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How Accurate Are Recent BLS Occupational Projections?

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How Accurate Are Recent BLS Occupational Projections?

Abstract

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Keywords

ILR, Cornell University, human resources, BLS, skill, occupation, economy, employment, work, job, farm laborers, labor, professional labor, service worker

Disciplines

Human Resources Management | Labor Relations

Comments

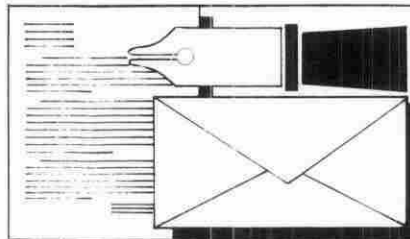
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Communications



Editor's Note—Every other year, the Bureau of Labor Statistics develops medium-term projections of the U.S. economy covering the labor force, economic trends, and employment by industry and by occupation. These projections are used by the Bureau as the framework for the Occupational Outlook Handbook, which provides information to guidance counselors, students, job seekers, and others on projected occupational trends and related information. The projections are also used by public and private analysts, and business, labor, and academic researchers. The most recent set of projections was published in the November 1989 issue of the Monthly Labor Review. As is normal practice, these projections are scheduled to be updated in a group of articles published in the Review in November 1991.

An important aspect of the Bureau's projection program is the evaluation of the accuracy of the projections—both the overall labor force and employment projections and the detailed occupational and industrial projections—and the most important factors causing differences between the projections and the actual outcomes once the terminal year in a set of projections has been reached. Previous evaluations of the Bureau's projections have been published in earlier editions of the Monthly Labor Review. An evaluation of the 1990 projections of labor force, economic trends and employment by industry and occupation will be undertaken shortly and will be published about mid-1992. It should be noted that evaluation of the 1990 occupational projections will be extremely difficult because of a major change in 1983 to the Standard Occupational Classification, which means that the 1990 projected data—based on earlier classifications—are not

strictly comparable with the actual 1990 occupational data.

The Bureau is always receptive to comment or criticism of its data or methods in this or any other program. In that spirit, the following communication by John Bishop and Shani Carter comments on the Bureau's 1990 occupational projections.

How accurate are recent BLS occupational projections?

John H. Bishop and Shani Carter

At the beginning of the 1980's, some analysts predicted an increase in lower-skilled jobs relative to higher-skilled jobs as a result of technological and other changes.¹ They based their forecasts in part on Bureau of Labor Statistics' projections of the future work force.

How good is the past record of BLS projections? This communication offers an evaluation of the accuracy of the BLS projections of employment growth in the 1980's by major occupational groups. It also considers the accuracy of earlier projections covering the 1960's and 1970's, and takes a preliminary look at the projections to 1995 and to 2000.

Earlier projections, published in the early 1970's, were based on extrapolating past rates of change of occupa-

tional shares and proved remarkably accurate. However, projection methods changed in the early 1980's, and since that change, BLS projections have significantly under-projected the rapid growth of higher-skill jobs, such as professional and managerial jobs, and correspondingly over-projected the growth of lower-skill jobs, such as operatives, and service workers.

BLS' occupational projections for 1990

The occupational projections made by the Bureau of Labor Statistics at the beginning of the 1980's significantly underestimated the growth of higher-skill occupations. In August 1981, BLS projected that professional, technical, and managerial jobs would increase only slightly more rapidly than total employment during the 1980's. It was projected that these jobs would account for 28 percent of employment growth between 1978 and 1990 and that the occupational categories of operatives, laborers, farm laborers, and service workers would account for 34 percent of employment growth.² In November 1983, BLS published new projections of occupational growth through 1995. At that time, the economy had entered and was emerging from a severe recession. Total 1982 employment was at essentially the same level as it had been in 1979. Professional, technical, and managerial employment had, however, increased by almost 5 percent and their share of employment had risen by 1.1 percentage points during the 3-year period. BLS increased its projected rates of growth for these jobs, but not by much. In the 1983 projections, professional, technical, and managerial jobs accounted for 30.7 percent of employment growth through 1995 (from the 1982 base) and for 37 percent of projected growth from the 1979 base. BLS

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also projected that operatives, laborers, farm laborers, and service workers would account for 31.5 percent of employment growth from the 1982 base and 27.9 percent of growth from the 1979 base.³

What were the actual patterns of job growth between 1978, the original base year, and 1989? *Professional, technical and managerial jobs accounted for 52 percent of employment growth during that period while operatives, laborers, farm laborers, and service workers accounted for only 9 percent of job growth.* Table 1 presents a detailed comparison of BLS' 1981 projections of occupational employment growth between 1978 and 1990 with actual growth rates between 1978 and 1989. (Because the comparison employs the 1980 census occupational categories, adjustments were made to the BLS projections to account for the occupations that were switched from one major occupational group to another.⁴ The first column of the table presents Current Population Survey estimates of the actual percentage growth of occupational employment between 1978 and 1989.⁵ At the bottom of this column, the 20.9 percent figure is the average absolute size of the deviations of occupational growth from the 22.1 percent growth trend for total employment. The second column of the table presents the low-trend projected percentage growth for 1978 to 1990 that was published by BLS in 1981. The low-trend projection is used in the comparison because actual employment levels in 1989 were very close to BLS' low-trend projection for 1990. The third column presents the difference between the actual and projected percentage increases for each occupational group. At the bottom of the column, the 13.2-percent figure is the average absolute size of these differences between actual and projected. In other words, relative to a baseline in which every occupation is assumed to grow at the same rate, the projections reduced the average error by 37 percent, from 20.9 to 13.2 percent.

The fourth column shows the difference between actual and projected numbers of workers in the occupational group in 1989. The largest difference occurred in BLS' projection of the

growth of managerial occupations, underestimating the growth by 36.4 percentage points or 3.4 million jobs. The Occupational Employment Survey (OES) yields an almost identical estimate (54 percent compared with 56.7 percent) of the growth of managerial employment and of the projection error.⁶

The growth of professional employment was underestimated by 1.86 million jobs (17 percent of the 1978 level of professional employment) when CPS data are used to measure the growth of professional jobs. (By contrast, if OES data are used, there is no projection error for professional and technical jobs combined.)

Employment of operatives was projected to grow by 14 percent. Actually, it fell by 10 percent, resulting in an over-projection of 2.2 million jobs. (In Occupational Employment Survey

data, the drop is even more precipitous.) Employment in other services was projected to grow 36 percent, but grew by 24 percent, resulting in an over-projection of 1.2 million jobs. Rates of growth for all lower-skilled jobs combined—operatives, laborers, farm laborers and service workers—are identical in OES and CPS data so our conclusion that the 1981 projections significantly over-projected the growth of lower-skilled jobs is independent of the source of data on the growth of occupational employment.

Clearly, there is a pattern to the projection errors: BLS projections made since 1981 have substantially under-projected the growth of skilled occupations and substantially over-projected the growth of occupations requiring lower or more moderate skills. Were these errors unforeseeable consequences of unanticipated events

Table 1. Comparison of actual and projected growth of major occupational groups, 1978-90

Major occupational group	Growth rates ¹		Difference (actual (-) projected)		Share of employment increase
	Actual	BLS projected	Percent of base	Numbers (in thousands)	
Total	22.1	22.5	-0.4	21,294	—
Executive, administrative, public administration	56.7	20.3	36.4	3,401	25.0
Professional	42.3	25.3	17.0	1,858	22.0
Technical	45.8	41.8	4.0	100	5.0
Sales occupations	36.7	26.3	10.4	1,070	18.0
Administrative support	18.4	23.6	-5.2	-809	13.0
Protective service	35.9	32.3	3.6	52	2.0
Private household	-26.1	-15.3	-10.9	-127	-1.0
Other services	24.3	36.0	-11.7	-1,198	12.0
Precision production and craft	13.9	23.9	-10.0	-1,214	8.0
Machine operators	-10.0	14.1	-24.1	-2,209	-4.0
Transportation operatives	7.9	20.4	-12.5	-566	2.0
Laborers	-3.9	16.9	-20.8	-1,057	-1.0
Farm, forestry, fishing	-7.9	-13.1	5.2	193	-1.0
Average projection error	² 20.9	—	³ 13.2	—	—

¹ Actual growth rates measured from 1978 to 1989; projected rates measured from 1978 to 1990.

² Average absolute size of the projection error if all occupations had been assumed to grow at the same rate. It is the mean discrepancy (without regard to sign) between the occupation's percentage growth and the percentage growth of total employment.

³ Average absolute size of the difference between actual 1978 to 1989 percentage growth and projected 1978 to 1990 percentage growth.

SOURCE: Data on the actual levels of employment are from *Employment and Earnings*, January 1984, p. 14, and January 1990. Information on the changes in occupational definitions in 1982 is from Gloria Peterson Green, Khoan tan Dinh, John A. Priebe, and Ronald R. Tucker, "Revisions in the Current Population Survey Beginning in January 1983," *Employment and Earnings*, February 1983, pp.7-15. Projected low-trend percentage growth is from Max Carey, "Occupational employment growth through 1990," *Monthly Labor Review*, August 1981, pp. 42-55. The comparison employs the 1980 census occupational categories, so adjustments were made to the BLS projections to account for the occupations that were switched from one major occupational group to another.

such as the microcomputer revolution and the trade deficit? Or were the projections published in 1981 based on a flawed method of projecting occupational growth?

There are many potential sources of error in the BLS occupational projections. Projections of industry final demand shares may be wrong. The input-output matrix used in preparing the projections is often quite old and this contributes to errors in projecting value-added shares. The share of industry output that is imported was particularly difficult to predict in the 1980's. Productivity growth in specific industries may also be in error, resulting in incorrect projections of industry employment. Substantial changes have occurred in the occupational composition of industries and this has often been a major source of error in occupational projections. BLS derives occupational employment demand by multiplying projected industry employment totals by an assumed industry occupational share vector. Adjustments are made to these vectors when BLS studies of the introduction of new technology indicate that changes can be anticipated by the end of the projection period.⁷ Because studies cannot be funded for every industry and for every technological innovation and the effects of these changes are very difficult to foresee 10 years in advance, we hypothesize that many of the changes that will occur in the composition of occupational demand within industry will be and are missed by BLS projections. When BLS made the projections of 1990 occupational employment in 1981, they had only one wave of Occupational Employment Statistics survey data available to them for most States and industries. The *BLS Handbook of Methods* describes what is done when data is thought to be of doubtful comparability:

When an occupation is added, deleted or changed in definition from one OES survey to the next, extrapolated trends are not developed: the current-year ratios for these occupations are held constant in the preliminary projected matrix.⁸

Because reliable OES trend data were not available in 1981, extrapolation was not the primary basis for projecting

Table 2. Comparison of actual and logarithmic extrapolation of growth of major occupational groups, 1980-89

Major occupational groups	Growth rates ¹		Difference ¹ (actual (-) projected)	
	Actual	Logarithmic extrapolation	Percent of base	Numbers (in thousands)
Total	18.2	18.2	—	—
Executive, administrative, public administration	45.4	36.9	8.5	867
Professional	31.5	29.8	1.7	204
Technical	28.6	44.2	-15.6	-441
Sales	29.6	22.0	7.6	826
Administrative support	10.7	22.1	-11.4	1,892
Protective services	31.5	19.5	11.9	178
Other services (including private household)	15.9	15.4	.5	231
Precision production, and craft	12.6	13.3	-.7	-87
Machine operatives	-6.7	-3.6	-3.1	-272
Transportation operatives	8.8	7.0	1.8	79
Laborers	4.1	-5.3	9.4	439
Farm, forestry, fishing	-5.9	-12.2	6.3	231
Average projection error	² 13.6	—	³ 6.5	—

¹ Actual and extrapolated growth rates measured from 1980 to 1989.

² Average absolute size of the projection error if all occupations had been assumed to grow at the same rate. It is the mean difference (without regard to sign) between the occupation's percentage growth and the percentage growth of total employment.

³ Average absolute size of the discrepancy between an occupation's actual 1980-89 percentage growth and extrapolated 1980-89 percentage growth.

SOURCE: Data on occupational employment levels using 1980 census occupational categories are from *Employment and Earnings*, January 1990, and Deborah Pisetzer Klein, "Occupational Employment Statistics for 1972-92," *Employment and Earnings*, January 1984, pp. 13-16.

1990 industry-specific occupational shares. In most cases, industry specific occupational share vectors were assumed to be stable.

In our view, occupational staffing ratios are seldom stable over periods of 10 years or more. It is better, when projecting or forecasting employment in major occupational categories, to start with a presumption that trends are stable (and then change that assumption if contrary evidence is available) than a presumption that the ratios themselves are stable. Let us examine how accurate projections would have been had they been based on an assumption that trends in occupational shares are stable. This can be done by simply calculating the rate of change of occupational employment shares for a baseline period and then assuming that these rates of change will continue. To get a preliminary idea about how well extrapolation works, we calculated 1989 occupational employment levels, starting from a 1980 baseline. The lat-

ter was chosen because that is the information that was available at the time BLS made its August 1981 occupational projections. First, the growth rates of the logarithm of the employment share for the 12 major occupational groups between 1972 and 1980 were calculated using data employing 1980 census occupational classifications.⁹ Then 1989 occupational shares were calculated by simply applying 9 years of this growth rate to the 1980 baseline share for that occupation.¹⁰ The resulting estimates are presented in table 2. This very simple logarithmic extrapolation does a remarkably good job of predicting occupational employment levels for 1989. The average absolute value of the projection error is 6.5 percent, 52 percent lower than the 13.6 percent projection error resulting from a naive model in which all twelve occupations grow at the same rate from a 1980 base and the 13.3 percent mean error in the BLS projections published in 1981. If private household workers

are treated as a separate occupation, the average absolute error increases to 7.4 percent, still 52 percent below the 15 percent average error that results from the naive model predicting employment growth for thirteen occupations.

The systematic character of the errors can be explored by comparing the actual and extrapolated shares of employment growth in higher- and lower-skilled occupations. The professional, technical, and managerial occupations, which accounted for 50.9 percent of employment growth between 1980 and 1989, were projected to account for 47.8-47.4 percent of that growth. The operatives, laborers, farm laborers, and service workers occupations, which accounted for 12.2 percent of employment growth, were projected to account for 7.5-8.6 percent of employment growth. The extrapolation method slightly under-projected the growth of both lower- and higher-skilled jobs. One reason for these errors was our failure to project the slowdown in the growth of clerical jobs caused by the introduction of the microcomputer (an error also made by the BLS projections analysts in 1981). By 1980, the last year of the baseline period which sets the projected growth rate for each occupation, a cumulative total of only 600,000 microcomputers had been sold to business. The IBM Personal Computer was not introduced until 1982. When a big change is about to occur but has not yet gotten off the ground, simple extrapolations of past trends in occupational staffing will be wrong.

Another problem with simple extrapolations is that they are likely to be sensitive to the years selected as the beginning and end of the baseline period. Recessions cause blue-collar employment to decline relative to white-collar employment, so starting or ending a baseline period during a recession will distort extrapolations into the future. Occupational shares are measured with error and this can also distort simple extrapolations. A natural way to deal with these two problems is to estimate regression models in which the logarithm of each occupation's share of total employment is predicted by a time trend and a cyclical variable such as the unemployment rate. The

model was estimated on CPS data from 1972 through 1980 and projections made to 1989, assuming a 1989 unemployment rate of 5.5 percent. The results are presented in table 3. While the regression equation extrapolation does substantially better than BLS' 1981 methodology, it, surprisingly, does not do better than the straight-line extrapolation. The average absolute size of the projection error is 8.4 percent, which is a 38-36 percent reduction from the average projection errors that result from assuming constant employment shares or using the BLS projections published in 1981. While the bias is not as large, the regression projections under-project the growth of higher-skill occupations and over-estimate the growth of lower-skill occupations, just as the BLS projections did. The professional, technical, and managerial share of job growth is under-projected by 11.8 percentage points and

the operatives, laborers, farm laborers, and service workers share of job growth was over-projected by 7.2 percentage points.¹¹ On a priori grounds, the projection based on the regression must be preferred over the simple extrapolation. *It would appear that even projections based on an assumption of stable trends in occupational shares under-project the magnitude of upskilling during the 1980's.* Something else happened—probably the spread of the microcomputer and the large trade deficit in combination—to accelerate upskilling during the 1980's.

BLS' occupational projections for the 1970's

While BLS' occupational projections for the 1980's were off target, BLS did better projecting occupational employment growth during the 1970's. Table 4 compares BLS' employment growth projections for 1966 through 1975 to

Table 3. Comparison of actual and logarithmic regression projection of growth of major occupational groups, 1980-89

Major occupational groups	Growth rates ¹		Difference ¹ (actual (-) projected)	
	Actual	Logarithmic projection	Percent of base	Numbers (in thousands)
Total	18.2	18.2	—	—
Executive, administrative, public administration	45.4	31.5	13.9	1,420
Professional	31.5	23.5	8.0	946
Technical	28.6	36.5	-7.9	-232
Sales occupations	29.6	20.9	8.7	944
Administrative support	10.7	19.7	-9.0	1,497
Protective services	31.5	14.9	16.6	248
Other services (including private household)	15.9	17.9	-2.0	-227
Precision production and craft	12.6	20.6	-8.0	-982
Machine operatives	-6.7	6.6	13.3	-1,175
Transportation operatives	8.8	7.6	1.2	54
Laborers	4.1	5.7	-1.6	-73
Farm, forestry, fishing	-5.9	-16.6	10.7	389
Average projection error	² 13.6	—	³ 8.4	—

¹ Actual and logarithmic regression projected growth rates measured from 1980 to 1989.

² Average absolute size of the projection error if all occupations had been assumed to grow at the same rate. It is the mean difference (without regard to sign) between the occupation's percentage growth and the percentage growth of total employment.

³ Average absolute size of the difference between an occupation's actual 1980-89 percentage growth and logarithmic regression projected 1980-89 percentage growth.

SOURCE: Data on occupational employment levels using 1980 census occupational categories are from *Employment and Earnings*, January 1990, and Deborah Pisetzer Klein, "Occupational Employment Statistics for 1972-82," *Employment and Earnings*, January 1984, pp. 13-16. Regressions projecting the logarithm of the occupation's share of employment with a trend and the unemployment rate were estimated on data from 1972 to 1980 and then projections were made from 1989.

actual growth between those years for nine major occupational groups.¹² The average absolute projection error was only 4.4 percent of the 1966 employment levels, or 59 percent below the mean projection error that results from the naive model that assumes all major occupations grow at the same rate. Table 5 presents comparable data on the 1971 BLS projections of occupational growth for 1970 to 1980.¹³ The average absolute discrepancy between actual and projected growth for the 1970's is 6.8 percent, 45-percent lower than the mean projection error produced by a naive model. Overall, projections of the 1970's appear to have been significantly more accurate than the projections of the 1980's that were made in 1981. Why is this so?

Let us examine how the earlier projections were made. Industry-specific occupational staffing ratios were projected based on trends derived from the 1950 and 1960 censuses. The methods employed were described as follows:

Historical statistics on the changing occupational composition of detailed industries were projected by simple time trend. The trend for each industry-occupational ratio derived from census data was extended to 1975, and the indicated change from the 1960 level was added to the appropriate ratio in the base period (1960) industry-occupational employment table. A variety of other statistics covering varying spans of time between 1950 and 1965 was gathered and arranged to reveal evidence of trends in employment by occupation for particular industries or for the entire economy. Analysis was directed to finding the causes of past changes in occupational structure. An attempt was made to determine whether these factors were likely to continue to affect occupational structure in the period ahead to a similar, greater or lesser extent.¹⁴

It appears that when occupational staffing ratios are assumed to exhibit a relatively constant trend—unless information is available to the contrary—that much better projections result.

The resulting 1970's projections were not perfect, however. While the errors were smaller, their pattern is familiar. The growth of managerial jobs, which was under-projected by 36.4

Table 4. **Actual and projected growth of major occupational groups, 1966-1975**

Major occupational group	Growth rates ¹		Difference (actual (-) projected)		Share of employment increase ²
	Actual	BLS projected	Percent of base	Numbers (in thousands)	
Total	16.0	17.7	-1.7	-1,265	—
Managerial	20.8	26.5	-5.7	-420	13.0
Professional, technical	32.7	34.0	-1.3	-124	25.7
Sales occupations	12.8	16.7	-3.9	-183	5.2
Clerical occupations	27.5	23.1	4.4	523	27.4
Service workers	17.2	28.8	-11.6	-1,120	14.1
Craft and kindred workers	19.6	21.6	-2.0	-197	15.9
Operatives1	.9	-.8	-106	.0
Nonfarm laborers	18.4	3.5	14.9	550	5.7
Farm workers	-21.8	-17.1	-4.7	-187	-16.7
Average projection error	³ 10.8	—	4.4	—	—

¹ Actual growth rates measured from 1966 to 1974; projected rates measured from 1966 to 1975.

² 1966 to 1974.

³ Average absolute size of the projection error if all occupations had been assumed to grow at the same rate. It is the mean difference (without regard to sign) between the occupation's percentage growth and the percentage growth of total employment.

⁴ Average absolute size of the discrepancy between actual 1966 to 1974 percentage growth and projected 1966 to 1975 percentage growth minus 1.7 (to adjust for differences between projected 1975 and actual 1974 employment levels).

SOURCE: Projected and actual employment levels for 1974-75 are from Max Carey, "Evaluating the 1975 projections of occupational employment," *Monthly Labor Review*, June 1980, p. 14. Estimates of occupational employment levels in 1966 are from *Tomorrow's Manpower Needs: Volume III, Bulletin 1606* (Bureau of Labor Statistics, 1969), p. 4.

percent during the 1980's, was under-projected by 17.1 percent during the 1970's. The growth of operative jobs, which was over-projected by 24 percent in the 1980's, was over-projected by 11.7 percent in the 1970's. Our analyses also shows that the occupational shares of employment growth projected by BLS in studies completed in 1969 and 1971 followed the same pattern of over- and under-projection. Managerial, professional, and technical jobs, which were projected to account for 33.9 to 34.7 percent of aggregate employment growth, actually accounted for about 38.1 to 38.7 percent of employment growth between 1966 and 1980. Operatives, laborers and service jobs, which were projected to account for 27.4 to 29.6 percent of employment growth, actually accounted for only 19.8 and 13.1 percent of employment growth during these two overlapping periods. It would appear that even when past trends in the occupational composition of industries are extrapolated into the future, there

is still a tendency to under-project the relative growth of higher-skill jobs that prevailed during the 1960's and 1970's. *It may be that the upskilling demand effects of technological progress and work reorganization are inherently unforeseeable.*

Assessing the 1995 and 2000 projections

BLS analysts George Silvestri and John Lukasiewicz describe the process of projecting occupational staffing patterns for the BLS projections published in 1985 this way:

Staffing patterns of industries in the base-year industry occupation matrix are projected to the target year of the projections to account for changes expected to occur because of technological change, shifts in product mix, and other factors. The changes introduced into the input-output model for expected technological change, as an example, may also change future staffing patterns in industries using the new technology. (For example, one would ex-

pect greater employment of computer specialists as computer technology spreads across industries.)¹⁵

From this, it would appear that extrapolation was being used to generate some of the projected occupational staffing ratios specific to industries for 1995 and 2000. It is not clear from this description, however, just how common this practice was.

The occupational employment survey data is collected on a 3-year rotating cycle. It becomes available to analysts about 18 months after it is collected so some data are already 4.5 years old when BLS starts to use it for projecting occupational change. By the time the Bureau of Labor Statistics did its projections in 1983, most industries had responded to at least two occupational employment surveys. Because, however, only 13 States participated in the first wave of OES surveys in the late 1970's, geographic comparability was not maintained between the first and second waves of occupational employment surveys. In addition, the economy went into a deep recession in 1981. Thus, the 3 years of occupa-

tional employment survey trend data that were available to BLS analysts constituted unreliable indicators of future changes in staffing patterns, and appear not to have been heavily used to project future staffing ratios.

Current Population Survey data were available and were used to some degree but the sample was and is too small to provide reliable indicators of trends for detailed occupations. Complicating matters further was the change in the occupational classification system used for the 1980 census that was introduced into the Current Population Survey and the Occupational Employment Survey in 1982 and 1983. This meant that observed changes in staffing patterns between the 1970 and 1980 censuses could not be simply extrapolated into the future. It also meant that much of the data collected in the third and fourth waves of occupational employment surveys was inconsistent with data collected prior to 1983.

Comparability over time is also threatened by the periodic changes in the industry-specific list of occupations that respondents receive on their questionnaire. BLS staff feel that these

changes in the format of the questionnaire have often resulted in data that is not comparable over time. Given these data problems and BLS' focus on projecting employment in more than 500 different occupations, it is easy to see why BLS has not chosen to systematically extrapolate past trends in occupational staffing ratios derived from occupational employment data, but rather to rely on the judgment of analysts who can take problems of data quality into account. Sometimes the analysts feel that they are knowledgeable enough about the situation in a particular industry to project substantial changes in staffing patterns. But projecting big changes in staffing patterns is definitely perceived as "going out on a limb."¹⁶ Moreover, the staff is small and cannot be expert about all industries and occupations.

Based on this characterization of the methodology employed for the projections published in 1983 and subsequently, we would expect the projections to under-project the growth of higher-skill occupations but not by as much as the 1981 projections.

This appears to be what happened. The projections published in 1983 and 1985 appear to have substantially under-projected the growth of skilled jobs. The projections published in 1983 and 1985 projected that operative, laborer and service jobs would account for 27.8 percent of employment growth to 1995 and that professional, technical, and managerial jobs would account for 35 to 38.7 percent of employment growth. It is now clear that these projections are also far off the mark. The lower-skill categories (operatives, laborers, farm laborers, and service workers) in fact accounted for none of the employment growth between 1980 and 1984, and only 11.5 to 21.4 percent of the growth between 1984 and 1991. By contrast, the higher-skill categories (professional, technical, and managerial) accounted for 55.4 percent of employment growth between 1980 and 1984, 46.9 percent of growth between 1984 and 1988, and 87.5 percent of growth between March 1988 and March 1991. It would take a massive reversal of recent job growth patterns during the 1991 to 1995 period to make the BLS 1995 projections come true.□

Table 5. **Actual and projected growth of major occupational groups, 1970-1980**

Major occupational group	Growth rates ¹		Difference (actual (-) projected)		Share of employment increase ²
	Actual	BLS projected	Percent of base	Numbers (in thousands)	
Total	23.6	20.9	2.8	2,185	—
Managerial	31.7	14.6	17.1	1,419	14.0
Professional, technical	40.2	39.1	1.1	113	24.0
Sales occupations	27.2	18.7	8.5	412	7.0
Clerical occupations	32.0	26.0	6.0	820	24.0
Service workers	33.4	34.5	-1.1	-102	17.0
Craft and kindred workers	23.3	20.5	2.8	289	13.0
Operatives	-7	11.0	-11.7	-1,626	-1.0
Nonfarm laborers	19.7	-6	20.3	756	4.0
Farm workers	-13.5	-16.8	3.3	104	-2.0
Average projection error	³ 16.4	—	⁴ 6.8	—	—

¹ Actual and projected growth rates measured from 1970 to 1980.

² 1970 to 1980.

³ Average absolute size of the projection error if all occupations had been assumed to grow at the same rate. It is the mean difference (without regard to sign) between the occupation's percentage growth and the percentage growth of total employment.

⁴ Average absolute size of the difference between actual 1970 to 1980 percentage growth and projected growth plus 2.8 (to adjust for differences between projected and actual 1980 employment levels).

SOURCE: All data are taken from Max Carey and Kevin Kasunic, "Evaluating the 1980 projections of occupational employment," *Monthly Labor Review*, July 1982, p. 23.

Footnotes

ACKNOWLEDGMENT: This paper has benefited from conversations with BLS Associate Commissioner for Employment Projections Ronald E. Kutscher and other staff at the Bureau of Labor Statistics.

¹ See, for example, Education Commission of the States, "The Information Society: Are High School Graduates Ready?" Denver, CO, Education Commission of the States, 1982, p. 1; Russell Rumberger and Henry Levin, "Forecasting the Impact of New Technologies on the Future Job Market," Institute for Research on Education, Finance, and Government, February 1984, pp. 1-32; Russell Rumberger, "The Potential Impact of Technology on the Skill Requirements of Future Jobs," in Gerald Burke and Russell Rumberger, eds., *The Future Impact of Technology on Work and Education* (Philadelphia, PA, Falmer Press, 1987); and Henry Levin and Russell Rumberger, "Educational Requirements for New Technologies: Visions, Possibilities, and Current Realities," *Educational Policy*, Vol. 1, No. 3, 1987, p. 344.

² Max Carey, "Occupational employment growth through 1990," *Monthly Labor Review*, August 1981, pp. 42-55.

³ George Silvestri, John M. Lukasiewicz, and Marcus E. Einstein, "Occupational employment projections through 1995," *Monthly Labor Review*, November 1983, pp. 37-40.

⁴ Gloria Peterson Green, Khoan tan Dinh, John A. Priebe, and Ronald R. Tucker, "Revisions in the Current Population Survey Beginning in January 1983," *Employment and Earnings*, February 1983, pp. 7-15. For managers, this involved adding accountants, personnel and labor relations workers, and inspectors, n.e.c., to and subtracting ships officers and conductors from both the 1978 base and the 1990 projection. For professional workers, it involved adding decorators and window dressers, and health trainees, and subtracting accountants, personnel and labor relations workers, computer programmers, and sales engineers. When separate data were not available for some of the smaller occupations that were reclassified, they were left in the major group they had been in prior to 1983. The BLS has published CPS-based yearly estimates of employment by major occupational category back to 1972, using the 1980 census classification system in Deborah Pisetznier Klein, "Occupational Employment Statistics for 1972-82," *Employment and Earnings*, January 1984. This data series was used to calculate actual percentage rates of growth and actual shares of employment growth. Thus percentage growth calculations are based on definitions of major occupational categories that are consistent over time, but there are slight differences in the detailed occupations included

in a major occupational category for the two calculations. The data on 1989 employment are from *Employment and Earnings*, January 1990.

⁵ A household survey, like the CPS, yields data on the share of workers who describe themselves as being in a given occupation not the share of jobs that employers describe as being in a particular occupation. The advantage of CPS data is that it is available on a yearly basis, there is almost no reporting lag, and there is no danger of missing jobs being generated at new companies as there is with data derived from establishment surveys. A further advantage of the CPS is that it does not double count workers who have more than one job. For supply/demand comparisons, CPS data has the further advantage of also being the source of data on educational attainment. This means that under enumeration of undocumented workers and homeless individuals has little effect on estimates of the balance between supply and demand because these individuals are excluded from both sides of the equation.

The disadvantage of CPS data is the possibility that self reports of occupation are less accurate than data collected from employers. On the other hand, the data collection procedures used by the CPS have been more stable over time than those used by the Occupational Employment Survey, so CPS estimates of rates of change of occupational shares for the whole economy appear to be more reliable than OES estimates. In recognition of this fact, BLS articles describing past changes in occupational shares have been based on CPS data.

⁶ The ratio of Occupational Employment Survey and Current Population Survey estimates of aggregate occupational employment were calculated for both 1988 and 1978. Changes in these ratios were then used to construct an estimate of 1978-89 occupational employment growth based on OES data.

⁷ This characterization of how occupational staffing patterns were projected is based on the *BLS Handbook of Methods*, Bulletin 2134-1 (Bureau of Labor Statistics, 1982), p. 143, and conversations with Associate Commissioner Ronald E. Kutscher of BLS.

⁸ *BLS Handbook of Methods*, p. 143.

⁹ Deborah Pisetznier Klein, "Occupational Employment Statistics for 1972-82," *Employment and Earnings*, January 1984, pp. 13-16.

¹⁰ The projections of occupational shares that result from assuming constant logarithmic rates of change do not sum to one, however. To assure that final projected shares sum to one, the first stage shares were summed and then new final shares were calculated by dividing the initial projection for each occupation by

this sum. The logarithm of the share not the share itself was extrapolated because declining occupations are eventually projected to have a negative number of workers when a linear specification is used. If linear extrapolation had been substituted, the average absolute value of the projection error would have been slightly higher—7.15 percent of the 1980 baseline levels of employment.

¹¹ The regression model projects a lower high-skill share of employment growth than the simple extrapolations because controlling for the unemployment rate lowers the estimated time trends for higher-skill occupations. The unemployment rate was 7.2 percent in 1980 and this raised the share of professional employment and depressed the share of blue-collar employment in that year. The regression models corrected for this effect. Using 1980 as the final year of the base period for calculating the extrapolation growth rates, however, had the effect of raising the rates of growth for professionals and other white-collar occupations and making more negative the share decline rates of blue-collar occupations. These growth rates happened to be better approximations of what was about to happen than the regression-estimated trends.

¹² Projected and actual employment levels for 1974-75 are from Max Carey, "Evaluating the 1975 projections of occupational employment," *Monthly Labor Review*, June 1980, p. 14. Estimates of occupational employment levels in 1966 are from *Tomorrow's Manpower Needs: Volume III*, Bulletin 1606 (Bureau of Labor Statistics, 1969), p. 4. Comparisons are made with actual levels of employment in 1974 rather than 1975 because 1975 was a period of deep recession. The projection had assumed that the unemployment rate would be 3 percent in 1975. It was thought that 1974 was a closer approximation to the tight economy that had been assumed in the projection.

¹³ Max Carey and Kevin Kasunic, "Evaluating the 1980 projections of occupational employment," *Monthly Labor Review*, July 1982, pp. 22-30.

¹⁴ *Tomorrow's Manpower Needs: Volume IV*, Bulletin 1606 (Bureau of Labor Statistics, 1969), p. 9.

¹⁵ George Silvestri and John Lukasiewicz, "Occupational employment projections: the 1984-85 outlook," *Monthly Labor Review*, November 1985, p. 59.

¹⁶ This same phrase was also used by Faye Duchin in describing how she and Wassily Leontief felt when they projected major declines in the employment of draftsmen and clerical workers as a consequence of the growth of micro-computer technology.