Evaluating the BLS 1988–2000 employment projections

BLS employment projections for the period from 1988 to 2000 were borne out in most broad occupations; the chief source of error was the projection of changes in staffing patterns, attributable primarily to the conservative nature of the projections

Andrew Alpert
and
Jill Auyer

The BLS occupational employment projections developed for the 1988–2000 period were reasonably accurate, correctly capturing most general occupational trends. As with previous evaluations, however, the inaccuracies that surfaced reflected a conservative tilt to the projections. The primary source of error was the projection of changes in the utilization of occupations by industry, or staffing patterns, rather than the projections of industry employment themselves.

Evaluation measures

In the study presented in this article, several different measures were used to assess the accuracy of the projections for both major occupational groups and detailed occupations. Among the various measures, the most traditional involved comparing actual with projected employment in terms of percent change, numerical growth, and share of employment growth between 1988 and 2000. An absolute percent error—the absolute value of the numerical error divided by actual employment in the target year of the projection—was calculated for all major groups and detailed occupations. The actual and projected *directions* of change also were compared, to see whether employment in occupations that were projected to grow or decline actually did so.[1] Finally, because the 1988–2000 occupational employment projections were the basis for job outlook information presented in the 1990–91 edition of the *Occupational Outlook Handbook*, the accuracy of the projections was assessed in terms of the assumptions made about the factors affecting employment growth or decline.

Major occupational groups

Total employment grew by 21.7 percent between 1988 and 2000, slightly faster than the 15.3 percent that had been projected. The difference is largely the result of an underprojection of total employment by about 7.6 million. The direction of the employment change was anticipated correctly for all but one of the nine major groups. Employment in eight of the nine groups was underestimated. (See table 1.)

All but three of the major groups had absolute percent errors of less than 10 percent. The category of agriculture, forestry, fishing,

Andrew Alpert and Jill Auyer are economists in the Office of Occupational Statistics and Employment Projections, Bureau of Labor Statistics. E-mail: alpert.andrew@bls.gov or auyer.jill@bls.gov

Table 1. Employment, by major occupational group, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, 2000[1]	Share of total job growth, 1988–2000 (percent)	
	Projected 2000			Actual 2000							
	1988	Level	Share (percent)	Level	Share (percent)	Projected	Actual			Projected	Actual
Total, all occupations	118,104	136,211	100.0	143,786	100.0	15.3	21.7	–7,575	5.3	100.0	100.0
Executive, administrative, and managerial	12,297	15,006	11.0	14,995	10.4	22.0	21.9	11	.1	15.0	10.5
Professional specialty	14,568	18,070	13.3	20,360	14.2	24.0	39.8	–2,290	11.2	19.3	22.5
Technicians and related support	3,919	5,146	3.8	5,202	3.6	31.3	32.8	–56	1.1	6.8	5.0
Marketing and sales	12,109	14,535	10.7	15,485	10.8	20.0	27.9	–950	6.1	13.4	13.1
Administrative support, including clerical	22,080	24,698	18.1	25,564	17.8	11.9	15.8	–865	3.4	14.5	13.6
Service	18,479	22,651	16.6	23,160	16.1	22.6	25.3	–509	2.2	23.0	18.2
Agriculture, foresty, fishing, and related	3,503	3,334	2.4	3,998	2.8	–4.8	14.1	–664	16.6	–.9	1.9
Precision production, craft, and repair	14,427	15,866	11.6	16,022	11.1	10.0	11.1	–156	1.0	7.9	6.2
Operators, fabricators, and laborers	16,721	16,904	12.4	19,000	13.2	1.1	13.6	–2,097	11.0	1.0	8.9

[1] The absolute percent error is calculated as the numerical error (positive or negative), divided by actual employment in the target year of the projection.

and related occupations had the highest error of any major group, 16.6 percent. Professional specialty occupations and operators, fabricators, and laborers also had relatively high errors, 11.2 percent and 11.0 percent, respectively. The group with the lowest absolute error, 0.1 percent, was executive, administrative, and managerial occupations.

Five of the nine major groups had absolute errors below 5 percent. Of the five, the category of executive, administrative, and managerial occupations not only was the most accurately projected major group, but also was the lone group for which employment was overprojected. Technicians and related support occupations and precision production, craft, and repair occupations also had very low errors, 1.1 percent and 1.0 percent, respectively. The absolute percent error was 2.2 percent for service occupations and 3.4 percent for administrative support occupations.

In addition to making reasonably accurate employment projections at the aggregate major group level, the Bureau projected the share of total job growth of each group fairly accurately. For example, professional specialty occupations had the largest numerical error, off by more than 2 million workers, but still, the category's share of total job growth was underprojected by only 3.2 percent. The largest difference in share of job growth was 7.9 percent, for operators, fabricators, and laborers; the group's growth was projected to be 1 percent, but actually was 8.9 percent. The gap was due mainly to an overestimation of the effects of automation on the demand for workers.

Although agriculture, forestry, fishing, and related occupations had the highest employment projection error, at 16.6 percent, the group's share of total job growth was underprojected by only 2.8 percent. The group was projected to have a negative share of total job growth, but the share was actually positive. Finally, the share of total job growth accounted for by executive, administrative, and management occupations, the most accurately projected group, was actually overprojected by 4.5 percent.

Significant errors in the projections for detailed occupations with sizable employment can have a substantial impact on the overall projections for their respective groups. For example, employment in professional specialty occupations was projected to increase 24 percent over the 1988–2000 period; however, employment actually grew by 39.8 percent. Thus, employment in the category was underprojected by more than 2 million workers. Underprojections for several large professional specialty occupations—college and university faculty, social workers, special-education teachers, and teachers and instructors of vocational education and training—contributed significantly. In addition, an underprojection of computer-related employment by about 1 million workers had a substantial impact.[2]

Operators, fabricators, and laborers also were underprojected by more than 2 million workers. Together, the two categories (that is, operators, fabricators, and laborers and professional specialty occupations) accounted for almost three-fifths of the total numerical projection error for all

Table 2. Employment, by occupation, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
	1988	Projected 2000		Actual 2000		Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
		Level	Share (percent)	Level	Share (percent)								
Total, all occupations	118,104	136,211	100.00	143,786	100.00	15.3	21.7	–7,575	5.3	0.0	5.3	100.00	100.00
File clerks	263	290	.21	290	.20	10.2	10.2	0	.0	12.1	10.6	.15	.10
Property, real-estate, and community association managers	225	267	.20	267	.19	19.0	18.9	0	.1	1.4	.3	.24	.17
Directory assistance operators	33	26	.02	26	.02	–20.6	–20.4	0	.2	23.6	19.2	–.04	–.03
Credit checkers	35	44	.03	44	.03	26.4	25.9	0	.4	1.6	5.4	.05	.04
Farmworkers	938	785	.58	781	.54	–16.3	–16.7	3	.4	10.4	12.6	–.85	–.61
Advertising, marketing, promotions, public relations, and sales managers	406	511	.37	508	.35	25.7	25.2	2	.5	18.1	7.0	.58	.40
Mail clerks, except mail machine operators and postal service	136	137	.10	137	.09	1.2	.6	1	.6	12.6	11.1	.01	.00
Guards	795	1,050	.77	1,044	.73	32.2	31.4	6	.6	53.7	14.2	1.41	.97
Surgical technologists	35	55	.04	55	.04	56.4	55.2	0	.8	7.0	7.2	.11	.08
Stock clerks and order fillers	2,152	2,406	1.77	2,426	1.69	11.8	12.7	–20	.8	.8	1.8	1.40	1.07
General managers and top executives	3,030	3,509	2.58	3,539	2.46	15.8	16.8	–31	.9	7.0	6.3	2.64	1.98
Statistical clerks	77	76	.06	75	.05	–1.7	–2.6	1	.9	5.4	3.9	–.01	–.01
Engineering, natural science, and computer and information systems managers	258	341	.25	344	.24	32.0	33.3	-3	1.0	2.1	5.3	.46	.33
Maintenance repairers, general utility	1,080	1,282	.94	1,269	.88	18.7	17.5	12	1.0	5.4	6.3	1.11	.74
Pipelayers and pipelaying fitters	52	59	.04	59	.04	13.3	12.1	1	1.0	11.3	6.2	.04	.02
Helpers, construction trades	555	633	.46	640	.44	14.1	15.3	–7	1.0	9.6	10.5	.43	.33
Surveyors, cartographers, and photogrammetrists	40	45	.03	45	.03	10.9	12.2	–1	1.1	.4	4.4	.02	.02
Air traffic controllers	27	31	.02	31	.02	15.5	16.9	0	1.2	5.1	6.9	.02	.02
Drywall installers and finishers	152	178	.13	176	.12	16.9	15.4	2	1.4	1.2	3.1	.14	.09
Bank tellers	522	546	.40	555	.39	4.6	6.2	–9	1.6	18.3	15.2	.13	.13
Title examiners, abstractors, and searchers	27	31	.02	32	.02	17.3	19.2	–1	1.6	13.4	13.7	.3	.02
Production, planning, and expediting clerks	229	250	.18	254	.18	9.4	11.2	–4	1.7	5.1	2.1	.12	.10
Librarians	143	157	.12	160	.11	10.0	12.0	–3	1.8	12.8	13.0	.8	.07
Securities, commodities, and financial services sales agents	200	309	.23	315	.22	54.8	57.6	–6	1.8	1.5	3.1	.60	.45
Cooks, short order and fast food	630	719	.53	705	.49	14.1	12.0	14	1.9	6.3	3.8	.49	.29
Architects, except landscape and naval	86	107	.08	105	.07	24.7	22.3	2	2.0	4.1	1.8	.12	.07
Machine feeders and offbearers	249	218	.16	213	.15	–12.5	–14.2	4	2.0	2.8	1.0	–.17	–.14

Table 2. Continued—Employment, by occupation, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
		Projected 2000		Actual 2000									
	1988	Level	Share (percent)	Level	Share (percent)	Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
Machine-forming operators and tenders, metal and plastic	184	166	.12	169	.12	–10.0	–8.1	–3	2.0	10.3	15.5	–.10	–.06
Purchasing agents, except wholesale, retail, and farm products	206	236	.17	231	.16	14.6	12.2	5	2.2	1.8	.7	.17	.10
Industrial machinery mechanics	463	538	.40	526	.37	16.2	13.7	12	2.2	1.5	5.1	.41	.25
Firefighters	233	257	.19	251	.17	10.3	7.9	6	2.2	18.1	13.3	.13	.07
Plastic molding machine setters, setup operators, operators, and tenders	144	176	.13	172	.12	22.2	19.2	4	2.4	2.7	2.0	.18	.11
Musicians, singers, and related workers	229	251	.18	245	.17	9.5	6.9	6	2.5	26.1	15.3	.12	.06
Grinding, lapping, and buffing machine toolsetters and setup operators, metal and plastic	72	70	.05	72	.05	–2.1	.4	–2	2.5	1.4	4.6	–.1	.0
Operations research analysts	55	85	.06	83	.06	55.4	51.5	2	2.6	5.8	9.7	.17	.11
Sewing machine operators, nongarment	143	135	.10	131	.09	–5.6	–8.1	4	2.7	3.9	4.7	–.4	–.04
Paralegals and legal assistants	83	145	.11	141	.10	75.3	70.6	4	2.8	10.1	13.3	.34	0.23
Designers, except interior designers	236	301	.22	311	.22	27.4	31.5	–10	3.1	5.4	.6	.36	0.29
Insurance adjusters, examiners, and investigators	145	175	.13	180	.13	20.0	23.9	–6	3.2	4.4	1.8	.16	0.14
Bakers, bread and pastry	124	167	.12	172	.12	34.8	39.3	–5	3.2	7.3	4.4	.24	0.19
Registered nurses	1,577	2,190	1.61	2,120	1.47	38.8	34.4	70	3.3	3.4	1.4	3.38	2.11
Real-estate appraisers	41	49	.04	47	.03	19.9	16.0	2	3.3	8.9	5.1	.04	.03
Insulation workers	64	77	.06	74	.05	19.2	15.3	2	3.3	5.6	5.2	.07	.04
Machinists	397	433	.32	418	.29	9.1	5.5	14	3.4	9.4	4.1	.20	.08
Aircraft mechanics and service technicians	124	144	.11	140	.10	16.4	12.5	5	3.5	31.6	12.4	.11	.06
Painters and paperhangers	431	501	.37	484	.34	16.3	12.2	18	3.6	4.0	.9	.39	.20
Structural and reinforcing metal workers	78	92	.07	88	.06	18.2	14.0	3	3.7	17.3	11.4	.08	.04
Food preparation workers	1,027	1,260	.93	1,310	.91	22.8	27.5	–49	3.8	1.3	4.6	1.29	1.10
Plumbers, pipefitters, and steamfitters	396	469	.34	451	.31	18.4	14.0	17	3.9	14.0	9.6	.40	.22
Farm managers	131	160	.12	154	.11	22.1	17.6	6	3.9	21.4	11.2	.16	.09
Court clerks	42	51	.04	53	.04	21.4	26.4	–2	3.9	10.3	12.8	.05	.04
Medical assistants	149	253	.19	263	.18	70.1	77.1	–10	4.0	1.0	4.0	.58	.45
Announcers	49	59	.04	56	.04	19.2	14.4	2	4.2	.7	5.0	.05	.03
Painters, transportation equipment	46	45	.03	43	.03	–3.5	–7.5	2	4.3	6.5	3.8	–.01	–.01
Payroll and timekeeping clerks	176	172	.13	180	.12	–2.4	2.1	–8	4.4	4.0	7.2	–.02	.01

Table 2. Continued—Employment, by occupation, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
		Projected 2000		Actual 2000									
	1988	Level	Share (percent)	Level	Share (percent)	Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
Janitors and cleaners, including maids and housekeeping cleaners	2,895	3,450	2.53	3,300	2.30	19.2	14.0	150	4.5	8.7	4.2	3.07	1.58
Recreational therapists	26	35	.03	37	.03	36.9	43.5	–2	4.6	6.6	2.5	.05	.04
Artists and commercial artists	216	274	.20	287	.20	27.1	33.2	–13	4.6	.4	3.5	.32	.28
Coating, painting, and spraying machine operators, tenders, setters, and setup operators	113	123	.09	129	.09	9.0	14.5	–6	4.8	2.3	2.7	.06	.06
College and university faculty	846	869	.64	913	.64	2.8	8.0	–45	4.9	11.6	14.8	.13	.26
Paving, surfacing, and tamping equipment operators	70	82	.06	78	.05	16.6	11.2	4	4.9	19.6	12.2	.06	.03
Sheet metal workers and duct installers	246	257	.19	245	.17	4.3	–.6	12	5.0	17.3	10.9	.06	–.01
Computer programmers	519	769	.56	731	.51	48.1	40.9	37	5.1	27.5	22.8	1.38	.83
Baggage porters and bellhops	32	40	.03	43	.03	25.9	33.0	–2	5.3	4.6	4.4	.05	.04
Taxi drivers and chauffeurs	109	137	.10	130	.09	26.0	19.4	7	5.4	11.4	13.2	.16	.08
Freight, stock, and material movers, hand	884	905	.66	858	.60	2.4	–2.9	47	5.5	14.7	11.1	.12	–.10
Systems analysts	403	617	.45	653	.45	53.3	62.2	–36	5.5	3.8	11.3	1.18	.97
Woodworking machine operators and tenders, setters and setup operators	69	75	.06	80	.06	8.2	14.6	–4	5.6	2.0	3.8	.03	.04
Punching machine setters and setup operators, metal and plastic	51	50	.04	47	.03	–2.1	–7.3	3	5.6	12.5	7.5	–.01	–.01
Pest control workers	48	56	.04	53	.04	16.5	10.2	3	5.7	1.7	2.6	.04	.02
Chemists	80	93	.07	99	.07	16.7	23.8	–6	5.7	13.4	4.6	.07	.07
Postal mail carriers	285	310	.23	329	.23	8.8	15.5	–19	5.8	7.7	2.1	.14	.17
Human resources assistants, except payroll and time-keeping	129	141	.10	150	.10	9.4	16.3	–9	5.9	4.6	8.1	.07	.08
Billing, cost, and rate clerks	323	333	.24	355	.25	3.4	9.9	–21	6.0	2.9	5.7	.06	.12
Dispatchers, except police, fire, and ambulance	137	160	.12	170	.12	16.5	23.9	–10	6.0	.8	9.7	.13	.13
Textile bleaching and dyeing machine operators and tenders	26	23	.02	22	.01	–13.4	–18.3	1	6.0	13.4	23.0	–.02	–.02
Crossing guards	57	61	.04	57	.04	6.9	.8	3	6.0	23.0	14.3	.02	.00
Veterinarians	46	57	.04	61	.04	25.5	33.6	–4	6.0	11.4	15.2	.06	.06
Office machine and cash register servicers	56	57	.04	61	.04	1.3	7.8	–4	6.1	41.2	19.3	.00	.02

Table 2. Continued—Employment, by occupation, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
	1988	Projected 2000		Actual 2000		Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
		Level	Share (percent)	Level	Share (percent)								
Paper goods machine setters and setup operators	54	56	.04	60	.04	4.7	11.5	–4	6.1	9.4	4.0	.01	.02
Cooks, institution or cafeteria	403	467	.34	440	.31	16.0	9.3	27	6.1	20.0	10.4	.36	.15
Roofers	123	147	.11	156	.11	19.2	27.0	–10	6.2	6.4	.9	.13	.13
Civil engineers	186	219	.16	206	.14	17.4	10.5	13	6.2	10.8	5.3	.18	.08
Child care workers	670	856	.63	915	.64	27.8	36.6	–59	6.5	4.3	5.0	1.03	.95
Loan and credit clerks	151	192	.14	180	.13	27.2	19.5	12	6.5	6.5	8.1	.23	.11
Office clerks, general	2,519	2,974	2.18	3,192	2.22	18.1	26.7	–218	6.8	4.8	9.0	2.51	2.62
Bookkeeping, accounting, and auditing clerks	2,252	2,272	1.67	2,125	1.48	.9	-5.6	146	6.9	12.2	4.0	.11	–.49
Communication, transportation, and utilities operations managers	167	194	.14	209	.15	16.3	25.3	–15	7.2	5.9	12.1	.15	.16
Loan counselors and officers	172	209	.15	225	.16	21.5	31.0	–16	7.2	13.7	3.4	.20	.21
Dietitians and nutritionists	40	51	.04	55	.04	27.8	37.8	–4	7.3	8.3	2.6	.06	.06
Millwrights	77	90	.07	84	.06	17.3	9.2	6	7.5	12.4	5.6	.07	.03
Industrial truck and tractor operators	421	400	.29	433	.30	–5.1	2.8	–33	7.6	3.0	11.8	–.12	.05
Hard-tile setters	26	32	.02	30	.02	22.4	13.7	2	7.7	6.4	1.6	.03	.01
Teachers, secondary school	1,164	1,388	1.02	1,506	1.05	19.2	29.4	–118	7.8	8.1	14.8	1.24	1.33
Accountants and auditors	963	1,174	.86	1,089	.76	22.0	13.1	86	7.9	8.1	1.2	1.17	0.49
Electromechanical equipment assemblers, precision	59	53	.04	49	.03	–9.9	–16.6	4	8.0	6.3	5.8	–.03	–.04
Retail salespersons	3,834	4,564	3.35	4,223	2.94	19.0	10.2	340	8.1	8.5	1.0	4.03	1.52
Pharmacists	162	206	.15	191	.13	26.9	17.4	16	8.2	5.8	.5	.24	.11
Aircraft pilots and flight engineers	83	108	.08	100	.07	30.9	20.9	8	8.3	59.9	30.9	.14	.07
Physical therapists	68	107	.08	117	.08	57.0	71.4	–10	8.4	3.7	3.3	.21	.19
Grinders and polishers, hand	84	74	.05	80	.06	–12.6	–4.5	–7	8.5	4.4	3.2	–.06	–.01
Coin, vending, and amusement machine servicers and repairers	27	27	.02	30	.02	.5	10.0	–3	8.6	21.2	23.6	.00	.01
Inspectors, testers, and graders, precision	676	634	.47	693	.48	–6.2	2.6	–60	8.6	11.7	2.3	–.23	.07
Cement masons, concrete finishers, and terrazzo workers	114	134	.10	146	.10	16.9	27.9	–13	8.6	14.7	17.5	.11	.12
Bus drivers, school	349	418	.31	458	.32	19.9	31.3	–40	8.7	7.9	15.5	.38	.43
Cleaners and servants, private household	477	464	.34	509	.35	–2.6	6.7	–45	8.8	25.2	22.0	–.07	.12
Psychologists	104	132	.10	145	.10	27.0	39.5	–13	9.0	8.1	.3	.16	.16
Construction and building inspectors	56	64	.05	70	.05	14.2	25.7	–6	9.2	6.3	10.0	.04	.06
Combination machine tool setters, setup operators, operators, and tenders, metal and plastic	89	97	.07	107	.07	9.1	20.3	–10	9.3	1.8	5.7	.04	.07

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[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
	1988	Projected 2000		Actual 2000		Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
		Level	Share (percent)	Level	Share (percent)								
Data entry keyers	452	426	.31	471	.33	–5.6	4.2	–44	9.4	17.1	18.9	–.14	.07
Respiratory therapists	56	79	.06	87	.06	41.3	56.3	–8	9.6	15.8	7.8	.13	.12
Insurance policy processing clerks	171	186	.14	170	.12	8.8	–.9	17	9.8	5.1	4.5	.08	–.01
Truckdrivers, light and heavy	2,399	2,768	2.03	3,072	2.14	15.4	28.0	–303	9.9	3.4	6.8	2.04	2.62
Welfare eligibility workers and interviewers	91	102	.07	113	.08	12.0	24.3	–11	9.9	3.2	4.6	.06	.09
Opticians, dispensing	49	65	.05	72	.05	31.5	45.9	–7	9.9	3.4	7.2	.09	.09
Police patrol officers	367	421	.31	467	.32	14.7	27.3	–46	9.9	4.4	12.8	.30	.39
Supervisors, farming, forestry, and agricutural-related occupations	76	80	.06	89	.06	5.6	17.6	–9	10.2	10.0	12.9	.02	.05
Electricians	542	638	.47	712	.50	17.8	31.5	–74	10.4	6.0	16.6	.53	.66
Cement and gluing machine operators and tenders	40	36	.03	32	.02	–11.1	–19.5	3	10.5	7.8	.1	–.02	–.03
Waiters and waitresses	1,786	2,337	1.72	2,115	1.47	30.9	18.4	223	10.5	16.0	4.6	3.04	1.28
Electrolytic plating machine setters, setup operators, operators, and tenders, metal and plastic	44	41	.03	46	.03	–7.9	3.1	–5	10.7	6.5	6.5	–.02	.01
Cooks, restaurant	572	728	.53	816	.57	27.2	42.5	–88	10.8	7.6	3.5	.86	.95
Financial managers	673	802	.59	724	.50	19.3	7.7	78	10.8	12.9	3.3	.72	.20
Clinical laboratory technologists and technicians	242	288	.21	324	.23	19.2	33.9	–36	11.0	15.7	5.3	.26	.32
Painting, coating, and decorating workers, hand	45	43	.03	39	.03	–4.4	–13.9	4	11.0	9.0	5.3	–.01	–.02
Physician assistants	48	62	.05	69	.05	28.1	44.0	–8	11.1	8.5	3.0	.07	.08
Legal secretaries	263	329	.24	296	.21	25.5	12.7	34	11.3	4.6	15.3	.37	.13
Food counter, fountain, and related workers	1,626	1,866	1.37	2,108	1.47	14.7	29.6	–242	11.5	7.7	4.0	1.32	1.88
Duplicating, mail, and other office machine operators	164	181	.13	205	.14	10.5	24.8	–24	11.5	.4	6.1	.09	.16
Farm equipment mechanics	54	55	.04	49	.03	1.4	–9.1	6	11.5	29.1	67.9	.00	–.02
Meat, poultry, and fish cutters and trimmers, hand	110	129	.09	145	.10	16.6	31.9	–17	11.6	5.3	15.7	.10	.14
Heating, air-conditioning, and refrigeration mechanics and installers	225	263	.19	298	.21	16.8	32.4	–35	11.8	6.3	6.9	.21	.28
Nursing aides, orderlies, and attendants	1,184	1,562	1.15	1,393	.97	31.9	17.7	168	12.1	11.5	.5	2.09	.82
Carpenters	1,081	1,257	.92	1,120	.78	16.2	3.6	136	12.2	14.3	3.9	.97	.15
Weighers, measurers, checkers, and samplers, recordkeeping	40	45	.03	52	.04	12.2	28.0	–6	12.3	8.9	5.4	.03	.04
Meter readers, utilities	49	45	.03	51	.04	–8.8	4.2	–6	12.4	18.7	10.4	–.02	.01

Table 2. Continued—Employment, by occupation, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
	1988	Projected 2000		Actual 2000		Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
		Level	Share (percent)	Level	Share (percent)								
Automotive mechanics and service technicians	771	898	.66	798	.56	16.3	3.5	99	12.4	13.8	1.5	.70	.10
Recreation workers	186	221	.16	252	.18	18.9	35.8	–32	12.5	.7	11.3	.19	.26
Geologists, geophysicists, and oceanographers	42	49	.04	44	.03	15.7	2.7	6	12.6	11.1	.1	.04	.00
Human resources managers	171	208	.15	239	.17	22.1	40.0	–31	12.8	10.0	6.8	.21	.27
Lawyers	582	763	.56	676	.47	31.0	16.0	87	12.9	1.6	11.0	1.00	.36
Photographers	94	111	.08	128	.09	17.5	35.3	–17	13.2	61.1	3.6	.09	.13
Private detectives and investigators	47	61	.04	54	.04	30.8	15.5	7	13.2	24.4	2.7	.08	.03
Blue-collar worker supervisors	1,797	1,930	1.42	2,237	1.56	7.4	24.5	–307	13.7	12.0	2.7	.73	1.71
Stationary engineers	36	36	.03	31	.02	–1.3	–13.6	4	14.2	11.5	1.3	.00	–.02
Textile drawout and winding machine operators and tenders	227	197	.14	172	.12	–13.3	–24.2	25	14.3	2.7	18.6	–.17	–.21
Interviewing clerks, except personnel and social welfare	129	152	.11	133	.09	17.8	2.9	19	14.4	32.6	6.4	.13	.01
Laborers, landscaping and groundskeeping	806	998	.73	1,166	.81	23.8	44.6	–168	14.4	1.0	14.6	1.06	1.40
Cutting and slicing machine setters, operators, and tenders	91	80	.06	93	.06	–12.2	2.7	–14	14.5	15.4	3.7	–.06	.01
Government chief executives and legislators	69	71	.05	84	.06	3.0	20.7	–12	14.7	1.5	13.7	.01	.06
Automotive body and related repairers	214	270	.20	235	.16	26.2	10.0	35	14.7	18.4	2.7	.31	.08
Mobile heavy equipment mechanics	108	124	.09	108	.07	14.4	–.4	16	14.9	6.5	31.7	.09	.00
Hairdressers, hairstylists, and cosmetologists	609	683	.50	594	.41	12.1	–2.5	89	15.0	9.2	4.9	.41	–.06
Receptionists and information clerks	833	1,164	.85	1,370	.95	39.8	64.5	–206	15.0	3.0	8.5	1.83	2.09
Flight attendants	88	123	.09	106	.07	38.7	20.5	16	15.1	81.6	36.0	.19	.07
Optometrists	37	43	.03	37	.03	16.5	1.1	6	15.3	20.1	2.5	.03	.00
Extruding and forming machine setters, operators, and tenders	100	106	.08	125	.09	6.3	25.5	–19	15.3	8.3	8.2	.03	.10
Water and liquid waste treatment plant and system operators	76	87	.06	103	.07	14.5	35.5	–16	15.5	1.0	14.3	.06	.11
Biological scientists	57	72	.05	85	.06	26.0	49.2	–13	15.6	19.1	6.0	.08	.11
Secretaries, except legal and medical	2,903	3,288	2.41	2,845	1.98	13.2	–2.0	443	15.6	30.8	10.5	2.12	–.23
Physicians	535	684	.50	591	.41	27.8	10.4	93	15.7	14.0	1.1	.82	.22
Printing press machine setters, operators, and tenders	108	119	.09	141	.10	9.5	30.1	–22	15.9	16.1	4.6	.06	.13

Table 2. Continued—Employment, by occupation, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
		Projected 2000		Actual 2000									
	1988	Level	Share (percent)	Level	Share (percent)	Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
New-accounts clerks, banking	108	129	.09	111	.08	19.0	2.5	18	16.2	2.4	14.8	.11	.01
Bus drivers, transit and intercity	157	175	.13	210	.15	11.7	33.8	–35	16.5	5.7	19.6	.10	.21
Bricklayers, blockmasons, and stonemasons	167	193	.14	166	.12	15.8	–.6	27	16.5	14.4	1.9	.15	.00
Hotel, motel, and resort desk clerks	113	142	.10	170	.12	25.9	51.0	–28	16.7	18.8	2.5	.16	.22
Welders and cutters	325	309	.23	371	.26	–5.0	14.1	–62	16.7	11.5	6.8	–.09	.18
Highway maintenance workers	175	190	.14	163	.11	8.7	–6.9	27	16.7	34.6	12.3	.08	–.05
Police and detective supervisors	88	97	.07	116	.08	10.1	32.3	–20	16.8	4.9	11.4	.05	.11
Library assistants and bookmobile drivers	105	111	.08	133	.09	5.8	27.2	–22	16.8	4.2	14.0	.03	.11
Tire repairers and changers	88	100	.07	85	.06	14.1	–2.6	15	17.1	20.3	2.1	.07	–.01
Budget analysts	62	72	.05	61	.04	16.5	–.6	11	17.2	15.5	1.0	.06	.00
Driver/sales workers	242	255	.19	308	.21	5.4	27.4	–53	17.3	13.6	4.8	.07	.26
Dentists	167	189	.14	161	.11	13.1	–3.7	28	17.5	22.6	2.7	.12	–.02
Construction managers	187	236	.17	287	.20	26.0	53.1	–51	17.7	8.8	5.7	.27	.39
Court reporters, medical transcriptionists, and stenographers	159	122	.09	104	.07	–22.8	–34.4	18	17.7	28.0	.6	–.20	–.21
Counselors	124	157	.12	191	.13	26.9	54.3	–34	17.7	4.7	15.1	.18	.26
Public-relations specialists	91	105	.08	128	.09	15.4	40.2	–23	17.7	20.1	7.1	.08	.14
Railroad conductors and yardmasters	27	21	.02	26	.02	–19.5	–2.1	–5	17.8	16.1	1.9	–.03	.00
Logging equipment operators	46	44	.03	53	.04	–5.3	15.3	–9	17.9	11.3	1.3	–.01	.03
Science and mathematics technicians	232	275	.20	233	.16	18.6	.5	42	18.1	13.4	4.3	.24	.00
Bus and truck mechanics and diesel engine specialists	269	312	.23	264	.18	16.1	–1.8	48	18.3	20.8	.9	.24	–.02
Inspectors and compliance officers, except construction	130	148	.11	181	.13	13.9	39.3	–33	18.3	18.0	1.2	.10	.20
Billing and posting clerks and machine operators	99	89	.07	109	.08	–9.5	10.7	–20	18.3	13.8	5.4	–.05	.04
Numerical control machine tool operators and tenders, metal and plastic	64	70	.05	86	.06	9.2	33.7	–16	18.3	15.7	10.1	.03	.08
Tool and die makers	152	159	.12	135	.09	4.5	–11.7	25	18.4	26.8	6.2	.04	–.07
Chemical engineers	49	57	.04	48	.03	16.4	–1.7	9	18.4	4.1	2.2	.04	.00
Couriers and messengers	123	147	.11	124	.09	19.4	.8	23	18.4	12.4	.3	.13	.00
Education administrators	320	382	.28	469	.33	19.4	46.6	–87	18.6	5.6	12.9	.34	.58
Firefighting and prevention supervisors	47	51	.04	63	.04	9.5	34.8	–12	18.8	6.0	13.3	.02	.06
Dental assistants	166	197	.14	243	.17	18.9	46.6	–46	18.9	4.3	15.0	.17	.30

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	1988	Projected 2000		Actual 2000		Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
		Level	Share (percent)	Level	Share (percent)								
Power-generating and reactor plant operators	33	37	.03	31	.02	11.0	–6.8	6	19.1	6.4	31.4	.02	–.01
Cost estimators	169	195	.14	163	.11	15.4	–3.1	31	19.2	26.2	6.9	.14	–.02
Metal fabricators, structural metal products	40	39	.03	48	.03	–2.2	21.5	–9	19.5	4.2	12.4	.00	.03
Central office and PBX installers and repairers	75	59	.04	50	.03	–20.6	–33.7	10	19.7	48.7	18.8	–.09	–.10
Refuse and recyclable material collectors	126	126	.09	105	.07	.1	–16.4	21	19.8	51.0	19.0	.00	–.08
Human resources, training, and labor relations specialists	252	305	.22	381	.26	21.2	51.2	–75	19.8	18.7	4.5	.30	.50
Licensed practical and licensed vocational nurses	626	855	.63	713	.50	36.6	13.9	143	20.0	23.4	1.3	1.27	.34
Electrical power-line installers and repairers	104	122	.09	101	.07	16.8	–2.7	20	20.1	1.2	20.8	.10	–.01
Glaziers	49	58	.04	48	.03	17.6	–2.2	10	20.2	32.7	7.3	.05	.00
Carpet installers	56	68	.05	85	.06	21.2	52.0	–17	20.3	14.2	1.6	.07	.11
Lathe and turning machine tool setters and setup operators, metal and plastic	89	86	.06	71	.05	–3.1	–19.5	14	20.3	29.8	9.8	–.02	–.07
Detectives and criminal investigators	61	66	.05	83	.06	8.9	36.7	–17	20.4	12.8	6.8	.03	.09
Upholsterers	73	81	.06	67	.05	11.2	–7.7	14	20.5	12.8	8.0	.04	–.02
Teachers, preschool	238	309	.23	389	.27	30.2	63.7	–80	20.5	5.9	22.5	.40	.59
Cashiers	2,310	2,614	1.92	3,289	2.29	13.2	42.4	–675	20.5	20.5	.2	1.68	3.81
Bartenders	414	506	.37	419	.29	22.1	1.3	86	20.5	27.2	5.6	.51	.02
Mechanical engineers	225	269	.20	223	.16	19.8	–.7	46	20.7	11.6	1.1	.25	–.01
Dispatchers, police, fire, and ambulance	64	71	.05	89	.06	9.6	38.6	–19	20.9	6.3	15.0	.03	.10
Drafters	319	358	.26	296	.21	12.2	–7.3	62	21.0	25.1	6.3	.22	–.09
Photographic processing machine operators and tenders	49	57	.04	47	.03	17.5	–3.0	10	21.1	29.1	16.3	.05	–.01
Social workers	385	495	.36	629	.44	28.5	63.1	–133	21.2	12.7	7.9	.61	.95
Medical records and health information technicians	47	75	.05	95	.07	59.9	103.1	–20	21.3	25.7	1.7	.15	.19
Crushing, grinding, mixing, and blending machine operators and tenders	136	117	.09	149	.10	–13.9	9.6	–32	21.4	21.0	.5	–.10	.05
Procurement clerks	42	47	.03	59	.04	9.9	40.0	–13	21.5	27.4	2.6	.02	.07
Bindery machine operators and setup operators	63	71	.05	90	.06	11.4	42.1	–19	21.6	28.2	4.1	.04	.10
Office and administrative support supervisors and managers	1,183	1,319	.97	1,683	1.17	11.5	42.3	–364	21.6	16.5	5.6	.75	1.95
Library technicians	54	59	.04	76	.05	8.8	40.0	–17	22.3	8.5	13.6	.03	.08
Welding machine setters, operators, and tenders	99	86	.06	110	.08	–13.7	11.1	–25	22.4	12.1	10.9	–.08	.04

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	1988	Projected 2000		Actual 2000		Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
		Level	Share (percent)	Level	Share (percent)								
Butchers and meatcutters	258	269	.20	219	.15	4.5	–14.8	50	22.7	22.9	.5	.06	–.15
Food service and lodging managers	560	721	.53	587	.41	28.8	4.8	134	22.8	21.4	.3	.89	.11
Hosts and hostesses, restaurant, lounge, or coffee shop	183	239	.18	310	.22	30.5	69.4	–71	23.0	19.6	4.4	.31	.50
Cleaners of vehicles and equipment	215	230	.17	299	.21	7.0	38.9	–69	23.0	2.9	17.2	.08	.33
Clergy	185	199	.15	162	.11	7.2	–12.9	37	23.0	75.9	34.0	.07	–.09
Machine tool cutting operators and tenders, metal and plastic	148	133	.10	108	.08	–10.1	–26.9	25	23.1	34.8	8.8	–.08	–.16
Industrial engineers, except safety engineers	132	155	.11	126	.09	18.0	–4.2	29	23.2	9.2	5.9	.13	–.02
Industrial production managers	215	254	.19	206	.14	18.0	–4.3	48	23.2	20.7	.7	.21	–.04
Animal caretakers, except farm	92	106	.08	138	.10	15.5	50.5	–32	23.2	6.3	13.7	.08	.18
Order clerks	293	289	.21	377	.26	–1.5	28.7	–88	23.4	18.4	7.3	–.02	.33
Brokerage clerks	64	66	.05	86	.06	3.1	34.9	–20	23.5	15.7	9.3	.01	.09
Laundry and drycleaning machine operators and tenders, except pressing	169	208	.15	168	.12	22.8	–1.0	40	24.1	18.6	4.6	.21	–.01
Excavation and loading machine operators	76	84	.06	111	.08	10.2	46.3	–27	24.7	20.7	6.0	.04	.14
Claims examiners, property and casualty insurance	30	37	.03	49	.03	23.5	64.3	–12	24.8	24.3	2.5	.04	.07
Bakers, manufacturing	41	40	.03	53	.04	–3.2	29.6	–13	25.3	18.2	5.0	–.01	.05
Teachers, special education	275	317	.23	429	.30	15.6	56.1	–111	26.0	13.2	14.8	.24	.60
Reservation and transportation ticket agents and travel clerks	133	170	.12	230	.16	27.8	73.1	–60	26.2	6.2	27.4	.20	.38
Conservation scientists and foresters	27	30	.02	40	.03	8.3	47.9	–11	26.7	30.6	1.1	.01	.05
Insurance sales agents	423	481	.35	378	.26	13.7	–10.7	103	27.3	15.2	8.3	.32	–.18
Physical therapy assistants and aides	39	60	.04	82	.06	52.5	109.7	–22	27.3	25.8	1.4	.11	.17
Administrative services managers	217	274	.20	381	.27	26.2	75.4	–107	28.0	27.4	8.4	.31	.64
Electronics repairers, commercial and industrial equipment	79	92	.07	72	.05	17.1	–8.9	20	28.6	28.8	4.9	.07	–.03
Insurance claims clerks	103	115	.08	162	.11	11.0	56.4	–47	29.0	27.6	1.3	.06	.23
Solderers and brazers	29	27	.02	38	.03	–5.7	33.2	–11	29.2	21.0	17.6	–.01	.04
Head sawyers and sawing machine operators and tenders, setters, and setup operators	80	86	.06	66	.05	7.5	–17.1	20	29.6	37.7	6.1	.03	–.05
Dental hygienists	91	107	.08	152	.11	17.6	67.6	–45	29.8	16.8	15.5	.09	.24

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		Level	Share (percent)	Level	Share (percent)								
Proofreaders and copy markers	33	31	.02	44	.03	–7.4	32.3	–13	30.0	1.7	10.1	–.01	.04
Personal care and home health aides	327	535	.39	765	.53	63.3	133.8	–231	30.1	7.4	20.3	1.14	1.71
Drilling and boring machine tool setters and setup operators, metal and plastic	56	54	.04	41	.03	–3.1	–26.0	13	30.9	40.1	6.4	–.01	–.06
Textile machine setters and setup operators	37	33	.02	26	.02	–8.7	–30.3	8	30.9	12.7	15.1	–.02	–.04
Chemical plant and system operators	35	28	.02	40	.03	–20.4	15.6	–12	31.1	37.7	9.9	–.04	.02
Radiologic technologists and technicians	132	218	.16	166	.12	66.0	26.3	52	31.4	27.7	4.1	.48	.13
Manicurists	26	33	.02	48	.03	26.2	84.6	–15	31.6	35.3	4.6	.04	.09
Dental laboratory technicians, precision	51	56	.04	42	.03	10.2	–16.5	13	31.9	20.2	8.7	.03	–.03
Occupational therapists	33	48	.04	72	.05	48.8	121.1	–23	32.7	30.6	3.3	.09	.15
Correctional officers	186	262	.19	398	.28	40.8	113.6	–136	34.1	25.9	10.9	.42	.82
Packaging and filling machine operators and tenders	286	254	.19	385	.27	–11.4	34.4	–131	34.1	32.4	7.4	–.18	.38
Electrical and electronic technicians and technologists	341	471	.35	351	.24	38.2	3.0	120	34.1	46.0	4.3	.72	.04
Crane and tower operators	60	67	.05	50	.03	11.3	–17.0	17	34.2	25.3	3.8	.04	–.04
Sheriffs and deputy sheriffs	63	63	.05	96	.07	–.4	51.5	–33	34.3	23.3	14.3	.00	.13
Actors, directors, and producers	80	104	.08	158	.11	29.6	97.2	–54	34.3	31.2	17.9	.13	.30
Gas and petroleum plant and system occupations	30	22	.02	34	.02	–24.4	15.3	–12	34.5	49.0	28.0	–.04	.02
Teacher assistants	682	827	.61	1,269	.88	21.3	86.0	–441	34.8	21.5	16.0	.80	2.28
Child care workers, private household	375	347	.25	257	.18	–7.5	–31.4	90	34.9	10.6	22.0	–.16	–.46
Plasterers and stucco masons	26	29	.02	44	.03	8.1	66.6	–15	35.1	34.7	.3	.01	.07
Operating engineers	158	179	.13	132	.09	13.4	–16.3	47	35.4	48.5	6.4	.12	–.10
Machine builders and other precision machine assemblers	55	47	.03	73	.05	–14.8	32.5	–26	35.7	34.6	5.8	–.04	.07
Speech-language pathologists and audiologists	53	68	.05	106	.07	27.8	99.1	–38	35.8	30.9	7.9	.08	.21
Dining room and cafeteria attendants and bar helpers	448	578	.42	425	.30	29.0	–5.1	153	36.0	44.0	5.7	.72	–.09
Judges, magistrates, and other judicial workers	40	47	.03	74	.05	17.9	84.3	–27	36.0	28.6	.4	.04	.13
Economists and marketing research analysts	36	45	.03	71	.05	27.2	99.0	–26	36.1	40.9	5.5	.05	.14
Forest and conservation workers	40	44	.03	32	.02	10.7	–18.6	12	36.1	30.5	5.6	.02	–.03

Table 2. Continued—Employment, by occupation, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
	1988	Projected 2000		Actual 2000		Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
		Level	Share (percent)	Level	Share (percent)								
Counter and rental clerks	241	308	.23	486	.34	27.7	101.2	–177	36.5	51.4	6.0	.37	.95
Teachers and instructors, vocational education and training	239	255	.19	405	.28	6.6	69.4	–150	37.1	27.4	9.9	.09	.65
Sales agents, real estate	311	361	.26	263	.18	16.0	–15.6	98	37.4	32.4	6.5	.27	–.19
Machine assemblers	47	41	.03	66	.05	–11.8	42.6	–25	38.1	34.8	6.5	–.03	.08
Insurance underwriters	103	134	.10	97	.07	29.4	–6.4	37	38.3	33.2	4.2	.17	–.03
Small-engine mechanics	43	50	.04	36	.03	18.2	–14.9	14	38.8	36.1	.9	.04	–.02
Chemical equipment controllers, operators, and tenders	70	59	.04	97	.07	–15.5	38.5	–38	39.0	44.1	7.0	–.06	.10
Amusement and recreation attendants	175	217	.16	360	.25	23.7	105.0	–143	39.6	20.4	24.2	.23	.72
Fishers	46	50	.04	36	.03	8.6	–22.2	14	39.7	19.9	16.7	.02	–.04
Social and human service assistants	118	171	.13	284	.20	44.9	140.7	–113	39.8	29.0	12.3	.29	.65
Switchboard operators	254	316	.23	225	.16	24.3	–11.4	91	40.2	34.2	8.0	.34	–.11
Agricultural and food scientists	25	30	.02	22	.02	20.8	–13.9	9	40.3	36.0	4.2	.03	–.01
Central office operators	43	36	.03	26	.02	–14.9	–39.4	10	40.4	74.1	19.4	–.04	–.07
Pharmacy aides	70	89	.07	63	.04	27.1	–9.8	26	40.9	35.9	3.1	.10	–.03
Data-processing equipment repairers	71	115	.08	81	.06	61.2	14.3	33	41.0	54.7	19.2	.24	.04
Bill and account collectors	149	195	.14	330	.23	30.7	121.8	–136	41.1	40.4	4.2	.25	.71
Electronic home entertainment equipment repairers	44	49	.04	35	.02	12.6	–20.7	15	42.1	45.2	2.5	.03	–.04
Correspondence clerks	29	37	.03	26	.02	27.3	–10.4	11	42.1	58.4	10.8	.04	–.01
Shipping, receiving, and traffic clerks	535	591	.43	1,025	.71	10.4	91.5	–434	42.4	37.8	4.4	.31	1.91
Roustabouts, oil and gas	39	39	.03	27	.02	1.1	–29.2	12	42.8	6.0	34.9	.00	–.04
Emergency medical technicians and paramedics	76	86	.06	152	.11	13.0	99.1	–66	43.2	20.8	24.7	.05	.29
Parking lot attendants	47	54	.04	95	.07	14.1	101.1	–41	43.3	26.8	3.9	.04	.19
Medical secretaries	207	327	.24	227	.16	58.0	10.0	99	43.6	50.5	2.0	.66	.08
Pressing machine operators and tenders, textile, garment, and related materials	87	95	.07	66	.05	9.3	–24.0	29	43.8	21.9	15.9	.04	.08
Brokers, real estate	70	84	.06	58	.04	19.7	–16.7	25	43.8	39.2	3.1	.08	–.05
Management analysts	130	176	.13	313	.22	35.0	140.3	–137	43.8	53.9	3.5	.25	.71
Cannery workers	71	70	.05	48	.03	–2.1	–32.0	21	44.0	33.6	5.2	–.01	–.09
Adjustment clerks	231	278	.20	505	.35	20.2	118.3	–227	45.0	41.4	8.5	.26	1.07
Hand packers and packagers	635	560	.41	1,019	.71	–11.8	60.5	–459	45.1	41.8	8.8	–.41	1.49
Ophthalmic laboratory technicians	26	33	.02	23	.02	28.1	–12.1	10	45.7	23.4	26.1	.04	–.01
Electrical and electronic assemblers	237	134	.10	246	.17	–43.6	4.0	–113	45.8	50.5	18.4	–.57	.04
Ushers, lobby attendants, and ticket takers	44	48	.04	89	.06	8.0	100.1	–41	46.0	24.9	26.8	.02	.17

Table 2. Continued—Employment, by occupation, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
	1988	Projected 2000		Actual 2000		Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
		Level	Share (percent)	Level	Share (percent)								
Boilermakers	25	27	.02	18	.01	8.9	–25.6	8	46.4	57.4	6.4	.01	–.02
Psychiatric aides	114	141	.10	96	.07	23.6	–15.7	45	46.6	41.8	2.5	.15	–.07
Computer operators, except peripheral equipment	275	354	.26	241	.17	29.0	–12.0	113	46.7	74.8	10.2	.44	–.13
Barbers	76	76	.06	52	.04	.2	–31.8	24	46.9	30.0	15.2	.00	–.09
Jewelers and precious-stone and -metal workers	36	42	.03	28	.02	15.9	–21.2	13	47.1	40.4	2.7	.03	–.03
Electronic semi-conductor processors	38	34	.02	65	.05	–10.8	72.8	–32	48.4	48.8	.2	–.02	.11
Directors, religious activities and education	56	62	.05	121	.08	9.8	116.9	–60	49.4	22.6	36.8	.03	.25
Home appliance and power tool repairers	76	76	.06	51	.04	–.5	–33.4	25	49.5	47.4	9.5	.00	–.10
Broadcast and sound technicians	27	19	.01	39	.03	–31.1	41.5	–20	51.3	51.5	6.2	–.05	.04
Telephone and cable TV line installers and repairers	127	100	.07	206	.14	–21.3	62.5	–106	51.6	36.4	23.9	–.15	.31
Electrical and electronic equipment assemblers, precision	161	91	.07	197	.14	–43.8	21.8	–106	53.9	60.1	17.8	–.39	0.14
Shoe and leather workers and repairers, precision	32	32	.02	20	.01	.1	–36.4	12	57.5	10.6	67.7	.00	–.04
Purchasing managers	252	289	.21	182	.13	14.4	–28.0	107	58.8	60.6	1.4	.20	–.27
Precision instrument repairers	46	50	.04	31	.02	7.8	–33.6	19	62.4	45.3	11.6	.02	–.06
Cutters and trimmers, hand	63	65	.05	39	.03	2.7	–37.2	25	63.6	58.5	10.2	.01	–.09
Travel agents	142	219	.16	133	.09	54.1	–6.2	85	64.2	66.6	.4	.42	–.03
Instructors, adult (nonvocational) education	227	268	.20	163	.11	17.9	–28.3	105	64.5	75.3	13.8	.23	–.25
Electrical and electronics engineers	439	615	.45	369	.26	40.0	–16.0	246	66.7	63.2	4.7	.97	–.27
Aerospace engineers	78	88	.06	52	.04	12.7	–32.5	35	67.0	12.1	43.6	.05	–.10
Station installers and repairers, telephone	58	47	.03	27	.02	–19.8	–52.6	19	69.3	108.5	19.1	–.06	–.12
Fallers and buckers	36	30	.02	18	.01	–17.2	–51.2	12	69.6	66.3	1.4	–.03	–.07
Sewing machine operators, garment	620	531	.39	297	.21	–14.3	–52.2	235	79.2	14.3	56.6	–.49	–1.26
Peripheral equipment operators	42	54	.04	30	.02	29.0	–28.3	24	80.0	98.8	14.1	.07	–.05
Wholesale and retail buyers, except farm products	207	220	.16	120	.08	6.3	–42.1	100	83.6	87.2	.9	.07	–.34
Offset lithographic press operators	91	114	.08	62	.04	25.3	–32.4	53	85.3	77.7	9.0	.13	–.11
Compositors and typesetters, precision	26	25	.02	13	.01	–4.8	–49.4	12	88.2	65.0	12.9	–.01	–.05

Table 2. Continued—Employment, by occupation, 1988 actual and 2000 projected and actual

[Numbers in thousands]

Occupation	Total employment					Percent change, 1988–2000		Numerical error, 2000 (projected level minus actual level)	Absolute percent error, original projections, 2000[1]	Absolute percent error, simulated projections, 2000		Share of total job growth, 1988–2000 (percent)	
	1988	Projected 2000		Actual 2000		Projected	Actual			Ratio of actual industry totals to projected staffing pattern	Ratio of actual staffing pattern to projected industry totals	Projected	Actual
		Level	Share (percent)	Level	Share (percent								
Word processors and typists	985	924	.68	482	.34	–6.2	–51.1	442	91.7	129.2	12.4	–.34	–1.96
Railroad brake, signal, and switch operators	37	29	.02	14	.01	–22.9	–61.5	14	100.4	103.4	1.6	–.05	–.09
Aircraft assemblers, precision	31	31	.02	15	.01	–1.7	–52.8	16	108.1	27.9	54.6	.00	–.06
Statement clerks	32	33	.02	16	.01	2.6	–50.8	17	108.7	82.8	13.9	.00	–.06
Furnace, kiln, oven, drier, or kettle operators and tenders	62	52	.04	25	.02	–16.9	–60.5	27	110.6	114.5	.2	–.06	–.15
Custom tailors and sewers	130	146	.11	68	.05	12.4	–47.9	78	115.6	97.9	10.5	.09	–.24
Service station attendants	308	331	.24	140	.10	7.4	–54.6	191	136.6	126.9	2.7	.13	–.65
Housekeepers and butlers	34	33	.02	13	.01	–2.6	–60.5	20	146.4	102.0	22.0	.00	–.08
Typesetting and composing machine operators and tenders	39	45	.03	13	.01	14.3	–66.3	31	238.8	186.4	14.2	.03	–.10

occupations. Employment of operators, fabricators, and laborers was expected to change little over the projection period, but it actually grew close to 13.6 percent between 1988 and 2000. Employment of transportation and material-moving machine and vehicle operators, a category that includes truck and bus drivers, was off by about 516,000 workers. The underprojection of transportation workers alone accounted for more than one-third of the projection error for all operators, fabricators, and laborers. Some of the overall projection error for this major group also can be attributed to an underprojection of helpers, laborers, and material movers, including freight, stock, and material movers and hand packers and packagers, by about 421,000 workers. The underlying assumption behind the projection was that increasing automation would lead to less demand for these workers; the impact, however, was overestimated. Helpers, laborers, and material movers contributed about one-fourth of the error for the entire group.

Employment of marketing and sales occupations was expected to increase 20 percent between 1988 and 2000, but it actually grew 27.9 percent. This underprojection of about 950,000 workers resulted primarily from an underestimate of cashiers by more than 600,000 workers. Employment of cashiers was projected to grow only about as fast as the average for all occupations, with more widespread use of bar code readers increasing the productivity of workers in this category. In actuality, employment grew much faster than average: 42.4 percent between 1988 and 2000. At the same time, employment of retail salespersons increased by about 340,000 workers. A large increase in discount retailers over the projection period was expected to slow the demand for retail salespersons, but it appears that the impact was overestimated. The two occupations combined (that is, cashiers and retail salespersons) contributed about four-fifths of the total error for the entire major group.

The category of administrative support occupations, including clerical, was underprojected by 865,000 workers. Employment of adjusters, investigators, and collectors grew much faster than projected, resulting in an underprojection of about 401,000 workers. By contrast, employment of secretaries, stenographers, and typists was overprojected by more than 1 million workers and contributed more than one-fifth of the total error for the major group. This detailed group of occupations was expected to grow more slowly than average, on the basis of the assumption that increasing office automation would decrease the demand for these workers. However, the group's employment actually *declined* over the projection period. In contrast to the assumptions regarding automation for operators, fabricators, and laborers, the effects of automation on secretaries, stenographers, and typists were underestimated.

The category of agriculture, forestry, fishing, and related occupations was the only major category for which the direction of the change in employment was not correctly projected. Employment was expected to decline slightly, but it actually grew by about 14 percent. Although the numerical error was modest compared with that of other groups, the absolute percent error was the highest. It appears, however, that the error for this group was significantly affected by changes to the occupational classification system in the early 1990s. Existing occupational definitions were revised, and new occupations within agriculture, forestry, and fishing were added to the Occupational Employment Statistics (OES) survey, resulting in shifts in employment that accounted for the growth in the group.[3]

Detailed occupations

In addition to the nine major occupational groups, employment projections for 1988–2000 were developed for nearly 500 detailed occupations. However, occupations with 25,000 or fewer workers in 1988 were eliminated from the analysis, leaving 338 occupations for which projections were evaluated.[4] Table 2 presents data on each of the remaining occupations, ranked by absolute percent error. The absolute percent errors for all 338 occupations averaged about 23.2 percent.[5] Approximately two-thirds of the occupations had below-average errors.

The last two columns of table 2 present the projected and actual share of total job growth. Although there are some notable exceptions, the projected shares for the detailed occupations, like those for the major groups, were relatively accurate.

The majority of occupations had absolute projection errors below 20 percent. (See table 3.) These 197 occupations accounted for almost 74 percent of total occupational employment. Only 57 occupations had absolute average errors above 40 percent, a little more than 7 percent of employment.

Consistent with findings of past evaluations, projection error continues to be inversely related to employment size. In 1988, 155 out of the 338 occupations analyzed had between 25,000 and 100,000 workers. These 155 occupations had an average projection error of about 23.3 percent. However, as the following tabulation shows, the 39 occupations with more than 600,000 workers had an average error of only 14.8 percent:

Occupations by size of employment	*Mean absolute percent error*
Less than100,000	28.4
25,000 to 49,999	32.7
50,000 to 99,999	23.6
100,000 to 299,999	20.1
300,000 to 599,999	20.0
500,000 or more	14.5
600,000 or more	14.8
All occupations evaluated	23.2
Proportion of occupations with a lower-than-average error	66.6

The direction of employment change was projected correctly for roughly 70 percent of the occupations included in the evaluation.[6] Employment growth was projected for the majority of the occupations. Of the 232 occupations that actually grew between 1988 and 2000, an increase was projected for all but 30. However, of the 106 occupations for which employment declined, only 32 were projected to decline over the period.

Consistent with past evaluations, the 1988–2000 projections appear to be conservative in nature. For those occupations in which the direction of change was correctly anticipated, more than two-thirds were underprojected. In fact, of the two-thirds of occupations that were projected to grow by less than 30 percent, only about one-third actually did so. A higher proportion of occupations grew by more than 30 percent over the projection period. At the same time, only about 11.5 percent of the occupations were projected to grow by more than 30 percent, and one-third actually did. The same is true for occupations at the other extreme: more of the occupations shrank than were originally projected to. (See table 4.)

Sources of error

Errors in the projections for individual occupations can ultimately be traced back to errors in assumptions or judgments, resulting in incorrectly projected changes in staffing patterns, industry projections, or a combination of both. To determine whether projection errors could in fact be traced back to the one or the other, two matrices were created, for purposes of simulation. The first matrix was generated by multiplying the projected 2000 staffing patterns of industries by the actual 2000 industry employment numbers. This matrix reveals the outcome if perfect industry employment had been projected, isolating errors in the projections due to analytical judgments about changes in the staffing patterns. The second matrix was generated by multiplying the actual 2000 staffing patterns[7] by the 2000 projected industry totals. This matrix reveals the outcome if perfect staffing patterns had been projected, isolating errors due to incorrect industry projections.

The 2000 employment figure for each occupation from each matrix was then compared with the actual 2000 employment figure, and an absolute percent error was calculated. The two columns headed "Absolute percent error, simulated projections, 2000" in table 2 present projection errors from the two matrices created to analyze these effects. The two errors for an occupation can then be compared. If one error is

significantly higher than the other, the source of the error can be traced back to either the staffing pattern or the industry projection. For example, one can see clearly that the projection error for service station attendants is attributable more to errors in projected staffing patterns than to incorrect industry projections. The absolute percent error for service station attendants, 136.6 percent, was one of the largest. The error in the relevant matrix, using actual staffing patterns and projected industry totals, is 2.7 percent, whereas it is 127 percent with actual industry totals and projected staffing patterns. Slow growth was projected for service station attendants, with more repair and maintenance work seen moving outside of service stations. However, employment actually declined between 1988 and 2000, and most gas stations are now self-service only, no longer offering routine vehicle maintenance and having customers pump their own gas and even pay at the pump. The opposite is true in the case of aerospace engineers, an occupation with an absolute error of 67 percent. The percent error with projected staffing patterns and actual industry totals is 12.1 percent, and the error with actual staffing patterns and projected industry totals is 43.6 percent. Employment of aerospace engineers is concentrated in the aerospace manufacturing industry, which was projected to grow 0.3 percent annually, but actually declined by about 3.9 percent, on average, each year between 1988 and 2000.

About 54 percent of the occupations had errors attributable more to changes in the staffing pattern, and 21 percent had errors attributable more to industry projections. The remaining 25 percent of occupations had errors equally attributable to staffing pattern changes and industry projections. In most cases, both errors in industry projections and errors in staffing pattern projections had a small impact on accuracy, even if the errors were attributable more to one or the other factor.

Job clusters. In investigating sources of projection error, it is helpful to examine groups of related occupations, or *job clusters*. Several such clusters are examined closely in this section because they have large projection errors or because they highlight specific sources of error. In the case of many health-care-related occupations, for example, errors in the projections are attributable mainly to incorrect assumptions behind the projections of the utilization of workers in the occupation by industry. (See table 5.) The first group of health-care workers listed in the table is labeled the health-diagnosing occupations and consists of optometrists, physicians, and dentists. All of the health-diagnosing occupations actually grew more slowly than projected. For example, physicians were projected to grow 27.8 percent, but grew only 10.4 percent. (See table 2.) Dentists actually declined 3.7 percent, instead of growing 13.1 percent as projected.

The second and third groups of occupations listed in the table are dubbed health assessment and treating occupations and health technicians and technologists, respectively. Most

Table 3. Distribution of occupational absolute percent errors

Range of absolute percent errors	Number of occupations with errors in range	Percent of occupations with errors in range	Employment totals accounted for (thousands)	Percent of employment accounted for
0 up to, but not including, 10	116	34.3	53,826	48.1
10 up to, but not including, 20	81	24.0	28,708	25.7
20 up to, but not including, 30	48	14.2	13,843	12.4
30 up to, but not including, 40	36	10.7	7,329	6.6
40 up to, but not including, 50	30	8.9	5,377	4.8
50 up to, but not including, 60	5	1.5	643	.6
60 or greater	22	6.5	2,140	1.9

NOTE: Average absolute percent error for all occupations is 23.2 percent.

Table 4. Distribution of projected and actual percent changes

Range of percent changes	Projected		Actual	
	Number	Percent of total	Number	Percent of total
Total	338	100.0	338	100.0
Greater than 60	5	1.5	39	11.5
60 down to, but not including, 50	9	2.7	13	3.8
50 down to, but not including, 40	6	1.8	20	5.9
40 down to, but not including, 30	19	5.6	35	10.4
30 down to, but not including, 20	60	17.8	33	9.8
20 down to, but not including, 10	114	33.7	58	17.2
10 down to, but not including, 0	58	17.2	34	10.1
0 or less	67	19.8	106	31.4

Table 5. Sources of projection error for health-care-related occupations, 2000, and projected and actual share of total job growth, 1988–2000

Occupation	Absolute percent error[1]	Absolute percent error (ratio of actual industry totals to projected staffing patterns)	Absolute percent error (ratio of actual staffing patterns to projected industry totals)	Share of total job growth (percent)	
				Projected	Actual
Health-diagnosing occupations:					
Optometrists	15.3	20.1	2.5	0.0	0.0
Physicians	15.7	14.0	1.1	.8	.2
Dentists	17.5	22.6	2.7	.1	.0
Health-assessment and -treating occupations:					
Physician assistants	11.1	8.5	3.0	.1	.1
Occupational therapists	32.7	30.6	3.3	.1	.2
Speech-language pathologists and audiologists	35.8	30.9	7.9	.1	.2
Health technicians and technologists:					
Clinical laboratory technologists and technicians	11.0	15.7	5.3	.3	.3
Medical records and health information technicians	21.3	25.7	1.7	.2	.2

[1] Absolute percent error is calculated as the numerical error (positive or negative), divided by actual employment in the target year of the projection.

of these occupations grew faster than projected. For example, occupational therapists were projected to grow 48.8 percent, but actually grew 121.1 percent; and medical records and health information technicians were projected to grow 59.9 percent, but actually grew 103.1 percent. Both of these occupations were among the fastest-growing occupations between 1988 and 2000.

The main assumption behind the projected changes in staffing patterns for health-diagnosing occupations was that these occupations would decline as a share of the workforce in offices of health practitioners because of an increase in large group practices requiring a higher proportion of support staff. Among the major assumptions behind the expected increase in utilization of the other two groups of health-care workers was an increase in outpatient services and a shifting of responsibilities to lower skilled health-care workers in an attempt to contain costs. Because the health-diagnosing occupations were overprojected, the effects that group practices would have on the staffing patterns of doctors' offices appears to have been underestimated. The growing reliance on lower skilled health-care workers to carry out more routine tasks also appears to have been underestimated, because of the overly conservative projections for these occupations.

In contrast, the projection errors for occupations concentrated in the education services industry can be attributed more to error in the projection of industry employment rather than staffing. Overall employment in education services was projected to grow at an average annual rate of 1.2 percent, but it actually grew at a rate of 3.2 percent. Table 6 shows that the absolute percent errors are higher in the simulation testing for industry error, not only for teachers, but also for related occupations, such as counselors and school bus drivers. All of these occupations were underprojected.

A main contributor to growth in educational services is an increase in school enrollment, which is a reflection of the population growth of youths aged 5 to 17 years. In 1988, the Census Bureau projected an increase of 2 million among the elementary school population by 2000. This population actually increased by approximately 4.4 million. Also, in 1988 the Census Bureau projected an increase of 1.3 million in the secondary school population by 2000; it actually increased by 1.7 million.[8] Faster growth in the school-aged population caused enrollment rates to rise and increased the demand for teachers over the 1988–2000 period.

Errors in the projections for textile workers also can be traced back to incorrect projections in the industries in which they are employed. However, this group of occupations differs from those previously discussed, because employment was projected to decline rather than grow. Employment of textile workers is concentrated in three industries: knitting mills; apparel; and weaving, finishing, and yarn and thread mills. Overall employment in all of these industries declined at a faster rate than was projected. The category of knitting mills was projected to decline by 1.5 percent annually, but employment actually declined by 4.3 percent. Apparel was projected to decline by 1.5 percent annually, but actually declined by 6 percent. The category of weaving, finishing, and yarn and thread mills was projected to decline by 1.2 percent, but actually declined by 2.8 percent. As a result, the occupations in table 7 also declined faster than projected. For example, the category of sewing machine operators was projected to decline 14 percent, but actually declined by 52 percent and ended up as the occupation with second-largest job decline. While the major assumptions for the decline—a shift in U.S. apparel production overseas to countries with lower labor costs, an increase in cheap apparel imports, and greater worker productivity through the introduction of new labor-saving

Table 6. Sources of projection error for education-related occupations, 2000, and projected and actual share of total job growth, 1988–2000

Occupations	Absolute percent error[1]	Absolute percent error (ratio of actual industry totals to projected staffing patterns)	Absolute percent error (ratio of actual staffing patterns to projected industry totals)	Share of total job growth (percent)	
				Projected	Actual
Teachers, secondary school	7.8	8.1	14.8	1.24	1.33
Bus drivers, school	8.7	7.9	15.5	.38	.43
Counselors	17.7	4.7	15.1	.18	.26
Education administrators	18.6	5.6	12.9	.34	.58
Teachers, preschool	20.5	5.9	22.5	.40	.59

[1] Absolute percent error is calculated as the numerical error (positive or negative), divided by actual employment in the target year of the projection.

machinery—were correct, the impact of these trends on employment appears to have been underestimated.

The *Occupational Outlook Handbook*[9]

Projections of employment change are the foundation for statements on job outlooks in reports and career guidance publications. Accordingly, the quality of the information those statements provide depends on the accuracy of the projections on which they are based. Identifying sources of error and bias and evaluating their effects enables the Bureau of Labor Statistics to improve the accuracy of its projections.

An evaluation, however, also helps users whose decisions may be guided by the projections—a group that includes career guidance counselors, education planners, training officials, jobseekers, and students. Utilizing the information presented in an evaluation, all of these individuals can assess the reliability of job outlook statements. Therefore, significant weight should be given to evaluating discussions of employment *change*, as well as to evaluating discussions of employment levels.

The 1988–2000 occupational employment projections were the basis for the job outlook information presented in the 1990–91 edition of the *Occupational Outlook Handbook.* In the *Handbook*, growth descriptors are used to give readers a general impression of job prospects in each occupation. The following descriptors relating to ranges of employment growth or decline between 1988 and 2000 were used:[10]

Growth descriptor	*Projected change in employment, 1988–2000*
Much faster than average	Increase of 31 or more percent
Faster than average	Increase of 20 percent to 30 percent
About as fast as average	Increase of 11 percent to 19 percent
More slowly than average	Increase of 4 percent to 10 percent
Little or no change	Increase or decrease of 3 percent or less
Decline	Decrease of 4 percent or more

Table 8 gives a summary of the distributions of growth descriptors of occupations and also reinforces the conservative nature of the projections. Overall, 87 occupations ended up in the growth category projected, and another 100 occupations were one category higher or lower. The largest number of occupations was projected to grow about as fast as average. The majority actually grew much faster than average or declined. About 30 percent of all occupations were projected to have average growth, whereas only 14.8 percent actually did so. A little more than 26 percent of the occupations were projected to either grow faster than the average or decline; in actuality, almost 60 percent of the occupations fell into one of these two categories.

More than 65 percent of occupations projected to be in the much-faster-than-average category and almost 50 percent of declining occupations actually fell into their respective categories, making these categories the most accurate in terms of number of occupations. Of those occupations projected to grow as fast as average, only 20 percent actually did so. The higher degree of accuracy in the extreme-growth categories suggests that the accuracy of the BLS projections is greatest where there is actual strong growth or strong decline.

Fastest-growing occupations. The high degree of accuracy in projecting employment in those occupations which grew much faster than average becomes evident when one examines the 20 occupations projected to be the fastest growing.[11] (See table 9.) The average absolute error for this group was 23.6 percent, slightly higher than the 23.3-percent average error for all occupations. Only 6 of the 20 occupations projected to be fastest growing ranked among the top 20 actual fastest-growing occupations, 4 of which are health-care-related occupations. However, when all occupations were ranked on the basis of their actual percent change between 1988 and 2000, 15 of the 20 projected to grow the fastest ranked among the top 25 percent of occupations that actually did. All of these occupations were projected to have much faster than average growth, and all but 5 actually grew much faster than average. Of the 20 fastest-growing occupations,

the average growth, in percentage terms, was 55 percent; however, the actual average growth rate of those occupations, 110 percent, was double the projected rate.

Employment grew in all but two of the occupations projected to be among the 20 fastest growing, suggesting that the basic BLS assumptions about growth tended to be accurate; however, employment was either under- or overestimated. For example, the technological advances in radiology and the increasing importance of the discipline in diagnosing disease and injury were the major reasons that much faster than average growth was projected for radiologic technologists and technicians. However, the growth of that occupation seems to have been limited, possibly by the high cost of implementing the technology.[12] Nonetheless, the fundamental BLS assumptions about growth for the occupation were correct, and although it was not actually among the 20 fastest-growing occupations, radiologic technologists and technicians still experienced faster-than-average employment growth.

Employment was overestimated to a larger degree for data-processing equipment repairers and medical secretaries. Employment in these occupations had average and slower-than-average growth, respectively. In the case of data-processing equipment repairers, faster-than-average growth was projected because of rapid increases in the use of office computers and other technology that requires repair workers. However, employment growth was limited because the increased quality of the machines caused fewer breakdowns and many computers were designed to self-diagnose problems. In the case of medical secretaries, increased use of automated office technology hindered employment growth. Also, as technology shortened the completion time of tasks, other medical staff, such as medical assistants, performed tasks traditionally carried out by medical secretaries, further hindering their growth.

Occasionally, unforeseen changes in technology, business practices, or governmental regulations affect occupations to a significant degree. It is often difficult or impossible to anticipate and incorporate such changes into the growth assumptions for some occupations, and the changes frequently result in projection error. For example, the category of travel agents was among the 20 occupations projected to be the fastest growing, but it actually declined between 1988 and 2000. Travel agents were projected to have such high growth, in percentage terms, because of an increase in business travel and disposable income. These assumptions were correct; however, the development and use of the Internet and online travel services, enabling consumers to shop for the best deals and book trips themselves, were not anticipated in 1988.[13]

Another source of error in the BLS projections was the change in the classification system of occupations upon which

Table 7. Sources of projection error for textile-related occupations, 2000, and projected and actual share of total job growth, 1988–2000

Occupation	Absolute percent error[1]	Absolute percent error (ratio of actual staffing patterns to projected staffing patterns)	Absolute percent error (ratio of actual staffing patterns to projected industry totals)	Share of total job growth (percent)	
				Projected	Actual
Textile bleaching and dyeing machine operators and tenders	6.0	13.4	23.0	0.0	0.0
Textile drawout and winding machine operators and tenders	14.3	2.7	18.6	–.2	–.2
Textile machine setters and setup operators	30.9	12.7	15.1	.0	.0
Shoe and leather workers and repairers, precision	57.5	10.6	67.7	.0	.0
Sewing machine operators, garment	79.2	14.3	56.6	–.5	–1.3

[1] Absolute percent error is calculated as the numerical error (positive or negative), divided by actual employment in the target year of the projection.

Table 8. Distribution of projected and actual growth descriptors

Projected growth category	Projected number of occupations in each growth category	Actual number of occupations in each growth category					
		Declining	Little or no change	Slower than average	Average	Faster than average	Much faster than average
Total	338	87	36	25	50	34	106
Declining	51	25	5	4	6	1	10
Little or no change	32	16	5	5	0	4	2
Slower than average	50	12	3	5	8	7	15
Average	101	20	19	6	21	13	22
Faster than average	66	12	3	4	9	6	32
Much faster than average	38	2	1	1	6	3	25

Table 9. Projected and actual occupational employment rankings, by change from 1988 to 2000

Occupation	Projected rank, 1988–2000	Actual rank, 1988–2000	Absolute percent error
Fastest-growing occupations			
Paralegals and legal assistants	1	28	2.8
Medical assistants	2	23	4.0
Radiologic technologists and technicians	3	124	31.4
Personal care and home health aides	4	3	30.1
Data-processing equipment repairers	5	170	41.0
Medical records and health information technicians	6	11	21.3
Medical secretaries	7	198	43.6
Physical therapists	8	27	8.4
Surgical technologists	9	44	.8
Operations research analysts	10	49	2.6
Securities, commodities, and financial services sales agents	11	40	1.8
Travel agents[1]	12	260	64.2
Systems analysts	13	38	5.5
Physical therapy assistants and aides	14	9	27.3
Occupational therapists	15	5	32.7
Computer programmers	16	70	5.1
Social and human service assistants	17	1	39.8
Respiratory therapists	18	42	9.3
Correctional officers	19	8	34.1
Electrical and electronics engineers[1]	20	287	66.7
Occupations with the largest job growth			
Retail salespersons	1	15	8.1
Registered nurses	2	6	3.3
Janitors and cleaners, including maids and housekeeping cleaners	3	14	4.5
Waiters and waitresses	4	19	10.5
General managers and top executives	5	8	.9
Office clerks, general	6	3	6.8
Secretaries, except legal and medical	7	262	15.6
Nursing aides, orderlies, and attendants	8	31	12.1
Truckdrivers, light and heavy	9	4	9.9
Receptionists and information clerks[1]	10	7	15.0
Cashiers	11	1	20.5
Guards	12	24	.6
Computer programmers	13	29	5.1
Food counter, fountain, and related workers	14	11	11.5
Food preparation workers	15	20	3.8
Licensed practical and licensed vocational nurses	16	56	20.0
Teachers, secondary school	17	18	7.8
Systems analysts	18	23	5.5
Accountants and auditors	19	45	7.9
Personal care and home health aides	20	12	30.1
Occupations with the largest job declines			
Farmworkers	1	6	.4
Electrical and electronic assemblers[2]	2	144	45.8
Sewing machine operators, garment	3	2	79.2
Hand packers and packagers[2]	4	329	45.1
Electrical and electronic equipment assemblers, precision[2]	5	238	53.9
Word processors and typists[2]	6	1	91.7
Inspectors, testers, and graders, precision[2]	7	176	8.6
Court reporters, medical transcriptionists, and stenographers	8	16	17.7
Packaging and filling machine operators and tenders[2]	9	292	34.1
Machine feeders and offbearers	10	22	2.0
Textile drawout and winding machine operators and tenders	11	15	14.3
Child care workers, private household	12	8	34.9
Telephone and cable TV line installers and repairers[2]	13	283	51.6
Data entry keyers[2]	14	182	9.4
Industrial truck and tractor operators[2]	15	159	7.6
Crushing, grinding, mixing, and blending machine operators and tenders[2]	16	161	21.4
Machine-forming operators and tenders, metal and plastic	17	52	2.0
Welders and cutters[2]	18	251	16.7
Central office and PBX installers and repairers	19	32	19.7
Machine tool cutting operators and tenders, metal and plastic	20	18	23.1

[1] Occupation that was projected to grow, but actually declined.

[2] Occupation that was projected to decline, but actually grew.

the projections are based. (This kind of change, in which some occupations may have suboccupations added to or removed from them, is to be contrasted with a definitional change in an occupation. As mentioned earlier, occupations that had definitional changes were excluded from the analysis.) New occupations were added after the projections were made in 1988. This is one reason for the sharp decline in employment among electrical and electronic engineers. In 1988, computer engineers were classified as electrical and electronic engineers. Beginning in 1989, however, computer engineering was surveyed as a separate occupation, shifting employment away from electrical and electronic engineers.

Occupations with the largest job growth. Like the fastest-growing occupations, occupations with the largest job growth offer insight into those occupations which will have the greatest impact on the labor market. Occupations with the largest job growth often have slower growth in percentage terms, but a much larger number of workers, than those ranked among the fastest growing. As a result, the former occupations usually create more job openings. However, some occupations are among both the fastest-growing occupations and the occupations with the largest job growth. Three occupations examined in this analysis were in both categories: personal care and home health aides; shipping, receiving, and traffic clerks; and teacher assistants.

The projections for the 20 occupations with the largest job growth were relatively accurate, reflecting the fact that projection error is inversely related to employment size. (See table 9.)[14] Thirteen occupations with the largest projected job growth were among the top 20 with the largest actual job growth. The 13 occupations accounted for a combined 7.1 million jobs and 94 percent of net job growth. The average absolute percent error of the group was only 9.2 percent, well below the 24.5-percent average for all occupations.

Most of the occupations with the largest projected and largest actual job growth were in service industries—in particular, health, education, and food services. A growing elderly population with an increasing need for medical care is one factor driving growth among the different nursing occupations and personal care and home health aides. Also, increasing health care costs are channeling certain tasks into the hands of lower skilled health-care workers instead of physicians. As regards education services, rapidly increasing school enrollments are the major factor driving the demand for secondary school teachers and teacher assistants. Finally, a growing population with increasing income and more leisure time is one source of growth among workers in the food services industry, such as waiters and waitresses; food counter, fountain, and related workers; and food preparation workers. Strong economic growth and a growing population with higher incomes are also sources of growth for occupations in the retail trade sector. Employed mainly in retail trade, cashiers added the most new jobs between 1988 and 2000, almost 1 million. Combined with retail salespersons, cashiers added almost 1.4 million new jobs to the economy.

In one instance, an occupation projected to be among those adding the most jobs actually declined over the projection period. Secretaries, except legal and medical, were projected to add 385,000 new jobs, but employment actually declined by 59,000 jobs. In fact, secretaries ended up among the 20 occupations with the largest job *losses*, due mainly to increases in office technology that made those in the occupation more productive. As they became more productive, secretaries increasingly worked for more than one manager. Managers themselves also increasingly performed routine office work, such as word processing and filing, further reducing the need for secretaries.

Occupations with the largest job declines. Declining occupational employment stems from declining industry employment or factors such as technological advancements and changes in business practices. The average projected numerical decline for the 20 occupations with the largest losses was 58,000 jobs. The average actual numerical decline was 130,000 jobs. The accuracy among the occupations in this group was not as high as among those with the largest job growth: only 7 occupations that were projected to be among the occupations with the largest job declines actually were. (See table 9.)

Technological advancements were the major reason for both projected and actual declines in employment. New labor-saving machinery, for example, was a factor in the decline in textile jobs such as sewing machine operators and textile drawout and winding machine operators and tenders. The employment of office support workers, such as word processors and typists, and court reporters, medical transcriptionists, and stenographers was curtailed by new office technology, including e-mail and voice mail. Other factors, such as growing domestic and international competition and corporate restructuring, also dampened the level of employment in these occupations.

Among the 20 occupations with the largest projected employment declines, half actually grew over the projection period. The largest numerical difference between projected and actual employment levels was for hand packers and packagers. As regards many of the other occupations projected to decline, the effects of automation and other labor-saving technology appear to have been overestimated.

Conclusions and implications

Overall, the employment projections for the year 2000 were slightly more accurate than the earlier ones for 1995: employment for six of the nine major occupational groups was projected with greater accuracy for 2000. However, projections

on such an aggregate scale are, by their nature, uncertain. Because projections are made for individual occupations, and not major groups, errors are compounded as these occupations are combined. The detailed occupations that make up each group can be large enough that any error in their individual projection can affect the outcome for the group overall.

Compared with errors from past evaluations, the average absolute percent error for the 2000 occupational employment projections was not significantly different. The mean absolute percent error for the 2000 projections, 23.2 percent, was close to the mean absolute percent error of 24.0 percent for the 1995 projections and only slightly higher than the errors found in previous sets of projections.[15] However, the two most recent evaluations covered many more occupations than did the earlier ones.

The two matrices prepared for the simulations carried out in the current and previous evaluations have been analyzed and the major source of error for many detailed occupations identified. As the previous evaluation found, good industry projections are crucial to developing good occupational projections, but the chief source of errors appears to be the projected staffing patterns. In the matrix for which projected staffing patterns were applied to actual 2000 industry totals, the mean absolute percent error was 22.6 percent; in the matrix for which actual staffing patterns were applied to projected 2000 industry totals, the mean absolute error dropped to 9.3 percent.

Historically, all BLS evaluations of its occupational employment projections have yielded the result that the projections are conservative. The 1988–2000 projections are no exception: most of the projections were clustered around average growth, even when more occupations grew much faster than the average or declined. The inherent conservatism contributed to overall errors in staffing patterns, in part because analysts were conservative in projecting occupational coefficients or changes in the proportion of an occupation within each industry.

In projecting occupational patterns from 1988 to 2000, analysts reviewed historical employment data and conducted analyses to identify factors underlying trends. The evaluation of the 1988–2000 projections has provided analysts the first chance to look back at this work. Because an industry-occupation matrix was used to project employment by occupation, analysts projected changes to the occupation-industry cells on the basis of knowledge gained through research performed in preparing the *Occupational Outlook Handbook*. Judgments were made as to whether factors causing changes in occupational utilization within industries would have less, more, or the same effect in the future. The analysis also uncovered factors expected to affect the utilization of workers that did not affect them in the past. Analytical judgments were then translated into numerical estimates—increases or decreases in the coefficients of the industry-occupation matrix from 1988 to 2000. To maintain consistency among the judgments of analysts projecting occupational change, the following guidelines for describing changes were implemented to develop projected coefficients for all occupations across all industries:[16] changes of 5 percent to 9 percent are described as small, those from 10 percent to 19 percent are considered moderate, and those of 20 or more percent are said to be significant.

Biases towards conservatism are recognized by the Bureau; thus, the guidelines for projecting the changes in the occupational coefficients have been revised. For example, beginning in the early 1990s, the Bureau set forth new guidelines for interpreting the projected ranges for identifying small, moderate, and large changes in the occupational coefficients: according to these guidelines, any positive change up to 10 percent is considered small, a change from 10 percent to 20 percent is deemed moderate, one from 20 percent to 35 percent is held to be large, and a change of 50 percent or more is judged very large. The revised guidelines have allowed analysts to describe changes in the occupational coefficients more accurately, which should result in more accurate projections.

The influence of conservative coefficients of change on the projections, however, was not the only source of error. Rather, the impact of many technological changes and trends were not fully realized and therefore also contributed to errors in the projected staffing patterns. Incorrect analytical judgments relating to the impact of technological change and to trends such as outsourcing and the growing role of temporary-help firms played a large part in this regard. Furthermore, some events, such as the timing of business cycles, the onset of international conflicts, and the occurrence of natural disasters, are difficult to predict and ultimately have a substantial impact on the accuracy of the projections. □

Notes

[1] Another measure used to evaluate the projections included comparing the actual distribution of employment growth among occupations with the projected distribution. To evaluate how the errors attributed to detailed occupations affected the errors associated with their respective major groups, each detailed occupation's error was weighted by its employment size in 1988. (Each occupation's contribution to the error for a particular major group is presented in the analysis of the projections for the major occupational groups. The contribution was calculated by first dividing an occupation's projected employment by its actual employment in the target year. The result of the calculation was then multiplied by the ratio of the occupation's actual employment to the total actual employment for the major group, and this resulting value was then divided by the sum of the errors for all occupations to determine each occupation's share of the

error as a percentage.) A comparison of the projected and actual growth in terms of descriptors of the detailed occupations also is presented as a method of evaluation.

[2] This underprojection was really the result of changes in the occupational classification over time. In 1988, the only computer-related occupation for which a projection was developed was systems analysts. The projection turned out to be close to the mark. However, between 1989 and 1998, three more computer-related occupations, including the residual category of "all other computer scientists," were added alongside systems analysts. In 2000, these three occupations accounted for an additional 1 million workers.

[3] Over the 1988–2000 period, the OES definition of the detailed occupation category of landscaping and groundskeeping laborers was modified. The change caused workers in agriculture, forestry, fishing, and related occupations to be shuffled among detailed occupations within the major group. Therefore, more types of workers were classified as landscaping and groundskeeping laborers in 2000 than in 1988, which caused employment in agriculture, forestry, fishing, and related occupations to be underprojected.

[4] For an explanation of occupations that were eliminated from the analysis, see the technical note at the end of this article.

[5] Weighted by actual 2000 employment, the mean absolute percent error was 4.43 percent.

[6] Occupations with projected and actual growth between –3 percent and 3 percent were categorized as having little or no change. Those occupations whose projected and actual growth fell into this category were counted as having employment projected in the correct direction, even if the projected and actual employment figures were in different directions.

[7] See the technical note at the end of the for an explanation of why 1998 staffing patterns were used instead of the actual 2000 Standard Occupational Classification (SOC)-based patterns.

[8] See Valerie Personick, "Industry output and employment: a slower trend for the nineties," *Monthly Labor Review*, November 1989, pp. 25–41, for the original population projections. Updated population figures are given on the National Population Estimates page on the U.S. Census Bureau's website, **http://www.census.gov/population/www/estimates/uspop.html**.

[9] For additional information regarding the evaluation of material in the 1990–91 *Occupational Outlook Handbook*, see "The 1988–2000 Employment Projections: How Accurate Were They?" *Occupational Outlook Quarterly*, spring 2003.

[10] More information on these growth adjectives is available in the section titled "Key to understanding what's in the *Handbook*," in the *Occupational Outlook Handbook,* Bulletin 2350 (Bureau of Labor Statistics, 1990–91).

[11] The list of the 20 fastest-growing occupations was originally published in table 5 in the November 1989 *Monthly Labor Review.* Because of changes in the 2000 SOC system, some of the occupational titles now differ from the original 1988 titles. For example, human services workers are now called social and human service assistants.

[12] Assumptions regarding the growth of radiologic technologists and technicians were published in *Occupational Projections and Training Data*, Bulletin 2351 (Bureau of Labor Statistics, 1990) and in the "Job Outlook" sections of the respective occupations in the 1990–91 *Occupational Outlook Handbook.*

[13] Current growth assumptions were analyzed in *Occupational Projections and Training Data*, Bulletin 2542 (Bureau of Labor Statistics, 2002–03) and in the "Job Outlook" sections of the *Occupational Outlook Handbook*, Bulletin 2540 (Bureau of Labor Statistics, 2002–03).

[14] A table listing the 20 occupations with the largest job growth was originally published in the November 1989 *Monthly Labor Review.* Because of modifications to the SOC, one of the occupational titles changed from its original 1988 title: licensed practical nurses are now called licensed practical and licensed vocational nurses. Also stemming from the modifications to the SOC, the two occupations of order fillers, wholesale and retail sales; and stock clerks, stockroom, warehouse, or storage yard were combined into the sole occupation titled "stock clerks and order fillers." The combined occupation ranks among both those with the largest projected growth and those with the largest actual growth, but was not in the *Review* table. Because the original occupations were not combined when the projections were made, they are not included in the table.

[15] See Neal H. Rosenthal, "The quality of BLS projections: a historical account," *Monthly Labor Review*, May 1999, pp. 27–35.

[16] See *Occupational Projections and Training Data*, Bulletin 2351 (Bureau of Labor Statistics, April 1990).

APPENDIX: Technical Note

Framework of the projections. The 1988–2000 occupational employment projections were developed within the framework of an industry-occupation matrix containing 258 industries and 491 occupations. Data used for the 1988 matrix and the projected 2000 matrix came from a variety of sources. For industries covered by the Occupational Employment Statistics (OES) survey, the most current survey data were utilized to develop the occupational distribution or staffing patterns used to estimate 1988 wage and salary employment. Employment by occupation in each industry was derived by multiplying the occupational distribution of employment by 1988 wage and salary worker employment for each industry; data for each of these categories were obtained from the BLS Current Employment Statistics (CES) survey. Both the CES survey and the OES survey are surveys of business establishments, covering only wage and salary workers. Data from the 1988 Current Population Survey (CPS) were used to develop the occupational distribution patterns for workers in agriculture, fishing, hunting, and trapping, and for private households, as well as to develop economywide estimates of self-employed and unpaid family workers by occupation. Occupational distribution patterns for the Federal Government were developed by the Office of Personnel Management. Data from the National Center for Education Statistics were used for teachers.

In order to evaluate projections, the occupational employment data from the base year and the actual data from the target year must be comparable. The 1980 Standard Occupational Classification System (SOC) underwent a major revision in the year 2000. The titles and content of the major occupational groups and many detailed occupations in the 2000 SOC are now substantially different than they were in the previous version. Some major groups were renamed, combined, or reorganized. Some individual occupations were renamed or reclassified into different major groups. Many new occupations were added. Some were aggregated and some were split into more detail. Because of these changes, the occupations and major groups reflected in the 2000–10 national employment matrix are not comparable to those reflected in the 1988–2000 matrix.

Owing to the revisions to the SOC, the incomparability across occupations and major groups between 1988 and 2000 had to be addressed. A new industry-occupation matrix was created to get around the comparability problems. Actual employment data for 2000 were re-created for the purposes of the evaluation presented in the text by applying 1998 staffing patterns to the 2000 industry totals. Unlike the occupational structure, the industry structure had not changed between 1988 and 2000. Accordingly, the original 1988 and projected 2000 employment data published in 1989 were reconfigured to the 1998 occupational structure. Therefore, some of the occupational titles are not exactly the same as those published in the November 1989 *Monthly Labor Review* article. This incommensurability created by definitional changes limited the number of previous occupational employment projections that could be evaluated.

Because the 2000 SOC will be used until its next revision in 2010, the evaluations of projections made for 2005 and 2006 also will face the same type of comparability problems. In addition, comparability problems will be created when the 1987 Standard Industry Classification is replaced with the 2002 North American Industry Classification System as the new industry structure of the *Occupational Outlook Handbook*. As a result, new evaluation methods will be necessary to circumvent these problems.

Occupations eliminated from the evaluation. Only 338 of the 500 occupations for which projections were made from 1988 to 2000 were evaluated. Occupations were eliminated from the evaluation primarily for three reasons. First, all residual occupations, such as "all other managers," were dropped. Second, occupations whose definitions were not consistent between 1988 and 1998 due to changes in the occupational or industrial classification system were eliminated. Third, the list of occupations was confined to those employing more than 25,000 workers in 1988, because only those occupations were published in the original employment projections article that appeared in the November 1989 *Monthly Labor Review*.[1]

Other data errors. The discussion in the text of the article, as well as in this technical note, has focused on errors in individual projections that can be traced to incorrectly forecasted changes in staffing patterns or incorrect industry projections. Also, comparability problems stemming from inconsistencies in the occupational classification system over time were highlighted. It is important to bear in mind, however, that other data problems exist and that differences in actual and projected employment levels are not always due to projection errors. Consequently, real employment trends in an occupation may not necessarily be measured by comparable surveys 10 years apart.[2] Moreover, although survey data are generally considered reliable, sampling and response errors certainly had an impact on the data in both the initial and the terminal years of the projection period evaluated.

Notes to the appendix

[1] See George Silvestri and John Lukasiewicz, "Projections of occupational employment, 1988–2000," *Monthly Labor Review*, November 1989, pp. 42–65.

[2] For four decades, the Bureau of Labor Statistics developed projections in which the target year always ended in a zero or a five. Projections were prepared every other year, resulting in two, and sometimes three, sets of projections being prepared for the same target year. As a consequence, the projection horizon could be as short as 10 years or as long as 15 years. Beginning with the 1996–2006 projections presented in the November 1997 *Monthly Labor Review*, projections have been developed for a 10-year period only.