

BLS employment projections for 1990: an evaluation

Assessments of BLS projections of 1990 employment reveal that the projections improve the nearer to the target year they are made and as a result of evaluation; the downside is that they often fail to foresee major structural shifts in the U.S. economy

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The Bureau of Labor statistics regularly prepares projections of alternative future growth paths of U.S. aggregate economic activity and of the employment by industry generated by those projections.¹ The economic projections form the basis for occupational employment projections, which in turn underlie occupational outlook information prepared by the Bureau for use in career guidance and education planning. The projections also are used by other Federal agencies, State employment security agencies, and firms in the private sector. Because of their widespread usage, the Bureau regularly evaluates the projections against actual historical data covering the projected years as the data become available.

This evaluation is the final stage of the projection process, effectively closing the books on a given year's projections, and allows the Bureau to identify both strengths and weaknesses in the preparation of the projections. As a result, users gain insights into the accuracy of the projected values. This article examines projections of 1990 economic activity and employment, in the aggregate and by industry, and is part of a continuing effort to improve and refine the projections.² The article also compares the accuracy of the 1990 projections with that of projections for earlier years.

Over the period 1978 to 1985, the Bureau published four sets of aggregate economic and industry employment projections for the year 1990.³ In each of these, one projection—usually the so-called moderate scenario—is used as the basic alternative, and the others are variations of it. In part for ease of presentation, in this article the evaluation at the detailed level will concentrate on this basic alternative in each projection set. At the aggregate level, however, all alternatives will be examined.

For the first of the four sets of 1990 projections, two alternative growth scenarios were developed. For the last three sets, three alternatives were developed for each. For the most part, the alternatives were aggregate in nature; that is, aggregate economic assumptions were varied to arrive at a range of GNP and employment projections, and detailed industry relationships derived for the basic projection were then applied more or less unchanged to the aggregate alternatives.

In terms of levels, projections of GNP generally improved across the entire set of projections, while estimates of employment as a count of jobs generally worsened as they got closer to 1990. Despite the worsening in the total count, the distribution of employment by industry and the ranking of employment growth by industry improved with each

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set. Table 1 shows the various sets of projections and the percent error in the projections of GNP and employment.

GNP was overestimated by an average of 11.5 percent across the two 1978 projections and by an average of almost 8 percent in the three 1981 estimates. In both cases, the relatively large error was due primarily to overly optimistic assumptions regarding the potential for labor productivity growth over the decade of the 1980's. By contrast, the 1983 projection of GNP was in error by an average of only -0.4 percent, and the 1985 projection was off by an average of just 1.2 percent. The major source of error in the 1985 projection was an underestimate of the civilian labor force.

Total employment, on the other hand, was in error in the 1978 projection by only -0.4 percent, on average. The error then grew in absolute terms in each subsequent release, reaching -5.2 percent, on average, in the 1985 projection. The primary source of error in the employment projections appears to be related to errors in assumptions regarding labor productivity and errors in accounting for the conceptual difference between the household employment series (a count of persons) and the establishment employment series (a count of jobs).⁴

In what follows, we shall examine in more detail the level and sources of error in the aggregate projections—of GNP, the demand composition of GNP, and the aggregate level of employment—and in the detailed industry figures. Careful attention

will be paid at the industry level to three types of errors: level errors, distribution errors, and errors in the ranking of growth rates. A detailed examination of projections of the labor force to 1990 and an explanation of errors in the projections of occupational employment are presented elsewhere in this issue of the *Review*.

Framework for the evaluation

Each of the projections was based on a specific macroeconomic model run under a specific set of assumptions and targets. The major assumptions and results underlying the projections are as follows.

1978 projections. The 1978 projections were carried out at an aggregate level in the context of the Thurow econometric model,⁵ a small-scale model of demand activity maintained and periodically reestimated within the Office of Employment Projections. The projections were carried out in 1972 prices, and industry-level estimates were based on a 1972 Standard Industrial Classification (sic) definition. Two aggregate economic alternatives were developed in this round of projections:

(1) *Base alternative.* Prepared in 1977, the base alternative assumed a smoothly growing economy characterized by moderate inflation and moderate labor force growth, a declining unemployment rate, a strong comeback in labor productivity growth, and a Federal Government generally becoming less important over the decade of the 1980's. The major impediments to growth anticipated in the base projections were the high cost of imported oil and the subsequent impacts on the production process necessitated by a substitution of relatively less expensive inputs for petroleum-based products. Budget deficit problems from the early 1970's appeared to be well under control, and no adverse economic impacts were anticipated from this source. Neither were any major problems anticipated in the exchange rate for the U.S. dollar. As a result, foreign trade was expected to continue in a "business as usual" mode, with nominal balance-of-trade figures near zero and moderate real trade surpluses. The five industries projected to have the fastest rates of job growth over the decade were other medical services, other transportation equipment, miscellaneous business services, synthetic fibers, and computers and peripheral equipment. The five industries with the largest absolute increases in job growth were projected to be retail trade, State and local government (other than education), miscellaneous business services, other medical services, and hospitals.

(2) *High alternative.* This alternative assumed higher labor force participation rates than in the base projection, much faster growth in Fed-

Table 1. **Projected gross national product and total employment, and percent error in each in relation to actual figures, 1978, 1981, 1983, and 1985**

Year and alternative	Gross national product		Employment	
	Billions of 1982 dollars	Percent error	Millions of persons	Percent error
Actual, 1990	4,157.3	...	122.6	...
1978:				
Base ¹	4,543.7	9.3	118.6	-3.2
High	4,723.7	13.6	125.6	2.5
1981:				
Low	4,091.2	-1.6	122.0	-5
High-I	4,672.3	12.4	130.7	6.6
High-II ¹	4,670.5	12.3	124.0	1.1
1983:				
Low	3,995.5	-3.9	116.9	-4.6
Moderate ¹	4,119.4	-.9	118.3	-3.5
High	4,310.1	3.7	119.4	-2.6
1985:				
Low	3,999.1	-3.8	112.8	-8.0
Moderate ¹	4,192.3	.8	116.9	-4.7
High	4,437.9	6.7	119.0	-2.9

¹ Basic alternative.

eral grants-in-aid to State and local governments, and, consequently, faster employment growth due primarily to more intense spending at the State and local government levels.

1981 projections. Very few changes in techniques or underlying data definitions took place in the 1981 round of projections. What did change was that the economy was 3 years closer to 1990, a new Administration was in the White House, and the economy was recovering from a relatively mild recession in 1980 and heading into another, more serious one in 1981-82 (which, incidentally, was not anticipated in any of the alternatives for this set of projections). Three aggregate alternatives were prepared for the 1981 projections:

(1) *Low alternative.* The 1981 low alternative assumed continued high inflation, low productivity growth, and only moderate expansion in real GNP. The 1978 assumption that Federal expenditures would account for progressively smaller shares of GNP over the decade was still in place, and several significant personal tax cuts were assumed for the period as well. The five industries projected to exhibit the fastest rates of employment growth to 1990 were other medical services, typewriters and other office equipment, computers and peripheral equipment, coal mining, and hospitals. The numerically largest job gains were projected for eating and drinking places, retail trade except eating and drinking places, hospitals, miscellaneous business services, and other medical services.

(2) *High-I alternative.* The first high alternative for 1981 assumed marked improvements in both inflation and labor productivity growth, greater labor force growth, sharp reductions in the unemployment rate from its peak during the 1981 recession, and higher production levels.

(3) *High-II alternative.* The second high alternative embodied labor force growth consistent with that assumed in the low alternative, but much more marked improvements in labor productivity and inflation, leading to a GNP level commensurate with that in the high-I alternative and an employment level similar to that in the low projection.

1983 projections. By the time the next round of projections to 1990 was published, several major changes in the projection procedures had taken place. Previous to the 1981 publication date, all of the projection efforts of the Bureau had been merged, offering new challenges in terms of the timing of the preparation of the projections, but also offering the prospect of a more broadly based internal review of the resulting estimates. The more comprehensive review process had not been instituted prior to the 1983 projections. The forecast horizon had been moved forward 5 years to

1995. Hence, although estimates for 1990 were published, they were not subject to the same critical review that was true for the 1995 data. The aggregate projections were prepared in the context of the Chase econometric model, a detailed quarterly model of economic activity.⁶ Most important for the projections, though, were the facts that it was becoming increasingly apparent that significant slowdowns were occurring in the manufacturing sector, that Federal deficits were growing at a rate not anticipated in prior projections, and that the U.S. balance of trade was deteriorating at a rate never before experienced in the economy after World War II. Three alternative aggregate projections were developed for 1983:

(1) *Moderate alternative.* General fiscal restraint was presupposed in this projection, as Federal defense spending and nondefense spending were assumed to grow very slowly or to decline in real terms over the latter half of the decade. Combined with tax policy assumptions, this led to a projected steadily declining Federal budget deficit. Productivity growth was assumed to return to near post-World War II highs, and recovering markets for exports were expected to remove the growing trade deficits of the early 1980's. The result was moderate to strong growth in production and good growth across the board in employment.

(2) *Low alternative.* This scenario assumed higher budget deficits over the entire decade and a generally more sluggish economy, as purchases of durable goods were affected by higher interest rates. In accordance with the model, slower income growth would lead to lowered import levels and declining employment in manufacturing.

(3) *High alternative.* This scenario assumed a less restrictive monetary policy, leading to more robust GNP growth, albeit accompanied by higher inflation. Because the assumptions regarding Federal spending were virtually unchanged from the moderate growth alternative, but incomes were higher, the impact on the deficit would be to reduce it to zero near the end of the decade. Improved economic conditions would lead to higher rates of investment, more competitive domestic industries, and, consequently, improvements in the balance of trade.

1985 projections. The projections published by the Bureau in 1985, which also focused on 1995, were the last look taken at 1990. The economy had climbed out of the 1981-82 recession by this time, but was troubled on two fronts: the Federal budget deficit and the balance of trade with foreign countries. Investment growth had been very sluggish over the first half of the decade, and growth in labor productivity had been relatively poor as well. The 1985 aggregate projections were developed using the Wharton long-term annual model,⁷ and

industry-level data were now being developed in the context of the newly released 1977 input-output table for the U.S. economy. As with the 1983 publication, three scenarios were developed in 1985:

(1) *Moderate alternative.* In this scenario, it was assumed that sharp increases in real defense spending would be coupled with moderate increases on the nondefense side and relatively stable tax rates, leading to high Federal deficits throughout the projection period. Anticipated improvements in the value of the dollar in the late 1980's would lead to some resumption in export growth, but not enough to cure the trade deficits of the early 1980's. As a consequence, good growth in GNP was predicted, more than offsetting slowing labor force growth, due primarily to very optimistic assumptions regarding labor productivity.

(2) *Low alternative.* Lower labor force growth, combined with lower savings rates and lower investment spending, would lead to sharply lower GNP growth in this alternative, with more sluggish productivity behavior. Deficits, in both the Federal budget and the balance of trade, were projected to worsen, and employment growth would be well below the figure of the previous 10-year period.

(3) *High alternative.* In this alternative, it was projected that stronger labor force growth, accompanied by a generally more robust economy,

would lead to higher employment and production levels, though offset somewhat by higher productivity, due to relatively strong investment spending. Growth well above the previous 10-year historical period was expected for both GNP and employment.

Methodology of the projections

At an aggregate level, the Bureau uses a macro-economic model for its projections that is driven by assumptions regarding certain key variables in the areas of fiscal and monetary policy, demographics, foreign economic conditions, and energy. Perhaps more important than these exogenous assumptions, however, are variables that are determined by the model in use, but for which certain ranges have been reviewed in detail and determined in advance by BLS analysts to be acceptable. These target variables include the civilian labor force, the unemployment rate, the rate of growth of labor productivity, and, in a very rough way, the resulting rate of growth of GNP. They are generally subject to the greatest amount of uncertainty when long-run growth prospects are examined, and therefore, they are the variables most subject to wide variation when alternative economic projections are generated. The projected values for these key variables are presented, along with actual 1990 values and percent errors, in table 2. Also im-

Table 2. Major economic variables, actual and projected, 1990

Category	Actual, 1990	1978 projection ¹		1981 projection ¹			
		Base	High	Low	High-I	High-II	
Civilian labor force (millions)	124.787	119.367 (-4.3)	125.603 (0.7)	122.375 (-1.9)	128.123 (2.7)	122.375 (-1.9)	
Unemployment rate (percent)	5.5	4.5 (-18.2)	4.0 (-27.3)	6.0 (9.1)	4.0 (-27.3)	4.5 (-18.2)	
Employment (millions of persons)	117.924	113.996 (-3.3)	120.579 (2.3)	115.033 (-2.5)	122.998 (4.3)	116.868 (-9)	
Gross national product per employee (1982 dollars)	35.25	39.40 (11.8)	38.69 (9.7)	35.20 (-1)	37.41 (6.1)	39.29 (11.4)	
Gross national product (billions of 1982 dollars)	4,157.3	4,491.9 (8.0)	4,665.1 (12.2)	4,049.3 (-2.6)	4,600.8 (10.7)	4,591.5 (10.4)	
Employment (millions of persons)	117.924	113.996 (-3.3)	120.579 (2.3)	115.033 (-2.5)	122.998 (4.3)	116.868 (-9)	
Employment (millions of jobs)	122.571	118.615 (-3.2)	125.623 (2.5)	121.968 (-5)	130.660 (6.6)	123.960 (1.1)	
Conceptual difference ²	1.039	1.041 (.1)	1.042 (.2)	1.060 (2.0)	1.062 (2.2)	1.061 (2.0)	
		1983 projection ¹			1985 projection ¹		
		Low	Moderate	High	Low	Moderate	High
Civilian labor force (millions)	123.700 (-0.9)	124.951 (0.1)	125.400 (0.5)	120.100 (-3.8)	122.653 (-1.7)	124.300 (-0.4)	
Unemployment rate (percent)	6.8 (23.6)	6.0 (9.1)	5.2 (-5.5)	7.5 (36.4)	6.3 (14.5)	5.9 (7.3)	
Employment (millions of persons)	115.288 (-2.2)	117.454 (-.4)	118.879 (.8)	111.093 (-5.8)	114.926 (-2.5)	116.966 (-.8)	
Gross national product per employee (1982 dollars)	34.55 (-2.0)	34.74 (-1.5)	35.76 (1.4)	35.80 (1.5)	36.29 (2.9)	37.73 (7.0)	
Gross national product (billions of 1982 dollars)	3,983.5 (-4.2)	4,080.0 (-1.9)	4,251.4 (2.3)	3,977.1 (-4.3)	4,170.1 (.3)	4,412.9 (6.1)	
Employment (millions of persons)	115.288 (-2.2)	117.454 (-.4)	118.879 (.8)	111.093 (-5.8)	114.926 (-2.5)	116.966 (-.8)	
Employment (millions of jobs)	116.943 (-4.6)	118.315 (-3.5)	119.399 (-2.6)	112.797 (-8.0)	116.865 (-4.7)	119.02 (-2.9)	
Conceptual difference ²	1.014 (-2.4)	1.007 (-3.1)	1.004 (-3.4)	1.015 (-2.3)	1.017 (-2.2)	1.018 (-2.1)	

¹ Percent error in parentheses to right of figure.

² Variable embodying the statistical and conceptual differences between

employment as a count of persons (household series) and employment as a count of jobs (establishment series).

Table 3. Gross national product by major demand category, actual and projected, 1990

[Billions of 1982 dollars]

Category	Actual, 1990	1978 projection ¹		1981 projection ¹								
		Base	High	Low	High-I	High-II						
Gross national product	4,157.3	4,491.9 (8.0)	4,665.1 (12.2)	4,049.3 (-2.6)	4,600.8 (10.7)	4,591.5 (10.4)						
Personal consumption expenditures	2,681.6	3,041.6 (13.4)	3,113.9 (16.1)	2,494.9 (-7.0)	2,874.2 (7.2)	2,912.6 (8.6)						
Durable goods	427.4	473.3 (10.7)	484.7 (13.4)	336.2 (-21.3)	409.9 (-4.1)	415.3 (-2.8)						
Nondurable goods	911.1	1,103.7 (21.1)	1,129.9 (24.0)	904.1 (-8.6)	1,016.8 (11.6)	1,030.6 (13.1)						
Services	1,343.1	1,464.5 (9.0)	1,499.3 (11.6)	1,254.5 (-6.6)	1,447.5 (7.8)	1,466.7 (9.2)						
Gross private domestic investment	688.7	751.2 (9.1)	777.2 (12.9)	712.4 (3.4)	943.4 (37.0)	948.6 (37.7)						
Fixed investment	692.3	704.1 (1.7)	724.7 (4.7)	677.6 (-2.1)	892.0 (28.8)	897.3 (29.6)						
Nonresidential	515.5	504.1 (-2.2)	519.4 (.8)	505.5 (-1.9)	668.4 (29.7)	675.0 (30.9)						
Structures	120.9	160.1 (32.4)	165.8 (37.1)	136.7 (13.1)	153.7 (27.1)	154.7 (27.9)						
Producers' durable equipment	394.6	344.0 (-12.8)	353.6 (-10.4)	368.8 (-6.5)	514.7 (30.4)	520.3 (31.9)						
Residential	176.8	200.0 (13.1)	205.3 (16.1)	172.1 (-2.7)	223.5 (26.4)	222.3 (25.8)						
Exports	631.5	415.1 (-34.3)	452.3 (-28.4)	590.4 (-6.5)	648.2 (2.6)	597.4 (-5.4)						
Imports	665.3	457.8 (-31.2)	502.2 (-24.5)	540.0 (-18.8)	650.3 (-2.3)	660.6 (-.7)						
Government purchases of goods and services	820.8	741.8 (-9.6)	823.9 (.4)	791.5 (-3.6)	785.3 (-4.3)	793.6 (-3.3)						
Federal	343.7	271.8 (-20.9)	282.4 (-17.8)	326.2 (-5.1)	314.4 (-8.5)	320.4 (-6.8)						
National defense	258.7	188.0 (-27.3)	195.5 (-24.4)	247.1 (-4.5)	236.4 (-8.6)	249.0 (-3.7)						
Nondefense	85.0	83.8 (-1.5)	87.0 (2.3)	79.1 (-7.0)	78.0 (-8.2)	71.4 (-16.0)						
State and local	477.1	470.0 (-1.5)	541.4 (13.5)	465.3 (-2.5)	470.9 (-1.3)	473.2 (-.8)						
		1983 projection ¹			1985 projection ¹							
		Low	Moderate	High	Low	Moderate	High					
Gross national product	3,983.5 (-4.2)	4,080.0 (-1.9)	4,251.4 (2.3)	3,977.1 (-4.3)	4,170.1 (0.3)	4,412.9 (6.1)						
Personal consumption expenditures	2,560.3 (-4.5)	2,648.4 (-1.2)	2,760.4 (2.9)	2,613.1 (-2.6)	2,709.3 (1.0)	2,891.5 (7.8)						
Durable goods	342.5 (-19.9)	376.2 (-12.0)	425.2 (-5)	379.0 (-11.3)	391.2 (-8.5)	423.5 (-9)						
Nondurable goods	925.1 (1.5)	952.4 (4.5)	976.4 (2.2)	920.9 (1.1)	956.3 (5.0)	1,014.3 (11.3)						
Services	1,292.7 (-3.8)	1,319.7 (-1.7)	1,358.8 (1.2)	1,313.3 (-2.2)	1,361.7 (1.4)	1,453.7 (8.2)						
Gross private domestic investment	566.8 (-17.7)	695.7 (1.0)	778.9 (13.1)	750.7 (9.0)	789.7 (14.7)	838.7 (21.8)						
Fixed investment	548.1 (-20.8)	665.5 (-3.9)	747.2 (7.9)	707.4 (2.2)	735.5 (6.2)	772.8 (11.6)						
Nonresidential	393.7 (-23.6)	470.1 (-8.8)	509.8 (-1.1)	534.8 (3.7)	561.7 (9.0)	598.5 (16.1)						
Structures	110.8 (-8.3)	151.5 (25.3)	154.7 (27.9)	158.9 (31.5)	165.9 (37.2)	173.2 (43.3)						
Producers' durable equipment	282.9 (-28.3)	318.6 (-19.3)	355.1 (-10.0)	375.8 (-4.8)	395.8 (.3)	425.3 (7.8)						
Residential	154.4 (-12.7)	195.4 (10.5)	237.4 (34.3)	172.6 (-2.4)	173.8 (-1.7)	174.3 (-1.4)						
Exports	495.2 (-21.6)	485.1 (-23.2)	495.7 (-21.5)	462.1 (-26.8)	500.3 (-20.8)	522.5 (-17.3)						
Imports	385.9 (-42.0)	479.7 (-27.9)	539.4 (-18.9)	639.1 (-3.9)	643.6 (-3.3)	670.9 (.8)						
Government purchases of goods and services	747.2 (-9.0)	730.4 (-11.0)	755.8 (-7.9)	790.4 (-3.7)	814.4 (-.8)	831.1 (1.3)						
Federal	333.6 (-2.9)	305.9 (-11.0)	316.2 (-8.0)	347.1 (1.0)	347.1 (1.0)	347.1 (1.0)						
National defense	236.8 (-8.4)	214.8 (-17.0)	223.2 (-13.7)	273.0 (5.5)	273.0 (5.5)	273.0 (5.5)						
Nondefense	96.8 (13.9)	91.0 (7.1)	92.9 (9.4)	74.1 (-12.8)	74.1 (-12.8)	74.1 (-12.8)						
State and local	413.5 (-13.3)	424.5 (-11.0)	439.6 (-7.9)	443.3 (-7.1)	467.3 (-2.0)	484.0 (1.4)						
Percent distribution												
Category	Actual, 1990	1978 projection		1981 projection			1983 projection			1985 projection		
		Base	High	Low	High-I	High-II	Low	Moderate	High	Low	Moderate	High
Gross national product	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Personal consumption expenditures	64.5	67.7	66.7	61.6	62.5	63.4	64.3	64.9	64.9	65.7	65.0	65.5
Durable goods	10.3	10.5	10.4	8.3	8.9	9.0	8.6	9.2	10.0	9.5	9.4	9.6
Nondurable goods	21.9	24.6	24.2	22.3	22.1	22.4	23.2	23.3	23.0	23.2	22.9	23.0
Services	32.3	32.6	32.1	31.0	31.5	31.9	32.5	32.3	32.0	33.0	32.7	32.9
Gross private domestic investment	16.6	16.7	16.7	17.6	20.5	20.7	14.2	17.1	18.3	18.9	18.9	19.0
Fixed investment	16.7	15.7	15.5	16.7	19.4	19.5	13.8	16.3	17.6	17.8	17.6	17.5
Nonresidential	12.4	11.2	11.1	12.5	14.5	14.7	9.9	11.5	12.0	13.4	13.5	13.6
Structures	2.9	3.6	3.6	3.4	3.3	3.4	2.8	3.7	3.6	4.0	4.0	3.9
Producers' durable equipment	9.5	7.7	7.6	9.1	11.2	11.3	7.1	7.8	8.4	9.5	9.5	9.6
Residential	4.3	4.5	4.4	4.2	4.9	4.8	3.9	4.8	5.6	4.3	4.2	3.9
Exports	15.2	9.2	9.7	14.6	14.1	13.0	12.4	11.9	11.7	11.6	12.0	11.8
Imports	16.0	10.2	10.8	13.3	14.1	14.4	9.7	11.8	12.7	16.1	15.4	15.2
Government purchases of goods and services	19.7	16.5	17.7	19.5	17.1	17.3	18.8	17.9	17.8	19.9	19.5	18.8
Federal	8.3	6.1	6.1	8.1	6.8	7.0	8.4	7.5	7.4	8.7	8.3	7.9
National defense	6.2	4.2	4.2	6.1	5.1	5.4	5.9	5.3	5.3	6.9	6.5	6.2
Nondefense	2.0	1.9	1.9	2.0	1.7	1.6	2.4	2.2	2.2	1.9	1.8	1.7
State and local	11.5	10.5	11.6	11.5	10.2	10.3	10.4	10.4	10.3	11.1	11.2	11.0

¹ Percent error in parentheses to right of figure.

Evaluating 1990 Industry Employment Projections

portant to later stages of the projection process is the predicted distribution of GNP by major demand categories, shown in table 3.

Once a level and distribution of real GNP and an associated aggregate employment level are settled on, the analysis turns to the industry level of detail. The Bureau first distributes the various demand categories of GNP more finely (personal consumption spending, for example, is disaggregated to 82 spending types, such as spending on automobiles and on banking services), and then, each category of GNP is broken into its commodity content. The resulting disaggregation of GNP by detailed commodity is then used to drive a projected interindustry goods and services total requirements matrix, the result of which is the total output required from each detailed industry to produce the projected value for the GNP. This step is taken because certain commodities are not generally sold directly to final consumers (steel, for example), but rather, are embodied in other products that are sold to consumers (automobiles, for example). It would be

very difficult to determine employment requirements in these so-called intermediate industries if the analysis were based only on sales to final consumers.

The third stage of the projection process is to determine, for each industry in the economy, the level of employment necessary to produce that industry's output. This determination is made in the context of a detailed econometric model of labor productivity by industry and average annual hours by industry. Given the industry outputs from the previous stage of the projections, the productivity estimates (output per hour) are translated to total hours paid, by industry. Dividing this figure by average annual hours yields an estimate of the number of jobs in each industry. Employment projections for major sectors of the economy in 1990 are presented in table 4. Average errors for industry-level projections are given in table 5.

Initially, the projections are developed from the top down—from aggregate control values for pro-

Table 4. Employment by sector, actual and projected, 1990

[Thousands of jobs]

Sector	Actual, 1990	1978 projection ¹		1981 projection ¹			
		Base	High	Low	High-I	High-II	
Total employment	122,571	118,615 (-3.2)	125,623 (2.5)	121,968 (-0.5)	130,665 (6.6)	123,960 (1.1)	
Agriculture	3,276	3,046 (-7.0)	3,065 (-6.4)	2,953 (-9.9)	3,308 (1.0)	3,253 (-7.0)	
Mining	527	787 (49.3)	822 (56.0)	967 (83.5)	1,059 (100.9)	959 (82.0)	
Construction	6,842	6,033 (-11.8)	6,365 (-7.0)	6,920 (1.1)	7,509 (9.7)	7,104 (3.8)	
Manufacturing	19,561	23,882 (22.1)	25,244 (29.1)	23,476 (20.0)	25,520 (30.5)	23,905 (22.2)	
Durables	11,386	14,693 (29.0)	15,549 (36.6)	14,560 (27.9)	16,045 (40.9)	14,872 (30.6)	
Nondurables	8,175	9,189 (12.4)	9,695 (18.6)	8,916 (9.1)	9,475 (15.9)	9,033 (10.5)	
Transportation	3,843	3,332 (-13.3)	3,520 (-8.4)	3,693 (-3.9)	3,924 (2.1)	3,671 (-4.5)	
Communications	1,321	1,473 (11.5)	1,527 (15.6)	1,546 (17.0)	1,731 (31.0)	1,567 (18.6)	
Utilities	1,091	853 (-21.8)	899 (-17.6)	1,000 (-8.3)	1,160 (6.3)	1,003 (-8.1)	
Trade	27,843	27,370 (-1.7)	28,720 (3.1)	27,032 (-2.9)	29,231 (5.0)	27,445 (-1.4)	
Finance, insurance, and real estate	7,390	6,695 (-9.4)	7,089 (-4.1)	7,008 (-5.2)	7,464 (1.0)	7,108 (-3.8)	
Services	31,654	26,330 (-16.8)	27,781 (-12.2)	25,933 (-18.1)	28,149 (-11.1)	26,694 (-15.7)	
Government enterprises	1,846	2,017 (9.3)	2,216 (20.0)	1,758 (-4.8)	1,911 (3.5)	1,778 (-3.7)	
Special industries	17,377	16,797 (-3.3)	18,375 (5.7)	19,682 (13.3)	19,699 (13.4)	19,473 (12.1)	
		1983 projection ¹			1985 projection ¹		
		Low	Moderate	High	Low	Moderate	High
Total employment	116,943 (-4.6)	118,315 (-3.5)	119,399 (-2.6)	112,797 (-8.0)	116,865 (-4.7)	119,020 (-2.9)	
Agriculture	3,343 (2.0)	3,354 (2.4)	3,374 (3.0)	3,125 (-4.6)	3,164 (-3.4)	3,201 (-2.3)	
Mining	775 (47.1)	781 (48.2)	760 (44.2)	633 (20.1)	659 (25.0)	676 (28.3)	
Construction	7,020 (2.6)	6,963 (1.8)	7,052 (3.1)	5,910 (-13.6)	6,189 (-9.5)	6,276 (-8.3)	
Manufacturing	21,686 (10.9)	22,236 (13.7)	22,635 (15.7)	20,063 (2.6)	20,913 (6.9)	21,320 (9.0)	
Durables	13,218 (16.1)	13,550 (19.0)	13,871 (21.8)	12,349 (8.5)	12,872 (13.1)	13,122 (15.2)	
Nondurables	8,468 (3.6)	8,686 (6.3)	8,764 (7.2)	7,714 (-5.6)	8,041 (-1.6)	8,198 (3.3)	
Transportation	3,421 (-11.0)	3,451 (-10.2)	3,493 (-9.1)	3,363 (-12.5)	3,507 (-8.7)	3,567 (-7.2)	
Communications	1,685 (27.6)	1,688 (27.8)	1,726 (30.7)	1,429 (8.2)	1,485 (12.4)	1,511 (14.4)	
Utilities	1,046 (-4.1)	1,063 (-2.6)	1,068 (-2.1)	1,074 (-1.6)	1,111 (1.8)	1,135 (4.0)	
Trade	25,885 (-7.0)	26,355 (-5.3)	26,649 (-4.3)	25,991 (-6.7)	27,106 (-2.6)	27,706 (-5.5)	
Finance, insurance, and real estate	7,021 (-5.0)	7,113 (-3.7)	6,667 (-9.8)	6,699 (-9.4)	6,991 (-5.4)	7,146 (-3.3)	
Services	26,788 (-15.4)	27,161 (-14.2)	27,523 (-13.1)	27,080 (-14.4)	28,142 (-11.1)	28,662 (-9.5)	
Government enterprises	1,628 (-11.8)	1,607 (-12.9)	1,641 (-11.1)	1,473 (-20.2)	1,543 (-16.4)	1,573 (-14.8)	
Special industries	16,645 (-4.2)	16,543 (-4.8)	16,811 (-3.3)	15,957 (-8.2)	16,055 (-7.6)	16,247 (-6.5)	

¹ Percent error in parentheses to right of figure.

duction and employment to disaggregated industry results. The final stage of the process is when all the analysts involved in the projections review all phases of the work critically for consistency and meaningfulness. This aspect really came into its own during the preparation of the 1983 and later projections. Prior to 1983, the review was more limited in scope and generally did not involve analysts from all phases of the process.

With the more intensive review, all analysts became involved, from those preparing detailed labor force projections to those working on very specific projections of occupational employment. The review can have ramifications back to all levels of the projections and, as will be demonstrated later, appears to have markedly improved the accuracy of detailed BLS estimates since its inception.

Table 5. Various error measurements, industry-level employment projections, 1990

Year carried out and alternative	Level error			Distribution error		Rank error	
	Average percent	Average absolute error	Mean square error	Index of dissimilarity	Theil's information statistic	Growth rates	Absolute changes
1979:							
Base	-26.9	152.3	110,570	9.127	10.293	29.3	49.9
High	20.8	156.4	106,810	9.016	10.265	29.6	51.6
1981:							
Low	-4.0	126.8	108,594	7.787	8.355	52.8	62.1
High-I	54.0	144.3	97,667	7.435	8.262	49.5	61.1
High-II	9.3	124.2	93,016	7.582	8.039	52.0	63.5
1983:							
Low	-37.5	112.1	68,861	5.927	5.231	78.0	77.9
Moderate	-28.4	109.5	61,018	6.224	5.253	76.6	76.5
High	-21.1	109.4	54,154	6.518	5.624	74.9	75.6
1985:							
Low	-65.2	105.4	59,821	4.716	3.564	87.5	87.4
Moderate	-38.0	93.2	43,446	4.915	3.628	87.5	87.6
High	-23.7	87.2	35,730	4.997	3.620	87.5	87.7

Table 6. Sources of error in gross national product and employment projections, 1990

Levels	Actual, 1990	1978 projection		1981 projection			1983 projection			1985 projection		
		Base	High	Low	High-I	High-II	Low	Moderate	High	Low	Moderate	High
Gross national product (billions of 1982 dollars)	4,157.3	4,491.9	4,665.1	4,049.3	4,600.8	4,591.5	3,983.5	4,080.0	4,251.4	3,977.1	4,170.1	4,412.9
Civilian labor force (millions)	124.787	119.367	125.603	122.375	128.123	122.375	123.700	124.951	125.400	120.100	122.653	124.300
Unemployment rate (percent)	5.5	4.5	4.0	6.0	4.0	4.5	6.8	6.0	5.2	7.5	6.3	5.9
Gross national product per employee (1982 dollars)	35.254	39.404	38.689	35.201	37.405	39.288	34.552	34.737	35.762	35.800	36.285	37.728
Gross national product percent error due to:												
Total gross national product error .....	...	8.0	12.2	-2.6	10.7	10.4	-4.2	-1.9	2.3	-4.3	.3	6.1
Labor force error .....	...	-4.3	.7	-1.9	2.7	-1.9	-9	.1	.5	-3.8	-1.7	-4
Unemployment rate error .....	...	1.1	1.6	-5	1.6	1.1	-1.4	-5	.3	-2.1	-8	-4
Productivity error .....	...	11.8	9.7	-2	6.1	11.4	-2.0	-1.5	1.4	1.5	2.9	7.0
Interaction .....	...	-4	.2	0	.3	-1	.1	0	0	0	-1	-1
Employment (millions of jobs)	122.571	118.615	125.623	121.968	130.665	123.960	116.943	118.315	119.399	112.797	116.865	119.020
Civilian labor force (millions)	124.787	119.367	125.603	122.375	128.123	122.375	123.700	124.951	125.400	120.100	122.653	124.300
Unemployment rate (percent)	5.5	4.5	4.0	6.0	4.0	4.5	6.8	6.0	5.2	7.5	6.3	5.9
Conceptual difference (millions)	1,039	1,041	1,042	1,060	1,062	1,061	1,014	1,007	1,004	1,015	1,017	1,018
Employment percent error due to:												
Total employment error .....	...	-3.2	2.5	-5	6.6	1.1	-4.6	-3.5	-2.6	-8.0	-4.7	-2.9
Civilian labor force .....	...	-4.3	.7	-1.9	2.7	-1.9	.9	.1	.5	-3.8	-1.7	-4
Unemployment rate .....	...	1.1	1.6	-5	1.6	1.1	-1.4	-5	.3	-2.1	-8	-4
Conceptual difference .....	...	.1	.2	2.0	2.2	2.0	-2.4	-3.1	-3.4	-2.3	-2.2	-2.1
Interaction .....	...	0	0	0	.1	0	.1	0	0	.2	.1	0

Aggregate results

For the four basic alternative projections of 1990 real GNP, the worst was the 1978 estimate. From that point, the projections of GNP improved steadily, falling to a percent error of 0.3 percent by 1985, or less than \$13 billion. By contrast, employment projections improved from 1978 to 1981 and then diverged sharply from actual employment in 1983 and 1985, reaching an error of 4.7 percent in the last projection year, underestimating actual 1990 employment by almost 6 million jobs.

What are the sources of these errors? It is possible to express the estimate of GNP as an identity based on the civilian labor force, the civilian unemployment rate, and the level of real GNP per employee, a proxy for labor productivity. All of these factors are key target variables, as noted earlier, in the process of preparing and evaluating aggregate projections. Table 6 factors the errors in the projected values of the 1990 GNP into the shares attributable to errors in each of the three target variables. In examining these shares across the four basic alternative projections, it becomes immediately apparent that the largest source of error in the projections of GNP is errors in assumed rates of growth of labor productivity. In fact, with only a few exceptions, labor productivity has been overestimated in each of the alternatives developed in all 4 years in which projections were published.

Errors attributable to a misspecified unemployment rate have a relatively small effect on projected GNP. By contrast, errors in estimating the civilian labor force, because of the latter's relatively large weight in the GNP identity, will lead to relatively large percentage errors in GNP, even if the estimate of the labor force itself is in error by only a small amount. Nonetheless, in every case, the major error contributing to a misestimated GNP is a misspecification of labor productivity.

The same type of error factoring can be carried out for the estimate of employment by establishment. In this case, the productivity component of the identity is replaced with the conceptual difference, that variable which embodies the statistical and conceptual differences between employment and conceptual differences between employment as a count of persons (the household series) and employment as a count of jobs (the establishment, or payroll, series). As noted before, while the estimate of GNP for 1990 was improving from one projection to the next, the employment estimate was getting worse: the error increased from an underestimate of 4 million in 1978 to an underestimate of 5.7 million in 1985. In each of the basic alternative projections of employment by establishment, the largest share of the error was accounted for by errors in estimating the conceptual difference. Because the macroeconomic model is

oriented primarily toward the derivation of the employment, by household, necessary to produce the aggregate GNP, the conversion factor between the two concepts of employment is actually derived by adding up the industry-level estimates of employment. The main source of error in the employment projections by establishment was the failure to anticipate trends at industry and sector levels of detail. We shall explore this more fully in a later section.

Structure of demand

In examining the demand structure of GNP, there are essentially two questions to ask: Where did the Bureau expect growth in expenditures? and Where did the Bureau err in those expectations? Four areas are relevant in this regard.

Personal consumption. Personal consumption expenditures increased their share of GNP from 62 percent in 1978 to a high of 65.8 percent in 1986. The major reason for this increase was a long-term decline in the personal savings rate and a consumer spending splurge, particularly on new and expanded services. This spending was made possible by tax cuts instituted over the period and a lowering in the amount of income allocated to savings. The 1978 projections of personal consumption expenditures actually anticipated the surge in consumer spending, but overstated the increase in share. (See table 3.) The 1981 projection returned the personal consumption expenditures share of GNP to levels consistent with those of the early 1970's and consequently missed on the low side. Both the 1983 and the 1985 projections were quite close to what actually transpired in 1990.

What none of the four projections did well was anticipate the big drop in the share of GNP accounted for by purchases of nondurable goods, primarily food, clothing, fuels, and pharmaceuticals. Virtually all growth in real disposable income over the decade of the 1980's flowed into spending for new or expanded financial and medical services, a development not at all anticipated in the early BLS projections for 1990 and only partially accounted for in the later projections. This development represented a major structural change in the way consumers allocated their income.

Investment. Fixed investment—purchases of plant and equipment by businesses and the construction of new residential dwellings—makes up the most volatile component of GNP. Projections of 1990 business spending on equipment were low in 1978, high in 1981, low again in 1983, and, finally, very close to the actual figure in 1985. At the same time, projections of residential construction were too high over the first three sets of projections, be-

Table 7. Industry employment, actual and errors in projections, 1990

[Numbers in thousands]

Sector	Actual, 1990	1979 projection		1981 projection		1983 projection		1985 projection	
		Average error	Percent error	Average error	Percent error	Average error	Percent error	Average error	Percent error
Total employment	122,571	-452	-0.4	2,960	2.4	-4,352	-3.6	-6,343	-5.2
Agriculture	3,276	-220	-6.7	-104	-3.2	81	2.5	-112	-3.4
Dairy and poultry products	372	53	14.4	14	3.9	11	3.0	-49	-13.2
Meat animals and livestock	470	22	4.8	24	5.1	4	.9	-23	-5.0
Cotton	46	110	240.2	84	184.1	8	18.8	-12	-26.1
Food and feed grains	601	87	14.5	41	6.8	-12	-2.0	-50	-8.4
Other agricultural products	1,149	-278	-24.2	-269	-23.4	1	.1	8	.8
Forestry and fishery products	77	-31	-40.9	1	2.2	3	4.3	-1	-1.3
Agricultural, forestry, and fishery services	561	-184	-32.9	-1	-3	64	11.5	14	2.6
Mining	527	277	52.7	468	88.8	245	46.5	129	24.5
Iron and ferroalloy ores mining	18	9	52.8	17	94.4	6	33.3	-3	-16.7
Copper ore mining	17	41	244.1	18	109.8	9	56.9	-1	-5.9
Nonferrous metal ores mining, except copper	25	4	18.0	15	62.7	8	34.7	-2	-10.7
Coal mining	149	212	142.6	283	190.2	137	92.2	48	32.7
Crude petroleum and natural gas, except drilling	206	7	3.6	108	52.8	76	37.1	83	40.6
Stone and clay mining and quarrying	90	10	11.1	14	16.3	-2	-2.2	4	5.2
Chemical and fertilizer mineral mining	22	-8	-36.4	10	45.5	9	40.9	-1	-6.1
Construction	6,842	-643	-9.4	335	4.9	169	2.5	-717	-10.5
New construction	5,405	-733	-13.6	301	5.6	-114	-2.1	-601	-11.1
Maintenance and repair construction	1,437	90	6.3	34	2.4	284	19.8	-115	-8.0
Manufacturing	19,561	5,002	25.6	4,739	24.2	2,624	13.4	1,204	6.2
Durables	11,386	3,735	32.8	3,773	33.1	2,160	19.0	1,395	12.3
Ordnance	75	-6	-8.7	29	38.7	13	17.8	32	42.7
Guided missiles and space vehicles	134	-46	-34.3	-61	-45.5	-5	-3.7	13	10.2
Logging	127	-8	-6.3	-13	-10.2	4	3.4	-16	-12.9
Sawmills and planing mills	217	-13	-6.0	6	2.8	-17	-8.1	-26	-12.3
Other millwork, plywood, and wood products	451	0	-.1	-87	-19.4	-43	-9.7	-74	-16.4
Wooden containers	22	-7	-34.1	0	-3.0	-9	-43.9	-10	-45.5
Household furniture	307	209	68.1	86	28.0	42	13.8	7	2.3
Furniture and fixtures, except household	229	-39	-17.2	-32	-14.3	-30	-13.1	18	8.0
Glass	164	67	41.2	80	49.2	37	22.8	7	4.3
Cement and concrete products	229	46	20.1	31	13.8	8	3.6	14	6.4
Structural clay products	37	2	5.4	7	18.9	0	0	-2	-7.2
Pottery and related products	40	3	7.5	17	43.3	5	12.5	6	15.8
Other stone and clay products	102	58	57.4	77	76.1	62	61.1	48	47.1
Blast furnaces and basic steel products	276	293	106.3	308	111.7	152	55.2	35	12.7
Iron and steel foundries and forging	200	166	83.3	180	90.2	53	26.7	1	.8
Primary copper and copper products	101	81	80.7	65	64.7	59	58.7	35	35.0
Primary aluminum and aluminum products	86	90	104.7	89	103.5	86	100.0	66	77.1
Primary nonferrous metal and products	136	-31	-22.8	-24	-18.1	-51	-38.0	-62	-45.6
Metal containers	50	41	83.0	45	90.0	18	37.3	7	14.0
Heating apparatus and plumbing fixtures	61	18	30.3	42	68.9	14	23.0	1	2.2
Fabricated structural metal products	440	275	62.5	168	38.3	129	29.3	54	12.3
Screw machine products	96	29	30.7	49	51.0	18	19.4	8	8.7
Metal stampings	187	123	65.8	91	48.7	58	31.2	39	21.0
Cutlery, handtools, general hardware	133	103	77.4	98	74.2	50	37.6	26	20.1
Other fabricated metal products	360	38	10.6	99	27.6	45	12.5	24	6.7
Engines, turbines, and generators	89	60	68.0	72	81.6	62	70.4	30	34.5
Farm machinery	107	80	75.2	120	112.5	62	57.9	23	21.8
Construction, mining, and oilfield machinery	147	198	134.7	257	175.3	173	117.9	60	41.0
Material handling equipment	82	60	73.2	78	95.9	32	39.4	20	25.2
Metalworking machinery	337	112	33.2	124	36.9	47	13.9	20	6.0
Special industry machinery	164	73	44.8	67	41.1	44	26.8	20	12.4
General industrial machinery	257	145	56.6	148	57.6	83	32.4	47	18.5
Other nonelectrical machinery	327	63	19.4	39	12.1	4	1.4	9	2.8
Computers and peripheral equipment	397	97	24.4	177	44.6	191	48.2	237	59.8
Typewriters and other office equipment	43	3	8.1	36	85.3	16	38.8	5	13.2
Service industry machines	183	86	47.0	28	15.5	17	9.3	2	1.3
Electric transmission equipment	98	186	189.8	155	158.8	144	146.9	128	131.0
Electrical industrial apparatus	170	129	76.2	156	92.0	93	55.1	58	34.3
Household appliances	125	95	76.4	68	54.7	58	46.9	26	21.3
Electric lighting and wiring	190	120	63.2	132	69.8	48	25.3	28	15.1

Table 7. Continued—Industry employment, actual and errors in projections, 1990

[Numbers in thousands]

Sector	Actual, 1990	1979 projection		1981 projection		1983 projection		1985 projection	
		Average error	Percent error	Average error	Percent error	Average error	Percent error	Average error	Percent error
Radio and television receiving sets	84	55	65.5	27	32.5	19	23.4	7	8.7
Telephone and telegraph apparatus	128	97	75.8	92	72.4	59	46.1	42	33.3
Radio and communication equipment	138	176	127.5	287	208.2	303	220.0	414	300.0
Electronic components	585	38	6.6	83	14.2	169	28.9	199	34.1
Other electrical machinery and equipment	167	15	9.0	20	12.2	3	2.2	17	10.4
Motor vehicles	812	379	46.7	158	19.5	6	.8	32	4.0
Aircraft	760	-227	-29.9	36	4.7	-73	-9.6	-70	-9.3
Ship and boat building and repair	198	70	35.6	87	44.1	56	28.3	19	9.9
Railroad equipment	33	33	101.5	42	129.3	13	40.4	4	12.1
Motorcycles, bicycles, and parts	13	26	203.8	15	120.5	5	38.5	3	28.2
Other transportation equipment	46	270	588.0	83	181.2	51	110.9	55	121.0
Scientific and controlling instruments	609	-402	-66.0	-344	-56.5	-316	-51.9	-340	-55.9
Medical and dental instruments	247	-64	-26.1	-48	-19.4	-41	-16.6	-32	-13.2
Optical and ophthalmic equipment	43	50	117.4	54	125.6	43	100.0	36	84.5
Photographic equipment and supplies	100	92	92.0	53	53.7	69	69.7	32	32.3
Watches and clocks	11	28	259.1	15	136.4	11	103.0	5	45.5
Jewelry and silverware	86	15	18.0	5	6.2	-4	-5.0	-7	-8.9
Musical instruments and sporting goods	129	75	58.1	42	32.8	10	8.0	12	9.3
Other manufactured products	221	0	.2	44	19.9	-5	-2.3	-9	-4.4
Nondurables	8,175	1,267	15.5	966	11.8	464	5.7	-190	-2.3
Meat products	430	-54	-12.7	-44	-10.4	-71	-16.7	-86	-20.2
Dairy products	159	-13	-8.5	0	-.4	-13	-8.4	-25	-15.9
Canned and frozen foods	304	75	24.8	3	1.0	31	10.4	-19	-6.5
Grain mill products	128	32	25.0	29	22.9	16	12.8	3	2.9
Bakery products	217	1	.5	-6	-2.9	-9	-4.5	-21	-9.7
Sugar	25	10	40.0	8	33.3	5	21.3	-3	-12.0
Confectionery products	79	10	12.7	-6	-8.0	0	-.8	-8	-11.0
Alcoholic beverages	65	17	26.9	-1	-2.1	19	30.3	-2	-3.1
Soft drinks and flavorings	123	46	37.8	35	29.0	44	35.8	15	12.2
Other food products	159	27	17.0	-5	-3.1	11	6.9	-10	-6.3
Tobacco manufacturing	49	12	25.5	17	34.7	13	27.2	11	23.1
Fabric, yarn, and thread mills	377	179	47.6	159	42.4	78	20.7	24	6.5
Floor covering mills	64	43	67.2	0	1.0	-7	-10.9	-17	-27.1
Other textile mill products	51	38	75.5	25	49.7	21	41.2	0	1.3
Hosiery and knit goods	208	138	66.6	36	17.5	6	3.0	-24	-11.9
Apparel	857	510	59.5	382	44.7	206	24.0	58	6.8
Other fabricated textile products	217	31	14.3	23	10.9	6	3.1	-25	-11.7
Paper products	490	58	11.9	57	11.6	27	5.6	-9	-1.8
Paperboard	210	68	32.4	18	8.9	-10	-4.8	-23	-11.0
Newspaper printing and publishing	497	8	1.7	30	6.2	-4	-9	13	2.7
Periodical and book printing and publishing	358	-105	-29.3	-45	-12.6	-58	-16.4	-60	-16.8
Other printing and publishing	823	-226	-27.5	-131	-15.9	-76	-9.3	-3	-.4
Industrial inorganic and organic chemicals	293	117	40.1	130	44.4	64	22.1	7	2.4
Agricultural chemicals	56	4	7.1	17	30.4	27	48.2	6	11.3
Other chemical products	104	19	18.8	14	13.5	9	8.7	-3	-3.5
Plastic materials and synthetic rubber	104	8	7.7	0	-.6	10	9.9	-17	-17.0
Synthetic fibers	80	109	136.9	18	23.3	36	45.8	2	2.5
Drugs	238	-5	-2.3	-1	-.7	15	6.3	-9	-3.9
Cleaning and toilet preparations	161	12	7.5	-8	-5.0	5	3.5	-8	-5.0
Paints and allied products	62	34	54.8	9	15.1	8	13.4	-2	-4.3
Petroleum refining and related products	159	23	14.5	30	19.3	24	15.3	23	14.7
Tires and inner tubes	86	71	83.1	41	47.7	16	18.6	3	4.3
Rubber products, except tires and tubes	176	27	15.3	5	2.8	-24	-13.8	-31	-18.0
Plastic products	630	-147	-23.4	27	4.3	-12	-1.9	21	3.4
Leather tanning and industrial leather	15	1	10.0	0	-2.2	0	4.4	0	-.4
Leather products, including footwear	121	84	69.8	96	79.6	48	39.9	31	26.2
Transportation	3,843	-417	-10.9	-80	-2.1	-388	-10.1	-364	-9.5
Railroad transportation	287	177	61.8	188	65.6	98	34.1	33	11.7
Local transit and intercity buses	402	-70	-17.5	-49	-12.2	-58	-14.5	-77	-19.3
Truck transportation	1,827	-196	-10.7	134	7.4	-118	-6.5	-91	-5.0
Water transportation	183	11	6.0	11	6.2	24	13.1	32	17.9
Air transportation	759	-232	-30.6	-252	-33.3	-231	-30.5	-226	-29.8
Pipeline transportation	19	-1	-5.3	3	15.8	4	24.6	1	5.3
Transportation services	366	-106	-29.0	-116	-31.7	-106	-29.0	-36	-9.8
Communications	1,321	179	13.6	293	22.2	378	28.7	154	11.7
Radio and television broadcasting	238	21	9.0	32	13.4	62	26.2	23	9.8

Table 7. Continued—Industry employment, actual and errors in projections, 1990

[Numbers in thousands]

Sector	Actual, 1990	1979 projection		1981 projection		1983 projection		1985 projection	
		Average error	Percent error	Average error	Percent error	Average error	Percent error	Average error	Percent error
Communications, except radio and television.	1,083	157	14.5	261	24.2	316	29.2	130	12.1
Utilities	1,091	-215	-19.7	-36	-3.4	-32	-2.9	15	1.4
Electric utilities, public and private	694	-157	-22.7	-6	-1.0	10	1.4	65	9.5
Gas utilities, excluding public	207	-34	-16.4	43	20.9	12	5.8	19	9.2
Water and sanitary services, except public	190	-23	-12.4	-73	-38.6	-54	-28.4	-69	-36.3
Trade	27,843	202	.7	59	.2	-1,546	-5.6	-908	-3.3
Wholesale trade	6,551	-507	-7.7	29	.5	-268	-4.1	118	1.8
Eating and drinking places	6,841	—	—	111	1.6	-901	-13.2	-422	-6.2
Retail trade, except eating and drinking	14,451	709	4.9	-81	-6	-376	-2.6	-605	-4.2
Finance, insurance, and real estate	7,390	-498	-6.7	-196	-2.7	-456	-6.2	-444	-6.0
Banking	2,282	-155	-6.8	-298	-13.1	-323	-14.2	-501	-22.0
Credit agencies and financial brokers	1,098	104	9.5	171	15.6	244	22.3	355	32.3
Insurance	2,297	-125	-5.5	-148	-6.4	-122	-5.3	-164	-7.2
Real estate	1,713	-321	-18.8	78	4.6	-254	-14.9	-134	-7.8
Services	31,654	-4,598	-14.5	-4,728	-14.9	-4,496	-14.2	-3,692	-11.7
Hotels and lodging places	2,561	-760	-29.7	-544	-21.3	-654	-25.5	-425	-16.6
Personal and repair services	1,163	99	8.6	257	22.1	372	32.0	368	31.6
Barber and beauty shops	744	-260	-34.9	-26	-3.6	-78	-10.5	-84	-11.3
Miscellaneous business services	7,284	-2,760	-37.9	-2,756	-37.8	-2,132	-29.3	-1,116	-15.3
Advertising	274	-50	-18.4	-73	-26.6	-56	-20.7	-24	-8.9
Professional services, n.e.c. ¹	2,925	-696	-23.8	-629	-21.5	-314	-10.7	-124	-4.3
Automobile repair	1,260	-102	-8.1	-85	-6.8	-228	-18.1	-194	-15.4
Motion pictures	567	-318	-56.2	-250	-44.2	-248	-43.8	-210	-37.1
Amusements and recreation services	1,163	-133	-11.4	-133	-11.4	-104	-9.0	-125	-10.7
Doctors' and dentists' services	2,509	-584	-23.3	-591	-23.6	-572	-22.8	-562	-22.4
Hospitals	3,553	917	25.8	490	13.8	363	10.2	-341	-9.6
Medical services, except hospitals	2,201	922	41.9	222	10.1	-9	-4	229	10.4
Education services (private)	2,590	-752	-29.1	-482	-18.6	-388	-15.0	-548	-21.2
Nonprofit organizations	2,860	-118	-4.1	-126	-4.4	-445	-15.6	-533	-18.6
Government enterprises	1,846	270	14.7	-30	-1.6	-220	-12.0	-316	-17.1
Post office	819	—	—	-134	-16.4	-212	-25.9	-129	-15.8
Other Federal enterprises	182	-5	-2.7	33	18.1	-1	-7	-49	-26.9
Local government passenger transit	205	—	—	-13	-6.5	5	2.6	-8	-3.9
Other State and local enterprises	640	275	43.0	84	13.1	-12	-2.0	-129	-20.3
Special industries	17,377	209	1.2	2,241	12.9	-710	-4.1	-1,290	-7.4
General government	16,354	-74	-5	1,678	10.3	-1,099	-6.7	-1,410	-8.6
Private households	1,023	283	27.7	562	55.0	388	38.0	119	11.7

¹ n.e.c. = not elsewhere classified.

NOTE: Dash indicates no projection carried out that year.

cause of a failure to predict the slower growth of average home values over the decade, and, again, on the mark in the 1985 projection. The category of investment whose figures the Bureau failed most consistently to project accurately was non-residential construction—the construction of new office buildings, commercial structures, warehouses, and the like. Expectations for growth in this category of GNP were, without exception, well above the actual behavior of construction investment over the decade of the 1980's. Bureau analysts failed to appreciate the amount of overbuilding that took place in the late 1970's and early 1980's, which was exacerbated by slowdowns in export growth. The resulting oversupply of business structures is still in the process of being worked off today. The failure of BLS analysts to anticipate that manufacturing output would slow and manufacturing employment

would decline over the 1980's was the primary cause of the error in projecting investment needs.

Foreign trade. Exports of goods and services fluctuated considerably in the 1980's. Two decades of steady growth peaked in 1980, with exports accounting for 12.2 percent of GNP. During the first half of the 1980's, the exchange rate soared, as a result of generally deteriorating business conditions in the Nation. The steadily growing Federal budget deficit, combined with lower savings and investment rates and the movement of many heretofore domestic manufacturing operations to offshore locations, generated the exchange rate surge, which meant cheaper imports and more expensive exports.

By 1985, the export share of GNP had dropped to 10.1 percent, while imports of goods and services had increased their share to 13.0 percent from

10.4 percent in 1980. Over the remainder of the decade, imports continued to account for increasing shares of GNP, reaching a 16.0-percent share by 1990. A fall in the exchange rate and a push on the part of many U.S. manufacturing firms to regain lost markets and to become competitive in emerging new markets led to a resurgence in export growth. Exports accounted for 15.2 percent of GNP by 1990, up sharply from the 10.1-percent low point in 1985.

How did the BLS projections fare against this turbulent backdrop? Imports were, without exception, underestimated in all four sets of 1990 projections. The Bureau failed to anticipate the exchange rate anomalies of the 1980's and the subsequent impacts on relative prices. The 1981 and the 1985 projections were the best of the four, underestimating imports by less than 4 percent in each case.

Export projections were more interesting. In 1978, exports for 1990 were underestimated an average of 31 percent. The Bureau clearly had missed the fact that foreign trade was fated to become an increasingly important factor in U.S. economic growth. Realizing that the earlier projections had been unrealistic, the Bureau raised the projected growth of exports considerably in the 1981 projection and came the closest of the entire set of projections to predicting 1990 exports: the 1981 projection underestimated actual exports by only about 3 percent, on average. After 1981, the large increase in the exchange rate became apparent. Overcompensation for this factor then led to an average underestimation of exports in 1983 and 1985 of 22 percent. Clearly, the models in use by the Bureau and the understanding of BLS analysts were not adequate to capture foreign trade behavior over the confusing decade of the 1980's.

Government. Spending on national defense grew from a low of 5.4 percent of GNP in 1977 to a peak of almost 7 percent in 1987. By 1990, the share had fallen back to 6.2 percent of GNP. Plainly, BLS analysts did not foresee such a spending boost in 1978. Rather, they assumed that defense spending would continue to decline in importance over the decade, reaching a 4.2-percent share of GNP by 1990. By 1981, President Reagan was in the White House and had publicized his plan to bolster U.S. military preparedness. Bureau projections of defense spending published in that year were somewhat higher than the 1978 projections—5.5 percent of GNP, on average, but still a small decline in real values from the late 1970's. By 1985, at last understanding the intent of the Reagan Administration, but not yet anticipating the adverse reactions of many U.S. citizens to the surging budget deficit or the diminution of the Soviet Union as a world military

power, the Bureau assumed strong growth in defense spending over the remainder of the decade, in fact overstating actual 1990 defense purchases by almost \$16 billion.

At the same time that the Bureau was at first understating and then overstating defense growth, assumptions regarding growth in Federal non-defense spending were relatively accurate, within 3 percent of the actual spending level in every case. In the area of State and local government purchases of goods and services, BLS estimates were generally quite close to actual 1990 spending levels, except for the projections published in 1983. Reports at that time of major taxpayer revolts at the State level were taken quite seriously by the Bureau and led to underestimates of actual growth in State and local government spending of about 10 percent.

In sum, certain demand categories proved more tractable than others when it came to applying past trends to future expectations. Where BLS projections were worst was in those cases in which, using perfect hindsight, major changes in underlying economic relationships were seen to be taking place, areas in which no econometric approach to forecasting does well. At an aggregate level, GNP projections improved noticeably the closer they were to 1990, attaining an error of only 0.3 percent in the 1985 moderate growth projection.

Industry results

At the industry level of detail, there are three possible approaches to assessing a given set of projections: level errors, distribution errors, and rank errors. Let us examine each of these in turn.

Level errors. Level errors are generally a result of misspecified control levels. That is, errors at the aggregate level of detail will inevitably be carried over to the industry level. Because of the way aggregate employment was determined in the BLS approach to the 1990 projections, however, there was also an opportunity for analyst error at the industry level to affect the accuracy of the projections. As noted earlier, the aggregate model determines the level of employment by household, a count of persons. Industry employment projections, on the other hand, are developed from the establishment concept of employment, a count of jobs by industry. To ensure consistency between the two approaches to measuring employment, the conceptual difference between the two series is computed as a jobs-to-persons ratio and evaluated over the projection period for consistency with past trends.

The conceptual difference was a relatively well-behaved data series during the 1950's and

1960's. The ratio declined sharply between 1970 and 1975 and then proceeded to behave quite erratically for the next 10 years. Beginning in 1987, the series appeared to be returning to its average level of the 1960's. The 1978 conceptual difference projection was exactly on target, but later projections were considerably off the mark.

The 1981 estimate was much too high and led to a further exaggeration of the employment overestimate already flowing from the aggregate projections model. Because the conceptual difference ratio is not explicitly estimated until the industry job estimates are completed, it provides an index

of the amount of level error brought to the industry projections by the analyst preparing them.

It is useful to examine the percent errors in the 1981 projections of industry employment to determine what sectors or industries were the most seriously misperceived at the time. Table 4 presents the projected employments by major sector for all of the alternatives, along with their percent errors. Table 7 shows, at the industry level of detail, the average error across all alternatives published in a single year. The largest overstatement in the 1981 projections occurred, not surprisingly, in durable manufacturing, but serious overestimates of min-

Table 8. **Industry employment rankings, change, 1977-90, actual versus projected rankings, selected projections**

Industry	Actual, 1977-80	1979 base projection	1981 high-II projection	1983 moderate projection	1985 moderate projection
Fastest growing industries					
Miscellaneous business services	1	3	5	2	2
Credit agencies and financial brokers	2	22	6	8	7
Transportation services	3	9	12	7	4
Water and sanitary services, except public	4	25	56	18	30
Guided missiles and space vehicles	5	108	87	3	3
Motion pictures	6	88	106	85	40
Medical services, except hospitals	7	1	2	6	6
Air transportation	8	36	65	30	29
Professional services, n.e.c. ¹	9	32	24	9	8
Advertising	10	120	42	19	10
Doctors' and dentists' services	11	23	18	15	12
Hotels and lodging places	12	24	38	37	19
Automobile repair	13	73	14	24	20
Local government passenger transit	14	4	19	10	13
Education services (private)	15	60	48	27	35
Computers and peripheral equipment	16	6	1	1	1
Medical and dental instruments	17	15	30	12	11
Eating and drinking places	18	150	9	26	18
Real estate	19	55	21	23	25
Periodical and book printing and publishing	20	89	37	29	31
Largest level change					
Miscellaneous business services	1	3	4	2	1
Retail trade, except eating and drinking	2	1	2	1	2
General government	3	4	1	4	5
Eating and drinking places	4	2	3	3	3
Wholesale trade	5	8	7	7	4
New construction	6	7	5	6	8
Professional services, n.e.c. ¹	7	10	10	8	6
Doctors' and dentists' services	8	12	11	10	10
Hotels and lodging places	9	13	13	18	11
Hospitals	10	6	6	5	9
Medical services, except hospitals	11	5	8	9	7
Education services (private)	12	16	17	13	14
Nonprofit organizations	13	11	9	17	17
Insurance	14	14	15	15	13
Credit agencies and financial brokers	15	15	16	14	12
Real estate	16	20	14	16	15
Banking	17	9	12	12	16
Automobile repair	18	26	20	25	21
Truck transportation	19	19	18	24	22
Amusements and recreation services	20	17	21	21	23

¹ n.e.c. = not elsewhere classified.

ing and construction employment also occurred. These overestimates were offset by large underestimates of services employment, primarily in the miscellaneous business services industry. The underestimates reflected a failure to anticipate the contracting-out phenomenon of the 1980's.

In the 1983 projection of 1990 industry employment, overall employment levels were underestimated by an average of 4.4 million jobs, and in the 1985 projection, they were underestimated by 6.3 million jobs. Almost the entire error in the 1983 projection was due to industry bias, as reflected in the conceptual difference ratio. Employment in transportation, utilities, trade, services, and government were all understated, while the overestimates in mining and manufacturing were not nearly large enough to offset the low estimates. The largest errors occurred, again, in miscellaneous business services and general government employment. These two industries accounted for nearly three-fourths of the undercount in the 1983 projection.

In the 1985 projection, about 40 percent of the level error was accounted for by analyst bias at the industry level, with the remainder due to errors at the aggregate level of detail. As with the 1983 projections, the major errors occurred in services and government.

Industry distribution errors. Once the level errors have been determined, it becomes necessary to examine the extent to which BLS industry analysts were able to anticipate correctly the distribution of employment by industry. Two measures of goodness of fit have been used to evaluate the various projections to 1990: the index of dissimilarity and Theil's information statistic.⁸ Both are presented in table 5.

The index of dissimilarity is defined as $D = \sum |A_i - P_i| / 2$, where A_i is the actual employment in industry i as a percent of total actual employment and P_i is the projected employment in industry i as a percent of total projected employment. It is a measure of average absolute errors between the actual and projected industry percent distributions of employment. A perfect estimate would yield an index value of zero. Unfortunately, tests of the statistical significance of this index do not exist, but it is instructive to note that for each successive set of BLS projections for 1990, the index of dissimilarity is decreasing in size, implying that the projections improved steadily the nearer the year was to the target year.

In a like manner, the information statistic measures the amount of variation between two sets of percent distributions. In this article, we are looking at a projected percent distribution of employment and attempting to quantify the amount of extra information imparted by gaining access to the actual

Table 9. **Errors in projecting employment trends, selected projections, various years**

[Percentage points]

Year projected	Year published	Difference between projected and actual trends		
		Total employment	Industry trends (average absolute errors)	
			Un-weighted	Weighted by size of industry
1970	1966	-0.2	1.4	1.1
1975	1973	.6	2.3	1.3
1980	1970	-.3	1.3	1.0
1980	1973	-.2	2.7	2.1
1980	1976	-.4	1.5	1.2
1985	1973	-.2	2.0	1.5
1985	1976	-.1	1.9	1.4
1985	1979	.2	2.9	1.5
1990	1979	-.2	2.6	1.4
1990	1981	.2	2.6	1.4
1990	1983	-.5	2.8	1.7
1990	1985	-.8	2.8	2.0

percent distribution. If no new information is gained—that is, if the projected distribution is identical to the actual distribution—then the value of the information statistic will be zero. A quick examination of the values of the information statistic across the projections of 1990 employment distributions confirms the story told by the index of dissimilarity: the projections get progressively more accurate the closer the year is to the target year. The Theil statistic has the added benefit of being normally distributed when it is computed with the large number of degrees of freedom involved in assessing the all-industry percent distribution. Knowing this, we can formulate and test hypotheses regarding the value of the statistic. In the case of the 1990 projections, we wish to know whether the information statistic is significantly different from zero or, alternatively, whether we are unable to reject the null hypothesis, namely, that the statistic is equal to zero. In the first three sets of projections, from 1979, 1981, and 1983, we find that we must accept the fact that a significant distributional difference existed between actual and projected data. The 1985 projection, on the other hand, has an information statistic that is insignificantly different from zero. In short, the Bureau projected the distribution of employment imperfectly, but less and less so over the four projections.

Ranking errors. The third and final way of evaluating a set of projections is to compare pro-

jected growth rankings with those which in fact were realized. This is especially important in the context of the BLS industry employment projections because, customarily, the descriptions of the projections, as well as their utility, have relied heavily on presentations of the fastest growing industries or the industries with the largest changes in levels. In fact, one can reasonably argue that if the Bureau does a good job of projecting rankings, in spite of any level and distributional errors that may be present, then one of the main purposes of the agency in preparing industry-level projections will have been accomplished.

The BLS industry employment projections are typically ranked according to growth rate and according to changes in levels of employment, in both cases from the largest positive change to the largest negative change. The first type of ranking tends to capture the smaller, more volatile industries—generally, industries that are newly emerging or those in accelerating decline. The second approach generally focuses attention on the bigger, more stable industries. Both types of rankings were computed for each of the alternative sets of projections and compared with actual 1977–90 growth rankings by means of a rank correlation coefficient⁹ and are presented as the final two columns in table 5.

In both cases, the correlation between actual and projected growth rankings started out dismally low and improved markedly as the year in which the projection was made drew nearer to the target year, 1990. The rank correlation coefficients on growth rates were much lower initially than were the corresponding coefficients on changes in level. This is as expected, because it is generally easier to make predictions about large, stable industries than about small, volatile ones. What is most interesting is that projections of both types of rankings improve to almost the same level of accuracy: by 1985, BLS analysts were able to anticipate both relative growth rates and relative changes in level with an almost 88-percent accuracy.

The rank correlation coefficients presented in table 5 cover the entire spectrum of industries. Another way of assessing how the Bureau did at projecting rankings is presented in table 8. In the table, the 20 fastest growing industries and the 20 industries with the largest changes in level are shown, based on actual data between 1977 and 1990. For each of the industries, its relative rank in one of each year's projections is also presented. It is instructive to ask how many of the top 20 industries in each type of ranking in 1990 were projected to be in the top 20. The following tabulation answers this question:

	1979	1981	1983	1985
Fastest growing . . .	6	9	12	14
Largest change . . .	19	19	17	17

Thus, the accuracy of the BLS projections of the smaller, fastest growing industries increased steadily from only 30 percent in 1979 to 70 percent in 1985. The industries with the largest changes were easier to predict over the entire period, with 85- and 90-percent accuracy rates.

In sum, BLS projections of industry employment evolved over time as new information on industries became available, as new Administrations began to have their impact on the economy, and as structural changes in the economy began to be felt. As one would hope, they evolved in a positive way, toward an increasingly accurate estimate of employment distribution and growth. Errors in levels were the single factor that did not show marked improvement over time, an indication, perhaps, of the extent to which the Bureau's methods and models are wedded to a rigorous examination and extrapolation of historical trends in the data.

Past BLS projections

So far, we have examined only the errors in BLS projections of the 1990 economy. To judge the overall effectiveness of the evaluation program, and to put this set of projections into the context of all of the Bureau's earlier projections, it is useful to compare errors in the 1990 projections with those identified in earlier projections. The Bureau has now evaluated 12 employment projections. The error in the projection of total employment growth ranges from -0.8 percent in the 1985 projection of 1990 employment to 0.6 percent in the 1973 projection of 1975 employment. (See table 9.) The first two projections for 1990 employment, those published in 1979 and 1981, were very close to being the best projections ever prepared by the Bureau, in terms of total employment level. Conversely, the last two projections for 1990, those published in 1983 and 1985, were the worst ever published by the Bureau. The primary sources of error in the employment level were noted earlier. As regards the 1983 and 1985 projections, it is perhaps not coincidental that the primary year of interest in both of them, and thus the year receiving the most attention during the review process, was not 1990, but 1995. Data for 1990 were published, but considerably less effort was given to analyzing that particular year's results.

The average absolute errors for projected industry employment trends have ranged from 1.3 percentage points to 2.9 percentage points per year. The spread is slightly smaller when the

errors are weighted for industry size, ranging from 1.0 percentage point to 2.1 percentage points per year. The 1980 projections prepared in 1970 were the most accurate of the 12 projections that were evaluated, while the 1975 projections published in 1973 were the least accurate. The projections for 1990 published in 1979 and 1981 were both in error by 1.4 percentage points, close to the middle of the error range of past BLS projections, while the projections for 1990 published in 1983 and 1985 were near the worst end of the error range, again due perhaps to the prominence of the year 1995, rather than 1990, in the projections.

Summary and recommendations

What has been learned by examining BLS projections to 1990? Several major points are immediately apparent. First, and not surprisingly, the projections improve at both an aggregate and industry level of detail as the year in which they were made moves closer to the target year. For this reason, intermediate projection years should continue to be published, even when the terminal year is pushed forward by 5 years. Thus, projections to 2005 should also include projections to 2000. The review process should be modified to include not only the terminal year, but this earlier year as well, and a careful review of the time path of the economy to the terminal year should be carried out.

Second, estimates of GNP by the Bureau are generally much more accurate than are aggregate employment projections related to GNP. This is due primarily to a tendency on the part of BLS analysts to overestimate potential labor productivity growth. The implication is that future projections should very carefully assess the factors underlying slower productivity growth and assign reasonable probabilities to the continuation of those factors in the future. To a certain extent, this recommendation has already been adopted in projections published by the Bureau since 1985.

Third, the estimates at the industry level of detail, in terms of level, distribution, and growth ranking, have improved noticeably as a direct result of the intensive review process instituted between the 1981 and 1983 projections. That this review process should be continued goes without saying. Care must be taken, however, on the part of the industry employment analyst to prevent the distortion of the jobs-to-persons conceptual difference as the review process proceeds. In other words, adequate feedback from industry employment through industry industrial activity and to the aggregate level of detail must be carefully provided for. Again, this factor has been taken into account to a greater extent in later BLS projections.

Fourth, it is obvious from the anomalies of the 1980's that the Bureau does not do well at predicting major structural shifts in economic relationships, such as the decline of the manufacturing sector and the large shifts in foreign trade balances over the 1980's. To the greatest extent possible, the models used rely on past data and the trends implicit in those data. Because structural change entails a break in past trends, the methodology of the projections would tend to imply that there is not much to be done about this last problem with the projections. However, alternative projections are now prepared surrounding the basic alternative. Their purpose is to address those areas of the projections which analysts feel are most open to question regarding future adherence to historical trends. A careful examination of past projection errors may well suggest further alternatives that should be explored in any given round of projections.

Finally, while BLS projections do contain serious errors, their usefulness and accuracy have improved markedly over time. Today, they continue to provide valuable information about possible future courses for the U.S. economy as a whole and for employment at the industry level of detail in particular. □

Footnotes

¹ The latest projections, titled "Outlook: 1990-2005," appeared as a series of articles in the November 1991 *Monthly Labor Review*. Such medium-term projections are prepared on a 2-year cycle for the labor force, in detail; for aggregate economic activity; for industry-level output and employment; and for occupational demand by industry. A full statement of the methodology underlying BLS projections in general is included in *Outlook: 1990-2005*, Bulletin 2402 (Bureau of Labor Statistics, May 1992).

² The Bureau has published evaluations of projections for the years 1970, 1975, 1980, and 1985. For the latest labor force and aggregate/industry evaluations, see Howard N Fullerton, Jr., "An evaluation of labor force projections to 1985," *Monthly Labor Review*, November 1988, pp. 7-17; and John H. Tschetter, "An evaluation of BLS projections of the 1985 economy," *Monthly Labor Review*, September 1988, pp. 24-

33. For the most recent published evaluation of occupational projections, see Max L. Carey and Kevin Kasunic, "Evaluating the 1980 projections of occupational employment," *Monthly Labor Review*, July 1982, pp. 22-30.

³ Aggregate economic projections for 1990 are in the following *Monthly Labor Review* articles: Norman C. Saunders, "The U.S. economy to 1990: two projections for growth," December 1978, pp. 36-46; Norman C. Saunders, "The U.S. economy through 1990—an update," August 1981, pp. 18-27; Arthur J. Andreassen, Norman C. Saunders, and Betty W. Su, "Economic outlook for the 1990's: three scenarios for economic growth," November 1983, pp. 11-23; and Betty W. Su, "The economic outlook to 1995: new assumptions and projections," November 1985, pp. 3-16. Industry employment projections are in the following *Monthly Labor Review* articles by Valerie A. Personick: "Industry output and em-

ployment: BLS projections to 1990," April 1979, pp. 3-14; "The outlook for industry output and employment through 1990," August 1981, pp. 28-41; "The job outlook through 1995: industry output and employment," November 1983, pp. 24-36; and "A second look at industry output and employment trends to 1995," November 1985, pp. 26-41.

⁴ The household survey underlies BLS projections of aggregate employment, while the establishment, or payroll, survey underlies BLS industry-level employment projections. To ensure consistency between the two projections, careful attention must be paid to the conceptual difference between the two employment series. This difference is examined periodically. For an analysis of the difference during the 1960's, see Gloria P. Green, "Comparing employment estimates from household and payroll surveys," *Monthly Labor Review*, December 1969, pp. 9-20. The period of the 1970's is examined in Alexander Korns, "The Difference Between the Payroll and the Household Measures of Employment, 1975-79," *Survey of Current Business*, December 1979, pp. 44-49. The 1980's are covered in Paul Flaim, "How many new jobs since 1982? Data from two surveys differ," *Monthly Labor Review*, August 1989, pp. 10-15.

⁵ The Thurow model is described fully in Lester C.

Thurow, "A Fiscal Policy Model of the United States," *Survey of Current Business*, June 1969.

⁶ This model appears in complete detail only in proprietary user documentation of Chase Econometric Associates, Inc. Since the preparation of BLS projections using the model, Chase has merged with another economic consulting firm, and the model has been generally abandoned.

⁷ A detailed discussion of the Wharton model is in *The Wharton Long-term Annual Model of the U.S. Economy* (Philadelphia, Wharton Econometric Forecasting Associates, Inc., 1983).

⁸ See Henri Theil, *Principles of Econometrics* (New York, John Wiley and Sons, 1971), pp. 641-44, for a description of the information statistic. An application of the statistic to the analysis of the accuracy of projections is contained in R.A. Kolb and H.O. Stekler, "The Information Content of Long-term Employment Forecasts," *Applied Economics*, forthcoming.

⁹ A description of the rank correlation coefficient, developed by C. Spearman, may be found in G. W. Snedecor and W. G. Cochran, *Statistical Methods*, 6th ed. (Ames, Iowa, Iowa State University Press, 1967), pp. 193-95.

A note on communications

The *Monthly Labor Review* welcomes communications that supplement, challenge, or expand on research published in its pages. To be considered for publication, communications should be factual and analytical, not polemical in tone. Communications should be addressed to the Editor-in-Chief, *Monthly Labor Review*, Bureau of Labor Statistics, U.S. Department of Labor, Washington, DC 20212.
