

# An evaluation of labor force projections to 1985

*Among the five rounds of projections of the 1985 labor force conducted between 1970 and 1980, those produced in 1978 yielded results closest to actual 1985 values*

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The final step in the Bureau of Labor Statistics employment projections process is evaluation of the results of each round of projections. Evaluations are helpful to the persons designing projections as well as to the users of the projections estimates themselves. Because the labor force projections are used in a variety of ways, there must be several criteria used to evaluate them.

The Bureau has always assessed each of its labor force projections, but has only published evaluations of the projections to 1975 and 1980.<sup>1</sup> Those evaluations showed the level of the male labor force projected to be too high and that of women too low—so low, in fact, that the overall level of the projected labor force was too low.

Five projections of the 1985 labor force were prepared over the 1970–80 period.<sup>2</sup> (See table 1.) The following tabulation shows, for the “moderate growth” scenario of each of the five rounds, the projected 1985 labor force (in millions) and its difference from the actual level:

Projection for 1985 made in:	Labor force	Error
1970.....	104	-11.0
1973.....	106	-9.7
1976.....	107	-6.8
1978.....	113	-2.5
1980.....	115	-.5
1985 labor force (actual).....	115	—

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The overall errors steadily diminished, growing smaller at an increasing rate through the 1978 projection. This improvement in accuracy continued through the 1980 projection, in which the overall error was under a million, or less than 1 percent.

It is to be expected that the more distant projections would be less accurate than the more recent ones. If we adjust for the length of the projections period by using the annualized growth rate assembled for each round, the same relative positions in terms of accuracy are maintained. The following tabulation displays historical growth rates for the total civilian labor force with the projected and actual annual rates of change to 1985. (The historical rate is measured over the same number of years *before* the year of the projection round as 1985 is *after* the year of the projection.)

Projection for 1985 made in:	Historical rate	Projected rate (1)	Actual rate (2)	Error (1)-(2)
1970.....	1.41	1.67	2.28	-0.61
1973.....	1.62	1.65	2.24	-.59
1976.....	2.33	1.61	2.10	-.49
1978.....	2.58	1.87	1.94	-.07
1980.....	2.71	1.87	1.60	-.27

As shown, the more recent projections are the more accurate. The 1980 projected labor force growth rate is the only one that exceeded the actual growth rate.<sup>3</sup>

The historical rate allows us to compare the projection with a “naive” projection. To the extent that the historical rate is closer to the actual rate than the projected rate,

**Table 1. The 1985 labor force, and labor force participation rates, actual and as projected in 1970, 1973, 1976, 1978, and 1980**

Labor force group	Labor force (in thousands)						Participation rate (in percent)					
	As projected in—					Actual 1985	As projected in—					Actual 1985
	1970	1973	1976	1978	1980		1970	1973	1976	1978	1980	
Total .....	104,418	105,716	108,602	112,953	114,985	115,461	61.1	61.7	63.2	65.3	66.5	64.8
Men, 16 and older .....	65,010	64,057	62,903	63,007	63,600	64,411	80.4	79.1	77.5	77.0	77.7	76.3
16 and 17 years .....	1,831	1,584	1,777	1,877	1,886	1,663	47.9	45.8	50.7	53.6	53.7	45.1
18 and 19 years .....	2,041	2,147	2,404	2,459	2,501	2,471	61.6	63.7	71.4	74.1	73.4	68.9
20 to 24 years .....	7,856	7,554	7,795	8,091	8,205	8,283	82.3	81.8	83.0	85.7	86.9	85.0
25 to 34 years .....	18,840	18,929	18,021	17,925	17,976	18,808	97.4	95.5	94.9	94.3	94.7	94.7
35 to 44 years .....	14,616	14,350	14,192	14,218	14,252	14,506	97.4	95.8	95.1	95.2	95.4	95.0
45 to 54 years .....	9,834	9,698	9,709	9,681	9,801	9,870	95.3	92.6	90.6	89.9	91.0	91.0
55 to 59 years .....	4,406	4,418	4,283	4,213	4,247	4,250	88.2	87.2	82.5	79.5	80.1	79.6
60 to 64 years .....	3,441	3,295	2,879	2,740	2,875	2,809	73.9	70.4	59.9	55.7	58.5	55.6
65 to 69 years .....	1,335	1,322	1,104	969	1,046	1,024	35.9	35.2	28.0	24.0	25.9	24.4
70 years and older .....	810	760	739	796	811	727	13.2	12.3	11.8	11.6	12.5	10.5
Women, 16 and older .....	39,408	41,659	45,697	49,946	51,385	51,050	43.7	46.2	50.3	54.8	56.5	54.5
16 and 17 years .....	1,190	1,247	1,551	1,705	1,745	1,491	31.7	36.9	45.4	49.8	51.0	42.1
18 and 19 years .....	1,869	1,948	2,221	2,487	2,431	2,276	51.0	55.8	61.5	69.2	68.3	61.7
20 to 24 years .....	5,987	6,505	7,329	7,742	7,678	7,434	57.9	65.0	72.5	76.8	76.5	71.8
25 to 34 years .....	9,424	10,330	12,210	14,607	14,955	14,742	46.7	51.1	61.2	73.2	75.1	70.9
35 to 44 years .....	8,393	8,557	9,723	11,079	11,617	11,567	53.6	54.6	61.1	69.5	72.9	71.8
45 to 54 years .....	6,153	6,540	6,761	6,746	7,078	7,452	55.6	57.7	59.1	58.7	61.7	64.4
55 to 59 years .....	2,959	3,033	2,870	2,804	2,817	2,990	52.3	52.7	50.4	49.0	49.3	50.3
60 to 64 years .....	2,175	2,180	1,870	1,732	1,886	1,942	38.7	38.7	33.1	31.1	33.8	33.4
65 to 69 years .....	782	814	721	645	738	695	16.3	16.8	14.3	12.8	14.6	13.5
70 years and older .....	476	505	453	399	440	462	5.1	5.1	4.5	4.4	4.3	4.3
Whites .....	91,221	—	—	98,876	100,316	99,926	60.8	—	—	65.9	66.8	65.0
Men .....	57,127	—	—	55,753	56,228	56,472	80.3	—	—	77.9	78.5	77.0
Women .....	34,094	—	—	43,123	44,088	43,455	43.2	—	—	54.9	56.2	54.1
Blacks and others .....	13,197	—	—	14,079	14,667	15,535	63.1	—	—	61.7	64.4	63.3
Men .....	7,883	—	—	7,256	7,372	7,940	81.2	—	—	70.5	71.9	71.6
Women .....	5,314	—	—	6,823	7,297	7,595	47.4	—	—	54.4	58.3	56.8

NOTE: Dash indicates data not available.

a naive projection would have been better. The projections made in 1970, 1978, and 1980 were better than the naive projections; the 1973 projection was essentially the same growth rate as a naive projection; and the 1976 projection was worse than a naive projection.

This tabulation also allows us to characterize the labor force projections. The 1970 projection embodies an assumption that the labor force growth would increase modestly, when in fact, it increased greatly, mainly between 1975 and 1980. The 1973 projection envisioned labor force growth at the same rate as had prevailed. The 1976 projection, made after rapid growth in the labor force, implied that growth would slow significantly; it dropped only slightly. The 1978 projection, released the year of greatest labor force growth, also assumed that labor force growth would drop significantly. It did, with the error in the growth rate being less than a tenth of a percent. The 1980 projection, which occurred after the greatest growth in the labor force had been completed, measured the greatest rate of increase in the labor force, but projected growth at the same rate as the 1978 projection. The labor force grew more slowly than projected.

The Bureau prepares projections by developing for each specific age-sex (and, more recently, race) group a projected labor force participation rate. Then, using population projections by the Bureau of the Census for each

group, total labor force levels are estimated. Consequently, there are two possible sources of error in the labor force projections—the population projection and the participation rate projection.

In the past, population projections have been a trivial source of error and their contribution to the errors in the labor force projections was ignored. However, after the 1980 census, there was a significant upward revision in the estimated civilian noninstitutional population that resulted in a similar upward revision in the labor force estimates. As a result, population projections played a larger role in the errors in the 1985 labor force projections.

This article discusses, in order, the consequences of errors in the population projections and the effects of labor force participation rate errors. Included is an examination of the errors in the labor force participation rates of specific demographic groups and the resulting errors in estimates of labor force composition.

### Population errors

The following tabulation shows, for each of the five projections rounds, the projected 1985 population (including Armed Forces overseas) for the total population age 16 and over and for men and women (in millions), with the error for the total population:

	Total	Men	Women	Total error
Projection for 1985 made in:				
1970 .....	176	85	91	-7.3
1973 .....	176	84	91	-7.9
1976 .....	176	84	92	-7.0
1978 .....	178	85	92	-6.0
1980 .....	178	85	92	-6.0
1985 population (actual) .....	184	88	95	—

As the tabulation indicates, the error in the projection for the population of working age rose, then fell, and was lowest for the most recent projections.<sup>4</sup> To examine further the effects of the population projection error, the projected participation rates for 1985 were multiplied by the actual 1985 civilian noninstitutional population; the results are displayed in tables 2 and 3. As table 2 indicates, had the actual civilian noninstitutional population been known or projected correctly, two labor force projections would have been above the actual 1985 level, whereas none of the projections was. The first four were less accurate because of the underprojection, and the last, more accurate.

The first four projected male labor force levels were lower than the actual. The female labor force for the last two 1985 projections also was less than the actual, because the projected population was too low. Generally, the differences in the total labor force were about 3 million. (See table 3.) The differences between the actual and

projected labor force levels are more variable for men than for women, for whom the difference ranged from 1.1 million to 1.5 million. The difference between actual and projected levels for the male labor force ranged from 1.9 million to 2.4 million.

Use of a population projection close to the actual 1985 level would have reduced the error in the annual labor force growth rate by 0.2 percentage point for each of the first three projections; it would have changed the sign of the error of the fourth projection from negative to positive; and the 1980 projection would have been more inaccurate.

There are four aspects of a population projection: the base-year estimate and projections of births, of deaths, and of net immigration.<sup>5</sup> The two sources of error affecting labor force projections are base-year estimates and net immigration assumptions. Should the estimated structure or size of the population in the base year be incorrect, this error will be extended through the early years of the projection. If projected net immigration is too low or too high, both the level and the age composition of the population would be affected.

Although the components of population projection error affecting the labor force projections can be separated into two parts, the cause of the error was essentially the same in all five projections rounds: underestimates or underprojections of net immigration. Both undocumented and refugee immigration affected the base-year estimates and the population projections.

**Table 2. The 1985 labor force, actual and projected using the participation rates projected in 1970, 1973, 1976, 1978, and 1980 with the actual 1985 population**

[In thousands]

Labor force group	Labor force					Actual 1985	Errors due to participation rate projections <sup>1</sup>				
	As projected in—						1970	1973	1976	1978	1980
	1970	1973	1976	1978	1980						
Total .....	107,931	109,110	112,067	116,202	118,367	115,461	-7,530	-6,352	-3,395	741	2,906
Men, 16 and older .....	67,403	66,116	65,130	64,863	65,503	64,411	2,992	1,705	719	452	1,092
16 and 17 years .....	1,767	1,690	1,870	1,977	1,981	1,663	104	27	207	314	318
18 and 19 years .....	2,209	2,284	2,560	2,657	2,632	2,471	-262	-187	89	186	161
20 to 24 years .....	8,021	7,972	8,089	8,352	8,469	8,283	-262	-311	-194	69	186
25 to 34 years .....	19,348	18,970	18,851	18,732	18,811	1,880	540	162	43	-76	3
35 to 44 years .....	14,868	14,624	14,517	14,532	14,563	14,506	362	118	11	26	57
45 to 54 years .....	10,334	10,042	9,825	9,749	9,868	9,870	464	172	-45	-121	-2
55 to 59 years .....	4,710	4,656	4,405	4,245	4,277	4,250	460	406	155	-5	27
60 to 64 years .....	3,733	3,556	3,026	2,813	2,955	2,809	924	747	217	4	146
65 to 69 years .....	1,503	1,474	1,173	1,005	1,085	1,024	479	450	149	-19	61
70 years and older .....	910	848	814	800	862	727	183	121	87	73	135
Women, 16 and older .....	40,528	42,993	46,937	51,338	52,863	51,050	-10,522	-8,057	-4,113	288	1,813
16 and 17 years .....	1,123	1,307	1,609	1,764	1,807	1,491	-368	-184	118	273	316
18 and 19 years .....	1,881	2,058	2,268	2,552	2,519	2,276	-395	-218	-8	276	243
20 to 24 years .....	5,993	6,728	7,504	7,950	7,919	7,434	-1,441	-706	70	516	485
25 to 34 years .....	9,716	10,631	12,733	15,229	15,625	14,742	-5,026	-4,111	-2,009	487	883
35 to 44 years .....	8,637	8,798	9,846	11,199	11,747	11,567	-2,930	-2,769	-1,721	-368	180
45 to 54 years .....	6,435	6,678	6,840	6,794	7,141	7,452	-1,017	-774	-612	-658	-311
55 to 59 years .....	3,108	3,131	2,995	2,912	2,929	2,990	118	141	5	-78	-61
60 to 64 years .....	2,247	2,247	1,922	1,806	1,963	1,942	305	305	-20	-136	21
65 to 69 years .....	838	864	735	658	751	695	143	169	40	-37	56
70 years and older .....	549	549	485	474	463	462	87	87	23	12	1

<sup>1</sup>Difference from actual 1985 values.

The base-year population estimates for labor force projections using the 1970 census reflected underenumeration of immigrants in the 1970 census as well as underprojection of immigration during the 1970's. Until recently, the Census Bureau did not incorporate any estimate of undocumented immigrants into its middle series population projections because such persons were not counted in its estimates of current population levels. Thus the base-year estimates were too low because of underenumeration in the 1970 census and, further, undocumented immigrants were not included in the population estimates for the intercensal years.

The 1980 census differed significantly from the 1970 census in coverage, yielding a significantly higher estimate of the civilian noninstitutional population. Much of this difference, but not all, can be attributed to procedural changes designed to capture the effects of immigration.

Although the population errors cannot be allocated between errors in base-year estimates and the specific immigration scenarios, it is possible to determine the share of overall error in the projections of the labor force due to population estimates and the share due to participation rate error. Table 2 shows the errors due to the projection of participation rates. The last columns of table 3 show population estimate-induced errors.<sup>6</sup> Putting the two types of errors together:

	<i>In millions</i>		
	<i>Total error</i>	<i>Participation</i>	<i>Population</i>

Projection for 1985 made in:			
1970 .....	-11.0	-7.5	-3.5
1973 .....	- 9.7	-6.3	-3.4
1976 .....	- 6.9	-3.4	-3.5
1978 .....	- 2.5	.7	-3.2
1980 .....	- .5	2.9	-3.4

The errors due to the population projection did not vary much across the sets of projections, from a high of 3.5 million for the 1970 round to a low of 3.2 million for the 1978 round. Because the errors due to participation rates dropped for the first four projections, the population errors became a greater proportion of the overall error in the labor force projections in each succeeding projection. Two-thirds of the error in the 1970 projection may be attributed to the participation rate errors; by the 1976 projection, that share had dropped to one-half. The participation rate errors in the 1978 projection were small and yielded a slight overprojection. The 1980 projections yielded an even higher overprojection. Although the overall error was much smaller in 1980, the errors in participation rate and population projections were larger, but offsetting. Except for the 1978 round, the 1980 labor force projections had the lowest participation rate error.

According to this analysis, the errors in the population projection were roughly the same size for all five projections. They accounted for a smaller proportion of the earliest projection error, but as participation rate error decreased in later projections, population projection error accounted for an increasing proportion of the error in the projected labor force level. By 1980, the errors in projecting labor force participation and in projecting population offset each other. As indicated earlier, the primary source of error for the population projections was underestimates of immigration, and in particular, lack of any accounting for undocumented immigrants.<sup>7</sup>

### Labor force participation rates

The errors of the projections of the labor force participation rates can be examined for individual participation rate errors or by aggregation of the errors.

	<i>Labor force (in millions)</i>			
	<i>Total</i>	<i>Men</i>	<i>Women</i>	<i>Error</i>
Projection for 1985 made in:				
1970 .....	104	65	39	11.0
1973 .....	106	64	42	9.7
1976 .....	109	63	46	6.8
1978 .....	113	63	50	2.5
1980 .....	115	64	51	.5
1985 labor force (actual) .....	115	64	51	—

*Summary measures of errors.* The first characterization of the errors in the labor force projections for 1985 is the mean absolute percent error (table 4). The measure for the projected participation rates ranged from 5.6 to 17.0, with the first two projections having by far the greatest measured error. The other three projections had measured errors of similar magnitude, around 5.8, with the 1978 projection having the lowest error. This corresponds with the earlier finding that the growth rate projected in 1978 had the smallest error. It appears that, in terms of mean absolute percent error, the 1976 projection is more like the 1978 and 1980 projections than like the earlier two.

The second summary measure of the errors in the labor force projections is the regression of actual against projected levels. If the projections were perfect, then the actual level plotted against the projected would yield a straight line through the origin with a slope of 1. (See charts 1 and 2.) We may test this by regressing actual against projected and testing the hypothesis that the intercept is zero and the slope 1.

**Table 3. Difference between projected and actual labor force, and between the original labor force projection and one using the actual 1985 population, 1970, 1973, 1976, 1978, and 1980**  
(In thousands)

Labor force group	Difference between the projected 1985 labor force and the value projected in—					Errors due to population projections <sup>1</sup>				
	1970	1973	1976	1978	1980	1970	1973	1976	1978	1980
Total .....	-11,043	-9,745	-6,859	-2,508	-476	-3,513	-3,394	-3,465	-3,249	-3,382
Men, 16 and older .....	599	-354	-1,508	-1,404	-811	-2,393	-2,059	-2,227	-1,856	-1,903
16 and 17 years .....	168	-79	114	214	223	64	-106	-93	-100	-95
18 and 19 years .....	-430	-324	-67	-12	30	-168	-137	-156	-198	-131
20 to 24 years .....	-427	-729	-488	-192	-78	-165	-418	-294	-261	-264
25 to 34 years .....	32	121	-787	-883	-832	-508	-41	-830	-807	-835
35 to 44 years .....	110	-156	-314	-288	-254	-252	-274	-325	-314	-311
45 to 54 years .....	-36	-172	-161	-189	-69	-500	-344	-116	-68	-67
55 to 59 years .....	156	168	33	-37	-3	-304	-238	-122	-32	-30
60 to 64 years .....	632	486	70	-69	66	-292	-261	-147	-73	-80
65 to 69 years .....	311	298	80	-55	22	-168	-152	-69	-36	-39
70 years and older .....	83	33	12	69	84	-100	-88	-75	-4	-51
Women, 16 and older .....	-11,642	-9,391	-5,353	-1,104	335	-1,120	-1,334	-1,240	-1,392	-1,478
16 and 17 years .....	-301	-244	60	214	254	67	-60	-58	-59	-62
18 and 19 years .....	-407	-328	-55	211	155	-12	-110	-47	-65	-88
20 to 24 years .....	-1,447	-929	-105	308	244	-6	-223	-175	-208	-241
25 to 34 years .....	-5,318	-4,412	-2,532	-135	213	-292	-301	-523	-622	-670
35 to 44 years .....	-3,174	-3,010	-1,844	-488	50	-244	-241	-123	-120	-130
45 to 54 years .....	-1,299	-912	-691	-706	-374	-282	-138	-79	-48	-63
55 to 59 years .....	-31	43	-120	-186	-173	-149	-98	-125	-108	-112
60 to 64 years .....	233	238	-72	-210	-56	-72	-67	-52	-74	-77
65 to 69 years .....	87	119	26	-50	43	-56	-50	-14	-13	-13
70 years and older .....	14	43	-9	-63	-22	-73	-44	-32	-75	-23

<sup>1</sup>Difference between the projection made with the actual 1985 population and the projection made in the reference year.

**Table 4. Difference between actual and projected 1985 labor force participation rates, for the 1970, 1973, 1976, 1978, and 1980 projections rounds**

Labor force group	Percentage-point difference					Absolute percentage-point error				
	1970	1973	1976	1978	1980	1970	1973	1976	1978	1980
Total .....	-3.7	-3.1	-1.6	0.5	1.7	5.7	4.8	2.5	0.8	2.6
Men, 16 and older .....	4.1	2.8	1.2	.7	1.4	5.4	3.7	1.6	.9	1.8
16 and 17 years .....	2.8	.7	5.6	8.5	8.6	6.2	1.6	12.4	18.8	19.1
18 and 19 years .....	-7.3	-5.2	2.5	5.2	4.5	10.6	7.5	3.6	7.5	6.5
20 to 24 years .....	-2.7	-3.2	-2.0	.7	1.9	3.2	3.8	2.4	.8	2.2
25 to 34 years .....	2.7	.8	.2	-.4	.0	2.9	.8	.2	.4	.0
35 to 44 years .....	2.4	.8	.1	.2	.4	2.5	.8	.1	.2	.4
45 to 54 years .....	4.3	1.6	-.4	-1.1	.0	4.7	1.8	.4	1.2	.0
55 to 59 years .....	8.6	7.6	2.9	-.1	.5	10.8	9.5	3.6	.1	.6
60 to 64 years .....	18.3	14.8	4.3	.1	2.9	32.9	26.6	7.7	.2	5.2
65 to 69 years .....	11.5	10.8	3.6	-.4	1.5	47.1	44.3	14.8	1.6	6.1
70 years and older .....	2.7	1.8	1.3	1.1	2.0	25.7	17.1	12.4	10.5	19.0
Women, 16 and older .....	-10.8	-8.3	-4.2	.3	2.0	19.8	15.2	7.7	.6	3.7
16 and 17 years .....	-10.4	-5.2	3.3	7.7	8.9	24.7	12.4	7.8	18.3	21.1
18 and 19 years .....	-10.7	-5.9	-.2	7.5	6.6	17.3	9.6	.3	12.2	10.7
20 to 24 years .....	-13.9	-6.8	.7	5.0	4.7	19.4	9.5	1.0	7.0	6.5
25 to 34 years .....	-24.2	-19.8	-9.7	2.3	4.2	34.1	27.9	13.7	3.2	5.9
35 to 44 years .....	-18.2	-17.2	-10.7	-2.3	1.1	25.3	24.0	14.9	3.2	1.5
45 to 54 years .....	-8.8	-6.7	-5.3	-5.7	-2.7	13.7	10.4	8.2	8.9	4.2
55 to 59 years .....	2.0	2.4	.1	-1.3	-1.0	4.0	4.8	.2	2.6	2.0
60 to 64 years .....	5.3	5.3	-.3	-2.3	.4	15.9	15.9	.9	6.9	1.2
65 to 69 years .....	2.8	3.3	.8	-.7	1.1	20.7	24.4	5.9	5.2	8.1
70 years and older .....	.8	.8	.2	.1	.0	18.6	18.6	4.7	2.3	.0
Whites .....	-4.2	—	—	.9	1.8	6.5	—	—	1.4	2.8
Men .....	3.3	—	—	.9	1.5	4.3	—	—	1.2	1.9
Women .....	-10.9	—	—	.8	2.1	20.1	—	—	1.5	3.9
Black and other .....	-.2	—	—	-1.6	1.1	.3	—	—	2.5	1.7
Men .....	9.6	—	—	-1.1	.3	13.4	—	—	1.5	.4
Women .....	-9.4	—	—	-2.4	1.5	16.5	—	—	4.2	2.6
Mean absolute percent error .....	—	—	—	—	—	17.0	13.6	5.8	5.6	6.0

NOTE: Dash indicates data not available or not applicable.

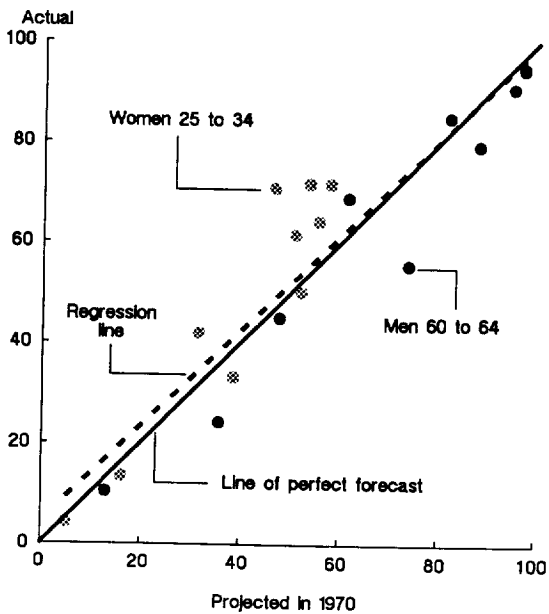
	Intercept	Slope	F-test of hypothesis	Probability > F
Projection for 1985 made in:				
1970 .....	4.5	0.9	0.42	0.67
1973 .....	1.0	1.0	.13	.88
1976 .....	-1.0	1.0	.18	.84
1978 .....	-.4	1.0	1.09	.35
1980 .....	-2.1	1.0	5.15	.01

This tabulation suggests that the 1980 projection was the best in projecting labor force participation rates. However, when the labor force participation rates were combined with the population estimates, the 1980 projection was too high.<sup>8</sup>

In the chart for each projection, the projected participation rates are compared, in scattergram form, with the regression line they yield and with the "line of perfect forecast." If the projection were perfect, the regression line of projected on actual would be on the line of perfect forecast. In each case, rates plotted in the lower left-hand corner are for older workers, who have low rates of labor force participation; those in the upper right corner are for men in the prime working years, whose rates are the highest.

For 1970, there is a cluster above the line of perfect forecast in the center of chart 1—the projected participation rates for women in the age groups between 20 and 44.

**Chart 1. Labor force participation rates for 1985, actual and as projected in 1970**



NOTE: Black points indicate observations for men. Gray points indicate observations for women.

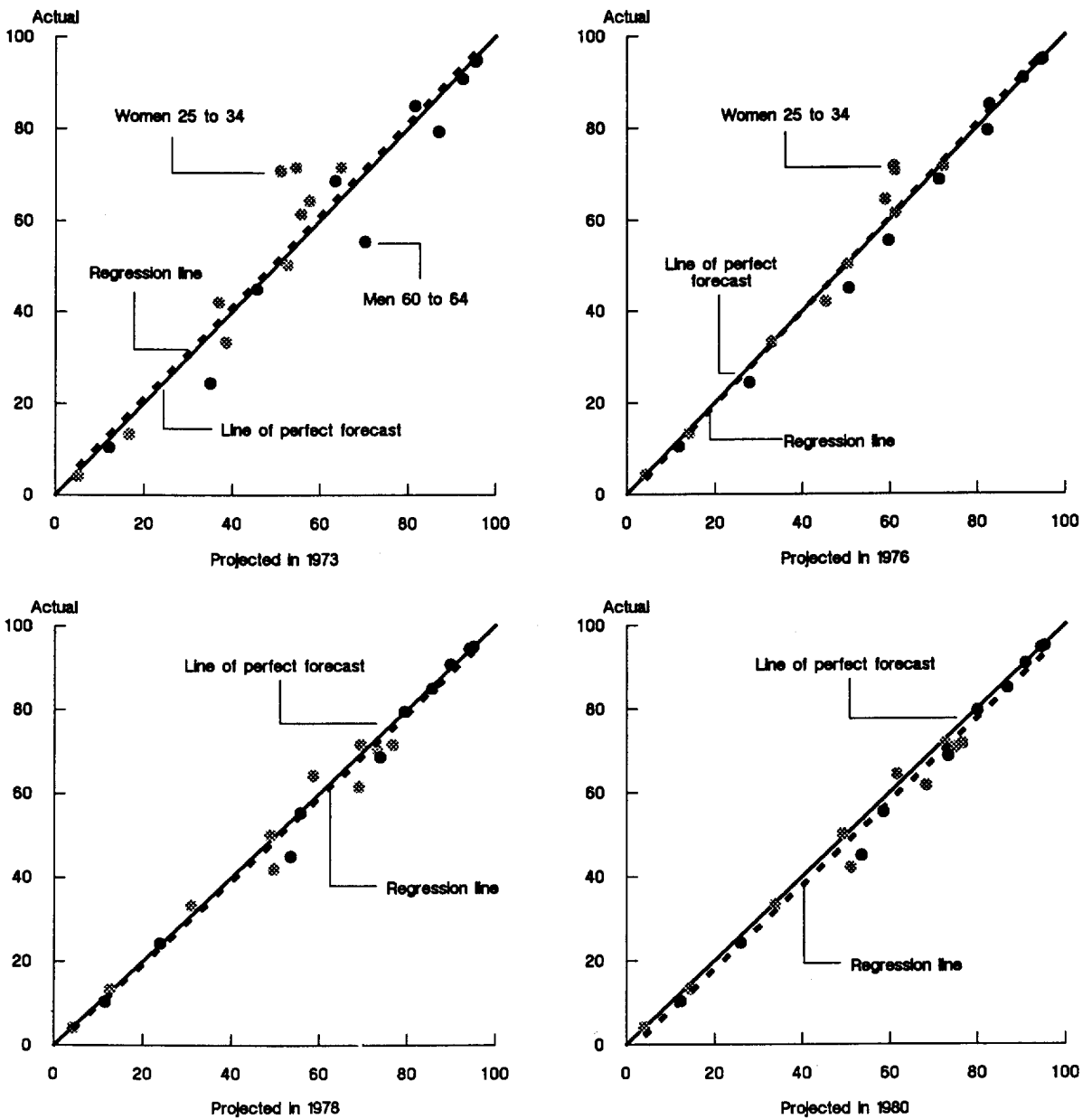
The outlying observation below the line is for men 60 to 64. As would be assumed from earlier comments, the rate for women 65 and older is close to the line of perfect forecast. The regression line for 1973 (chart 2) is closer to the line of perfect forecast, even though there was only a small improvement in the errors for the groups of women ages 20 to 44 and for men 60 to 64. By 1976 (chart 2), the values are even closer to the line of perfect forecast, and the cluster of rates for women is smaller because the rate for women ages 20 to 24 is projected much more accurately. The errors for men 60 to 64 are also sufficiently small that they are not noticeable. Even the two remaining outlier age groups—women 25 to 34 and 35 to 44—have smaller errors. The regression line summarizing the projection appears to be the closest to the line of perfect forecast.

The lines for the 1978 and 1980 projections (chart 2) appear to move progressively away from the line of perfect forecast. However, for both projections, there are really no age groups that appear to be poorly projected. The offsetting high projections for women in the groups ages 24 to 44 and for men 60 to 64 move the regression line for the 1976 projection close to the line of perfect forecast, but the larger errors for specific groups in the projection prevent the regression line from being considered as close to the line of perfect forecast as those for 1978 and 1980. What numerical summaries of the 1980 projections have indicated is revealed graphically here: the projected participation rates are more tightly clustered around the regression line, which is parallel to, but distinct from, the line of perfect forecast.

*Range of errors.* The errors in the participation rates range from 24.2 percentage points too low for women ages 20 to 24 in the projection made in 1970 to 18.3 percentage points too high for men 60 to 64, also in the 1970 projection (table 4). The same two groups also had the greatest errors in the 1973 projection, but women ages 35 to 44 were the worst underprojected in 1976, with 16- and 17-year-old men the most overprojected. The participation rate for the latter group continued to be difficult to project—in 1978, it was the worst overprojected, by 8.5 percentage points. The worst underprojection that year was for women 45 to 54 (-5.7 percentage points). The problem of projecting the growth in women's labor force participation moved to successively older groups as the 1970's progressed. In the 1980 projection, rates for the youngest groups in the labor force were the most difficult to project—those for 16- and 17-year-old women were overprojected by 8.9 points, and those for men the same age, by 8.6 percentage points. Rates for women ages 45 to 54 were the most underprojected, by 2.7 points, and those for women 25 to 34 and 35 to 44 were overprojected.

As a group, women age 70 and older had the lowest absolute errors. In fact, rates for women 55 and older were projected with less error than those of their male counter-

**Chart 2. Labor force participation rates for 1985, actual and as projected in 1973, 1976, 1978, and 1980**



NOTE: Black points indicate observations for men. Gray points indicate observations for women.

parts. This primarily reflects the less dynamic labor force activity of this group over the 1970–85 period. Although the largest errors were for women in age groups 20 to 44 at the beginning of the period, we have seen that, by the 1980 projection, rates for the 16- and 17-year-old group were the most difficult to project. Persons 70 and older and teenage men had their participation projected too high in all projections; women 45 to 54 had their participation projected too low in all projections; all other groups had their participation both over- and underprojected.

In general, participation for men was projected higher than the actual rate—the overall rates were too high for all five projections, with the lowest error in 1978 and the greatest in 1970. For women, the first three projections of participation were too low—by 10 percentage points in the 1970 projection. In 1978, the overall participation rate for women was projected too high by 0.3 percentage point. The 1980 projection also had participation too high for women (2.0 points), as measured by the overall rate. (See table 4.) This suggests that, as time passed, the

projections of women's and men's participation were adjusted by Bureau analysts to reflect the changes in participation observed.

Because the errors in participation for women were greater than those for men in the first three projections, the overall participation rate was underprojected, even though more participation rates for individual age groups were over- than underprojected. The 1978 projection was dominated by the male rates and was slightly overprojected. By 1980, rates for both women and men were overprojected.

Although the overall 1985 participation rate for blacks was projected quite closely in 1970—an error of -0.2 percentage point—this was the result of large offsetting errors of almost 10 percent for black men and women. Overall white participation was underprojected in 1970. White women's participation was underprojected by more than 10 percentage points. Participation of white men was overprojected by 3 percentage points. It should be noted that the 1970 labor force projection methodology divided the labor force up by race after the overall labor force was projected. The middle scenario from the 1970 projection round also assumed that rates for blacks and whites would converge over time.

Starting with the 1978 round, the labor force was projected by two race groups independently. Because the white labor force is still the much larger component, errors in the projection of this group affect the overall error more. Thus, because white participation was overprojected in both 1978 and 1980, the overall participation rate was overprojected in both years. Participation for white men and women alike was overprojected in both rounds, with the greatest error in 1980.

In 1978, participation of both black men and women was underprojected. This only slightly offset the overprojection of white rates. The errors were much greater for blacks and others than for whites. In the 1980 round, rates for blacks were more accurately projected than were those for whites. However, the rates for black women were projected too high. The overall rate for black men was nearly perfectly projected. Given that the black participation rates as measured are more variable than the white rates, this is a surprising development.

*Relative errors.* As noted earlier, the errors in labor force participation rates of older women are small. That is not surprising as their participation is low. Relative to the size of their participation rates, however, the error is large. For example, in the 1970 and 1973 rounds, the 0.2-percentage-point error for women age 70 and older is an 18.6-percent relative error. Men in the prime working years have participation near 100 percent, and relative errors for this group are roughly the same size as the percentage-point errors; women's participation is lower, and thus relative errors for their projections are always

larger than the percentage-point errors.

Turning to the relative error in overall participation, the earlier characterization of the 1970 round as being by far the least accurate projection and 1978 as being the most accurate continues to hold. Men's participation was generally more accurately projected than women's, based on their overall participation. However, in 1978, the overall rate for women was more accurately projected. Men's participation was equally accurate in the 1976 and 1980 rounds, whereas women's participation was projected more accurately in 1980 than in 1976. That is, there was no improvement in the projection of men's rates over the last three projections, but there was for women's.

The relative errors by race were higher for whites than for blacks and others in both the 1970 and 1980 rounds. The relative errors for white women also were higher than those for their black counterparts in 1970 and 1980. For men, the relative error for blacks was much higher than that for whites in 1970. In 1978, the relative error for black men was the same as for white men and, by 1980, was less.

Among detailed age groups, the largest relative errors in the early projections rounds were for older men and for women ages 25 to 44. Starting in 1978, the relative errors for women 25 to 44 were no longer large, but those for teenagers of both sexes and for men 75 and older were. However, these errors were almost half the size of the earlier relative errors for 25- to 44-year-old women. Given the greater cyclical responsiveness of the teenage labor force, higher relative error might be expected. The larger error for women 70 and older does not have much impact on the size of the overall labor force. As indicated earlier, it reflects their low participation rate. The following tabulation summarizes the relative errors in participation rates for the detailed groups:

Projection for 1985 made in:	<i>Median relative error</i>	<i>Mean absolute percent error</i>
1970 .....	3.3	17.0
1973 .....	1.2	13.6
1976 .....	.6	5.8
1978 .....	.2	5.6
1980 .....	3.6	6.0

This summary suggests that the relative error in the projected participation was least in the 1978 round, but that the 1976 projection was of about the same quality. The median relative error and the mean absolute percent error offer contradictory evidence about the quality of the 1980 projection. Recall that the 1980 projection of 1985 labor force participation was too high. The median of the relative errors is highest for this projection. However, the measures also indicate that the spread around the errors lessened over time, and was lowest in the 1980 projection. The relatively small mean absolute percent error reflects this clustering.



**Table 5. Distribution of the projected civilian labor force, 1970, 1973, 1976, 1978, and 1980, and actual, 1985**

Labor force group	Distribution						Percentage-point difference from 1985 actual				
	1970	1973	1976	1978	1980	1985	1970	1973	1976	1978	1980
Total .....	100.0	100.0	100.0	100.0	100.0	100.0	—	—	—	—	—
Men, 16 and older .....	62.3	60.6	57.9	55.8	55.3	55.8	6.5	4.8	2.1	-0.0	-0.5
16 and 17 years .....	1.8	1.5	1.6	1.7	1.6	1.4	.3	.1	.2	.2	.2
18 and 19 years .....	2.0	2.0	2.2	2.2	2.2	2.1	-.2	-.1	.1	.0	.0
20 to 24 years .....	7.5	7.1	7.2	7.2	7.1	7.2	.3	.0	.0	.0	.0
25 to 34 years .....	18.0	17.9	16.6	15.9	15.6	16.3	1.8	1.6	.3	-.4	-.7
35 to 44 years .....	14.0	13.6	13.1	12.6	12.4	12.6	1.4	1.0	.5	.0	-.2
45 to 54 years .....	9.4	9.2	8.9	8.6	8.5	8.5	.9	.6	.4	.0	.0
55 to 59 years .....	4.2	4.2	3.9	3.7	3.7	3.7	.5	.5	.3	.0	.0
60 to 64 years .....	3.3	3.1	2.7	2.4	2.5	2.4	.9	.7	.2	.0	.1
65 to 69 years .....	1.3	1.3	1.0	.9	.9	.9	.4	.4	.1	.0	.0
70 years and older .....	.8	.7	.7	.7	.7	.6	.1	.1	.1	.1	.1
Women, 16 and older .....	37.7	39.4	42.1	44.2	44.7	44.2	-6.5	-4.8	-2.1	.0	.5
16 and 17 years .....	1.1	1.2	1.4	1.5	1.5	1.3	-.2	-.1	.1	.2	.2
18 and 19 years .....	1.8	1.8	2.0	2.2	2.1	2.0	-.2	-.1	.1	.2	.1
20 to 24 years .....	5.7	6.2	6.7	6.9	6.7	6.4	-.7	-.3	.3	.4	.2
25 to 34 years .....	9.0	9.6	11.2	12.9	13.0	12.8	-3.7	-3.0	-1.5	.2	.2
35 to 44 years .....	8.0	8.1	9.0	9.8	10.1	10.0	-2.0	-1.9	-1.1	-.2	.1
45 to 54 years .....	5.9	6.2	6.2	6.0	6.2	6.5	-.6	-.3	-.2	-.5	-.3
55 to 59 years .....	2.8	2.9	2.6	2.5	2.4	2.6	.2	.3	.1	-.1	-.1
60 to 64 years .....	2.1	2.1	1.7	1.5	1.6	1.7	.4	.4	.0	-.1	.0
65 to 69 years .....	.7	.8	.7	.6	.6	.6	.1	.2	.1	.0	.0
70 years and older .....	.5	.5	.4	.4	.4	.4	.1	.1	.0	.0	.0
Dissimilarity index .....	—	—	—	—	—	—	7.5	5.7	2.8	1.5	1.4

NOTE: Dash indicates data not applicable.

*Composition errors.* Although much of the interest in the labor force projections centers on their levels and growth rates, there is also interest in the projected labor force participation rates which contribute to the size of the labor force. Similarly, there is interest in the resulting future composition or age-sex structure of the labor force. The summary measure used to evaluate the projected labor force composition is the index of dissimilarity, which measures how much the projected composition would have to change to be like the actual composition of the 1985 work force. The index of dissimilarity is calculated as half the sum of the absolute values of the differences in distribution of the two groups being compared.

According to the dissimilarity indexes presented in table 5, the 1980 projected composition would have to change by 1.4 percentage points to have the same composition as the actual 1985 estimates. The 1970 projection of composition was worst, and composition projections improved with each subsequent round. The improvement was greatest between the 1973 and 1976 projections. Despite the errors made in the earliest projection, none would have needed as much as a 10-percentage-point change in composition to equal the 1985 actual.

#### Assumptions and projection errors

Of concern in the evaluation of projections is why one round has less error than another, particularly if the explanation yields information that could improve future projections. The BLS labor force projection method involves a high level of disaggregation of the population, followed by extrapolation of the labor force participation rate for each population group. The refinement of the methodology over time has included using data for age cohorts 5 years

wide (1973 to present), use of parental status for women (1973-78), and disaggregation by race (1978 to present). The extrapolation technique developed for the 1973 projection dampened the estimated participation growth rates for women rapidly, owing to the assumptions discussed below. For the 1976-80 rounds, tapering of growth rates for women's participation was designed to be greatest toward the end of the projection period. Because the projections generally improved in later rounds, the question arises as to whether the improvements over time result from changes in methods or simply from the availability of later data.

For the labor force projections made over the 1973-80 period, the *change* in participation rates was projected. These changes were applied to a "takeoff" participation rate to derive successive participation rates. To project the rate of change, past changes in participation rates were estimated. It was *assumed* that participation rate changes would ultimately cease over the projections period.

For the 1973 projection, when the drop in fertility rates had just begun, it was assumed that the rapid growth in women's labor force participation would soon cease as fertility increased. In fact, the opposite occurred. Even if a behavioral model relating fertility and women's labor force participation had been developed and used, the expectation that fertility would rise still would have led to projections of participation lower than that which actually occurred. For the remaining projections, it was also assumed that changes in participation would end, but that the greatest slowdown would take place after 1985—for the 1976 projection, between 1990 and 1995; for later projections, after 1995. For the 1980 projection, it was

assumed that the rate of participation change for women ages 20 to 44 would grow for 3 years, then drop.

The problems involved with selecting a takeoff point have been discussed by Paul Ryscavage, Lucy Kok and Chris de Neubourg, and J. Scott Armstrong.<sup>9</sup> Especially in the short run, a projection's accuracy can be seriously affected by the choice of a takeoff point. The problems of accuracy in the 1973 projection in part reflect a decision to use the year 1970 as a takeoff point because only the years 1980, 1985, and 1990 were projected. The 1976 projection used the average estimate of the 3 preceding years and later projections have used the estimate from the preceding year. If the rate of change is underestimated because linear change is assumed when change is actually nonlinear, then every year the takeoff point is moved back from the year of the last observation compounds the problem. The effect of not using the estimate from the most recent year is to shift the projection down (or up) for the entire period covered.

The 1973, 1976, and 1978 projections explicitly used the fertility rate assumptions discussed earlier to derive the number of women with young children in 1985. The use of the assumptions overstates the number of such women for the 1973 and 1976 rounds and understates it slightly for the 1978 round. Because the projected fertility rate for women for 1985 was between the last observed fertility rate and the ultimate fertility rate, the error was not as great as the tabulation below indicates. Following are fertility assumptions for the five projections and the actual 1985 fertility rate:

Projection for 1985 made in:	<i>Fertility rate</i>
1970 .....	2.8
1973 .....	2.1
1976 .....	2.1
1978 .....	1.7
1980 .....	2.1
1985 fertility rate (actual).....	1.9

Although fertility rates did not enter as explicitly into the projection in 1970, they did affect the judgment of those preparing the projection, who reduced women's participation to reflect the fertility assumption. The expected rebound in fertility affected the models of women's participation chosen. Thus, if the 1985 fertility could have been correctly foreseen, the participation rate projections for women would have been more accurate.

*Overall test of 1985 labor force projections.* Eleven explicit tests of the 1985 labor force projections were made. To aid the reader in judging which projection was indeed best, the following tabulation lists the number of times a specific projection was best or worst according to the battery of tests:

Projection for 1985 made in:	<i>Best</i>	<i>Worst</i>
1978 .....	5	-
1980 .....	5	1
1976 .....	1	-
1973 .....	-	2
1970 .....	-	8

There was a definite loser—the 1970 projection was worst in 8 of the 11 tests. The 1980 projection ranked best on five tests, but was *worst* once. In considering this, the reader is cautioned that there are several ways a projection can be “best” overall. For example, if errors offset, the projected level of the labor force would be nearly the actual level, yet the group participation rates and the projected population would have been incorrectly projected. However, if the reader's main use of the projections were to obtain a fairly accurate estimate of the level or the growth of the overall labor force, these details would not matter.

The 11 tests help the user evaluate the projections in terms of his or her own needs—for accurate level of the total, for accurate participation rate projections, for accurate projections of labor force composition, and so forth. Different tests of the accuracy of the participation rate projections allow the user to focus on overall accuracy or accuracy of estimates for specific labor force groups.

As we have seen, in terms of the *level of the 1985 labor force*, the 1980 projection had the smallest error and the 1970 projection had the greatest. When *growth estimates of the overall labor force* are compared, the 1978 projection was best; the 1970 round was worst, although the 1973 round had virtually the same error. After adjustment for population projection errors, the 1978 projection had the lowest *absolute error* and the 1970 projection the greatest. The error of the 1980 projection was increased by this adjustment.

The 1978 projection had the smallest *median error* and the 1970 projection, the greatest. The most recent projection, made in 1980, had the second largest median error. However, the 1976 projection had the errors most tightly clustered around the median error, which was not significantly different from the 1978 median error. The 1970 projection had the greatest *dispersion around the median error*.

The dispersion of errors suggested testing to see if the errors were *normally distributed*. Only the errors for the 1980 projection were, according to the test. The 1973 projection was worst by this measure. Turning to relative errors in the projected participation rates (rather than the absolute errors), we found the 1978 projection had the lowest *median relative error*, but the 1980 projection was worst by this measure. This suggests that the 1980 projection did worst with those groups with lower participation rates—older and younger workers. A user concerned with the projection of the rates for these groups should be cautious. On the other hand, the *relative errors around the*

median error were most tightly clustered for the 1980 projection. Once again, the 1970 projection was the most widely dispersed. In terms of the *mean absolute percent error*, that for the 1978 projection was lowest and that for the 1970 projection was greatest.

The errors in projected participation by individual groups were tested by regressing actual values against those projected. The 1980 projection had the only regression line with coefficients consistent with the hypothesis of projected, as a group, being like the actual. The 1973 projection had the lowest F-statistic. Finally, we looked at the *labor force composition errors* and found the 1980 projection the best, and the 1970 round, the worst. The 1980 projection had a small positive bias overall, but none of the individual groups errors was especially large. (However, for those groups with low participation rates, this could be a problem.) The 1973 projection was the opposite, having a slight negative bias.

It is easier to identify why the 1970 and 1973 projections were the least accurate than why the 1978 round was the most accurate. The first two projections and their methodology were built around the assumption that the increase in labor force participation of younger women—ages 20 to 34—would not continue. In fact, this assumption was wrong—the increase accelerated through the late 1970's and is still continuing, though not as rapidly. It is doubtful that any methodological approach could have overridden such a fundamental assumption.

AS A GROUP, the projections to 1985 were more accurate than the projections to 1980:<sup>10</sup>

	Projection to—	
	1980	1985
Error in level (millions):		
Best (year) .....	-3.1 (1976)	-0.5 (1980)
Worst (year) .....	-6.9 (1965)	-11.0 (1970)
Error in growth rate (percent):		
Best (year) .....	-0.41 (1965)	-0.07 (1978)
Worst (year) .....	-0.60 (1973)	-0.61 (1970)
Mean absolute percent error:		
Best (year) .....	7.7 (1976)	6.0 (1980)
Worst (year) .....	14.9 (1965)	17.0 (1970)
Index of dissimilarity:		
Best (year) .....	2.3 (1976)	1.4 (1980)
Worst (year) .....	7.6 (1965)	7.5 (1970)

Unlike the projections prepared for 1980, one projection for 1985 was higher than the actual recorded that year. According to these summary measures, the worst projection to 1985 was worse than the worst projection to 1980, but the best projection to 1985 was significantly more accurate than the best to 1980. When adjusted for the actual population, four projections to 1985 were more accurate. Generally, the more recent projections were more accurate, with the 1978 projection yielding the best results. □

#### —FOOTNOTES—

<sup>1</sup>See Paul Ryscavage, "BLS labor force projections: a review of methods and results," *Monthly Labor Review*, April 1979, pp. 14–22; and Howard N Fullerton, Jr., "How accurate were the projections of the 1980 labor force?" *Monthly Labor Review*, July 1982, pp. 15–21.

<sup>2</sup>See the following *Monthly Labor Review* articles: Sophia Cooper Travis, "The U.S. labor force: projections to 1985," May 1970, pp. 3–12; Denis F. Johnston, "The U.S. labor force: projections to 1990," July 1973, pp. 3–13; Howard N Fullerton, Jr., and Paul O. Flaim, "New labor force projections to 1990," December 1976, pp. 3–13; Paul O. Flaim and Howard N Fullerton, Jr., "Labor force projections to 1990: three possible paths," December 1978, pp. 25–35; and Howard N Fullerton, Jr., "The 1995 labor force: a first look," December 1980, pp. 11–21.

<sup>3</sup>The actual growth rates are calculated using the labor force with the 1980 census weights.

<sup>4</sup>The population projection for the 1970 labor force projection was published as *Projections of the Population of the United States, by Age, Sex, and Color, to 1990, With Extensions of Population by Age and Sex to 2015*, *Current Population Reports*, Series P–25, No. 381 (Bureau of the Census, December 1967); the population projection for the 1973 labor force projection was published as *Projections of the Population of the United States by Age and Sex: 1972 to 2020*, *Current Population Reports*, Series P–25, No. 493 (Bureau of the Census, December 1972); the population projection for the 1976 labor force projection was published as *Projections of the Population of the United States: 1975 to 2050*, *Current Population Reports*, Series P–25, No. 601 (Bureau of the Census, October 1975); the population projection for the 1978 and 1980 labor force projections was published as *Projections of the Population of the United States: 1977 to 2050*, *Current Population Reports*, Series P–25, No. 704 (Bureau of the Census, July 1977).

<sup>5</sup>The population projection used in 1970 was Series C, from *Current Population Reports*, Series P–25, No. 381; the population projection used in 1973 was Series E, from *Current Population Reports*, Series P–25, No. 493; the population projection used in 1976 was Series II, from *Current Population Reports*, Series P–25, No. 601; the population projection used in 1978 was Series II, from *Current Population Reports*, Series P–25, No. 704.

<sup>6</sup>The population error displayed is the difference between the total error and the participation rate error. It thus may include an interaction term.

<sup>7</sup>This was anticipated by the authors of the 1978 projections, who suggested that "[t]he population projections might have to be revised to reflect a better knowledge of net migration trends, particularly with regard to the inflows of undocumented aliens." See "Labor force projections to 1990: three possible paths."

<sup>8</sup>As will be seen later, the errors in the projections are found not to be normally distributed. The reader may ask why an F-test is used, for the normal distribution is required for such a test. A short answer is that the F-statistic still provides a useful indication. For a discussion of the problem and methods of handling the problem, see Henry Scheffe, *The Analysis of Variance* (New York, John Wiley & Sons, 1959), ch. 10, "The Effects of Departures from the Underlying Assumptions," pp. 331–69.

<sup>9</sup>Paul Ryscavage, "BLS labor force projections: a review of methods and results," p. 15; Lucy Kok and Chris de Neubourg, *Projecting labour supply, methods, theory and research: an international comparison* (The Hague, Organisatie voor Strategisch Arbeidsmarktonderzoek, 1986), p. 47; and J. Scott Armstrong, *Long-Range Forecasting* (New York, John Wiley, 1978), pp. 53–55.

<sup>10</sup>See Fullerton, "How accurate were the projections."