An evaluation of BLS' projections of 1980 industry employment

Employment was underestimated in projections made in 1970, 1973, and 1976; estimates of labor force growth and unemployment turned out to be offsetting factors

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The Bureau of Labor Statistics periodically publishes projections of gross national product (GNP) and output and employment by industry. These projections provide a framework for BLS' occupational projection program as well as for employment analysis of energy. housing. transportation, and defense issues. This article is a final step in the projection process—evaluation of the projections of the 1980 economy. Evaluation is an important part of the projection program, for only after the projected period has run its course can we quantify the limitations of our projected data.

BLS published three projections of the 1980 economy.[1] Those published in April 1970 underestimated employment (including military) in 1980 by 4.0 percent: those published in December 1973 underestimated employment by .9 percent: and those published in 1976 underestimated employment by 1.4 percent. These errors were kept modest by offsetting estimates: for example. an underestimate of labor force growth was offset by an underestimate of the unemployment rate. The 1980 recession slightly increased the gap between projected and actual employment.

For the three projections, the absolute difference between the projected and actual trends by industry was 1.9 percentage points per year. The absolute difference in the number of projected and actual jobs was 90,000 or 15 percent, per industry. The larger differences, for the most part, occurred among the smaller industries in terms of employment.

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BLS accurately projected one-third to one-half of the fastest-growing industries.

Among major industries, projected employment levels in State and local government and manufacturing were consistently higher than actual levels: employment in the other major industries was usually lower. The errors for manufacturing partly reflect the effect of the unanticipated 1980 recession on durable goods industries. (The projections are intended to capture longer term secular trends, rather than business cycle changes.) In addition, other factors such as trade issues and their impact on manufacturing industries were not sufficiently anticipated. As a consequence of the errors for the major industries, each of the projections slightly underestimated the long-term shift from goods- to service-producing industries.

How good were the employment projections when compared to alternative employment projections and projecting techniques? The errors in BLS' projections were the same size or magnitude as the errors of projections developed by two private organizations. And BLS' projections, which reflect models and judgments, performed better than two simpler models.

There are five components of the 1980 projections: labor force, aggregate or macroeconomic activity, industry outputs, industry employment, and occupational employment. The labor force and occupational employment projections have been evaluated.[2] This article evaluates the projections of 1980 aggregate economic activity and industry output and employment. It discusses errors in the employment projections and calculates the part which can be attributed to

the 1980 recession. It also examines the effects of industry employment projections on occupational employment projections. Finally, the sources of errors in the employment projections are determined.

Evaluation complicated by revisions

The 1970 projections of the U.S. economy in 1980 estimated industry employment trends over the 1968–80 period; the 1973 projections estimated trends over the 1972–80 period; and the 1976 projections estimated trends over the 1973–80 period. Projected employment trends are based on assumptions about labor force growth, unemployment rates, and the adjustment between the number of employed persons and the number of jobs.[3] One assumption is that the economy will expand steadily toward full employment. In 1970, employment projections assumed a 1980 economy near full employment; in 1973 and 1976, they assumed a point on a path towards full employment by 1985. Projected trends in industry employment are based on assumptions of total employment, level and distribution of the gross national product, labor productivity by industry, and an input-output matrix.

To emphasize the uncertainty of projections, BLS has traditionally developed scenarios which cover alternative assumptions about employment and GNP levels. The projections reviewed here are the middle or base scenario. While the differences at the macro or GNP level among the scenarios were moderately broad in terms of percentage and dollar amounts, the differences in terms of trends were narrow. This also applies for industry employment.

This evaluation is complicated by revisions in the series which were projected. For example, the definitions and methods for structuring the industries have changed twice. The 1970 projections reflected the 1958 Standard Industrial Classification (SIC); the 1973 projections reflected the 1967 SIC; the 1976 projections reflect the 1972 SIC. This and other revisions mean that the projected values, as originally published, cannot be directly compared to current data. For this evaluation, the projected trends are applied to the revised historical data series to obtain projected 1980 values which are consistent across the three projections. In essence, the base for each projection has been revised to reflect data revisions. The projected trends are unchanged.

Total employment underestimated

BLS underestimated total employment growth in each of the three projections by .2 to .4 percentage points per year. The following tabulation shows projected and actual annual growth rates in total employment for the three projections:[4]

Year published	Period covered	Projected	Actual	Difference
1970	1968–80	1.5	1.8	−0.3
1973	1972–80	2.0	2.2	−.2
1976	1973–80	1.8	2.2	−.4

In the 1970 projection, BLS expected total employment to grow 1.5 percent per year over the 1968–80 period; employment actually grew 1.8 percent per year, a difference of 0.3 percent.

The difference between projected and actual trends reflects some offsetting estimates. BLS consistently underestimated labor force growth during the 1970's, especially the trends in participation rates for women.[5] However, the low labor force estimates were offset by estimated unemployment rates which were 1.7 to 3.2 percentage points lower than actual rates. There was an upward trend in unemployment throughout the 1970's, and the rate did not return to the relatively low 1973 level following the 1973–75 recession, despite uninterrupted growth over the 1975–79 period. The labor force underestimate was further offset by an overestimate of the adjustment between the number of employed persons and the number of jobs. Because a person can have two or more jobs, the number of jobs in the economy exceeds the number of persons employed.

The 1970 projections put the number of jobs in 1980 at 101.7 million, compared with the actual number of 105.9 million, a difference of 4.2 million jobs. The 1973 projections estimated the number of jobs would be 104.9 million; the 1976 projections, 104.4 million.

One trend that has characterized employment over the past several decades is the movement from the goods-producing sector (agriculture, mining, construction, and manufacturing industries) to the service-producing sector (transportation, communication, public utilities, finance, trade, other services, and government industries excluding military). The projections slightly underestimated this shift. In the 1970 and 1973 projections, the service-producing sector was projected to account for 69.6 percent of all civilian jobs in 1980, and in 1976 projections, 69.9 percent. In 1980, 70.8 percent of all civilian jobs were in the service-producing sector. The difference for the most part can be attributed to the unanticipated 1980 recession.

Industry differences modest

At the industry level, the differences between actual and projected trends were usually modest. (See table 1.) For the 1970 projections, industry employment was expected to grow an average of .86 percent per year over the 1968–80 period; the actual growth was 1.08 percent per year, a difference of .22 percentage points per year. The following shows the mean projected and actual employment trends and differences by industry for the private economy, except households, for the three projections:[6]

Year published	Pro-jected	Actual	Dif-ference	Absolute difference Unweighted	Weighted	Squared
1970	1.08	0.86	−0.22	1.30	1.02	1.81
1973	2.31	2.07	−.24	2.73	2.05	3.59
1976	1.64	1.34	−.30	1.50	1.18	2.07

For the three projections, the difference between projected and actual trends was less than 2 percentage points per year

Table 1. Employment in 1980, projected and actual trends by industry for the private economy, except households

[Average annual rate of change]

Industry	1968–80 period			1972–80 period			1973–80 period			Absolute difference
	Projected in 1970	Actual	Difference	Projected in 1973	Actual	Difference	Projected in 1976	Actual	Difference	
Livestock and livestock products	-2.6	-1.8	0.8	-4.4	-4.8	-0.3	-3.4	-5.2	-1.8	1.0
Crops and other agricultural products	-2.6	-1.8	.8	-5.3	.5	5.8	-2.9	.1	3.0	3.2
Forestry and fishery products	1.0	3.9	3.0	1.2	1.3	.1	1.1	7.2	6.2	3.1
Agriculture, forestry, and fishery services	1.0	3.6	2.6	1.5	6.7	5.2	1.3	2.8	1.5	3.1
Iron ore mining	-0.9	-.1	.8	2.6	3.0	.4	-2.3	.3	2.6	1.3
Copper ore mining	0.4	1.9	1.5	1.8	-2.8	-4.6	1.0	-3.9	-4.9	3.6
Other nonferrous metal ore mining	0.4	1.9	1.5	3.0	8.5	5.5	3.1	10.0	6.9	4.6
Coal mining	-3.0	5.7	8.7	.1	4.7	4.6	2.7	5.7	3.0	5.4
Oil and gas extraction	-0.9	3.3	4.2	-1.0	9.1	10.1	3.3	6.0	2.7	5.7
Stone and clay mining and quarrying	0.9	.7	-.1	1.2	2.6	1.4	-.1	.1	.3	.6
Chemical and fertilizer mining	0.9	.7	-.1	1.3	5.2	4.0	.0	4.2	4.2	2.8
Construction	2.5	2.6	.1	1.4	5.3	3.9	1.0	2.8	1.8	1.9
Complete guided missiles and space vehicles	-2.7	-5.1	-2.4	3.7	9.4	5.7	.7	.7	-.0	2.7
Other ordnance	-2.7	-5.1	-2.4	-2.0	2.5	4.6	-.1	-2.8	-2.6	3.2
Food products	-0.1	-.4	-.3	.1	.0	-.1	-.6	.0	.6	.3
Tobacco manufacturing	-2.2	-1.6	.6	-.7	-1.0	-.3	-2.6	-1.5	1.1	.7
Fabric, yarn, and thread mills	-1.0	-1.5	-.5	.6	-2.2	-2.9	-.0	-1.7	-1.7	1.7
Miscellaneous textiles and floor coverings	-0.8	-.5	.3	.7	-3.6	-4.3	-.7	-1.1	-.4	1.7
Hosiery and knit goods	-0.8	-.5	.3	.3	-2.1	-2.4	-1.3	-2.0	-.7	1.1
Apparel	1.3	-1.0	-2.3	1.8	-1.5	-3.2	.8	-1.3	-2.0	2.5
Miscellaneous fabricated textile products	1.0	-.4	-1.4	2.4	.2	-2.1	1.2	.9	-.3	1.3
Logging, sawmills, and planing mills	.0	.9	.9	-.7	.4	1.0	-.7	.9	1.6	1.2
Millwork, plywood, and other wood products	.0	.9	.9	1.0	.3	-.6	.2	1.1	.9	.8
Household furniture	1.7	.0	-1.6	2.8	-1.5	-4.3	.0	-.9	-.9	2.3
Other furniture	3.0	1.5	-1.5	2.6	1.6	-1.0	.6	1.7	1.1	1.2
Paper products	1.3	.2	-1.1	2.0	.4	-1.6	.6	.5	-.1	.9
Paperboard	.8	-.8	-1.6	3.7	-.7	-4.4	2.3	-.7	-3.0	3.0
Publishing	1.2	1.3	.1	2.0	2.6	.6	1.2	1.8	.6	.4
Printing	1.2	1.3	.1	2.2	4.7	2.5	1.9	2.2	.4	1.0
Chemical products	0.4	.5	.1	2.7	1.1	1.6	.6	1.9	1.2	1.0
Agricultural chemicals	0.4	.5	.1	1.8	2.2	.3	.8	2.7	1.9	.8
Plastic materials and synthetic rubber	1.9	-1.1	-3.0	4.8	-.8	-5.6	2.8	-1.5	4.3	4.3
Synthetic fibers	1.9	-1.1	-3.0	1.5	-2.1	-3.7	1.1	-2.3	-3.4	3.4
Drugs	1.9	2.1	.2	3.6	2.7	-.9	2.1	2.7	.6	.6
Cleaning and toilet preparations	1.9	2.1	.2	3.3	2.8	-.5	1.1	1.9	.8	.5
Paint	0.5	-.6	-1.1	1.9	-.5	-2.3	1.4	-.2	-1.5	1.6
Petroleum products	-1.7	.8	2.5	-1.7	-.5	1.2	.5	.7	.2	1.3
Rubber products	2.5	2.5	-.0	2.4	-2.5	-4.9	1.8	-.9	-2.7	2.5
Plastic products	2.5	2.5	-.0	5.3	3.2	-2.1	4.1	4.3	.2	.8
Leather, footwear, and leather products	-2.3	-3.4	-1.1	-0.1	-3.7	-3.7	-2.0	-2.3	-.4	1.7
Glass	1.2	.8	-.4	2.9	-1.7	-4.7	.9	.1	-.8	2.0
Cement, clay, and concrete products	2.0	.4	-1.5	1.7	.5	-1.3	.3	-.6	-.9	1.2
Miscellaneous stone and clay products	2.0	.4	-1.5	2.1	.8	-1.3	.2	.8	.6	1.2
Blast furnaces and basic steel products	-.8	-.9	-.1	.7	-2.2	-2.9	.4	-1.2	-1.6	1.5
Iron and steel foundries and forgings	-.8	-.9	-.1	.0	-1.9	-2.0	-.3	-.3	.0	.7
Primary copper and copper products	1.8	.4	-1.5	1.3	1.2	-.0	.0	-.9	-.9	.8
Primary aluminum and aluminum products	1.8	.4	-1.5	.1	2.8	2.7	4.1	1.7	-2.4	2.2
Other primary nonferrous metals and products	1.8	.4	-1.5	2.0	2.7	.7	.7	2.5	1.7	1.3
Metal containers	.1	-1.2	-1.3	2.3	-1.1	-3.3	1.7	-1.6	-3.4	2.7
Heating apparatus and plumbing fixtures	1.6	1.5	-.0	2.0	.7	-1.3	-.4	.4	.7	.7
Fabricated structural metal products	1.6	1.5	-.0	3.3	2.8	-.5	2.0	1.6	-.4	.3
Screw machine products	.8	-.4	-1.2	4.0	-1.5	-5.5	2.4	.2	-2.2	3.0
Other fabricated metal products	1.0	1.5	.5	4.1	.6	-3.5	2.0	1.4	-.6	1.5
Engines, turbines, and generators	.7	2.0	1.4	4.6	2.9	-1.8	2.0	2.2	.1	1.1
Farm machinery	1.4	2.4	1.0	1.2	1.4	.1	2.0	2.4	.4	.5
Construction, mining, and oilfield machinery	1.1	3.5	2.4	2.2	2.9	.7	3.8	3.7	-.2	1.1
Material handling equipment	2.8	1.1	-1.7	3.4	4.9	1.6	2.5	1.3	-1.2	1.5
Metal working machinery	.7	1.1	.4	3.4	4.6	1.2	2.6	2.7	.1	.6
Special industry machinery	1.7	.3	-1.4	2.5	3.0	.4	1.2	1.2	.1	.6
General industrial machinery	1.0	1.3	.2	4.4	3.3	-1.0	3.2	2.0	-1.2	.8
Machine shop products	4.1	3.2	-.9	2.3	8.0	5.7	3.1	4.5	1.5	2.7
Computers and peripheral equipment	4.1	3.2	-.9	10.0	12.2	2.2	5.9	6.4	.4	1.2
Typewriters and other office equipment	4.1	3.2	-.9	4.0	6.1	2.1	1.4	1.9	.5	1.2
Service industry machines	2.3	2.1	-.3	2.8	.7	-2.1	.8	1.0	.2	.8
Electric transmission equipment	1.1	.9	-.2	5.7	5.6	-.0	1.8	1.9	.1	.1
Electrical industrial apparatus	1.1	.9	-.2	2.3	1.1	-1.1	3.3	1.3	-2.0	1.1
Household appliances	1.3	-.6	-1.9	.6	-3.4	-3.9	1.6	-1.5	-3.0	3.0
Electric lighting and wiring	1.5	.6	-.9	5.2	.9	-4.3	2.5	.4	-2.1	2.4
Radio and television sets	.9	-.9	-1.7	-1.1	-4.7	-3.6	-2.6	-3.3	-.7	2.0
Telephone and telegraph apparatus	.9	-.9	-1.7	1.0	3.9	2.9	.2	-.1	-.3	1.6
Other electronic communication equipment	.9	-.9	-1.7	2.8	6.0	3.3	-.6	2.7	3.3	2.8
Electronic components	2.1	2.8	.6	3.9	10.8	6.9	.8	4.8	3.9	3.8
Other electrical machinery	.5	2.8	2.3	.6	1.2	.6	1.9	2.8	.9	1.3
Motor vehicles	.2	.5	.3	2.3	-5.6	-7.9	-1.8	.0	1.8	3.3
Aircraft	-1.0	-2.0	-1.0	1.5	10.5	9.0	1.9	2.5	.6	3.5
Ship and boat building and repair	.9	1.8	.9	7.2	-.9	-8.2	3.1	2.0	-1.1	3.4
Railroad and other transportation equipment	.9	1.8	.9	1.2	6.5	5.3	4.1	3.5	-.5	2.2
Miscellaneous transportation equipment	.9	1.8	.9	.1	-12.8	-12.9	-.4	-5.0	-4.6	6.1
Scientific and controlling instruments	1.6	1.1	-.5	3.9	3.7	-.3	2.1	2.4	.3	.4

[Average annual rate of change]

Industry	1968–80 period			1972–80 period			1973–80 period			Absolute difference
	Projected in 1970	Actual	Difference	Projected in 1973	Actual	Difference	Projected in 1976	Actual	Difference	
Medical and dental instruments	.9	2.7	1.7	4.2	6.5	2.4	4.2	6.4	2.2	2.1
Optical and ophthalmic equipment	.9	2.7	1.7	.7	3.6	2.9	1.3	4.1	2.8	2.5
Photographic equipment and supplies	.9	2.7	1.7	4.0	1.3	-2.7	2.0	1.4	-.5	1.7
Miscellaneous manufactured products	.9	.4	-.5	.3	-2.0	-2.3	1.1	.2	-.9	1.2
Railroad transportation	.6	1.1	.4	-2.9	-.6	2.3	-2.2	-1.1	1.2	1.3
Local transit and intercity buses	.6	1.1	.4	1.0	2.5	1.5	.4	-.2	-.6	.8
Truck transportation	.6	1.1	.4	3.1	2.2	-.8	1.1	2.3	1.2	.8
Water transportation	.6	1.1	.4	.2	2.8	2.5	-1.0	.4	1.4	1.5
Air transportation	.6	1.1	.4	4.0	5.7	1.8	1.8	3.1	1.3	1.2
Other transportation	.6	1.1	.4	1.3	9.3	7.9	2.0	6.5	4.5	4.3
Communications, except radio and television	.9	1.7	.8	1.6	4.4	2.9	1.4	1.3	-.1	1.3
Radio and television broadcasting	2.1	3.7	1.6	1.2	5.9	4.6	2.2	4.4	2.2	2.8
Electric utilities	.6	1.7	1.1	.2	5.0	4.8	2.0	2.7	.7	2.2
Gas utilities	.6	1.7	1.1	.8	1.4	.6	-.6	.1	.7	.8
Water and sanitary services	.6	1.7	1.1	4.1	5.4	1.3	4.1	2.4	-1.7	1.4
Wholesale trade	1.7	2.8	1.2	2.0	3.9	1.9	1.8	3.1	1.3	1.4
Retail trade	1.7	2.8	1.2	2.1	2.6	.6	2.2	2.9	.7	.8
Finance	1.9	3.2	1.3	4.1	5.5	1.4	3.7	4.1	.4	1.0
Insurance	1.9	3.2	1.3	2.0	3.5	1.5	2.3	2.6	.3	1.0
Other real estate	1.2	4.2	2.9	1.3	6.5	5.2	1.8	3.8	2.1	3.4
Hotels and lodging places	1.8	1.6	-.2	2.4	2.8	.3	2.3	3.4	1.1	.6
Other personal services	1.8	1.6	-.2	1.6	1.8	.2	.1	1.1	1.0	.5
Miscellaneous business services	4.1	5.9	1.8	6.6	8.9	2.3	4.8	7.1	2.3	2.1
Advertising	4.1	5.9	1.8	2.1	5.7	3.7	.8	2.7	1.9	2.4
Miscellaneous professional services	4.1	5.9	1.8	3.6	7.3	3.7	5.0	6.0	1.0	2.2
Automobile repair	1.7	3.9	2.2	3.4	4.9	1.5	2.3	5.0	2.7	2.1
Motion pictures	2.1	3.9	1.8	.3	1.0	.7	.1	2.5	2.4	1.6
Other amusements	2.1	3.9	1.8	3.3	4.4	1.1	1.8	4.7	2.9	1.9
Health services, excluding hospitals	3.2	3.9	.7	4.9	5.5	.5	6.9	5.9	-1.1	.8
Hospitals	3.2	3.9	.7	5.3	3.6	-1.7	4.6	4.1	-.5	1.0
Educational services	3.2	3.9	.7	1.9	4.1	2.1	2.9	4.1	1.1	1.3
Nonprofit organizations	3.2	3.9	.7	2.9	3.3	.3'	2.4	2.4	-.1	.4

NOTE: The actual trends are least squares growth rates; the projected trends are compound interest rates.

for two-thirds of the 293 industries (71 trends for the 1970 projections and 111 trends each for the 1973 and 1976 projections). Percentage differences, however, are not the appropriate statistic for evaluating projections because they allow positive differences to offset the negative differences. The unweighted absolute difference, which looks at the differences without regard to positive or negative signs, indicates that the projected trends differed by 1.3 percentage points per year for the 1970 projections.

Another way to evaluate the projection errors is to weight the differences between projected and actual trends by the employment size of each industry, that is, the weighted absolute difference. This procedure reveals that the larger differences occurred in the smaller industries, as the weighted differences are smaller than the unweighted differences.

A final way to evaluate the projections is to fault a projection for particularly large errors in individual industries, the root mean squared difference. The projections contain numerous large differences between actual and projected trends for individual industries. This is apparent in the preceding tabulation—the squared differences are considerably larger than the absolute differences. The largest differences between actual and projected trends occurred in copper ore mining, plastic materials, synthetic fibers, metal stamping, and other transportation equipment industries, all of which are small in terms of employment.

These data suggest that the 1970 projections were the most accurate, even though the projected levels (at least for the total economy) were off by a larger margin than the 1973 and 1976 projections. The absolute differences, whether unweighted, weighted, or squared, were smallest for the 1970 projection. In terms of employment levels, the absolute difference was 149,000 jobs, or 15.2 percent of 1980 employment per industry, for the 1970 projections; 81,000 jobs, or 17.0 percent, for the 1973 projections; and 62,000, or 12.9 percent, for the 1976 projections.

Major industry employment. Employment growth projections in government and manufacturing were consistently overestimated, while employment growth in the other industries was usually underestimated. (See table 2.) The overestimation of State and local government employment reflects the cutbacks in government programs in the late 1970's. The high estimates for manufacturing reflect, for the most part, overestimates of production for durable goods industries which, in turn, reflect the effects of the 1980 recession, the 1978–79 surge in oil prices, and an overestimate of domestic auto sales. These and other factors caused employment in motor vehicles alone to decline 20 percent between 1979 and 1980. Projected employment for 1980 in motor vehicles was overestimated an average of 22 percent in each of the three projections. Durable manufacturing

employment declined .6 percentage points during the 1979–80 period. Clearly, the recession increased the projections errors.

Within manufacturing, projected employment in the high-tech industries differed from actual employment by − 1.7 percent for the 1970 projections, 3.6 percent for the 1973 projections, and − 3.1 percent for the 1976 projections. Manufacturing high-tech industries include those with a greater proportion of technology-oriented workers than the average for manufacturing and a ratio of research and development expenditures to sales near or above the average for all industries.[7] The projection errors for these industries were less than the errors for manufacturing as a whole.

The low estimates of jobs in trade and services in each of the three projections reflect greater than expected declines in the average workweek and less than expected gains in labor productivity. Again, the errors for some industries are magnified by the employment shifts that occurred between 1979 and 1980.

Industry rankings. How well did BLS project the relative growth rates of individual industries? With each projection, BLS attempted to characterize the fastest growing industries. In terms of employment, BLS correctly ranked 7 of the 17 fastest growing industries in the 1970 projections; 11 of 27 in the 1973 projections; and 15 of 27 in the 1976 projections.

In 1970, BLS projected that employment in office computing and accounting machines, business services, and medical and educational services would grow the fastest of all industries in the private sector. These were among the fastest growing industries. As projected, employment in office machines grew 5.0 percent per year over the 1968–80 period. Optical equipment and coal mining were two of the fastest growing industries; BLS projected them to be among the slowest.

We can examine the ability to project relative growth

rates across industries by calculating the correlation between actual and projected trends. If our projections were perfect, then the projected trends would explain 100 percent of the variation in the actual trends—perfect correlation. The projected trends accounted for only 28 percent of the variation in the actual trends in the 1970 projections; 33 percent in 1973; and 15 percent in 1976.

We can also examine the ability to project relative employment levels—the correlation between actual and projected 1980 employment levels. Here, the projected levels explained more than 90 percent of the variation for each projection. These differences in the explanatory power of trends versus levels is to be expected because trends are considerably more volatile in the long run.

Recession affects industry employment

The fact that BLS did not anticipate the 1980 recession increased the difference between projected and actual trends by 2 to 5 percentage points per industry. The projections were not intended to be forecasts of a specific year, but rather estimates of what the economy might look like as it moves along a steady medium-term growth path toward full employment. By emphasizing 1980, it appears that BLS overestimated the medium-term trends for some industries, for example, the auto industry where employment was expected to grow .4 percent per year over the 1968–80 period. Auto employment declined .8 percent per year over the 1968–80 period, but grew 1.4 percent per year over the 1968–78 period.

We illustrate the effects of the recession by calculating "projections" of the 1978 and 1979 economies. The calculation applies the projected 1968–80 industry employment trends of the 1970 projections to the 1968–78 period to obtain an estimate of 1978 employment, and to the 1968–79 period to obtain an estimate of 1979 employment. The following tabulation compares the mean absolute percent

Table 2. Employment in 1980 in major industries, projected and actual levels
[Numbers in thousands]

Industry	Projected in— 1970	Projected in— 1973	Projected in— 1976	Actual	Percent differences 1970	Percent differences 1973	Percent differences 1976
Total employment	101,725	104,944	104,399	105,920	− 4.0	− 0.9	− 1.4
Government	19,203	18,647	18,899	17,914	7.2	4.1	5.5
Federal	5,647	4,893	5,105	5,126	10.2	− 4.5	− 0.4
Civilian	2,184	2,055	2,142	2,207	− 1.0	− 6.9	− 2.9
Military	3,463	2,838	2,963	2,919	18.6	− 2.8	1.5
State and local	13,556	13,754	13,794	12,788	6.0	7.6	7.9
Private	82,522	86,297	85,500	88,006	− 6.2	− 1.9	− 2.8
Agriculture	2,664	2,186	2,589	2,860	− 6.9	− 23.6	− 9.5
Mining	451	537	599	723	− 37.6	− 25.7	− 17.2
Construction	5,546	5,286	5,384	5,865	− 5.4	− 9.9	− 8.2
Durable manufacturing	13,167	13,757	13,167	12,423	6.0	10.7	6.0
Nondurable manufacturing	8,974	9,294	8,753	8,250	8.8	12.7	6.1
Transportation	3,085	3,278	3,037	3,250	− 5.1	0.9	− 6.6
Communication	1,116	1,304	1,318	1,362	− 18.1	− 4.3	− 3.2
Public utilities	812	863	919	966	− 15.9	− 10.7	− 4.9
Trade	19,594	21,156	21,541	22,493	− 12.9	− 5.9	− 4.2
Finance and real estate	4,536	5,334	5,407	5,702	− 20.4	− 6.5	− 5.2
Services, except households	18,491	20,048	19,867	21,097	− 12.4	− 5.0	− 5.8
Households	2,770	1,825	1,291	1,598	73.3	14.2	− 19.2
Other government enterprises	1,316	1,429	1,655	1,501	− 12.3	− 4.8	10.3

errors in the employment projections of the 1978 and 1979 economies with those of the 1980 economy:

Year published	1980	1979	1978
1970	15.3	14.0	13.4
1973	17.0	12.7	11.4
1976	12.7	9.8	8.2

Impact on occupational employment. As noted earlier, industry employment estimates, along with a projected industry-occupation matrix, are the basis of occupational employment estimates.[8] However, only the industry employment projection published in 1970 was used in the occupational employment projections. The 1973 and 1976 industry employment projections were used to estimate 1985 occupational employment.

To isolate the effect of industry estimates on occupational projections, the industry estimates for 1980 are multiplied by actual 1980 industry staffing patterns. This yields a projection of occupations which is then compared to actual employment by occupation.

Industry employment estimates caused some sizable errors in the projections of occupational employment in the 1970 projections. For example, professional and technical workers' share of employment would have been overestimated by 2.8 percentage points, the hypothetical share of 19.1 percent compared with the actual share of 16.3 percent. To a large extent, the error reflected the overestimate of State and local government, especially employment of teachers. However, other elements in the occupational projections offset estimates of industry employment because the projected share of professional occupations underestimated the actual share by .8 percentage points. In the 1970 projections, the share of service occupations would have been slightly overestimated because of the industry projections.

The following tabulation shows the mean percent error in 1980 occupational employment projections attributed to 1970 industry employment estimates (1973 and 1976 estimates were not used to develop 1980 occupational employment, but are calculated here to show their implications):

Year published	Error	Absolute error
1970	6.0	12.4
1973	-0.3	4.8
1976	-1.2	4.1

Unexpected structural changes

During the 1970's, several events substantially affected the structure of the U.S. economy: the increases in energy prices in 1974 and the 1979–80 period, and the increases in food prices in response to the 1973 Russian wheat deal and to weather conditions in 1978. These events were not anticipated by BLS. They affected the performance and structure of the economy in several ways. The higher energy prices, for example, were partly the cause for a considerable deceleration in labor productivity growth. The economy was also affected by new fiscal and monetary initiatives to control inflation.

Between 1970 and 1980, the labor force grew by 23.7 million persons, compared with 13.4 million between 1960 and 1970, a difference of 10.3 million. The magnitude of the 1970–80 increase was not fully anticipated by BLS and caused a number of problems for the projections. For example, one factor in the slowdown in labor productivity was the number of inexperienced workers entering the labor force in the 1970's. Also, demand for several industries grew more rapidly than anticipated (the fast-food restaurants component of retail trade, for example).

Source of the errors

Were our errors caused by erroneous assumptions, by incorrectly specified models, or by other factors? In essence, were we right for the wrong reason or wrong for the right reason? Knowing the source of our errors may help improve future projections and will also highlight the imprecise nature of the projections. So far, the discussion has focused on industry employment, one of the end products of the projection process. Reaching this result involved (1) assumptions about future trends in the labor force, unemployment rate, aggregate labor productivity, and other variables and (2) a model which depicted the structure of the U.S. economy. The errors in projecting industry employment could have occurred because of incorrect assumptions, incorrectly specified models, random errors, or a combination of these factors.[9]

Employment. A first step in our projection methodology is the derivation of total employment. This begins with a projection of the labor force. The labor force, when combined with an assumed unemployment rate among civilian workers and an assumed level of Armed Forces, yields the number of employed persons. This number is then adjusted for dual jobholders and other factors to achieve a projected estimate of the number of jobs in the economy.

To determine the source of the error attributed to each component of the employment estimate, we calculated a series of hypothetical employment levels. For the error caused by the labor force assumption alone, we projected total employment as if the correct unemployment rate, Armed Forces, and other factors were known. A comparison of this hypothetical employment with actual 1980 employment gives a measure of the effect of the projected labor force estimate. For the 1970 projections, if the projected civilian labor force had been the only error, then the projected employment would have been 8,641,000 jobs below actual employment. If the projected unemployment rate had been the only error, then the projected employment would have been 3,506,000 jobs above the actual employment. Thus, for the 1970 projections as well as the other projections, these two variables were offsetting. (See table 3.)

Supply GNP. Another step in the projection methodology

is the estimates of supply GNP. These estimates begin with the derivation of employment from assumptions about the labor force and the number of unemployed persons for the target year. Employment was combined with projected annual hours per employee to provide an estimate of total annual hours paid. This figure, multiplied by output per hour—aggregate labor productivity—yielded an estimate of potential GNP. Because this estimate was derived from economic resources, it is called "supply GNP." As seen in the following tabulation, BLS consistently overprojected the 1980 supply GNP:

	GNP (1972 dollars in billions)	
Year published	Projected	Percent difference
1970	$1,729.2	17.3
1973	1,718.9	16.6
1976	1,607.7	9.1
Actual 1980	1,474.0	—

To isolate the error which would be attributed to each component of GNP, we calculated a series of hypothetical GNP's. For the error caused by the labor force assumption, we constructed a projected supply GNP as if the correct labor productivity, number of unemployed, and other factors were known. A comparison of the hypothetical and actual 1980 GNP is the measure of the effect of the projected labor force estimate.

For the 1970 projections, projected supply GNP was $255.2 million greater than actual GNP for the year 1980. (See table 4.) If the projected labor force had been the only error, then the GNP estimate would have been $125.4 billion below the actual figure. If the nonfarm labor productivity estimate had been the only error, then the projected GNP would have been $250.8 billion too high. Because of offsetting errors in projections of the labor force, unemployment, average workweek, and other factors, the labor productivity error was nearly the same as the total GNP error.

The largest source of error in the three projections of GNP stemmed from overestimation of private labor productivity. The 1973 projection assumed a considerable acceleration in labor productivity, compared with its postwar growth. The 1970 and 1976 projections embodied only modest changes, compared with past trends. In fact, a large deceleration in

Table 4. Factored errors in computation of supply gross national product

[Billions of 1972 dollars]

Item	1970 projections		1973 projections		1976 projections	
	Billions	Percent	Billions	Percent	Billions	Percent
Total error	$255.2	100.0	$244.9	100.0	$133.7	100.0
Error due to:						
Labor force	−125.4	−49.1	−100.9	−41.2	−74.2	−55.5
Unemployment level.	56.1	22.0	53.4	22.0	42.4	31.7
Adjustment factor ..	16.8	6.6	33.7	13.8	15.6	11.7
Federal government employment	−6.6	−2.6	−.8	−.3	−1.4	−1.0
State and local government employment	−5.9	−2.3	−5.4	−2.2	−9.1	−6.8
Agriculture employment	.6	.2	−3.0	−1.2	3.3	2.5
Agriculture workweek......	1.0	.4	−1.0	−.4	−1.6	−1.2
Nonagriculture workweek......	72.1	28.3	27.8	11.4	28.2	21.1
Agriculture productivity	9.5	3.7	10.5	4.3	7.6	5.7
Nonagriculture productivity	250.8	98.3	226.4	92.4	130.7	97.8
Interaction.......	−14.1	−5.5	3.8	1.6	−7.8	−5.8

NOTE: Data reflect the calculation of supply GNP with the projected value of an individual variable and the actual value for all other variables in the supply GNP equation.

labor productivity trends occurred during the 1975–79 period.

Industry outputs. For all three projections, the absolute difference between projected and actual industry output trends was 2.68 percentage points per year per industry. In one-third of the estimates, the difference between actual and projected trends was less than 2 percentage points per year. The absolute, unweighted, weighted, and squared differences were smallest for the 1970 projections:

Year published	Projected	Actual	Difference	Absolute difference		
				Unweighted	Weighted	Squared
1970	4.21	2.59	1.62	1.87	1.36	2.30
1973	5.40	2.64	2.75	3.41	2.48	4.05
1976	3.83	2.60	1.22	2.58	1.86	3.43

The largest overestimates of output usually occurred in construction and durable manufacturing industries, reflecting the effects of the 1980 recession. Residential investment expenditures dropped over the 1979–80 period and as a result, construction output was overestimated by 30 percent or more. During the 1970's, increases in the exploration for oil and investment expenditures for commercial office buildings minimized errors in estimating construction activity.

Auto production was overestimated by more than 40 percent in each projection. Problems in the auto industry affected the steel, tire, and other supplying industries. The influx of foreign steel and autos into the domestic market, the 1980 recession, and energy-related problems were not anticipated. The errors in estimating construction activity affected the estimates of the cement and heating and plumbing industries. However, these errors offset underestimates in some industries such as the optical and ophthalmic equip-

Table 3. Factored errors in computation of total employment

Item	1970 projections		1973 projections		1976 projections	
	Millions	Percent	Millions	Percent	Millions	Percent
Total error	4,195	100.0	976	100.0	1,521	100.0
Error due to:						
Civilian labor force .	−8,641	−206.0	−6,364	−652.0	−4,752	−312.4
Unemployment level	3,506	83.6	3,506	359.2	2,725	179.2
Armed forces	581	13.8	−150	−15.4	58	3.8
Adjustment factor ..	678	16.2	2,525	258.7	699	46.0
Interaction.......	−319	−7.6	−493	−50.5	−251	−16.5

NOTE: Data reflect the calculation of total employment (jobs concept) with the projected value of an individual variable and the actual value for all other variables in the employment equation.

ment, computers and peripheral equipment, and electronic equipment industries.

Industries with the largest projection errors included other transportation equipment (motor homes, bicycles), copper ore mining, other nonferrous ore mining, tires and inner tubes, and primary copper products. These are small industries in terms of output.

GNP components. The components of GNP—consumption, investment, foreign trade, and government—were more indicative of 1979 than 1980. The difference, of course, is because of the 1980 recession. The share of investment in the 1980 GNP was overestimated by 1.1 percentage points in the 1970 projections and 3.0 percentage points in the 1973 projections. (See table 5.) During the 1980 recession, residential investment declined $11.9 billion (1972 dollars) from 1979's level, or 20 percent. The change in business inventories dropped from a $7.3-billion increase in 1979 to a $5-billion decrease in 1980. If 1979 had been the target year of the projections, the investment errors would have only been .2 to 1.1 percentage points. Producer durable equipment's share of GNP was also overestimated in the three projections.

The errors in estimating consumption's share of 1980 GNP ranged from − 1.7 to − .5 percentage points. If 1979 had been the target year, the errors would have been slightly smaller, − .1 to − 1.3. For all three projections, consumption was expected to grow at about the same yearly rate as total GNP, and this occurred. The most difficult component of consumption to estimate was purchases of consumer durables. In the 1970 and 1973 projections, consumer durables were expected to grow slightly slower than total consumption; the reverse occurred. Expenditures for consumer nondurables were expected to grow modestly slower than GNP; this pattern occurred. Expenditures for consumer services were expected to grow either at the same rate or

slightly faster than total consumption; in reality, they grew faster.

The three projections underestimated the export share of 1980 GNP by 2.3 to 4.7 percentage points. BLS analysts did not anticipate the surge in the export of food and feed grains, capital goods (except autos), and services. Even if 1979 had been the target year, exports would have been underestimated.

The import share of GNP was reasonably accurate for the 1973 and 1976 projections, but not for the 1970 projection. The 1970 projection was based on import growth .5 percentage points per year slower than GNP; it grew 2.5 percentage points per year faster.

Estimates of Federal Government purchases were reasonable for the three projections. State and local government expenditures, however, were overestimated, reflecting unanticipated budgetary problems facing State and local government in response to tax amendments, such as "Proposition 13" in California and "Proposition Two and One-half" in Massachusetts, and to the 1980 recession.

Isolating output errors. Estimated output reflects several factors—level and distribution of real GNP, projected bridge tables, and projected input-output coefficients. The bridge table converts the broad final demand categories, such as consumption expenditures for durable goods, to the industries producing the items in the categories, such as electrical appliances. The input-output coefficients represent purchasing patterns of businesses and technologies and innovations in producing goods and services. Both the bridge and input-output tables embody assumptions concerning energy, computers, business services, and other products and technologies.

Because of changes in input-output definitions and other factors, it is not possible to show the projection errors for the bridge tables and input-output coefficients. Nor is it possible to estimate the effect that projected final demand distribution, input-output coefficients, and bridge tables had on the projected output trends. The combined projection errors for these three factors increased the absolute errors of the output projections by the same magnitude as the errors in the projected level of GNP.

Isolating the error which would be attributed to two components involves constructing two hypothetical projections of outputs. For the effect of the GNP level, we constructed industry output levels which combined projected GNP and actual industry distributions. A comparison of these hypothetical outputs with actual outputs is a measure of the effect of projected GNP level. For the effect of final demand, input-output coefficients, and bridge tables, we constructed industry outputs which combined the actual GNP and the projected distribution of industry outputs. A comparison of these second hypothetical outputs with actual output levels is a measure of the impact of final demand and other factors.

The errors attributable to the projected distribution of

Table 5. Percent distribution of demand gross national product in 1980, projected and actual					
Item	Projections published in —			Actual	
	1970	1973	1976	1979	1980
Gross national product	100.0	100.0	100.0	100.0	100.0
Consumption	61.4	61.4	62.6	62.7	63.1
Durable goods	8.4	9.2	(¹)	9.9	9.3
Nondurable goods	23.3	24.1	(¹)	23.9	24.1
Services	29.7	28.1	(¹)	28.9	29.7
Investment	16.2	17.1	16.6	16.0	14.1
Nonresidential structures	3.9	4.2	3.8	3.3	3.3
Producer durable equipment	6.8	7.3	7.6	8.2	8.0
Residential structures	4.3	4.1	3.7	4.0	3.2
Inventories	1.2	1.5	1.5	.5	− .3
New exports	.8	.8	1.4	2.5	3.4
Exports	6.1	8.3	8.5	9.9	10.8
Imports	− 5.3	− 7.5	− 7.2	− 7.4	− 7.4
Government purchases	21.6	20.7	20.6	18.8	19.3
Federal	7.9	7.2	6.8	6.9	7.2
State and local	13.7	13.5	12.6	11.9	12.1
¹Not available.					

outputs were small, 4 to 7 percent. However, the absolute error attributable to the projected distribution of outputs is nearly the same as that attributable to the projected GNP level for the 1970 and 1973 projections.

The following tabulation shows the effects of GNP and other factors on output estimates in private industries, except households:

	Output errors		Error due to GNP		Error due to distribution	
Year published	Percent	Absolute percent	Percent	Absolute percent	Percent	Absolute percent
1970 ...	28.9	32.4	20.9	20.9	4.5	17.7
1973 ...	29.2	33.8	22.3	22.3	5.9	19.5
1976 ...	18.7	25.1	11.8	11.8	6.5	18.4

Employment/output ratios. For the three projections, the absolute difference between projected and actual labor productivity trends was 2.38 percentage points per year per industry. In more than half of the estimates, the difference between the actual and projected trends was less than 2 percentage points per year. The 1970 projections were the most accurate of the three, with the lowest absolute differences, whether unweighted, weighted, or squared. Unlike employment and output, the larger difference did not always occur in the smaller industries in terms of employment. The following tabulation shows projected and actual employment/output trends by industry for the private economy, except households:

				Absolute difference		
Year published	Pro-jected	Actual	Dif-ference	Un-weighted	Weighted	Squared
1970	−2.92	−1.66	−1.27	1.27	1.50	2.01
1973	−3.84	−.97	−2.87	2.94	3.76	3.76
1976	−2.36	−.94	−1.42	2.38	1.96	3.26

Analysis of industry employment errors

Projected outputs times projected employment/output ratios yields projected industry employment. There are sufficient data to identify the errors for four factors—the level and distribution of both GNP and labor productivity. (See table 6.) The distribution of output includes the effects of the final demand distributions, bridge tables, and input-

Table 6. Factor analysis for industry employment

Year published	Projection error	Effect of projected—			
		Output		Productivity	
		Level	Distri-bution	Level	Distri-bution
Percent:					
1970	0.2	20.9	4.5	−19.8	1.4
1973	5.5	22.5	5.9	−17.9	3.1
1976	2.3	11.8	6.5	−13.0	2.1
Absolute percent:					
1970	15.3	20.9	17.7	19.8	15.7
1973	17.0	22.3	19.5	17.9	18.5
1976	12.9	11.8	18.4	13.0	13.6

NOTE: For the 1970 projections, these data are the mean values for 71 industries; for the 1973 and 1976 projections, 111 industries.

output coefficients. The distribution of labor productivity reflects the estimated relative growth trends of labor productivity.

The data in table 6 highlight that aggregate errors in the GNP and labor productivity levels are nearly offsetting at the industry level. The distribution of industry outputs and labor productivity increased the employment errors. However, the errors resulting from the distributions of outputs and labor productivity are about the same as the errors resulting from the aggregate assumptions.

Alternative projections

Were BLS' projections significantly less accurate than those of other analysts? If so, then more radical remedies and significant chances for improvement exist. The difference between projected and actual trends for employment were about the same for BLS and other medium-term forecasts of employment. BLS underestimated total employment by .9 percent in its 1973 projections and had an absolute difference per private industry of 10.6 percent when weighted for size of the individual industry. In 1974, Clopper Almon of the University of Maryland underestimated total employment in 1980 by 3.0 percent and had an absolute difference per private industry of 11.6 percent when weighted for industry size.[10]

In 1976, BLS underestimated total employment by 1.4 percent, and had an absolute error per private industry of 8.1 percent when weighted for industry size. In its 1976 projections, Chase Econometrics underestimated total employment by 4.2 percent and had an absolute error per private industry of 8.3 percent.[11]

BLS calculation of industry projection errors is based on 111 observations; both Almon's and Chase Econometrics' errors are based on 44 observations. Almon's and Chase Econometrics' estimates are for full-time equivalent jobs; BLS' are for jobs regardless of the number of hours worked. This distinction might affect the comparison if the workweek differed among the projections. Since the projections cited here, Chase Econometrics, Almon, and BLS have extensively revised and expanded their models.

Like BLS', Almon's and Chase Econometrics' projections of industry employment were based on a series of econometric and input-output models as well as judgments. However, specifications of the respective projection models differ. The similarity in the aggregate projection error may not be surprising because BLS' labor force projections were used by both Almon and Chase Econometrics. All three assumed the economy would move steadily toward full employment and thus did not anticipate the 1980 recession.[12] The differences in total employment between BLS and the other forecasters reflect the targeted levels of unemployment and the adjustments between the number of employed persons and the number of jobs.

Simpler techniques. BLS' projections are better than either

a simple extrapolation of past trends in industry employment or a simple regression equation when forecasting. The following tabulation shows the absolute percent errors in industry employment projections of the 1978, 1979, and 1980 economy:[13]

Year published	Period covered	BLS model	GNP regressions		Time trend
			Projected	Actual	
1970..........	1978	15.3	24.3	25.5	36.0
1973..........	1979	17.0	22.7	16.9	21.8
1976..........	1980	12.7	16.7	11.7	14.1

BLS' projections are based on a series of econometric and input-output models plus judgments. One might substitute either a time trend or a regression equation approach. A regression approach might relate an industry's employment to trends in GNP and the unemployment rate. A time trend would extrapolate past trends in industry employment forward to some target year. These two alternatives are certainly naive approaches, yet they provide a useful upper bound to acceptable projection errors.

In the preceding tabulation, two projections of 1980 employment are made with the regression technique. One uses actual GNP and unemployment rate values; the other uses BLS' projected 1980 GNP and the unemployment rate values. The difference between the two projections illustrates the effect of the aggregate errors. BLS could have correctly projected the GNP and unemployment rate but used a simple regression model. The accuracy of this combination would have been about the same as BLS' projections over a relatively short period, but less accurate than BLS' projections over a longer period.

Past evaluations, future benefits

BLS has now evaluated five industry employment projections: one each of the 1970 and 1975 economy, and three of the 1980 economy.[14] When the time span of each projection is considered, the magnitude of the projection errors has remained about the same across the five projections, as shown in the following tabulation:

	Year published	Year projected	Absolute percent error	
			Unweighted	Weighted
1966		1970	10.3	8.1
1973		1975	14.8	8.0
1970		1980	15.3	12.5
1973		1980	17.0	10.6
1976		1980	12.9	8.1

Since the 1980 projections, BLS has expanded the industrial detail and other aspects of the projection process. These expansions may or may not lead to more accurate projections. One characteristic of any projection—economic, demographic, or other—is that small groups or industries are not likely to be as accurately projected as large groups.[15] This raises the difficult question of the appropriate level of detail for a projection. From the point of view of accuracy alone, greater detail may impair the projection, yet the interaction of detailed industry groups may be one of the most valued characteristics of the projection. Although the detailed industry projections may have greater errors, their use may lead to more accurate aggregate projections.

Since these 1980 projections, BLS has also replaced its macroeconometric model with one developed and maintained by a private company. The new model is much broader and more detailed than the models used in the projections evaluated here. This should foster a better understanding of the interaction of many economic trends. However, projections must at some place in their structure hold change constant, whether it is the elasticities of substitution between income and expenditures or the concept of full employment. And yet the structure of the economy is continuously changing. This has the effect of underestimating the degree of change.[16] ☐

————FOOTNOTES————

[1] The initial projections of the 1980 economy were described in "The U.S. economy in 1980: a preview of BLS projections," *Monthly Labor Review*, April 1970, pp. 3–34, and in *Patterns of U.S. Economic Growth*, Bulletin 1672 (Bureau of Labor Statistics, 1970). The second projections of the 1980 economy were described in "Projections of GNP, income, output, and employment," *Monthly Labor Review*, December 1973, pp. 27–42; *The U.S. Economy in 1985*, Bulletin 1809 (Bureau of Labor Statistics, 1974); and *The Structure of the U.S. Economy in 1980 and 1985*, Bulletin 1831 (Bureau of Labor Statistics, 1975). The third projections were described in Ronald E. Kutscher, "Revised GNP projections to 1980 and 1985: an overview," *Monthly Labor Review*, March 1976, pp. 3–8; Charles T. Bowman and Terry H. Morlan, "Revised projections of the U.S. economy to 1980 and 1985," *Monthly Labor Review*, March 1976, pp. 9–21; Thomas J. Mooney and John H. Tschetter, "Revised projections to 1985," *Monthly Labor Review*, November 1976, pp. 3–9; and Max L. Carey, "Revised occupational projections to 1985," *Monthly Labor Review*, November 1976, pp. 10–22.

[2] See Howard N Fullerton, Jr., "How accurate were the 1980 labor force projections?" *Monthly Labor Review*, July 1982, pp. 15–21; and Max

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

[3] The methodology for the 1970 projections is described in *Patterns of U.S. Economic Growth*, Bulletin 1672 (Bureau of Labor Statistics, 1970; for the 1973 and 1976 projections, *The Structure of the U.S. Economy in 1980 and 1985*, Bulletin 1831 (Bureau of Labor Statistics, 1975).

[4] In this tabulation and throughout the article, the actual rates are based on least squares growth rates; projected trends are based on compound interest rates.

[5] See Fullerton, "How accurate were the 1980 labor force projections?"

[6] In this tabulation and throughout the article, for the 1970 projections, the data are the mean values for 71 industries; for the 1973 and 1976 projections, 111 industries.

[7] Richard W. Riche, Daniel E. Hecker, and John U. Burgan, "High technology today and tomorrow: a small slice of the employment pie," *Monthly Labor Review*, November 1983, pp. 50–58. The authors give three definitions of high technology; this evaluation uses the third.

[8] For an evaluation of the occupational projections to 1980, see Carey and Kasunic, "Evaluating the 1980 projections of occupational employment."

[9] The ideal way to analyze the sources of error would be to have macro and input-output models plus 1980 data which are consistent with the models and data used in each of the projections. Then one could, in turn, examine the effect of each model and assumption. However, this is not feasible because of changes in the definitions and concepts of input-output tables, revisions in National Income Accounts, and changes in the system for classifying industries. The discussion in this section is an approximation of the ideal. As will be apparent, assumption and modeling errors appear to be about equal in magnitude and usually are offsetting.

The projections assume there are no changes in the income and price elasticities of the forecasting model. Such an assumption is obviously unrealistic as the forecast horizon lengthens and for changes during a projected period which exceed the changes during a historical period. The unanticipated events discussed earlier are indicative of these problems.

[10] Clopper Almon, Margaret B. Buckler, Lawrence M. Horwitz, and Thomas C. Reimbold, *1985: Interindustry forecasts of the American economy* (Lexington, Mass., Lexington Books, 1974).

[11] Chase Econometrics, *U.S. macroeconomic long-term forecasts, fourth quarter 1976.*

[12] Almon and others, *1985,* p. 5.

[13] One regression uses actual GNP and the unemployment rate to project employment; the other uses projected GNP and the unemployment rate.

[14] For evaluations of the production and employment projections for the 1975 employment and output projection, see Paul T. Christy and Karen J. Horowitz, "An evaluation of BLS projections of 1975 production and employment," *Monthly Labor Review,* August 1979, pp. 8–19; for the 1970 projections, see Valerie A. Personick and Robert A. Sylvester, "Evaluation of BLS economic and employment projections," *Monthly Labor Review,* August 1976, pp. 13–26.

[15] Henri Theil, *Applied Econometric Forecasting* (Chicago, Rand-McNally and Co., 1966).

[16] Jacob Mincer and Victor Zarnowitz, "The Evaluation of Economic Forecasts," in Jacob Mincer, ed., *Economic Forecasts and Expectations: Analyses of Forecasting Behavior and Performance* (New York, National Bureau of Economic Research, 1969), pp. 3–46.

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, D.C. 20212.