high levels achieved in 2000.[5] Workers with high school diplomas or less education have earned lower wages than in 2000.

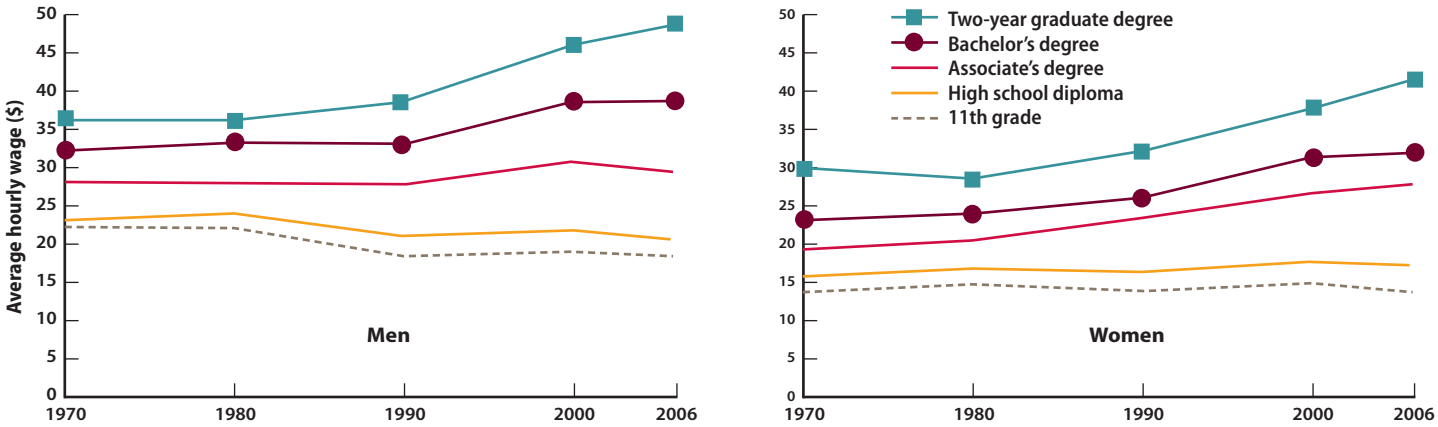
To understand the labor market demand for college-educated workers, economists convert earnings statistics to measures of the college wage premium. The college wage premium is the percentage increase in average earnings related to holding a bachelor's degree compared with a high school diploma. Since 1980, the college wage premium has increased substantially in California (Figure 3). In 1980, a California man with a bachelor's degree earned 39 percent more than a similar man with only a high school diploma. By 2006, the difference was 86 percent. The college wage premium also increased for California women and for men and women nationally. The premium for a one-year graduate degree relative to a high school diploma also increased over this period, from about 50 percent in 1980 to more than 100 percent in 2006 (not shown in the figure).

Table 1. Bachelor's and graduate degrees are more common in recent years

	1970	1980	1990	2000	2006
Bachelor's degree only (%)					
California workers	9	13	18	21	22
U.S. workers	8	12	16	19	20
California adults	8	12	17	18	20
U.S. adults	7	11	15	17	19
Graduate degree (%)					
California workers	8	11	10	12	13
U.S. workers	6	9	9	11	12
California adults	7	10	9	10	11
U.S. adults	5	7	8	9	10

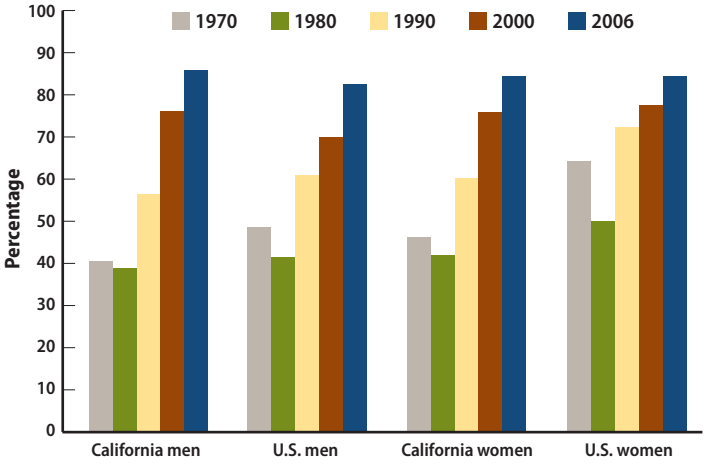
Sources: Author's calculations based on the decennial Census and the 2005 and 2006 American Community Surveys (combined).
Notes: The table shows the share with corresponding degrees among workers ages 25 and older and adults ages 25 to 64. Statistics for 1980 are not strictly comparable with statistics for 1990 (see note 2).

Figure 2. Wage gaps between education levels have grown



Sources: Author's calculations based on the decennial Census and the 2005 and 2006 American Community Surveys (combined).
Notes: Wages are adjusted for inflation to 2007 dollars using the CPI-U-RS. Statistics are regression-adjusted. Statistics for 1980 are not strictly comparable with statistics for 1990 (see note 2).

Figure 3. College wage premium has increased since 1980



Sources: Author's calculations based on the decennial Census and the 2005 and 2006 American Community Surveys (combined).
Notes: The figure shows the percentage increase in average hourly wage related to attaining a bachelor's degree relative to attaining only a high school diploma. Statistics for 1980 are not strictly comparable with statistics for 1990 (see note 2).

The trends described here demonstrate the growing demand for college education in the California labor market. The demand shift is characterized by an increase in the college wage premium occurring over the same period as growth in the share of workers with a college education. Had the increase in college education been supply-driven, the wage premium would have declined. Indeed, the college wage premium increased because the demand for college-educated workers has grown and the growth in supply has not kept pace.[6] The growth in demand for college-educated workers may have been particularly concentrated in a subset of college majors.[7] We do not have data to examine trends by college major, but computer science, engineering, and business majors tend to earn more than other majors.

These trends are not unique to California. Growth in the college wage premium and, more generally, growth in education premiums at all levels is a national trend. A large body of research has explored the causes, finding several contributing factors, the most important of which are technological change and trade. Technological changes have simultaneously increased the demand for educated workers who can operate sophisticated equipment and reduced the demand for less-educated workers, many of whom have been displaced by automation (Danziger and Gottschalk, 1995; Card and DiNardo, 2002). Growth in international trade has opened international markets for goods and services produced in the United States by educated workers in high-tech industries and financial services. Less-educated workers in production are increasingly displaced by low-paid production workers in other countries (Feenstra, 2000).[8] In addition, institutional changes, such as the

decline in the real value of the minimum wage (Lee, 1999) and shrinking unionization rates (Freeman, 1993), have led to lower wages for workers with less education.

These same factors—technology and trade, as well as institutional changes—have brought about markedly similar labor market changes in California and the nation (Figure 3). The similarity of state and national trends is not surprising in a national labor market where workers and firms are mobile.

Future Growth in the Demand for College-Educated Workers

In this section, we describe the changing industrial and occupational composition of the California economy since 1990, with a particular focus on the employment of college-educated workers. We use projections of the industrial and occupational structure for 2025 to project the demand for college-educated workers if current trends continue.

Long-term economic projections are fraught with uncertainty. Major changes in technology, trade, foreign economic development, politics, and other factors can alter the economic growth path in unforeseeable ways (see Neumark, 2005b, for further discussion). The decline in military spending in the late 1980s, the technology boom of the late 1990s, and the recent crises in the housing and financial markets are examples of changes that altered the economic growth path. Our long-term projections for 2025 measure the share of workers with bachelor's degrees that would be needed if past trends were to continue. We are not suggesting that these trends will certainly continue; rather, we seek to estimate the share of college-educated workers that would be required to continue the trends.[9]

We refer to our projections as estimates of future "economic demand." We base these projections on growth in the share of bachelor's degrees since 1990 within major industries and occupations as well as projected changes in the industrial and occupational structure. To the extent that labor market demand is segmented across different college majors, our analysis may overestimate demand shifts by including growth in college majors for which demand did not grow. Nevertheless, over this period the average college wage premium has increased as the demand for college-educated workers has grown and the growth in supply has not kept pace. In other words, at the aggregate level, the growth in the share of workers with bachelor's degrees since 1990 is likely to be an underestimate of demand growth because supply was a limiting factor. Below, we argue that our approach provides a more realistic projection of employer demand than do estimates of education and training requirements by occupation.

California's industrial structure can be characterized by employment across large, aggregated industrial sectors. Local and state government (14% of employment in 2006) and retail trade (11%) are the largest industries (Table 2). With the exception of farming, the number of workers employed in each of California's major industries has grown since 1990 and is projected to grow further by 2025. However, as a share of total employment (as shown in Table 2), durable manufacturing has experienced the greatest decline, from 10 percent of employment in 1990 to only 6 percent in 2006. Accommodation and food services has grown the most, from 4 percent to 8 percent.[10]

Increasing demand for college-educated workers can result from shifts in the industrial structure if industries that require more college-educated workers are growing faster than industries that require fewer college-educated workers. Demand can also increase without a change in industrial structure; it can result from shifts in employment within industries, as firms adjust to new technology and to trade opportunities. Shifts in industrial structure between 1990 and 2006 were not large enough to drive the 6 percentage point increase in employment of college-educated workers (from 28% to 34%). If the employment of workers with bachelor's degrees had not grown within industries, the shifts in industrial structure would have increased the demand for college-educated workers by less than half a percentage point. In other words, growth in employment of college-educated workers within industries explains most of the growth in the share of college-educated workers. Even if industrial structure had remained unchanged since 1990,

shifts within industries would have increased the college-educated share by almost 6 percentage points.

Economic projections show a continuation of small shifts in industrial structure (as measured for major industries in Table 2).[11] However, if growth in the number of college-educated workers within each industry were to continue, the share of California workers with at least a bachelor's degree would increase by more than 7 percentage points, to almost 42 percent in 2025.[12] Similar calculations imply that the share with a graduate degree would increase by almost 3 percentage points to 15.5 percent.

The California labor market can also be characterized by occupational structure (Table 3). Office and administrative support occupations employed the largest share of workers in 2006 (17%). With the exception of farming, fishing, and forestry, total employment in each of California's

Table 2. College education increased in most industries

	Industry as a Share of State Employment (%)			College-Educated Workers Within Industry (%)		
	1990	2006	2025	1990	2006	2025
High-growth industries						
Administration and support, waste management, remediation	3.7	6.5	8.3	14	17	21
Accommodation and food services	4.4	8.1	8.2	15	15	16
Health care and social assistance	7.1	8.8	9.8	37	41	46
Professional and scientific services	4.7	6.2	7.2	52	67	87
Construction	4.6	5.7	5.9	13	11	10
Arts, entertainment, and recreation	0.4	1.6	1.7	23	38	57
Education services	1.5	1.8	2.1	56	64	74
Other services	2.7	3.4	3.3	16	20	26
Local and state government	13.8	14.4	14.3	46	52	59
Finance, insurance	3.6	4.2	3.8	32	46	64
Slow-growth industries						
Information	3.4	3.2	3.3	36	50	67
Real estate	1.8	1.8	1.7	34	36	40
Mining	0.3	0.1	0.1	23	24	24
Transportation, warehousing	3.0	2.9	2.8	16	16	15
Wholesale trade	4.8	4.4	4.4	24	28	34
Utilities	0.7	0.4	0.3	22	28	36
Management of companies	2.0	1.5	1.5	56	60	66
Federal employees	3.6	1.7	1.3	28	36	46
Farm workers	4.0	2.4	1.6	10	10	11
Nondurable manufacturing	5.2	3.7	2.7	19	22	25
Retail trade	14.5	10.9	10.8	16	22	30
Durable manufacturing	10.2	6.4	4.9	26	34	44
Totals and economy-wide averages	100	100	100	28	34	42

Sources: Author's calculations based on industrial employment and projections from the California Employment Development Department (EDD) and on education and industrial employment from the decennial Census and the 2005 and 2006 American Community Surveys (combined).
Notes: High-growth industries are those that are growing as a share of overall employment between 1990 and 2025. Slow-growth industries are mostly growing industries but are declining as a share of overall employment. Totals may not sum to 100 percent because of rounding. For a description of industry categories, see www.census.gov/epcd/www/naics.html.

Table 3. College education increased in most occupations

	Occupation as a Share of State Employment (%)			College-Educated Workers Within Occupation (%)		
	1990	2006	2025	1990	2006	2025
High-growth occupations						
Construction and maintenance	3.8	5.8	6	7	7	6
Computer and mathematical science	1.2	2.5	3.3	65	69	75
Building and grounds cleaning and maintenance	1.9	3.8	3.9	4	5	6
Business operations	1.1	2.6	3.0	31	53	80
Transportation and material moving	4.9	6.6	6.7	8	8	7
Education, training, and library	5.4	6.0	6.9	78	77	76
Health care practitioner and technical	3.3	3.8	4.3	59	64	70
Community and social services	0.5	1.3	1.4	64	63	61
Personal care and service	2.1	3.0	3.0	10	15	22
Management	5.6	6.4	6.4	42	54	70
Health care support	1.9	2.1	2.6	12	16	21
Food preparation and service	6.8	7.2	7.4	7	10	13
Protective service	1.9	2.2	2.3	20	26	33
Legal	0.6	0.8	0.8	82	79	75
Arts, design, entertainment, sports, and media	2.5	2.5	2.6	48	60	74
Slow-growth occupations						
Extraction	0.1	0	0	6	2	0
Installation, maintenance, and repair	3.5	3.4	3.4	7	10	14
Life, physical, and social science	1.3	1.0	1.1	64	86	100
Sales and related	10.5	10.3	10.1	28	33	39
Architecture and engineering	2.9	2.1	2.0	59	70	84
Financial operations	2.8	1.7	1.8	55	67	81
Farming, fishing, and forestry	3.6	1.9	1.4	7	3	0
Office and administrative support	19.4	16.6	14.5	16	19	24
Production	12.6	6.3	5.1	6	8	10
Totals and economy-wide averages	100	100	100	28	34	41

Sources: Author's calculations based on occupational employment and projections from the California EDD and on education and occupational employment from the decennial Census and the 2005 and 2006 American Community Surveys (combined).
Notes: High-growth occupations are those that are growing as a share of overall employment between 1990 and 2025. Slow-growth occupations are mostly growing but are declining as a share of overall employment. Totals may not sum to 100 percent because of rounding. For a description of occupation categories, see www.bls.gov/soc/.

major occupations has grown since 1990 and is projected to grow further by 2025. However, as a share of total employment, production occupations have experienced the greatest decline, from 13 percent of employment in 1990 to only 6 percent in 2006.[13] Building and grounds cleaning and maintenance has grown the most, from 2 percent to 4 percent.

The occupational employment shifts between 1990 and 2006 explain relatively little (about 1 percentage point) of the 6 percentage point growth (from 28% to 34%) in the share of college-educated workers in California.[14] The shift toward college-educated workers within most occupations explains the bulk of the growth in employment of these workers (about 5 percentage points).

Economic projections show a continued small shift in occupational structure by 2025, but if growth in the employment of college-educated workers within occupations were to continue, the share of California workers with at least a bachelor's degree would increase by almost 7 percentage points, to 41 percent. Similar calculations imply that the share with postgraduate degrees would increase by almost 3 percentage points, to 15.5 percent.

The industry and occupation projections lead to similar results: If recent trends were to continue, labor market demand for college-educated workers would be as high as 41 percent of California workers in 2025. Our projections of demand for college-educated workers lead to very different conclusions than do estimates of employer needs derived from employer "education and training requirements" from the Bureau of Labor Statistics (BLS). According to BLS estimates of employer education requirements by occupation, the share of college-educated workers needed in the California economy in 2025 would be only 27 percent.[15] The two measures are conceptually different. The BLS-based approach considers whether employers need college-educated workers to staff positions. Our measure considers whether employers are choosing workers with bachelor's degrees.

For example, for supervisors of administrative workers, the BLS reports that employers require work experience but no formal postsecondary education for entry-level positions. We find that about 23 percent of workers in this occupation in California (and nationally) have bachelor's degrees. How do we know that this presence of workers with bachelor's degrees represents economic demand rather than simply overtrained workers? Employers are paying college-educated workers in this occupation 49 percent more than they pay workers with only high school diplomas (see Table 4, row 7). Employers are willing to pay more because these workers are more productive. For the economy to be at its most productive and efficient, growth in supply should meet projected growth in demand rather than "training requirements" as reported by BLS.[16]

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Office and administrative support occupations employed the largest share of workers in 2006.

Analysis of college wage premiums demonstrates that the growth in the share of college-educated workers within occupations is demand-driven. Table 4 reports growth in the share of workers with bachelor's degrees and growth in the college wage premiums for nine of the highest-employment occupations for which the BLS reports that bachelor's degrees are not required.[17] In all of these occupations except carpentry, there has been growth in both the share of college-educated workers and in the college wage premium. The wage premium is highest and has grown the most in the three occupations for which the BLS estimates the highest skill needs ("work experience" demonstrates higher skill need than "on the job training" (OJT)). In these nine occupations combined, college-educated workers earned 94 percent more than workers with only high school diplomas in

Table 4. The college wage premium has grown within "non-college" occupations

	BLS Requirement	Workers with a Bachelor's Degree (%)		College Wage Premium (%)	
	2000	1990	2006	1990	2006
Janitors and cleaners	30 day OJT	3	4	6	12
Carpenters	12 month OJT	6	5	13	3
Cashiers	30 day OJT	8	12	30	31
Waiters and waitresses	30 day OJT	9	15	23	31
Office clerks	30 day OJT	14	18	7	18
Bookkeeping, accounting, and auditing clerks	1–12 month OJT	15	16	13	19
Supervisors of administrative support workers	Work experience	21	23	23	49
Sales representatives, wholesale and manufacturing	Work experience	37	45	54	69
Registered nurses	Associate degree	51	63	55	75
All of above, combined	Less than a bachelor's degree	19	24	69	94
Aggregate occupations not requiring a bachelor's degree, combined	Less than a bachelor's degree	12	14	36	50
All occupations	All	28	34	60	86

Sources: Author's calculations based on education and wages from the 1990 decennial Census and the 2005 and 2006 American Community Surveys (combined).

2006. This very high college wage premium reflects the premium within each occupation and especially the greater concentration of college-educated workers in the highest-paying occupations (e.g., registered nursing).

More generally, in the aggregated occupational categories for which the BLS reports that bachelor's degrees are not required, the share of workers with college degrees was very low in 1990—12 percent (penultimate row of Table 4).[18] Over the following 16 years, the share of workers with college degrees increased relatively little, reaching 14 percent in 2006, and the college wage premium increased by only 14 percentage points (from 36% to 50%). These changes demonstrate an increase in demand for workers with a bachelor's degree even within occupations with lower skill requirements as measured by the BLS. However, the demand increases were much greater when measured across the entire economy (Table 4, final row).

Our analysis shows that increases in college wage premiums occurred over the same period as growth in the share of workers with a college education for a wide variety of occupational groupings. We conclude from this that growth in the share of workers with bachelor's degrees represents a fairly widespread increase in demand.

Demand for College-Educated Workers Will Not Be Met

We have shown that if recent trends persist, about 41 percent of workers in the California economy in 2025 would need a bachelor's degree (Table 3). This represents a 7 percentage point increase over the college-educated share in 2006 (34%). It would mean continuing the growth trend experienced between 1990 and 2006, when the share of workers with a college education increased from 28 percent to 34 percent.

Projections of educational attainment for the California working-age population suggest that the share with a college education will increase from 28 percent in 2000 to only

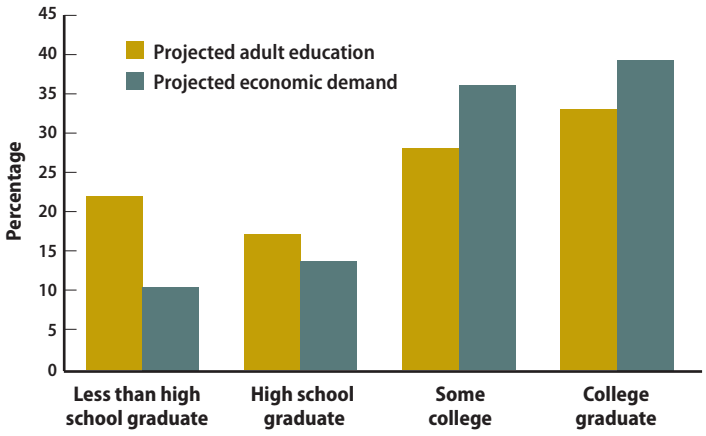
33 percent in 2020 (Johnson, 2005). For comparison, economic projections (similar to those in this report) suggest that 39 percent of workers will need a bachelor's degree in 2020 (Neumark, 2005a). Taken together, these results imply a workforce skills gap between the projected demand of the future economy and the projected education of the future workforce, as shown in the fourth set of bars in Figure 4.[19]

The projected workforce skills gap results from a continuation of growth trends in the demand for college-educated workers combined with a slowdown in the growth of the share of college-educated adults in the population. One reason for the slowdown is that California adults in their late 50s are among the best-educated adults in the state: 34 percent have a bachelor's degree.[20] The retirement of these workers will put a damper on growth in worker educational attainment. In contrast, California adults who reached retirement age between 1990 and 2006 were among the least-educated adults in the state, and their retirement contributed to improvements in the overall educational attainment of workers (Figure 5, solid lines).

A second reason for the slowdown in the share of college-educated adults is the low number of Latinos earning bachelor's degrees, because this group makes up a growing share of the working-age population in California. The share of Latinos with a bachelor's degree increased from 7 percent in 1990 to 10 percent in 2006 and is projected to reach only 12 percent in 2020. Despite these improvements, Latinos will continue to have the lowest college-education levels of any of the major racial and ethnic groups in California. Over this period, Latino education is an increasingly important factor in overall education levels. Latinos grew from 22 percent of the working-age population in 1990 to 29 percent in 2006 and are projected to grow to 40 percent by 2020.[21]

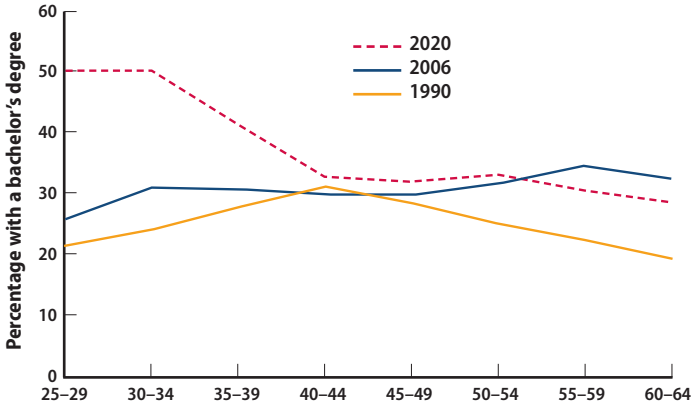
Migration is unlikely to be able to fill the gap between the projected economic demand and the supply of college-educated workers. To meet the projected demand for college-educated workers in 2025, migration would need to increase to almost 160,000 college-educated workers annually and to remain at that level for 20 years (Figure 6). Since 2000, international immigration has brought an annual average of 56,000 college graduates to California.[22]

Figure 4. The projected demand for college-educated workers exceeds the projected supply in 2020



Sources: The projected demand for college-educated workers exceeds the projected supply in 2020.

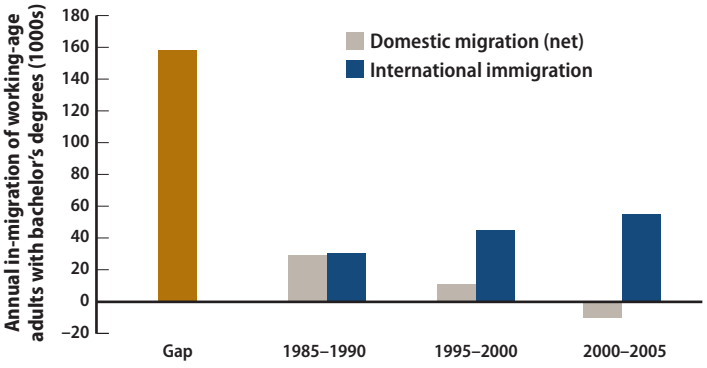
Figure 5. College education is highest among older adults



Sources: Author's calculations based on the decennial Census and the 2005 and 2006 American Community Surveys (combined).
Note: The figure shows actual values for 1990 and 2006 and a hypothetical scenario for 2020.

However, during this period, more college graduates left California for other states than arrived from other states. This is likely the first time in its history that California has sustained net out-migration of college graduates. Out-migration of college-educated workers since 2000 has been driven, in part, by high housing costs in the state and that may be temporary.[23] Nevertheless, even if California were to return to 1980 levels of net in-migration of college-educated adults from other states, migration would not come close to filling the projected gap between supply and demand.

Figure 6. Past migration trends fall far short of annual migration needed to meet the supply/demand gap in 2025



Source: Johnson and Reed (2007).
Notes: The figure shows the annual net migration of workers with bachelor's degrees that would be required to fill the supply/demand gap by 2025 relative to past annual migration trends of working-age adults (ages 25 to 64).

Substantial changes in domestic migration and international immigration that would be needed to fill the gap are not likely. The growth in the college wage premium is a national trend (Figure 3), and California will be competing with other states for college-educated domestic and international migrants. Moreover, a major expansion of international migration is unlikely in light of fairly restrictive federal immigration policy and the increasing global competition for skilled labor.

Finally, even with significant expansions in California higher education, the college-education gap is too large to fill. A rough calculation provides a sense of the magnitude of increase that would be required to meet an overall college-education level of 39 percent by 2020. In 2006, only 29 percent of young workers between the ages of 25 and 29 held a bachelor's degree. Suppose that the college-education rate for young workers were to jump to 50 percent, beginning with young adults reaching age 25 in 2009 and remaining at that level through 2020. Under this hypothetical scenario, by 2020, 50 percent of California workers ages 25 to 36 would hold a bachelor's degree. Figure 5 shows this scenario for 2020, using the Johnson projections for adults over the age of 36.[24] Overall, for workers ages 25 to 64, under this scenario 38 percent would hold a bachelor's degree in 2020. Thus, to meet the projected gap through increased educational attainment of young workers, college completion would need to increase to about 50 percent immediately. Such a large and immediate gain is not attainable; this rough calculation is simply meant to demonstrate the magnitude of change that would be required. A forthcoming study from PPIC will examine more realistic scenarios for increasing the production of bachelor's degrees (Johnson and Sengupta, forthcoming, 2009).

What Are the Implications?

In sum, our analysis shows that the supply of college-educated workers will not be able to expand enough to meet projected demand. Our projected demand is simply the continuation of current trends. Thus, our results suggest that current trends will not continue because the supply of college-educated workers will not grow as rapidly as in past decades.

Faced with this skills gap, the economy will adjust. As we have shown, the demand for college-educated workers has outpaced supply since the 1980s. In the future, we can expect to see some of the same adjustments that occurred in recent decades, although they are likely to be magnified because growth in the supply of college-educated workers will become more limited. The economy adjusts through changes in wages, unemployment, and underemployment. The supply of workers with a high school diploma or less is projected to exceed the demand for such workers. These workers will see an erosion of their wages or other compensation, as in the 1980s (Figure 2) or a decline in job opportunities leading to unemployment and underemployment, as in the 1990s.[25] These trends have serious implications for the resources available to low-income families and the demands on the state for social programs.

For workers with a college degree, growth in demand will continue to drive up wages (as in the 1980s and 1990s) and will encourage greater entry into the labor market.[26] This will increase the resources of higher-income families and drive up economic inequality in the state. Indeed,

growth in the education wage premium has been one of the most important factors in explaining the rise in income inequality in California in past decades (Reed, 1999).

Our projections of economic need were developed by considering "if recent trends continue." Our analysis shows that recent trends will not continue. The economic growth path that California has experienced since 1980 has been fueled by substantial growth in college education among workers. In the coming decades, the lack of college-educated workers will be a limiting factor that changes the path of the state's economic growth.[27]

If the economy cannot continue the recent trends, there are important implications for state and local planning. Policymakers plan and prepare for the future based on expectations and projections of future employment, income, government revenues, and demands for government services. The projections generally rely on some form of the assumption "if recent trends continue." Our results suggest that recent trends cannot continue because the supply of college-educated workers will not expand as rapidly as in past decades. Thus, the projections that form the basis of government planning should be reconsidered to take into account constraints imposed by more limited growth in the college-educated workforce.

What Can Be Done?

We have shown that growth in the supply of college-educated workers will not keep pace with the demand for such workers. Public policy clearly has a role to play in improving access and success in college attendance and graduation. Although rising compensation levels will reward people for making their own investments in college, the public system plays a major role. Most Californians prepare for college in the public K–12 system. A majority who enter college do so through the public community colleges. Most bachelor's degree students in California attend a public institution.[28]

The scope for improvement in public investments is broad. Increasing the number of workers with bachelor's degrees includes improving graduation rates, reducing time to graduation, and/or expanding the public university system (Johnson and Sengupta, 2009).[29] It will also be important to improve transfer rates and transferable credits from community colleges (Sengupta and Jepsen, 2006). Attention should also be focused on the earlier years of educational training and achievement. The quality of education in the public K–12 system is a precursor to success in college, including the availability of college-preparatory courses in high schools (Conley, 2006). Even preschool has been shown to improve rates of college attendance (Karoly, Kilburn, and Cannon, 2005).

Although the focus of this study is bachelor's degrees, this is clearly not the only realm for investment in workforce skills. California wage trends show a rising premium for education at all levels (Figure 2). Other research has shown that these trends are related not only to formal education but also to labor market experience and other skills, leading to a broad consensus that there has been and will continue to be a growing demand for skilled workers (Hilton, 2008; Welch, 2001). Furthermore, even with projected demand for bachelor's degrees at the level of 41 percent in 2025, the majority of jobs will not require bachelor's degrees. Improving the skills of workers who do not attend or complete college is a key component of workforce development. At the other end of the spectrum, the economy is also experiencing growth in demand for graduate and professional education. Growth in the supply of workers with education beyond a bachelor's degree has also been limited and is likely to be even more limited in the future for all the same reasons explored here for a bachelor's degree.

The economy of the future requires a skilled workforce. As demand has shifted toward college-educated workers, growth in the supply of such workers has not kept pace. Our projections suggest that growth in supply will be even more constrained in the future. Effective reforms and investments today will create a workforce that will help fuel future economic growth and bestow many additional economic and social benefits on the people and state of California. ●

Notes

[1] Estimates of working population and education are based on the author's calculations from U.S. Census Bureau data. Throughout the text, we examine workers ages 25 and older. We compare workers to the adult population of prime working age (ages 25 to 64). For brevity, we use "2006" to refer to data from the 2005 and 2006 American Community Surveys (combined).

[2] The 1970 and 1980 decennial Census asked respondents about completed years of education. We treat 16 years completed as a bachelor's degree. Starting in 1990, the decennial Census asked respondents about completed degrees. Survey changes may overstate the growth in bachelor's degree attainment. An alternative data source, the Current Population Survey (CPS, March files), consistently asked respondents about completed years of education and shows slower growth in the share with a bachelor's degree between 1980 and 1990. Using the CPS, we verified that the change in the survey education questions between 1980 and 1990 appears to have had no substantial effect on the estimated wage premium for a bachelor's degree relative to a high school diploma (shown in Figure 3 with estimates from the decennial Census).

[3] See Johnson and Reed (2007) for a study of migration and education in California.

[4] Figure 2 shows an average hourly wage based on predictions from ordinary least squares regressions. The regressions are estimated separately by sex and by calendar year for a total of 10 regressions. The dependent variable is the natural log of hourly wage. Education is included as piecewise linear (a dummy for less than a high school diploma and linear years of schooling for less than high school, a dummy for some college and linear years of schooling for some college, and a dummy for a bachelor's degree and linear years of schooling beyond a bachelor's degree). The model controls for a quartic in potential experience (age less years of education less 6), indicators for five racial/ethnic groups, and an indicator for foreign-born. Predictions are calculated for a person with 15 years of experience at the 2006-based average of all other characteristics. The estimated wage premiums reported in Figure 3 do not necessarily measure a purely causal effect of education. However, estimation strategies that attempt to identify causal effects also find high and rising college wage premiums (Card, 2001).

[5] In real terms, average annual earnings actually fell about 7 percent for California men with a bachelor's degree, from $83,500 to $76,900. However, average hourly wages (calculated as annual earnings divided by the product of weeks worked and usual hours per week) were very similar in the two years: $44.98 in 2000 and $44.92 in 2006. Over this period, there was a small decline in the number of hours of work.

[6] Unemployment and reduced labor force participation also reflect economic demand and worker responses to economic demand. In 2006, unemployment among workers with a high school diploma but no college education was 4.8 percent, whereas among workers with a bachelor's degree, unemployment was 2.8 percent. In that same year, 28 percent of adults with only a high school diploma did not participate in the workforce, whereas among adults with a bachelor's degree, the share not participating was 19 percent.

[7] See U.S. Department of Education (1998) and Hammermesh and Donald (2008) for studies of earnings by college major.

[8] Immigration has played a relatively small role in the growth of education wage premiums. Estimates differ, but even larger estimates of the effect of immigration suggest that it has been small relative to the growth in the wage premium shown in Figure 3 (Peri, 2007; Borjas, 2003).

[9] One approach to validating projections is to determine whether the same analysis, if done 10 or 20 years earlier, would have provided a realistic view of recent trends. Unfortunately, the lack of historic projections and changes in industry and occupation codes prevent us from doing this validation. However, the trends in Figure 1 are fairly consistent with our projection method in the following sense. Our projections are based on a linear extrapolation of changes within industry and occupation, combined with structural changes in industry and occupation distributions. Because the structural changes have been relatively small, our projections result in nearly linear growth in the share of workers with a bachelor's degree. Structural changes were also relatively small in the 1970s and 1980s and, as shown in Figure 1, the growth in the share has been fairly consistent across decades.

[10] The industrial and occupational patterns described in this section appear to be similar for the period 1980 to 1990. However, because of differences in industry and occupation codes in the 1980 Census, we begin our analysis with 1990.

[11] Economic projections are from the California Employment Development Department (EDD) for 2004–2014. We use EDD projections because of the availability of information on both industrial and occupational employment. We aggregate to the major industry and occupation categories as shown in Tables 2 and 3. Calculations based on industry projections from the Cali-

fornia Department of Transportation lead to similar conclusions (Johnson and Reed, 2007). Employment by industry and especially by occupation does not match perfectly between the EDD data and Census Bureau survey data. For consistent EDD-based employment, we use EDD projections to calculate a constant annual growth rate by industry or occupation between 2004 and 2014 and apply that rate to generate employment in 2006 and 2025. For 1990, we use the 2006 EDD-based estimate and adjust by the change in employment share between 1990 and 2006 as measured in Census Bureau data.

[12] We calculate educational demand in 2025 for each industry (or occupation) by applying the same annual percentage point change in share as exhibited for that industry (or occupation) between 1990 and 2006. We calculate the change in economy-wide educational needs using industry shares based on EDD data. The estimated economy-wide change is added to the Census Bureau–based education levels for workers (as shown in Table 1) to calculate the projected share of college-educated workers in 2025. See Neumark (2005b) for further details on these methods.

[13] Production occupations include assemblers of machinery and equipment, food processing workers, metal workers, machinists, textile workers, wood workers, plant operators, and other occupations.

[14] We use the aggregated occupations in Table 3 to perform these calculations. If occupations were defined at a finer level (as in Table 4), we would expect to see a larger effect of changes in occupational structure. However, we did not analyze this directly because detailed occupation codes are not comparable in 1990 and 2006. A similar discussion applies to industrial structure.

[15] Estimates are based on author's calculations from occupational projections by the California EDD. See California Postsecondary Education Commission (2006) for an analysis that uses the BLS-based approach to measure future education and training needs.

[16] In addition, there are several problems with using the BLS estimates of employer requirements to measure future needs. First, the BLS reports only one level of required qualifications for entry into an occupation. Employer needs are likely to differ across specific positions, firms, and industries and for entry-level versus more advanced positions. To address this, the BLS has introduced a second set of training requirements, based on the education levels of current workers in the occupation, similar to the method used in this study (see www.bls.gov/emp/optd/optd001.pdf). In addition, the training requirements approach does not incorporate the potential need for upgrading of skills in the future.

[17] The nine occupations in Table 4 were selected from the largest California occupations for which consistent occupational codes are available in the 1990 Census and the 2006 American Community Survey. To maintain substantial samples in estimating wage premiums for specific occupations in Table 4, wage regressions combined genders with an intercept-shift for males. For consistency, this approach was applied to all regressions reported in Table 4. In all other ways, the regressions were estimated as for Figure 3.

[18] The aggregated occupations included here are those listed in Table 3 for which less than 35 percent of workers in 2006 held a bachelor's degree. Within these aggregated occupations, there were only five specific sub-occupations for which the BLS reported that a bachelor's degree was required. These five occupations were removed from the analysis reported in Table 4.

[19] In this section, we focus on estimates for 2020 because education projections for the adult population in 2025 are not available.

[20] The phenomenon is not restricted to California. Among U.S.-born white males nationwide, those ages 55 to 59 are the most likely to have graduated from college. Men in their late 50s were of prime draft age during the Vietnam War, and it is likely that some of them considered college an attractive alternative to military service in Vietnam.

[21] Latino shares are based on California Department of Finance estimates and projections (1998, 2007). A higher share of U.S.-born Latinos hold a bachelor's degree: 11 percent in 1990 and 16 percent in 2006.

[22] Among recent international immigrants to California, about 41 percent have a bachelor's degree.

[23] In 1998, only 7 percent of college-educated workers who left California in the previous year cited a housing-related reason for leaving, compared with 27 percent in 2006. Housing-related reasons include the attractions of cheaper housing, new or better housing, owning rather than renting, wanting a better neighborhood, and establishing one's own household. Job-related reasons remained the dominant response even in 2006 (37% overall). See Johnson and Reed (2007).

[24] Johnson (2005) projects increases in the education of older workers based on patterns since 1990.

[25] These adjustments can increase the share of college-educated workers if workers with low education are unemployed, decide not to work, or leave the state.

[26] The economic adjustments will increase the college wage premium, providing incentives for workers to invest in higher education and migrants to come to California. However, our analysis in the previous section shows that these responses are not likely to be great enough to meet the projected demand. The economy will adjust so that supply equals demand, but it will likely result in less than 41 percent of the workforce having a college education.

[27] Fountain and Cosgrove (2006) use production models to conclude that limited economic attainment of the California workforce will lead to reduced employee compensation and overall loss of production in affected industries as well as to reductions in consumption and state and local tax revenues.

[28] In 2005, 76 percent of people graduating from a California college with a bachelor's degree attended a public college or university (Johnson and Reed, 2007).

[29] Brady, Hout, and Stiles (2005) estimate the broader social returns to investments in college education in California.

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About the Author

Deborah Reed is an associate director of research and a senior fellow at PPIC. She was previously PPIC's director of research and the first recipient of the Thomas C. Sutton Chair in Policy Research. She has research expertise in poverty, income inequality, education, and labor markets in California. Her recent publications include studies of California's future workforce needs, poverty measurement, and intergenerational progress among immigrants. Before joining PPIC, she was an adjunct professor of economics at the University of Michigan and a consultant for the World Bank. She holds a Ph.D. in economics from Yale.

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