BLS Economic Growth Model System Used for Projections to 1990

U.S Department of Labor
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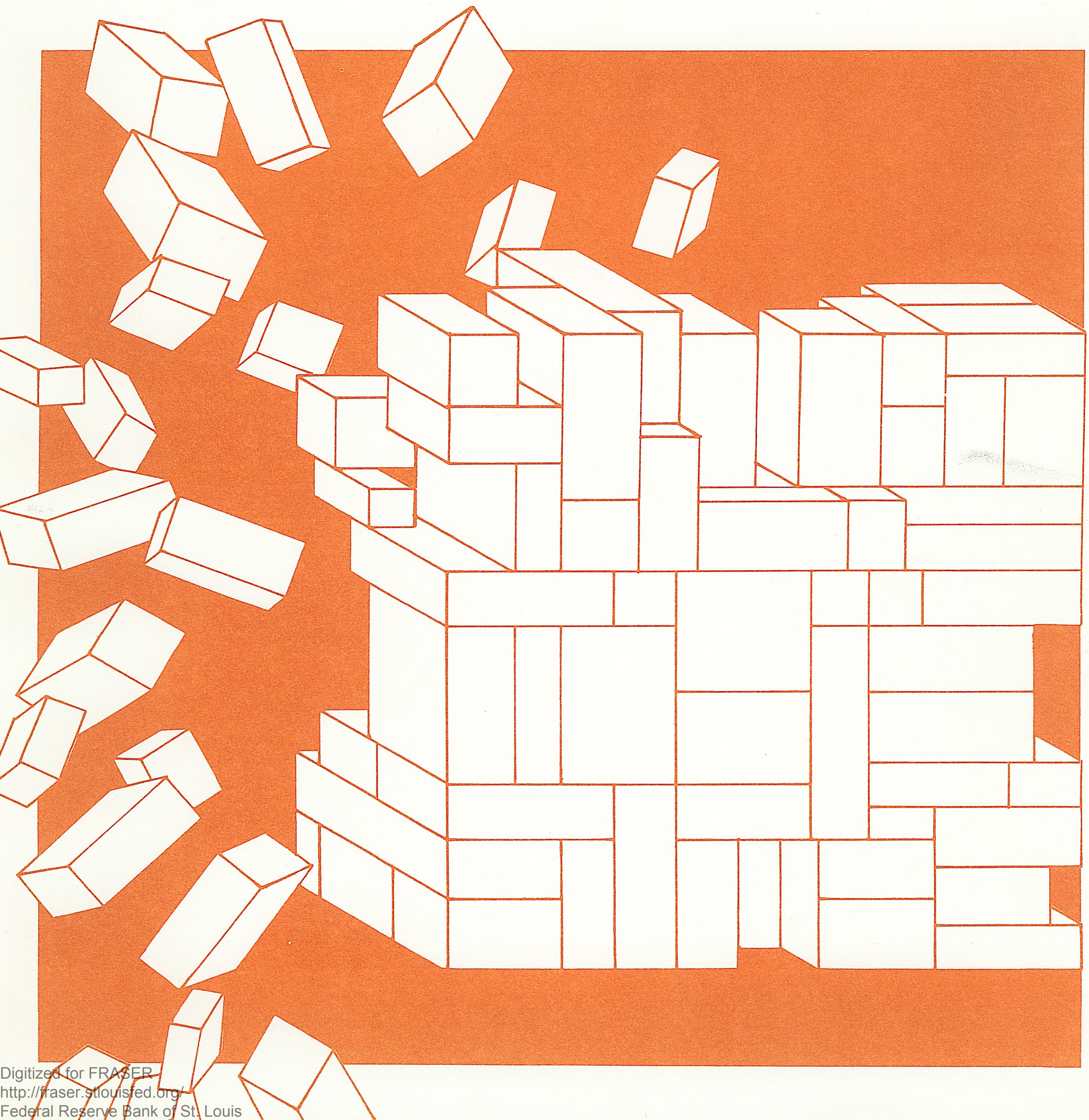

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U.S. Department of Labor
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Preface

This bulletin describes the Bureau of Labor Statistics current Economic Growth model which was used to develop the revised 1990 industry and occupational employment projections. It is intended primarily for those analysts who desire detailed information on the BLS projection methods, models, and techniques. The text covers the components of the Economic Growth system used to develop these projections in the sequence of their application. The appendixes provide the detailed equations used in the various model systems.

The revised 1990 employment projections, based upon changed economic conditions and later data, were published in the August 1981 *Monthly Labor Review*.. The results of the earlier version of the 1990 projections were presented in three articles published in the *Monthly Labor Review* in December 1978 and April 1979.

Earlier projections of industry and occupational employment for 1970, 1975, 1980, and 1985 are cited in the text. Industry employment projections are used as a basis for the occupational projections developed in the last part of the projections cycle. The occupational projections are used in planning training programs and in counseling students and workers and by businesses for personnel planning and market research. The industry projections are used by business firms as a source of information in developing long-range capital investment programs and in anticipating changes in the structure of markets.

This bulletin was prepared in the Office of Economic Growth and Employment Projections, under the supervision of Ronald E. Kutscher, Assistant Commissioner for Economic Growth and Employment Projections. The report was prepared by Richard Oliver. Howard Fullerton provided the explanation of labor force projections. Norman C. Saunders contributed the methodology on the macroeconomic projections. Material on the techniques of projecting interindustry coefficients was provided by Karen Horowitz. Methodologies used in projecting the major final demand sectors were provided by Arthur Andreassen, Betty Su, and David Frank. Valerie Personick developed the estimates of industry employment. Neal Rosenthal prepared the section on occupational methodology and John Tschetter the section on areas of new development. Marilyn Queen assisted in the preparation of the manuscript.

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Chapter 1. BLS Projections System

The revised 1990 employment projections are the latest in a series that started in the mid-1960's as an interagency project to study the conditions and requirements for balanced economic growth in the United States. The first Economic Growth model, formulated in 1963 for the 1970 projections, was a conventional application of the input-output technique using only one other model. Since that time, projection studies have been completed for 1975, 1980, 1985, and 1990.[1] While the general approach has been similar for each of these studies, the methodology has been continually modified to include greater industrial detail, other models, more rigorous analytical techniques, a more automatic system for processing calculations, and broader coverage including labor force and occupational projections in the current version. The interagency character of the projections has also changed. Although certain data assumptions are still coordinated with other agencies, the projections have become more a BLS responsibility.

Current methodology

In the current version of the BLS Economic Growth system, two functions were made a formal part of the Economic Growth model system: The aggregate labor force projections and the projection of occupational employment levels. There are currently seven major steps in projecting employment levels: (1) A projection of labor force supply; (2) a macro model projection of the aggregate economy; (3) a disaggregation of gross national product to detailed demand categories; (4) a distribution of each demand category to producing industries; (5) projection of an input-output table and its use in solving for industry outputs; (6) a projection of productivity, hours, and employment at the industry level of detail; and (7) the projection of an industry-occupational matrix used to project occupational employment levels.

Some portions of each step are independent of the other steps, but, in general, each step is also dependent to some degree upon the step prior to it. The current approach allows for only limited conceptual or computerized feedback from a later step to an earlier one. However, results at certain stages are compared analytically with earlier controls, and adjustments are made.

Brief overview of Economic Growth system. The revised employment projections, using this current methodology, began with an estimate of the size of the aggregate labor force available in 1990. To cover a range of uncertainties, three alternative scenarios were prepared: A high, low, and middle estimate of the projected labor force. Population projections prepared by the Bureau of the Census for various age, sex, and racial groups were used as a basis for the labor force supply estimates. Labor force participation rates for each group were projected by extrapolating past growth rates. Different base periods were used in the regression for each age group to provide the basis for the different alternatives. The total labor force was calculated for each group by multiplying the projected participation ratios by the census projections of population in each group. These projections were used as an input to the macroeconomic model projections. The high-trend I version of economic growth used the high labor force alternative. The low-trend version of economic growth and the high-trend II version used the middle-level labor force estimate.

Next, a set of assumptions, or scenarios, describing alternative conditions of growth in the economy were developed. Various assumptions, such as policy targets, were formulated and used in conjunction with the macroeconometric model, along with base period data. This model used these assumptions to develop consistent projections of supply or potential GNP growth and the resulting income flows. Income flows were next used by the model in projecting demand GNP by major components. Supply and demand GNP were balanced in the model providing control totals for the purchases of various final demand sectors consistent with all conditions and assumptions.

[1] *Employment Projections for the 1980's,* Bulletin 2030 (Bureau of Labor Statistics, 1979). *Occupational Projections and Training Data, 1980 Edition,* Bulletin 2052 (Bureau of Labor Statistics, 1980). "Revised BLS Projections to 1980 and 1985," *Monthly Labor Review,* March, August, and November 1976 and "Revised Occupational Projections to 1985," *Monthly Labor Review,* November 1976. The following Bureau of Labor Statistics bulletins: *Occupational Projections and Training Data,* Bulletin 2020 (1979); *The Structure of the U.S. Economy in 1980 and 1985,* Bulletin 1831 (1975); *The U.S. Economy in 1985,* Bulletin 1733 (1974); *Projections of the Post-Vietnam Economy, 1975,* Bulletin 1733 (1972); *The U.S. Economy in 1980,* Bulletin 1673 (1970); *Patterns of U.S. Economic Growth,* Bulletin 1672 (1970); and *Projections 1970: Interindustry Relationships, Potential Demand and Employment,* Bulletin 1536 (1966).

Control totals for each of the categories of demand GNP developed in the macro model were used with various techniques and submodels to distribute aggregate demand to detailed categories of demand or product groups. For example, personal consumption expenditures for nondurable goods were distributed to various product groups, such as food purchased for use at home, while investment in producers' durable equipment was distributed by producing industry; i.e., computers or metalworking machinery.

The next step was to distribute the functional or product level demand in each sector to specific purchases of goods and services produced by 156 different industry demand sectors using projected distribution factors or "bridge" tables. The industry classification in this sequence of the model is always consistent with the interindustry models used in subsequent steps to project intermediate demand. The coefficients of the input-output models were projected separately based upon such factors as expected changes in industry technology, shifts in inputs, and changes in the mix of products. These projected ratios provided the framework for estimating the purchases each industry must make to support its projected sales. The projected interindustry tables, or matrices, provided estimates of the projected output needed from each industry for all final and intermediate demand requirements. At this stage in the model sequence, each industry's output level was evaluated for projected changes in total output and the share going to final and intermediate sales. Where annual rates of change in output or the distribution of intermediate and final demand varied significantly from past experience, the reasons were reexamined and changes made in the final demand purchases or coefficients where necessary.

The projections sequence in the BLS Economic Growth model system then proceeded to estimate industry employment requirements. A labor demand model was used to project productivity changes in each industry. With the industry productivity projections, industry output requirements were converted to industry employment requirements. Finally, the industry employment changes were compared to historical change. If the growth in employment appeared reasonable, it was aggregated and compared with levels used at the macro stage. At all steps in this process, the disaggregated estimates were made consistent with their macro counterparts.

The industry employment projections were used for calculating the occupational employment levels. The method incorporated an industry-occupational model to distribute industry employment levels to various occupations. This projection method involved first developing the occupational staffing patterns for each industry in a current period (1978). These patterns were projected to 1990 based upon past experience and various analyses. The projected employment levels in each industry were multiplied by the occupational distribution for the industry. Summing across industries provided an estimate of the total projected employment in each occupation consistent with the industry projections.

An outline of the various analytical stages of the projections is given below. Chart 1 shows the computational blocks of the system.

A. Labor force projections
  1. Project labor participation rates
  2. Apply rates to population projections
  3. Calculate labor force size

B. Macroeconomic projections
  1. Policy inputs
  2. Potential GNP
  3. Income flows
  4. Demand sectors

C. Final demand purchases
  1. Functional levels
  2. Industry purchases

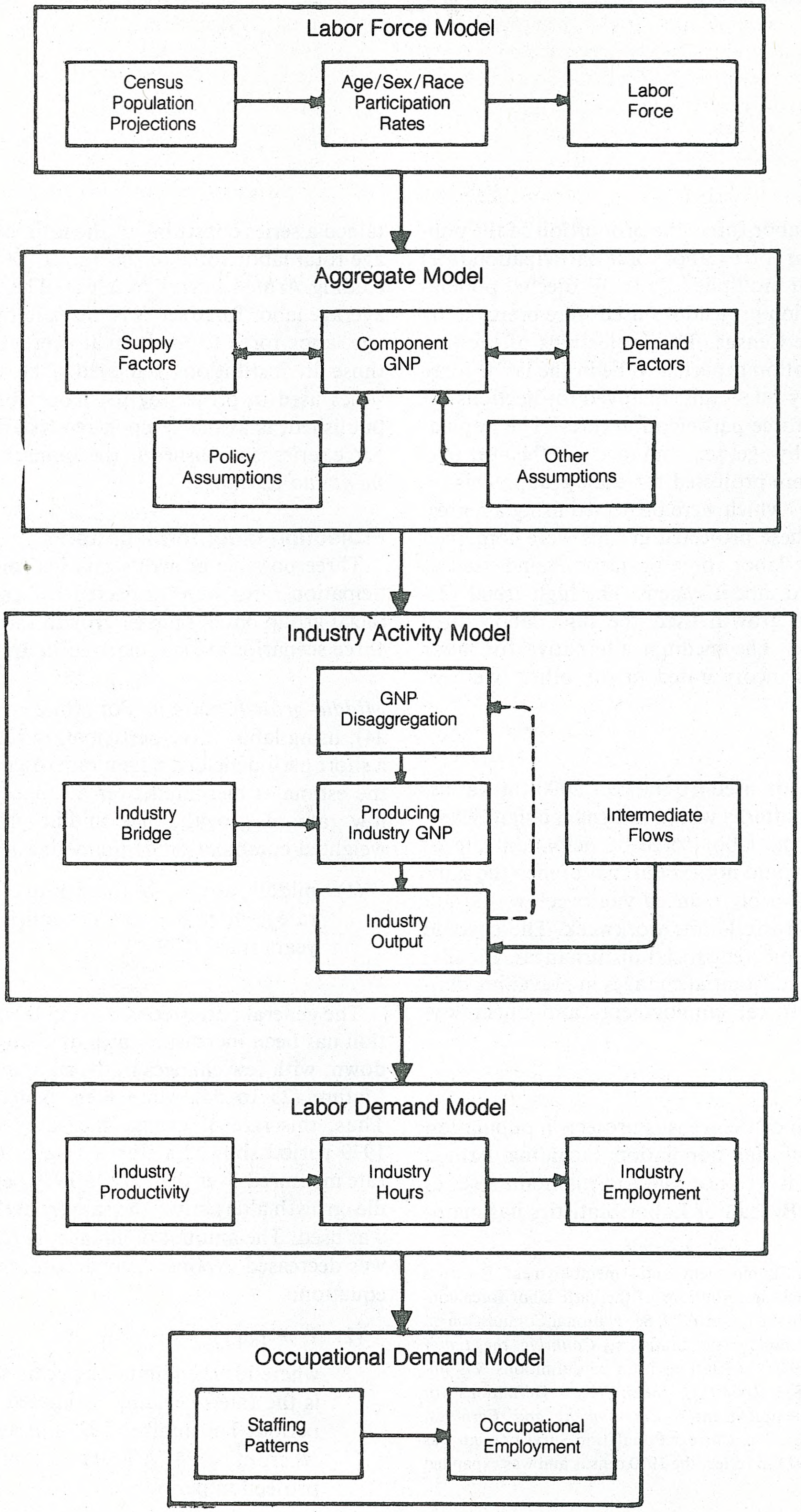
D. Interindustry tables
  1. Base period tables
  2. Coefficient projections
  3. Projected tables

E. Projected industry outputs
  1. Calculation of gross outputs
  2. Evaluation and feedback

F. Projected industry employment
  1. Productivity changes
  2. Labor demand
  3. Evaluation and feedback

G. Projected occupational employment
  1. Industry occupational staffing patterns
  2. Total employment by occupation

Chart 1: Employment Projections System



Chapter 2. Aggregate Labor Force Projections

To project the labor force, the proportion of the population in the labor force (labor force participation rate) was projected and multiplied by the projected population. The population projections used were prepared by the Bureau of the Census. The projections of the percent of the population expected to be in the labor force were prepared by BLS; this involved projections of changes in labor force participation rates. The population was grouped by age, sex, and race and then the participation rates were projected for each group. This resulted in 54 groups which were projected using a regression approach. These projected groups were combined into the aggregate labor force projections and used as input to the macro model system. The high-trend version of economic growth used the high labor force growth alternative. The medium alternative for labor force growth was incorporated in the other two versions.

Assumptions

In the time horizon used (to the year 2000), it was assumed that work patterns would not change significantly. For example, the labor force participation rate of women generally would not exceed that of men the same age; similiarly, a sharply reduced workweek would not become the standard full-time workweek. There would be no major wars or great social disturbances. Finally, there would be no substantial changes in prevailing definitions of labor force, employment, and unemployment.[2]

Data sources

Since the Bureau of the Census projects a population series known as "total population including Armed Forces overseas," it was necessary to maintain a series for this base. The Bureau of Labor Statistics has maintained a series consisting of the ratio of the annual average total labor force to the July 1 total population, including Armed Forces overseas. The published annual average labor force series is the ratio of the annual average labor force to the annual average population with those in institutions removed. The total labor force series used in projecting the labor force, although not published, is available upon request. The civilian labor force series is published in the January issue of *Employment and Earnings*.

Projecting labor force patterns

Three possible growth scenarios for labor force participation rates were projected for each age, sex, and racial group based on past growth rates. (Details of the three scenarios are summarized in appendix A.)

Middle-growth pattern. For white male youths (16 to 24), using labor force participation rates observed over a short period yielded a high rate of growth, while using the estimates measured over a longer period yielded a low rate of growth. The middle-growth rate was a weighted combination of the high and low patterns:

(1) middle rate $= b^i$ (high rate$_i$) $+ (1 - b^i)$ (low rate$_i$) where $b = 0.90$ i, and i is the number of years since 1979.

The general pattern observed in labor force participation has been increasing rates of change, whether up or down, with few changes in the sign of the growth rates. Mature (25 to 54) white men exhibited this pattern. Thus, this rate of change measured over the 1960 to 1979 period showed a slower rate of decrease than the rate measured over the 1972 to 1979 period; for the middle-growth alternative, the rate from the longer interval was used. The amount of change, r, for each projection was decreased exponentially according to the following equation:

(2) $r_i = r_0 [552 - i^2 + i]/552$

where i is the number of years since 1979, and r_0 is the rate of change estimated over the historic period. The number 552 is derived from $n^2 + n$, where $n = 24$. n is set so that it is beyond the projection period.

[2]A Commission on Employment and Unemployment Statistics recommended no changes in difinitions of the basic labor force concepts when it reported in the fall of 1979. See National Commission on Employment and Unemployment Statistics, *Counting the Labor Force*, Washington, 1979. The last revision of definitions was implemented in 1967. See Robert L. Stein, "New Definitions for Employment and Unemployment," *Employment and Earnings*, February 1967, pp. 1-25. The Current Population Survey design was modified in January 1973 to reflect the 1970 census and was expanded in January 1978.

Different middle-growth path scenarios were developed for two age groups of black-and-other men younger than retirement age; those 16 to 24, and those 25 to 59. Because of the higher sampling variability observed in the total labor force rates at this level of disaggregation, the short-term labor force rate of change estimates were discarded for men 16 to 24. The moderate-growth pattern was based on the upper confidence-interval estimate of change measured over the long run for young black-and-other men. For men 25 to 59, the middle-growth rate pattern was based on the rate of change measured over the short run. Once a growth rate was estimated, it was projected according to equation (2).

For the middle-growth scenario, women of both racial groups under 65 years of age were divided into three age groups, 16 to 19, 20 to 44, and 45 to 64. The rate of growth was measured over the recent past for women ages 16 to 44 and was measured over the longer period for women ages 45 to 64. For women 20 to 44, the rate of growth was projected to increase at an increasing rate for 3 years, then to increase at a decreasing rate according to an adjusted version of equation (2). The divisor in equation (2) was changed so that the rate of growth became zero in 1995; then between 1995 and 2000, the labor force rate grew by a percentage point. For women 45 to 64, equation (2) was used unchanged, which implied that the rate of growth would continue to change until 2000. In no scenario was the labor force participation rate for women allowed to exceed the rate attained in 2000 by men of the same age and ethnic group.

The same three retirement age scenarios (65 and over for women, 60 and over for black-and-other men, 55 and over for white men) were used for all racial and sex groups. The middle-growth scenario used the long-run rate, r, which was divided by two before being exponentially decreased according to equation (2).

High-growth pattern. For white youths (16 to 24), the labor force participation rates observed over a short period yielded the high rate of growth. They were projected according to equation (2). The rate of change in participation of white men 25 to 64 measured over the 1960 to 1979 period showed a slower rate of decrease than the rate measured over the 1972 to 1979 period. For the upper growth rate alternative, the assumption was made that labor force participation for the age group 25 to 39 would increase at the same rate it had declined over the 1960–79 period; for men 40 to 64, the rate of change was set at zero, continuing the last observed labor force participation rate. The amount of change, r, for each projection was decreased exponentially according to equation (2).

The high-growth scenario for black-and-other men ages 16 to 64 was that rate of change which would make the black total labor force ratio equal to the comparable high white male ratio in the year 2000. The path is expressed by the two equations:

(3) $r = [\log(\text{black 1fpr 1979}) - \log(\text{white 1fpr 2000})]/21$ and then using:

(4) $r_0 = (\text{black 1fpr 1979}) \exp [r (i)]$

where i is the number of years since 1979, and 1fpr is the labor force participation rate.

For the high-growth scenario, women of both racial groups under 65 years of age were divided into three age groups, 16 to 19, 20 to 44, and 45 to 64. For women 20 to 44, it was assumed that the growth measured over the shorter term would continue to increase at an increasing rate for 5 years, while for women 16 to 19 and 45 to 64, growth was projected to accelerate for only 3 years. After that, the growth rates were projected to increase at a decreasing rate according to an adjusted version of equation (2). The divisor in equation (2) was changed so that the rate of growth would become zero in 1995; between 1995 and 2000, the labor force rate grew slightly, by 1 percentage point. The effect was to have a more rapid increase in the short run than the middle-growth scenario.

The high labor force growth scenario for those at the retirement ages was the same for all sex-ethnic groups. It reflects, at least implicity, the assumption that recent legislation and high inflation will stop the pattern of declining labor force participation. The rate of decrease was held at zero or the participation rate was set to hold constant over the entire 1980 to 2000 period.

Low-growth pattern. For white male youths, using labor force participation rates observed over the long range provided a low rate of growth, as the rate of change measured over the 1958–77 period yielded the lower rate of growth. The rate of change for prime-age white men as measured over the 1958–77 period showed a slower rate of decrease than the rate measured over the 1970–77 period. For the low-growth alternative, the decreasing pattern since 1970 was projected. The amount of change, r, for each was estimated according to equation (2). For black-and-other men, ages 16 to 64, the low alternative projection was based on the change measured over the long run, with the rate of change decreasing according to equation (2).

For women 16 to 19, the rates from the long-run estimates were used, while for women 20 to 64, the rates from the short-run estimates were used. For both groups, the lower estimate of labor force growth (smallest increase or greatest decrease) was used to make the projection. The rate of change was then projected according to equation (2).

For the low-growth retirement age projection, which was made in the same way for all sex-ethnic groups, the rates of change were measured over the short term with its more rapid rate of decrease. For all of these older age groups, the labor force rate was kept above 1.2 percent.

Population projections

Although the emphasis in the presentation of these projections was on labor force participation rates, some discussion of population projections is necessary, as they affect the levels of the projected labor force.[3] There are three elements to a population projection: Future births, future deaths, and future migration. The Bureau of the Census projects birth and survival rates but only the level of net migration . Evaluating the effect of these in reverse order, data on emigration have not been collected for more than a decade because of their dubious accuracy. Although documented immigrants presumably are counted accurately, if they then leave, they are not necessarily counted. Further, most conjectures about the number of undocumented workers put their level above that of legal net migration. However, it is necessary to distinguish between a net flow of 400,000 migrants and the conjectured stock of 1.5 to 6 million illegal migrants. Although most migrants are of working age, the labor force projections should be affected only if the assumptions are off by a factor of 2. It may be quite difficult to do appreciably better than the Bureau of the Census assumption of 400,000 net migrants per year.

Mortality assumptions allow for a small decrease between now and the year 2050. Given the sudden and unexpected decrease in mortality rates recently, this assumption looks quite conservative. However, the effects of this will be upon the older population, who have low and declining labor force participation rates.

Of the three elements in a population projection, the Bureau of the Census has prepared alternatives only for level of fertility. These alternatives vary according to the ultimate level of fertility that will be attained. The central population projection, Series II, embodies an assumption that, ultimately, fertility will be at replacement levels so that the native-born population will not increase in size (starting about the year 2050). The upper population projection, Series I, reflects the pattern that would occur if fertility returned to the high levels of the early sixties; the low population projection, Series III, presents a pattern that leads to a falling population in the next century. By 1995, the size of the younger labor force would be affected by these scenarios, but before then, fertility paths only enter the model as they affect women's labor force participation. Since mothers of young children have been increasing their labor force participation, different patterns of fertility change should make less and less difference as time passes.

The Bureau of the Census Series II population projection was used for the labor force projections. Series II projects an ultimate fertility rate of 2.1 children per women. The current rate of fertility is following the Series II projection well, because the Bureau of the Census projected the fertility rate to drop to below replacement levels before rising in the 1980's. Although there is nothing to indicate that the fertility rate will return to replacement levels in this century, it should be above the Series III level. The selection of a population projection series makes no difference in the labor force projection until after 1992.

Two population estimates were made concurrently with the new round of labor force projections: The civilian noninstitutional population, and the total noninstitutional population. The projection of the civilian noninstitutional population was made in two steps: Estimation of the noninstitutional population, and removal of the Armed Forces. The total noninstitutional population has only the institutional population removed.

The civilian noninstitutional population for each age group, 16 and 17, 18 and 19, 20 to 24, 25 to 29, 70 to 74, 75 and over, was calculated using the ratios of the total noninstitutional population to the total population published with the population estimates.[4] After this, the Armed Forces were subtracted.

Projection of the total and civilian labor force

The total labor force was calculated by multiplying the projected total labor force participation ratios by the Series II population projection; the civilian labor force was projected by subtracting the Armed Forces from the total labor force. Two more labor force rates were calculated: The ratio of the civilian labor force to the projected civilian noninstitutional population, the civilian labor force participation rate; and the ratio of the total labor force to the total noninstitutional population, the total labor force participation rate. Since the labor force participation rates as published for survey data are the ratio of the annual average labor force to the annual population (always with the institutional population removed), the rates were not strictly comparable to the historical data.

At the time the projections were prepared, the goal of the Department of Defense for 1985 was an active duty force of 2,061,000 people: 254,000 women and 1,807,000 men in the Armed Forces by 1985. In order to make the projections consistent with Current Population Survey estimates, it was necessary to include the Coast Guard and reserves on active duty for less than 6 months. To make the labor force projections, it was necessary to have an age-race distribution also. To obtain that, it was assumed that each sex group would

[3]The methodology and assumptions for the most recent Bureau of the Census population projections are in *Current Population Reports*, Series P-25, No. 704 (Bureau of the Census, 1947), pp. 9-11.

[4]*Current Population Reports*, Series P-25, No. 643 (Bureau of the Census, 1977), table A-3.

have the same ethnic-age structure as in 1979, the most recent year for which Bureau of the Census data were available.[5] From 1986 on, the Armed Forces were assumed to have the same age structure as that projected for 1985. With the addition of the Coast Guard and reserves, the Armed Forces would have the following composition (in thousands):

	Both sexes	*Men*	*Women*
1980	2,088	1,910	178
1981	2,099	1,900	199
1982	2,111	1,892	219
1983	2,120	1,885	235
1984	2,125	1,876	249
1985	2,129	1,871	258

Interpreting the projections

If the future labor force could be determined with no error, then only one series would be necessary; this accuracy was not possible. Most users would like an assessment as to the likelihood of the forecast occurring. Given the judgmental aspects involved in making these forecasts, formal confidence intervals could not be constructed. However, four comments should be helpful. First, the three forecasts were made with reasonable assumptions about the future of the labor force. Second, only the high projection has any turning points; it is quite likely that some of the labor force series will indeed change direction. Third, as Theil points out, projections must at some place in their structure hold change constant, whether it is the level of net migration or the rate of change; this has the effect of underestimating the amount of change. Further, as Mincer and Zarnowitz indicate, it is harder to project a rising level of activity.[6] For men, this tendency would overestimate the level of their labor force activity, while the rate and level of women's activity would be underestimated. The relative sizes of the two components of the labor force would be even more poorly projected. Since several groups of both men and women had rates that appeared to be changing at an increasing rate, the problem will likely continue, even if all such phenomena must stop. Finally, examination of several labor force projections and of sensitivity studies of labor force models indicated that the confidence interval was at least as wide as 6 percentage points, which suggested that a crude, but useful, rule of thumb would be to use the unemployment levels and rates for age groups as confidence intervals.

Users should avoid the temptation to use the middle-growth projection simply because it is in the middle. For some purposes, either the high- or low-growth scenarios will prove more useful. The high-growth scenarios will be useful in exploring not only the aspects of faster labor force growth, but also those of convergence of labor force activity rates. The low-growth alternative presents the opportunity to explore aspects of more divergent labor force trends. The way in which the projections were made allows modularity; for example, recombining the high-growth labor force projections for older workers with low-growth projections for other workers. Alternately, under an assumption of competition of male and female labor force activity, the male high-growth scenario could be combined with the female low-growth scenario.

[5] *Current Population Reports, Estimates of the Population, by Age, Sex, and Race: July 1, 1977 to 1979*, P-25, No. 870, 1980.

[6] Henry Theil, *Applied Econometric Forecasting* (Chicago, Rand McNally and Co. 1977), pp. 13-14. Jacob Mincer and Victor Zarnowitz, "The Evaluation of Economic Forecasts," in Jacob Mince, ed., *Economic Forecasts and Expectations: Analyses of Forecasting Behavior and Performance* (New York, National Bureau of Economic Research, Columbia University Press, 1969), pp. 3-46.

Chapter 3. Aggregate Economic Projections

The BLS macroeconomic model provides estimates of growth in the major sectors of the economy that are consistent with all assumptions and conditions of a particular projection scenario. The purpose of the aggregate projections is to provide consistent and integrated control totals for the projected industry purchases that are developed later in the system. Projections for the overall economy are prepared using a modified version of a fiscal policy model first designed and estimated by Lester Thurow in 1969.[7]

The BLS macro model is a relatively small-scale model (approximately 50 equations) whose purpose is to capture the impacts of those factors which affect demand and supply over the medium to long term. The model is structured around a framework in which output produced is balanced with output demanded via income flows. To bring about this balance between supply and demand GNP, the model is structured to respond to fiscal policy changes, which affect the level and distribution of spendable income in the personal and corporate sectors. The following discussion of the model covers its three main areas or blocks: Supply, income, and demand. Although these blocks are treated as separate entities, they are not independent, due to simultaneous solutions in the structure of the model. A fourth block, price/wage determination, is discussed briefly. Major exogenous variables are pointed out as necessary. All of the behavioral equations and major model identities referred to are detailed in appendix B.

The four computational blocks of the macroeconomic model are outlined below. It is important to note that all blocks are solved simultaneously.

A. Supply-side GNP
  1. Aggregate labor force, employment, and average hours
  2. Total hours
  3. Aggregate capital stocks
  4. Gross product originating
  5. Output per hour

B. Income
  1. Corporate sector
    a. Profits
    b. Capital consumption allowances
    c. Corporate profits taxes
    d. Corporate dividends
  2. Personal income
    a. Indirect business taxes
    b. Transfers to persons
    c. Social insurance contributions
    d. Personal taxes
    e. Personal savings

C. Demand-side GNP
  1. Personal consumption expenditures
  2. Gross private domestic investment
    a. Producers' durable equipment
    b. Nonresidential structures
    c. Residential structures
    d. Change in business inventories
  3. Net foreign trade
    a. Exports
    b. Imports
  4. Government
    a. Federal
    b. State and local
      i) Education
      ii) Other

D. Price/wage
  1. Private GNP implicit price deflator
  2. Private compensation per hour

Assumptions of the macro projections

There are 51 variables in the BLS macroeconomic model that are exogenous, or that had to be estimated externally in various ways for the projected periods. From a solution point of view, all exogenous variables are considered assumptions. From a structural approach, however, the exogenous variables must be grouped in three ways. First were those items projected with sophisticated techniques outside the Office of Economic Growth and Employment Projections such as the population projections. Second were items which represented either policy instruments or policy goals. The policy instruments, such as Federal tax rates or Federal employment levels, represent the Federal Government's position at any particular point in time. The policy goals, such as the unemployment rate or the Federal deficit,

[7] Lester C. Thurow, "A Fiscal Policy Model of the United States," *Survey of Current Business*, June 1969, pp. 45-64.

were the result of such measures. Finally, there were those exogenous variables which were assumptions in the narrowest sense; i.e., a judgment as to the probable course of a particular item. An example of this category would be the inflation rate.

When all of these variables were projected and considered as a whole, they presented a picture of the economic conditions assumed for a particular set of projections. All of the projection results were heavily influenced by the initial assumptions required to operate the macro model. These followed from the nature of the scenario or the conditions examined for their effects on employment. Four categories of explicit assumptions were developed for each scenario: Demographic, fiscal policy, price, and productivity assumptions. In addition, certain general goals or guidelines affected the projections process. For example, the effects of rising energy prices and potential energy shortages were considered and were assumed, or expected, to be insufficient to have a significant effect on aggregate economic growth. Foreign trade was assumed to achieve a rough balance over time. And, in balancing supply and demand GNP, there was an attempt to maintain Federal outlays as a percent of GNP at below current rates and approximately to balance budget receipts and expenditures to the extent the scenarios permitted.

Demographic. Demographic assumptions included the projected size of the population and its component groups, such as urban and rural, number of households, and changes in the size of the school-age population. The primary determinants of the demographic assumptions were the current and expected level and age distribution of the population based on the three projected population series.[8] The series II projections were used for the base projections. Projections of the number of households and the number of students were also available from the Bureau of the Census.[9] It was assumed that recent trends in urban population growth would continue throughout the projected period.

Fiscal policy. Fiscal policy included a variety of assumptions about personal and business taxes, Federal purchases of goods and services, Federal transfer payments, grants-in-aid, and subsidies. Federal personal income tax cuts were assumed for the 1980's of sufficient magnitude to offset the impact of inflation on the personal tax rate. The tax rate on corporate profits was assumed to drop moderately, leveling off at 45 percent after 1980. Estimates of contributions for social security programs were based upon the expected taxable wage base and the combined employer/employee tax rate. Federal purchases of goods and services, excluding compensation, were assumed to grow slowly in real terms, increasing at an average of slightly less than 2 percent per year. Federal transfer payments consisted of: (1) Unemployment insurance benefits; (2) social security benefits; (3) Federal civilian employee retirement; (4) railroad retirement; (5) veterans' benefits; (6) hospital and supplementary medical insurance; (7) supplementary security income; and (8) all other Federal transfer payments. Projections of each category were generally based upon expected inflation, changes in the size of client populations, and expected real changes in benefits. For this projection series, all categories were assumed to maintain the same level of real benefits through 1983; after 1983, modest annual increases in real benefits were assumed for each. Grants-in-aid to States and localities and subsidies to Federal Government enterprises were assumed to continue unchanged in real terms.

Price. While price assumptions did not directly affect the determination of real GNP, they did affect the projections in several important ways. First, wage rates and interest rates were influenced to a great extent by price changes. These in turn affected consumption expenditures and residential investment. Second, price changes affected the Federal budget. They entered implicitly into the determination of various expenditure levels, while on the revenue side, they affected personal income taxes because of the progressive tax structure. The movement of prices in the future, of course, could not be adequately projected. Price assumptions used in the projections were judgments that might contain substantial error. For these projections, the inflation rate was assumed to be lower than the average rate since 1973, but above the average for the 20 years preceding 1968.

Productivity and employment. Private nonfarm productivity was assumed to grow slowly during the projected period; above the average for the period 1968-77, but below that for 1955-68. A slow recovery to rates of growth typical of the 1960's was assumed, predicated upon the reversal of some previously depressing factors. Members of the post-World War II baby boom would be more experienced as workers during the 1980's. Also, recent rapid growth in the levels of investment in environmental and energy conservation equipment was expected to slow down by 1985, allowing a greater proportion of investment funds to be spent on more industrially productive plant and equipment.

The moderate labor force projection was adopted for the base case and its alternative, while the higher labor force estimate was used for the high-trend alternative. From these levels, assumptions were then made as to

[8] *Current Population Reports,* Series P-25, No. 704, July 1977 and 1978.

[9] Projections of the number of households were from *Current Population Reports,* Series P-25, No. 607, July 1977 and 1978. School enrollment participation rates by age group were drawn from *Current Population Reports,* Series P-20, No. 278, July 1977 and 1978.

the expected size of the agricultural labor force, the Armed Forces, and the Federal civilian labor force, leaving a residual of private nonfarm labor to be employed. The unemployment rate, treated as a policy objective in the projections, had a major impact on the results. After recovery from the 1980 recession, unemployment was assumed to achieve a stable long-run rate.

The major variables for which explicit assumptions were required in the projected years are:

U.S. population
Urban population
School enrollment
Number of households
Civilian labor force

Unemployment rate
Military employment
Federal civilian employment
Agricultural employment
Private GNP deflector

Farm equipment purchases
Farm structures purchases
Equipment discards
Structures discards
Residential structures discards

Statistical discrepancy
Unemployment insurance contribution rate
Combined social security contribution rate
Social security benefits coverage ratio
3-month Government bill rate

3- to 5-year Government bond rate
Federal gasoline tax
Motor fuel usage
Federal corporate profits tax rate
Exports of goods and services

Federal purchases less compensation
Federal transfer payments
Federal grants to State and local governments
Federal subsidies to enterprises
State and local corporate profits taxes

Transfer payments
Interest payments
Subsidies to enterprises

Supply GNP

The first stage in the model sequence is to determine what the economy can produce. This occurs in the supply block, which is divided between the private and public sectors. These two sectors are defined on a gross product originating basis. That is, all income generated in the private sector is allocated to that sector regardless of which sector consumes the products. Under this definition, the public sector includes only compensation paid to Federal, State, and local general government employees. All other income is assumed by national income accounting conventions to originate in the private sector. Private production is further distributed between farm and nonfarm activities.

The first step in determining private production is to arrive at an estimate of the labor input to the process. In the original version of the Thurow model, there were several behavioral equations specified to determine labor force participation rates for males and females. The current version takes the labor force as exogenous. Labor force projections start with population projections made by the Bureau of the Census. The principal area of uncertainty in these projections is the estimate of the labor force participation rate for women. The unemployment rate of the civilian labor force was set exogenously as a target variable. Thus, civilian employment as a count of persons is determined by multiplying the civilian labor force by the employment rate (equation 1, appendix B).

Employment data at the industry level of detail are available from the monthly BLS survey of business establishments.[10] This survey is a count of jobs, whereas the household survey, which forms the basis for the historical time series on the labor force and unemployment rate, is a count of persons. In order to maintain consistency between aggregate and industry results, equation 2 (appendix B), is used to relate establishment based civilian employment to civilian employment on a persons basis and the unemployment rate. A major difference between the two series arises from individuals who hold more than one job, who would be counted only once in the household survey as being employed, but more than once in the establishment survey. Other differences between the two series have been examined in detail elsewhere.[11] The absolute difference between the two series, termed the conversion factor, tends to increase in recovery periods, as the number of persons holding two or more jobs increases, and to decline in recessionary periods, as the number of these workers declines. The unemployment rate is entered into the equation in an attempt to capture this tendency.

State and local government employment per capita in education and noneducation (equations 3 and 4) are related behaviorally to real purchases of goods and services per capita, and to trends in urban population growth as a proportion of the total population. Pur-

[10] This BLS survey is described in monthly issues of *Employment and Earnings* (Bureau of Labor Statistics).

[11] Gloria P. Green, "Comparing Employment Estimates From Household and Payroll Surveys," *Monthly Labor Review*, December 1969.

chases per capita represent the average demand for State-provided services. This demand is moderated somewhat as the urban population expands due to the more efficient delivery of services in urban areas. Federal civilian employment and private farm employment were exogenous. Deducting these items from civilian jobs yields an estimate of private nonfarm employment in equation 5.

Equations 6 and 7 estimate average annual hours worked in the farm and nonfarm sectors. In both cases, the equations are basically time trends to explain the long-term secular movement of these series, with the unemployment rate entered to account for variations around the trend. In the nonfarm equation, the female labor force participation rate was entered as a proxy for recent increases in part-time workers. Traditionally, women entering the labor market have been more likely to accept part-time work. The continuation of this trend, however, is subject to some question, and the female participation rates must be carefully evaluated in the projection period. Multiplying average annual hours by employment in equations 8 and 9 yields estimates of total hours worked in the farm and nonfarm sectors. Total hours worked in the two sectors are transformed into indexes in equations 10 and 11, and, as such, form the labor inputs to the macro model production relationships.

Capital stock series for farm and nonfarm equipment and structures are derived by identities 12-15. Stock series are maintained as well for residential structures and business inventories (equations 16 and 17). However, these two stock series do not enter the production relationships. Stocks are updated by adding current investment to last year's capital stock and subtracting discards. Five discard series are maintained, all exogenous to the model. The resulting fixed business capital series are then indexed (equations 18 and 19), and these indexes form the capital input to the macro model production relationships.

The final step in calculating private supply GNP is to translate hours worked and capital stocks into a resulting flow of goods and services via a production relationship. Two production functions are used in the macro model, one for the farm sector (equation 20) and the other for the private nonfarm sector (equation 21). In both cases, the functions allow for changing capacity utilization (as indicated by the unemployment rate), the impact of available labor and capital, and disembodied technical progress in the form of a time trend. The capacity utilization term is nonlinear, that is, as employment increases relative to the available labor force, output per hour also increases, but at a diminishing rate. In the original formulation of these relationships, a measure of embodied technical progress for both capital and labor was introduced. Since that time, however, it has been found that the equations estimated without these terms enjoy a slight statistical superiority.

The final step in estimating supply GNP is to arrive at values for gross government product. As was noted earlier, the supply concept of government covers, by convention, only compensation of employees. Four equations are included to arrive at compensation for Federal military, Federal civilian, State and local education, and State and local noneducation employees (equations 22-25). In all four cases, the equations contain terms for the absolute level of employment as well as adjustment factors to account for shifts in the pay structure over time.

The four government compensation estimates are combined with the two private components of GNP to arrive at the supply-side estimate of total real GNP (equations 26 and 27).

Income flows

Unlike the supply side of the model, the income flows are determined in current prices. The income block is divided between corporate and personal incomes. The corporate sector centers around six equations and two identities. First, the gross flow of corporate funds (equation 28), defined as book corporate profits and capital consumption allowances, is estimated as a function of nominal private GNP, capacity utilization, and the relative movements of output prices and labor costs. Second, corporate capital consumption allowances, with (equation 29) and without (equation 30) the capital consumption adjustment, are related to the fixed stock of business capital. Third, Federal corporate profits taxes are determined in equation 31 as a function of corporate profits and the Federal corporate profits tax rate. State and local corporate profits taxes are exogenous.

Corporate dividend payments are derived (equation 32) as a function of lagged dividend payments, reflecting the importance of precedent on this item, and to corporate internal funds net of fixed investment expenditures. Inventory valuation adjustments are related in equation 33 to price change, changes in real business inventories, and to last year's stock of inventories. A dummy variable has been added to reflect the effects of the oil price increases not adequately covered in the private GNP deflator. Identities 34 and 35 are then specified for corporate internal funds and for undistributed corporate profits.

The key to personal income is an identity which expresses personal income as a series of deductions from and additions to GNP as depicted below:

Gross national product
- Less: Corporate and noncorporate capital consumption allowances
- Equals: Net national product
- Less: Indirect business taxes

Business transfer payments
Statistical discrepancy
Plus: Subsidies less current surplus of government enterprises
Equals: National income
Less: Book corporate profits
Social insurance contributions
Plus: Transfer payments
Net interest
Consumer interest
Dividends
Business transfer payments
Equals: Personal income

Noncorporate capital consumption allowances (equation 36) depend upon the housing stock as the principal explanatory variable. The housing stock multiplied by a time trend is used as an additional explanatory variable. Determined in real terms, noncorporate consumption allowances are then converted to current dollars with the capital consumption deflator in equation 37. Federal indirect business taxes (equation 38) are related to private nominal GNP, the Federal tax rate on gasoline, projected motor fuel usage, and a dummy variable for the Korean War period. State indirect business taxes (equation 39) are related to major State-funded expenditures, that is, purchases of goods and services and transfer payments less grants-in-aid from the Federal Government. Business transfer payments, the statistical discrepancy, and subsidies to Federal and State government enterprises are exogenous.

Federal interest payments are determined in equation 40 as a function of the 3- to 5-year Government bond rate, times a proxy for the Federal debt. The proxy is constructed from the 1954 value of public issues of marketable bills, bonds, and notes, incremented by the value of the Federal deficit (+) or surplus (—) in each succeeding year. State and local interest payments are exogenous.

Social insurance contributions are determined by four equations and one identity. The major determining variable in three of the equations is compensation adjusted for employer contributions for social insurance. Therefore, equation 41 relates the employer share of social insurance contributions to total contributions. Following this determination are three equations (equations 42-44) for the following types of contributions: (1) Unemployment insurance funds, (2) social security funds, and (3) all State and local government social insurance funds. The unemployment fund contributions are determined as a function of adjusted compensation and the exogenous average employer contribution rate for this category of social insurance. Social security contributions are related to the adjusted level of compensation, the wage base, social security coverage, and the combined employer/employee tax rate. The tax rate and coverage ratio are exogenous as is the wage base in the historical period. In the projection period, however, attempts have been made to relate the wage base to changes in nominal average compensation, lagged two periods. State insurance funds are related to adjusted compensation of State employees only. All other contributions to Federal programs, such as Federal civilian employee retirement funds, are exogenous. An identity is introduced at this point summing the four types of contributions to arrive at the total level of social insurance contributions (equation 45).

Interest paid by consumers is determined in equation 46 by the level of personal income and the yield on 3-month Government bills. Combining all of these items in equation 47 yield the estimate for personal income.

Median family income (equation 48) is a function of the employment rate, GNP per worker, and the share of GNP going to personal income. Federal personal taxes depend upon the level of personal income in equation 49. Progressivity is built into the equation by including the average tax rate on median family income. State and local personal taxes (equation 50) are a function of personal income, lagged taxes, and a time trend. Deducting personal taxes from personal income (equation 51) yields an estimate of disposable personal income. Personal savings are related to the level of disposable income, medium-term interest rates, and the inflation rate in equation 52. Aggregate personal consumption expenditures are determined by an identity in equation 53.

Demand GNP

There are currently three equations (equations 54-56) in the model for personal consumption expenditures. The durable goods equation depends upon total personal consumption as an income proxy as well as the unemployment rate, the previous year's residential investment, the change in real disposable income, and a proxy for consumer debt burden. Nondurable goods purchases are related to total consumption, the debt burden, and the unemployment rate. Consumption of services is a function of total consumption, the unemployment rate, and the stock of residential structures.

There are four equations for investment (equations 57-60). Nonfarm equipment purchases depend upon private nonfarm GNP, the internal flow of funds available for investment, the existing stock of equipment, and the interaction between capacity utilization and profitability as measured by the previous year's ratio of internal funds to the capital stock. Nonfarm structures purchases are related to private nonfarm GNP and the previous year's investment in structures. Farm purchases of equipment and structures are exogenous.

The equation for changes in the stock of business inventories is not formulated to capture short-run fluctuations in inventories. Rather, it represents an attempt to estimate desired inventory changes by means of a stock-adjustment process, modified to allow for a time trend and a nonlinear capacity utilization variable.

Investment in residential structures depends upon the number of households, medium-term interest rates, and real disposable income per household. This latter variable is included to take account of increasing family incomes which are not necessarily reflected on a per capita basis.

Imports of goods and services are determined in equation 61 by real incomes, relative prices, lagged imports, and a capacity-pressure variable based upon the spread between potential and actual GNP. This particular variable has an accelerator impact on imports. That is, as the actual/potential GNP ratio moves away from its long-run average, the impact on imports increases at an increasing rate.

Purchases of goods and services by the Federal Government are determined by an identity given in equation 62. Compensation, determined in the supply block, is added to exogenous goods purchases to arrive at this figure. State and local purchases are determined by equations for the education (equation 63) and noneducation (equation 64) sectors. Noneducation purchases are related to private GNP, Federal grants-in-aid for noneducational uses, and the unemployment rate. Education purchases are determined as a function of private GNP, Federal education grants, and school enrollments.

Price/wage sector

As was previously noted, the supply and demand blocks of the BLS macro model are determined in constant prices, whereas the income side is expressed in current prices. In the original formulation of the model, the movement between real and nominal prices was accomplished with a set of exogenously specified deflators. The price/wage sector has been added to insure internal consistency between price and wage determination and to determine the rate of inflation within the model.[12]

There are two major equations and four identities in this sector of the model. The price equation (equation 65) determines the implicit deflator for private GNP as a markup on unit labor costs and crude materials prices. The unemployment rate is also included. The percent change in private compensation per hour (equation 66) is, in turn, a function of private productivity, prices, and the unemloyment rate. Equations 67-70 are identities for private compensation per hour, private compensation, unit labor costs, and the spread between price change and wage change. Equations 71-79 are derivations of other deflators as a function of the private GNP deflator. Finally, equation 80 is an identity for the total GNP deflator as a weighted sum of the various demand component deflators.

Balancing the macro model

Summation of the derived real components of demand in equation 81 yields the demand-side estimate of GNP. The demand- and supply-side estimates of GNP ordinarily will not agree, and the magnitude of such an imbalance is represented by equation 82. A positive sign for the gap represents a situation of excess supply, while a negative sign indicates excess demand. Although the sum of disposable incomes for all of the sectors necessarily equals the estimate of the GNP, demand for GNP will fall short of or exceed the supply of GNP unless the total purchases of the various sectors happen to equal their combined incomes.

The gap between supply and demand GNP depends in part on the government policies incorporated in the model. If there is a gap, this implies that the target rate of unemployment cannot be achieved with the existing fiscal assumptions. Thus, the various policy instruments in the model are modified to effect a balance between supply and demand. Many combinations of policies are possible, and a final choice is made on the basis of many considerations that are outside the model.

Solving the macro model

The solution of the model is somewhat different from the foregoing discussion of behavioral relationships and identities. In order to facilitate solution, equations are arranged by block, where equations within a block are simultaneous. Initial estimates of the key block results are provided and iterative solution techniques are applied to refine the initial solution until the model arrives at a consistent solution.

[12] Richard C. Barth, "The Development of Wage and Price Relationships for a Long-Term Econometric Model," *Survey of Current Business*, August 1972, pp. 15-20.

Chapter 4. Final Demand Projections

Gross national product is the final output of the economy measured from the demand side, or the output of the economy distributed among its final users. Final users are broadly categorized as persons, businesses, governments, and foreign. Final demand consists of the purchases made by these groups, or the purchases of the demand sectors of GNP. Final demand projections involved estimating the future purchases of each demand sector, by industry of origin. For the 1990 projections, the economy was disaggregated into 156 different industries. These industries define the bills of goods, or lists of purchases, prepared for each final demand sector. The output of the macro model provided control totals for each final demand sector. The first step in projecting distributions of purchases for each sector was to develop data series for the purchases each made in past years. The years studied were primarily years for which the Department of Commerce published input-output studies (1958, 1963, 1967, and 1972);[13] 1972 became a base year for the projections. In addition, many data series were available through 1979, providing recent trends. These historical data were used with a variety of techniques and submodels to project purchases.

Assumptions

Various assumptions underlay projections of the detailed purchases of the final demand sectors. In general, these assumptions followed the conditions of the scenarios being examined; major changes expected in the magnitude and nature of the activities of each demand sector; and in some cases, changes in the demand, price, and availability of particular products. While assumptions were developed primarily for functional levels of demand sectors, such as education or space, they were also used for important industry sectors, as in the case of energy costs and availability. Prior to making the detailed projections of purchases, assumptions for each scenario were developed.

Major functional areas were considered first. For example, the recent history of health care was examined for trends, and various current proposals for change were considered. Since the classification of health purchases is different for private and public buyers, the extent of increased Federal Government participation through 1990 had to be examined. Since information at the time was limited, it was assumed that Federal Government participation would increase slightly, but that no comprehensive national program would be adopted by 1990. Further, the extent to which medical purchases would continue to be influenced by new technologies had to be considered. Educational purchases, as a total, were assumed to vary with fluctuations in the size of the school-age population. During the projected period, the size of the school-age population was expected to decline, but the post-World War II baby boom members would be entering childbearing age. The possibility of the private sector increasing its share of school expenditures, relative to the public share, also had to be evaluated. In addition, the impact of increasing energy costs and shortages on purchases of different types of transportation services was considered, with various assumptions developed dealing with investment in mass transit, railroads, and highways. Levels of defense and space outlays were based on assumptions made about international conditions and the rate of space exploration.

Product purchases were considered in certain cases. Purchases of ordnance were based upon assumptions about defense replacement requirements and U.S. policies on military sales to foreign governments. Aircraft purchases were heavily influenced by defense assumptions, expected foreign military sales, and airline investments. Energy was the principal area where assumptions were made on a product level. Energy assumptions in the projections were based, in general, on forecasts prepared by the Department of Energy which were primarily forecasts of the total use of energy by type of fuel. These projections provided the basis for estimating the output levels of domestic energy industries. In some cases, estimates were also available on consumption by particular demand sector. In other cases, energy purchases by final demand sector were estimated using past trends, constrained by the projected total use of each type of energy. In general, it was assumed that the prices of natural gas and oil would increase more rapidly than the prices of coal and elec-

[13] *The Input-Output Structure of the United States, 1958*; *1963*; *1967*; and *1972* (U.S. Department of Commerce, Bureau of Economic Analysis).

tricity. Coal and electricity were assumed to be more readily available through 1990.

Personal consumption expenditures

Personal consumption expenditures (PCE) are the value of all consumer goods and services purchased by individuals and other nonprofit institutions. Purchases of dwellings are not included, although the rental value of owner-occupied dwellings is imputed to consumption outlays.

The distribution of PCE to producing industries was accomplished in two major steps. After total consumption was determined by the BLS macroeconometric model, the first step was to project consumption, by type of expenditure, for 12 major product groups defined by the Department of Commerce: (1) Food and tobacco; (2) clothing, accessories, and jewelry; (3) personal care; (4) housing; (5) household operation; (6) medical care expenses; (7) personal business; (8) transportation; (9) recreation; (10) private education and research; (11) religious and welfare activities; and (12) foreign travel and other, net. These 12 major product groups were summed up and then scaled to the projected total consumption controls of the macro model. Next, using these 12 product groups, a set of 82 lower level product categories, defined by the Department of Commerce as well, were projected. These 82 detailed product categories were also forced and scaled to sum to their appropriate 12 aggregate controls. Historical data for each of these categories were available from the Department of Commerce as part of the National Income and Product Accounts.[14] These data were used to develop two sets of behavioral equations to project the 12 major product groups and the 82 detailed product categories.

The second step was to distribute these 82 product expenditures to the producing industries. This task was accomplished with the use of projected "bridge" tables or matrices which distributed each of these 82 categories to its component industries as well as to the transportation, insurance, and trade industries. The result was the PCE bills of goods, the largest component of final demand.

Input-output tables constructed by the Department of Commerce exist for the years 1958, 1963, 1967, and 1972.[15] Each input-output table has an associated PCE bridge table which distributes expenditures for the 82 products. Each product was assigned to one or more of the Bureau of Economic Analysis (BEA) 496 sectors or industries. The BEA estimates these products for each year and benchmarks them to new bridge tables as they become available.

[14] *Survey of Current Business*, July issues, tables 2.4 and 2.5.

[15] *The Input-Output Structure of the United States, 1958*; *1963*; *1967*; and *1972* (Bureau of Economic Analysis).

Product projections. A consumption submodel was used to project the 12 major product groups as well as the 82 detailed product categories. This model, which related consumer expenditures primarily to income and prices, was originally developed by Houthakker-Taylor,[16] with the 1958 constant-dollar data from 1929 to 1964, used to estimate a set of 82 product expenditure categories. Total PCE and the annual change in PCE are primary variables used as a proxy for disposable income. PCE has a high level of explanatory power in these equations. Relative prices, which were calculated as the implicit price deflator for that good or service divided by the implicit price deflator for total PCE, were also used extensively. The lag structure of the equations allowed changes in explanatory variables to be distributed over time.

For these projections, 1947-78 data, in 1972 constant dollars, were used to reestimate real consumption expenditures for the 12 major groups and the 82 detailed categories. It was assumed that consumer decisions are based on a bundle of goods and services purchased simultaneously rather than on purchasing one good or one service at a time. Based upon this expenditure concept, a set of 12 major product equations was simulated first over the projection period, using preliminary total PCE controls from the macro model. For these projections, the macro model prepared three alternative forecasts of trend growth, differing primarily in the assumed labor force growth, unemployment rates, inflation rates, and production levels. Thus, total PCE controls in the alternative forecasts were provided by the macro model. The lagged value of the particular product equation, disposable personal income obtained from the macro model, and relative prices[17] were primary determinants in these equations. Additionally, with regard to the influence of other factors on consumption, the gross stocks

[16] H. S. Houthakker and L. D. Taylor, *Consumer Demand in the U.S.: Analyses and Projections* (Cambridge, Mass., Harvard University Press, 1970).

[17] The price model assumed a markup specification; the input costs, such as labor and energy, were marked up to yield final product prices. This is naive in that it is not based on any particular formation. A specification equation is formed as follows:

$$p_t = AO + A1(\text{time}) + A2(\text{unit labor costs})_{t-1} + A3(\text{energy prices})_{t-1}$$

where p_t = implicit price deflator in year t of the good, 1972 = 100
time = time trend, 1945 = 1
unit labor costs_t = unit labor costs, private business economy, in year t
energy prices_t = producer price index of fuels and related products,
and power in year t, 1967 = 100

The price equation is essential, not in itself, but as a vehicle to close the consumption model. Time series data for the explanatory variables–unit labor costs and energy prices, both historical and projected period–were provided by the macro model.

of durable goods[18] and demographic variables[19] were also introduced into these equations. For example, the stock of television sets was found to be an important determinant in the recreation group, and the population 18-34 age group was found to be important in explaining the expenditures in the household operation group.

Using time series data, the estimation of the specification regression occurred at the product level. One of two estimation techniques was used—either the Cochrane-Orcutt or nonlinear least squares. The results were evaluated from the economic and statistical points of view. If the regression coefficients either had an economically incorrect sign or were statistically insignificant, the respective variables were dropped from the estimated equation. For these 12 major product equations, the income coefficients were statistically significant and had a positive value for 11 of the 12; the price coefficients were significant and had a negative sign for 10 of the 12; the coefficients of the gross stocks of durable goods were significant and had a negative value in 2 equations; and the coefficients of the demographic variable were significant in 6 equations.

As mentioned above, the sum of the projected 12 major product groups was brought into balance with macro consumption totals by allocating the difference to groups according to their weighted average values.

After the 12 subtotals were forecast, the 82 detailed equations were projected by using their appropriate subtotal PCE controls, their relative prices (derived in the same manner), and the lagged value of the particular individual good or service, also, the gross stocks of durable goods were introduced into those 11 durable goods equations. Due to time limitations, demographic variables were not used in the 82 product categories. Using the same estimation techniques to estimate these 82 detailed products, the income coefficients were statistically significant and had a positive sign for 72 of the 82; the price coefficients were significant and had a negative sign for 65 of the 82; and the coefficients were significant and had a negative sign for 7 of the 11 durable goods equations. Finally, the 82 product equations were aggregated to their appropriate 12 major groups and were balanced with their corresponding subtotals by scaling the difference to categories according to their weighted average values. A complete PCE variable list and all of the behavioral equations, both consumption and price, are given in appendix C.

Industry projections. The 82 product expenditure categories were transformed to a set of final demands consistent with the input-output framework. Each of these 82 categories was made up of many types of goods and services, produced by different industries. A bridge table or matrix was used to transform the product forecasts into the 156 industries used in the projections.

A bridge table distributes the 82 product categories to their component goods and services and to the margin industries; i.e., wholesale and retail trade margin and transportation costs. The products are expressed in purchasers' values, while the bills of goods or the producing industries are expressed in producers' values. The difference is the cost added to a particular industry's output in getting that output from the point of production to the consumer, including transportation costs (railroad, truck, water, air, and pipe- line costs), insurance costs (for imports only), and wholesale and retail trade markups. The bridge table accomplishes two tasks at once—it allocates each of the 82 product categories to its producing industries, and removes the transportation and trade margins from the product and allocates them accordingly.

Bridge tables were developed by the BEA for all input-output years. Thus, at the time these projections were prepared, data were available for 1958, 1963, 1967, and 1972. Each bridge table had been prepared in current dollars. For this project, the 1963 and 1967 tables were reestimated in 1972 constant dollars and readjusted based on the 1972 Standard Industrial Classification (SIC). Also, the 1963 and 1967 tables were further modified in the way imports were handled.[20] First, imports were valued at domestic port value instead of foreign port value, decreasing the margin entries by the amount of margins associated with transporting the goods between the foreign and domestic ports and increasing the producers' value by an appropriate amount. Second, imports were assigned to the relevant domestic industry based on the nature of the product. For the 1972 bridge table, except for those noncomparable imports, all of the comparable imports were already val-

[18] The gross stock of durable goods is identified as:

$$\text{stock}_t = \text{stock}_{t-1} + \text{investment}_t - \text{discard}_t$$
$$\text{where discard}_t = AO + A1(\text{time}) + A2(\text{stock})_{t-1}$$
$$\text{and investment}_t = AO + A1(\text{consumption expenditures})_t$$

The annual data for investment in durable goods are made available by the Bureau of Economic Analysis in the form of worksheets, while the gross stock of durable goods appears in John C. Musgrave, "Durable Goods Owned by Consumers in the United States, 1925–77," *Survey of Current Business,* March 1979, pp. 17-25.

[19] The ratio of population age group 18-34 to the age group 16 and over was chosen in the consumption model. Annual historical data and projected data were obtained from the Bureau of the Census population estimates or the BLS macro model data base.

[20] The treatment of foreign trade was changed in these projections to yield domestic rather than total output. Imports that were competitive were subtracted from final demand by industry. Previously, imports were treated as a single, negative value in the export bill of goods. For more information, see the section on foreign trade in this chapter.

ued at domestic port value by the BEA; therefore, no further adjustment was needed.[21]

The 1972 bridge table was used as an initial estimate of the projected bridge tables. However, feedback from the final demand-output review required extensive work for some of these 82 products, especially for the product of "food for off-premise consumption," changing their relationships among industries producing these goods and services, as well as the margin industries in the projected years. In total, changes were made for 38 of the 82 categories, of which 13 were changed substantially and the rest only marginally for three alternative forecast versions.

Gross private domestic investment

Gross private domestic investment is composed of fixed investment and the change in business inventories. Fixed investment represents purchases of durable equipment and structures by both business and nonprofit institutions along with residential investment. Change in business inventories represents the value of the increase or decrease in raw materials, semifinished goods, and finished goods held by business. In projecting the industrial composition of investment demand, four categories were considered: (1) Residential construction, (2) nonresidential construction, (3) producers' durable equipment, and (4) change in business inventories. Control totals for each of these categories were derived from the BLS macroeconometric model and then allocated to producing industries.

Historical data series for each of the components of investment were developed. For residential structures, a detailed series from 1958 to 1979 was developed from data from the national income accounts. These data showed the movement of the detailed types of residential construction, such as single-family homes, multifamily units, and additions and alterations. For nonresidential structures, detailed data from the national income accounts showed expenditures for various types of construction, such as religious buildings, telephone and telegraph facilities, and farm buildings. In some cases, these detailed series had to be disaggregated using factors developed for input-output years to show trends for the more detailed types of construction. The data were then aggregated to the level of detail used in the Economic Growth industry model. These data series were developed in both current and constant (1972) dollars.

[21] The BEA's latest 1972 input-output tables were used in their present benchmark revision. However, during these projections, the revised estimates of the National Income and Product Accounts were only available for 1972. The changes of rate between the revised PCE and the previously published PCE for 1972 were weighted by each of the 82 product levels, and these weights were carried over by products in the projection period.

The development of historical bills of goods for producers durable equipment (PDE) involved two approaches that provided a check on the consistency of the data base from which the projections were made. The first approach studied the growth of demand in equipment over time. Annually, the national income accounts show PDE distributed among 24 major categories such as agricultural machinery, construction machinery, communication equipment, etc. Each of the 24 categories was in purchaser prices and contained a varying number of supplying industries. For the years for which input-output tables were prepared (I-0 years), bridge tables were available which allocated each of these 24 categories to the margin and the supplying industries. Bridge tables for non-I-0 years were constructed by interpolation to provide annual PDE bills of goods for the period 1958 to 1979.

The second approach made use of the assumption that an industry's investment was a function of its output. The *Annual Survey of Manufactures* and *the Census of Manufactures* are the sources for equipment investment for the historical period. For I-O years, capital flows tables are available which allocate the total investment of each industry to the supplying industries, thus, producing a PDE bill of goods. Bills of goods derived by these two approaches can be compared to spotlight changes that are occurring in the bridge table and the capital flows matrix.

To make PDE projections, both investment output ratios and capital flows were projected based on the historical trends they have demonstrated. Projected output by industry was first derived, then the projected investment output ratios were applied to derive the level of investment by each industry. This level of investment was run through a capital flows table giving a PDE bill of goods. This investment in total was made to equal total PDE as derived from the macro model runs. Obviously, changes in the distribution of PDE by industry changed the output level of each industry which caused a further change in the required investment. Adjustments were made repeatedly to the PDE column until PDE demand in each industry equaled the level of investment that was actually required by the distribution of output.

The handling of the business structures and residential new construction was different from the BEA input-output and past construction procedures. Previously, the inputs into the construction industries were shown in the body of the table; total construction final demands were shown in the gross private fixed investment and the government bills of goods. The output of the construction industry equals the final demand of this industry since there is no intermediate demand; i.e., there are no values in the row of the construction industry representing sales to other industries since construction does not contribute material inputs to the production process. The new construction industries were removed from the table and were placed in final demand columns composed of the materials and services purchased by the new construction industries with value added appearing as a new industry; i.e., the construction industry. The purchases of new construction on the part of the Federal and the State and local governments were included also in the bills of goods as direct purchase of the inputs. In order to derive the construction bills of goods, the input columns from historical tables were removed and made final demand columns. For the projected period, changes that could be expected in the input structure were incorporated in the projected bills of goods.

Historical data for the inventory change bill of goods are available only for the I-0 years. Input-output conventions allocate inventory change to the producing industry, no matter which industry held it. Using Census and *Annual Survey of Manufactures* data, inventory-to-shipments ratios for historical periods were derived and benchmarked to input-output conventions. These inventory-to-shipments ratios were projected and applied to projected outputs giving a change in inventory bills of goods.

Investment in equipment is allocated to many different manufacturing sectors, as well as to the trade and transportation sectors. In some cases, services which are capitalized on a firm's books are also included as equipment purchases. Types of equipment range from mining, construction, and oil-field machinery to amusement park equipment, computers, and office machinery.

The change in business inventories is very different from the other components of investment. There are entries, either negative or positive, in almost every industry except construction and services. The relative importance of any entry can change greatly from year to year. Detailed bills of goods are available only in I-0 years.

Initial estimates of the projected bills of goods for structures were made at the level of the most detailed historical data based on past relationships. Data from 1958 to 1979 were used to project the movement of these detailed categories into the future. These individual projections were aggregated and evaluated against the projected controls obtained from the macro model. Changes were made as necessary to the detailed projections until they added to the control totals. These estimates, along with estimates of the other final demand bills of goods, were used to generate initial estimates of output by industry. Capital flows tables, which allocate purchases of structures and equipment by type, along with investment-output ratios, which relate an industry's investment to its total output, were estimated for the projected years based on historical data. The projected investment-output ratios, capital flows tables, and outputs were used to create a bill of goods for structures to be checked for consistency with the initially projected construction vector. Changes were made as necessary to get a consistent set of tables, investment-output ratios, and projected bills of goods. The use of a capital flows approach allowed changes in industry outputs to change the investment of the industries.

Investment in equipment, like investment in plant construction, was projected by relating it to the output of the industries producing goods and services for sale to other industries and to final demand. Most industries require a wide variety of investment goods, and industries producing investment goods sell equipment to a variety of users. As a result, comparing the types of investment goods required against the initial estimates of equipment types produced was a complex process.

Initially, producers' durable equipment was projected for detailed industries based on historical trends. As in the case of nonresidential structures, these estimates were used to generate initial estimates of output by industry. At this point in the projection sequence, there was no assurance that the initial estimates of types of equipment produced were consistent with the types of investment goods required by the generated outputs. As with the nonresidential structures component of investment, investment-output ratios and capital flows tables were projected, which, with the generated outputs, allowed a check of the consistency of those projections. The projected capital flows tables, investment-output ratios, and initial bills of goods were adjusted until they were consistent. The capital flows table allowed changes in industry output to be reflected in the investment bills of goods.

Projections of net inventory change by producing industry were based primarily on projected industry outputs. A constant percentage of output for each industry was used as an initial estimate of the bill of goods. Industries which had a perishable product were adjusted to be more in line with past levels. The initial projections were modified as necessary in later stages in the projection process. Less effort was expended on the allocation of net inventory change to the producing industries since this item is relatively unimportant in long-run projections.

Foreign trade

Net exports represent the value of total exports of goods and services less the value of total imports of goods and services. Exports and imports are handled separately in the input-output system and are netted out only at a final stage to present a conceptually consistent level of GNP.

Unlike other sectors of final demand, historical data on foreign trade are plentiful and detailed. Instead of problems of disaggregation and estimation, foreign trade data must be compiled or aggregated into the input-output industry sectors. Data on both exports and imports can be obtained from the detailed merchandise trade statistics published annually by the Bureau of the Census. For exports, this included SIC product codes and schedule B commodity codes. For imports, data were available by SIC-based product codes and by special U.S. tariff schedule codes. Data requirements after aggregation involved modification and augmentation to reflect balance-of-payments and input-output conventions.

Although exports are treated the same as any other component of final demand in the input-output system, imports require a unique treatment. Total imports are projected by an equation in the macroeconometric model. This total is divided into two categories in the input-output system. The first category consists of all imports by final users, as well as intermediate imports, which are competitive with domestic products. The second category consists of intermediate imports which have no domestic counterparts, such as coffee and diamonds.

In the input-output system, this first category of imports is shown as a negative column of demand; that is, subtracted from final demand in order to yield demand for domestic output rather than total output for each industry. Automobiles are a good example of imports not subject to further processing. Intermediate and final demand for automobiles includes some share that is met by foreign producers. By subtracting the value of foreign automobiles from total demand for autos, the demand for domestic automobiles is derived. As this is done for every industry for which there are competitive imports, the result is a demand for domestic goods which, when applied to the coefficients of the input-output table, produces estimates of domestic, rather than total, output by industry.

The projection of competitive imports by industry was mainly based on analysis of existing and expected shares of the domestic market. Trade agreements which might restrict imports were also taken into account.

The second category of imports encompasses intermediate products that have no domestic substitutes in the sense that they cannot be replaced by domestic items in existing production processes without altering the nature of the product. These imports are directly allocated to the industries which use them in their production processes. Thus, coffee, which is not produced in the United States, is directly allocated to the food products industry where it is ground, blended, and packaged before being allocated to the personal consumption expenditure category of final demand. Once the intermediate, noncompetitive imports are allocated to the user industries, they are transformed into coefficients. The coefficients are then projected in much the same way as domestic coefficients in the input-output table.

After imports were initially projected, the level of exports was set so as to reach a nearly zero current-dollar trade balance in the projected years, an assumption or policy target. The value of total exports was distributed by industry, primarily on the basis of time trends and expected world conditions. It was necessary to rely on simple forecasting techniques to project exports by industry because long-term estimates of foreign income and prices were not widely available.

Industry projections. For most industries, the foreign trade projections relied on an analysis of the trends of imports and exports as shares of total output. The ratios for 1963, 1967, 1972, and, for merchandise trade, 1977 were compared, and the trend carried out to 1985 and 1990. The ratios were applied initially to estimates of 1985 and 1990 output to compute imports and exports. The industry levels of imports and exports were added and scaled to the total values of the macro model.

The results were sometimes modified based on a comparison with previous BLS projections of imports and exports. Where the previous projections relied on special analysis or special trade agreements that were still in effect, these were taken into account. A detailed discussion of the assumptions of the previous foreign trade projections is available in an earlier bulletin.[22]

For most industries, it was assumed that the ratios of imports and exports to output would continue to change according to past trends. One exception was the motor vehicle industry. Imports of all cars, trucks, buses, vans, and spare automotive parts have grown substantially as a share of the total output of these items purchased in the United States. This rise was assumed to continue through the early part of the 1980's as the auto industry struggles to recover from the 1980 recession. In the latter part of the decade, however, the import share was projected to stabilize. This was expected to occur as the result of two trends: (1) American cars would begin to compete effectively with gas-economizing imports; and (2) more foreign automakers would set up factories in the United States.

Specific assumptions were also made for the energy industries. To the degree possible, these assumptions were based on the midprice scenario in the *1979 Annual Report to the Congress* of the Department of Energy in June 1980. It assumed that crude oil nominal prices would rise from $31.37 a barrel in 1979 to $51.14 in 1985 and to $81.33 in 1990. The Department of Energy's projected rates of growth for domestic output and imports under these price conditions were applied to BLS historical data to derive the 1985 and 1990 levels

[22] *Methodology for Projections of Industry Employment to* 1990, Bulletin 2036 (Bureau of Labor Statistics, February 1980).

of domestic production of various types of energy and the level of oil imports.

Oil imports were assumed by the Department of Energy to be cut back drastically in the 1980's in the United States and other industrialized nations, reflecting the assumption that high prices and uncertain supply would force conservation and a shift to other energy sources. The principal alternative energy source was assumed to be coal—coal production and coal exports were projected to rise dramatically in the upcoming decade.

State and local government

State and local government demand is defined as the purchases of goods and services by all State and local government units. Purchases include the compensation paid to State and local government employees as well as all purchases of goods and services. Purchases of these units are less than total expenditures, which also include transfer payments to persons, such as welfare benefits and interest and subsidy payments. State and local government purchases are separated by type of function for analytical purposes. Major categories used were education, health, welfare and sanitation, public safety, and all other. Each of these functional categories was further distributed to a total of 20 different sublevels. Each of the 20 was further divided into employment, compensation, construction, and an all other purchases category.

The projection of State and local government purchases started with the overall control totals for purchases projected by the macroeconomic model. These levels were then distributed to 20 different State and local government functions using both a State and local government model and historical data trends. Historical data on 20 State and local government functions are maintained by BEA, broken out by compensation, construction, and all other purchases. These levels were projected based upon trends and special studies as well as by use of the State and local model. The results of the macro model and the two functional projection approaches were compared and reconciled to provide acceptable levels for each of the 20 functions and their components. The "all other purchases" component for each of the 20 functions was allocated to individual industries by projecting historical distribution patterns for the functions developed by BEA.

The macroeconomic model estimates of projected State and local government purchases were consistent with all macro assumptions and estimates, including grants-in-aid. This model provides a purchase total for each projected year, with subtotals for education and for all other functions as a group. Both of these categories are divided into compensation and all other purchases.

The State and local government model predicts expenditures and employment in current dollars for 20 functions. These functions are projected based upon Census and BEA data by calendar year. They include: (1) Elementary and secondary education, (2) higher education, (3) other education, (4) libraries, (5) highways, (6) health, (7) hospitals, (8) sewerage, (9) public utilities, (10) natural resources, (11) corrections, (12) police, (13) fire, (14) sanitation, (15) public welfare, (16) local parks and recreation, (17) general government, (18) other government enterprises, (19) public housing, and (20) water and air terminals. The model structure was based upon data for the years 1960-73. Equations for each function were first estimated for expenditures and employment. Expenditures in the model are in current dollars and apply to all outlays, not just purchases of goods and services. Another set of equations was used to convert expenditures to purchases and compensation. A final set of equations was used to convert purchases to constant dollars. Employment was estimated in full-time equivalent units. The model is driven by four major groups of variables: Growth in personal income; demographic data; grants-in-aid; and an "all other" category that included interest rates, prices, and unemployment rates.

BEA data also provided a basis for projecting functional State and local government purchases. Purchase data are available annually that can be compiled into 20 different functions. These include four educational functions: Elementary and secondary education, higher education, libraries, and other education. There are five health, welfare, and sanitation functions: Health, hospitals, sewers, sanitation, and welfare. Three functions are included in safety: Police, fire, and corrections. Other functions include: General government, highways, natural resources, parks and recreation, water and air terminals, public housing, public utilities, and other enterprises. These functional categories were initially projected based upon historical trends and expected changes.

The next step in the projections procedure was to reconcile the results of the macro model, the State and local model, and the projections of the functional BEA data base. Employment projections from the State and local model were converted to compensation in the desired format. Compensation was adjusted to agree with the macro model controls. Construction purchases were obtained by estimating the proportion of capital expenditures that were equal to new and used construction purchases by function. The results were extrapolated toward the projection years. As with total purchases and compensation, construction purchases were converted to constant dollars and calendar years. Ultimately, control totals were determined for the 20 functions for compensation, construction, and other purchases which were compatible with the controls provided by the macro model for education and noneducation.

These levels of functional purchases were distributed to the purchases projected to be made from 156 different industry sectors. This was accomplished by projecting base-period purchases for each function. Detailed purchase data by function were obtained from BEA worksheets for 1963, 1967, and 1972. These years provided a limited basis for projecting detailed industry purchases. The projections of purchases for each function were examined by annual rate of change and changes in the distribution pattern by industry. Where changes in a projected year seemed extreme, the projections were reexamined and revised if necessary.

Federal Government

The Federal sector consists of purchases of goods and services and of compensation paid by the Federal Government. Purchases are a major part of total Federal expenditures, which also include grants, transfers, and net interest. On the demand side of the national income and product accounts, the Federal sector is divided into the major components of defense and nondefense, which are further split into purchases of goods and services and compensation of military and civilian employees, all in current dollars. In constant dollars, however, only purchases of goods and services and compensation for the Federal sector in total are available. For these projections, the defense sector was disaggregated into two subsectors: Defense nuclear activities and other defense purchases. In addition, foreign military sales were examined and projected. The nondefense sector was disaggregated into four subsectors: Nondefense nuclear activities, National Aeronautics and Space Administration, Veterans Hospital medical care, and other nondefense purchases.

Federal purchases were projected on the basis of historical purchase patterns, expected changes, and assumptions and expectations of Government priorities in the future. Principal data sources were the Department of Commerce input-output studies and various unpublished records of agency purchases. Employment data were obtained from Office of Personnel Management reports, BLS data, and the U.S Budget appendixes. Construction data were obtained from a Department of Commerce series. As with other sectors, projected levels of total purchases were derived from the macro model. These were first broken down by functional activities, and then projected to industry purchases.

The macro model levels of projected Federal purchases were established exogenously in the process of balancing supply and demand GNP. This model provides values for total purchases, total compensation of military and civilian employees, as well as the number of civilian and military employees. The levels were established to insure consistency with overall projection assumptions. Assumptions were of major importance in the Federal sector since, in many cases, past experience was not useful for projection. For example, the projections have always assumed peaceful conditions without international tensions. A contrary assumption of war would result in unpredictably larger Federal purchases and a much larger defense share.

Regression equations were used to derive the total purchases of the six subfunctions. These were modified based upon expected program levels in the case of defense and space. The six subfunctions were modified until they came to the established macro totals. Real compensation was also derived for each subfunction using regression equations. Historical data for defense and nondefense new construction from 1952 to 1979 were used to derive regression equations to project purchases from the six new construction industries for each major component of the Federal sector; these two values were then allocated to the six subfunctions based on historical trends. (See preceding discussion on investment in structures regarding the handling of new construction in the Government account.)

Purchases, excluding compensation and new construction, for each of the six subsectors were distributed to the industries which composed the remainder of the economy. These distributions were made largely on the basis of historical data. Historical bills of goods were available for certain years for the defense, space, and nondefense sectors. These were examined for trend changes and for purchasing patterns in years with conditions similar to those assumed for the projected years. Industry data for recent years, available from the Bureau of the Census, were of particular importance.

Data for recent years from the Bureau of the Census and agency records provided recent trends. Trend data were modified based upon expected program changes, particularly for defense and space. Bills of goods were projected for each of the six subfunctions in 1972 dollars, based upon trends and expected program changes. Projected imports for the defense and nondefense sectors were shifted to the foreign trade bills of goods. Since most of the historical defense data bases included foreign military sales, these were projected separately. Foreign military sales were assumed to rise slowly to 1980, and then level off in constant dollars. These sales were transferred to the export bill of goods.

Chapter 5. Intermediate Demand Projections

After final demand purchases were projected, the intermediate demand, or additional output of each industry that is required to support the projected final demands, was calculated using an input-output model. This model provides a framework for projecting industry outputs, or the total of final and intermediate sales required of each industry.

An input-output "use" table is a rectangular matrix in which the entries represent the transactions of each sector with all other sectors. Each row of the matrix shows the sales of each commodity (the primary product of the industry with the same name) to every consuming industry and final demand. The sum of all the entries in a row represents commodity output. Each column of the matrix shows the inputs of commodities to that industry which are used to produce its output. The sum of purchased inputs plus value added (returns to capital, labor, and entrepreneurial ability) equals the output of the industry.

A second table, the "make" table, is a rectangular matrix which shows the production of commodities by each industry. Each row of the matrix shows which commodities that industry produces, and each row sums to industry output. Each column of the matrix represents a commodity and shows which industries produce the commodity. Each column sums to commodity output.

The 1972 BEA input-output study represents a major conceptual change from earlier benchmark input-output studies. The 1972 study went a long way in bringing the United States closer to United Nations conventions in input-output studies, and thus closer conceptually to many other countries. This study was used as a basis for the revised BLS projections, even though changes in the study and timing difficulties limited BLS ability to create a time series of consistent input-output tables for this set of projections. Consequently, many of the input coefficients remained unchanged over the projected period.

Changes from earlier BEA studies

The changes introduced in the 1972 input-output study were of several varieties. The most obvious change was the use of 1972 SIC codes, which resulted in changes in many industry definitions. The second change was the differentiation between a commodity and an industry. A commodity was defined as the primary product of the industry with the same name. (The secondary product of one industry is the primary product of another industry.) For the first time, it was possible to solve for both commodity and industry output, thus making possible differing analyses of the data. The third major change was in the handling of secondary products. Previous tables allowed for both redefinitions and transfers of these products, while in the new 1972 table, all secondary products were redefined. Another change was the inclusion of a new industry, Eating and Drinking Places, and the omission of two dummy industries, Business Travel and Entertainment and Office Supplies.

There are two commodities for which there are no industries in the BEA sectoring plan: (1) Scrap, used, and secondhand goods, and (2) noncomparable imports. There are five industries in the BEA table which have no commodities: (1) Forest products, (2) Federal electric utilities, (3) Commodity Credit Corporation, (4) Local government passenger transit, and (5) State and local electric utilities. Otherwise, each industry has a matching commodity.

Secondary products

The make table, or market shares matrix, mechanically redefines many of the secondary products using an "industry technology" approach. This means that the secondary products are assumed to have the same technology as the primary products of the industry where they were produced. When redefining these commodities, the structure of the producing industry is left unchanged, but the structure of the primary producer is modified to account for the differing technologies of the different industries which may be producing the commodity. Other secondary products which were not included in the make table were redefined using a "commodity technology" approach. This assumes that the secondary products differed greatly from primary products of the industry in which they were produced. For these, the input structure of the primary industry was used to adjust the input structure of the producing industry. These specific redefinitions were taken care of in the use table.

Valuation of transactions

Input-output relationships may be expressed either in producers' values or purchasers' values. Both BLS and BEA value inputs purchased by a consuming industry at the price the producer received. Trade margins and transportation costs associated with these inputs appear as direct purchases by the consuming industry from the trade and transportation industries. Since the input-output tables are in producers' values, all trade and transportation margins had to be stated as demand on those sectors. This method allows BLS to maintain the detail on actual purchases of specific materials—materials are not sold to or purchased from the trade industry. The output of these trade sectors is measured in terms of total margins—operating expenses plus profits.

The transactions recorded in the input-output tables are based on data contained in the *Census of Manufactures* and the other economic censuses. The Bureau of the Census assigns establishments to an industry based on the establishment's primary output—those products or services which produce the largest part of its revenue. Many establishments also produce other products which are different from the primary output—secondary products. A commodity is the primary production of the industry with the same name, and may be produced anywhere in the economy. Final demand is expressed in terms of commodities, as is the demand for goods used in production. But, these commodities may be produced by a variety of industries. The market-share matrix, derived from the make table, indicates what proportion of each commodity is produced in each industry. This allows an increase in demand for a commodity to increase production in each industry which produces it.

The Economic Growth projections for 1990 involved three sets of input-output tables—1972, 1985, and 1990. All tables were prepared in 1972 constant dollars. The 1972 tables represent an aggregation of the 496-order BEA tables to the BLS 156 sectors. The major difference in the BLS and BEA tables resulted from the movement of new construction materials purchases to final demand and the inclusion of a dummy industry to handle compensation and value added in new construction. The 1985 and 1990 tables were also projected in constant dollars based upon the 1972 table. Some data were updated to 1977, but in many cases, due to a lack of resources, coefficients were unchanged from 1972 over the projected period.

Projecting coefficients

Coefficients are projected to change for several reasons— technological change is an important factor, but not the only one. Changes in product mix or relative prices can also cause significant changes in coefficients. Because the BLS industries are aggregates of the more detailed BEA sectors, a simple change in the relative importance of those sectors can have a large impact on the coefficients. Also, as the relative price or availability of substitute inputs change, substitutions might occur.

Several different methods were used in projecting coefficients. Energy coefficients, both as inputs to other industries and as inputs from other sectors to energy producing industries, were projected using projections available from the Department of Energy. Several industries were studied intensively to pick up structural changes which had occurred since 1972, and changes were then projected forward (for example, the metals industries). In other industries, changes in expectations were incorporated (for example, a decrease in sugar in foods and soft drinks). For other commodities, the rows of the input-output tables were evaluated and increases or decreases throughout the economy were made based upon overall trends in the economy. In some cases, 1972 coefficients were reweighted based upon expected changes in the relative importance of detailed industries. Where resources were not available to study specific coefficients, they were left unchanged from their 1972 or 1977 level.

The same total requirements tables, calculated to show industry output required to meet demand for commodities, were used for each of the alternative models. The use and make tables consistent with each of these scenarios were calculated.

Chapter 6. Industry Output and Employment Projections

As described in the previous sections, the multiplication of projected final demand by the projected input–output matrix yielded initial estimates of gross domestic output by industry. These estimates were evaluated in light of past output trends and expectations for the future.

The historical data against which the initial output projections were compared are generally derived from a variety of sources. Manufacturing output is based on the value of shipments plus net inventory change for each 4-digit SIC industry that is published annually in the *Census of Manufactures* or in the *Annual Survey of Manufactures*. Measures of nonmanufacturing output are derived from a variety of sources, including the *Minerals Yearbook, Agricultural Statistics,* and *Business Income Tax Returns*. The various output measures are benchmarked to the input–output tables published by the Bureau of Economic Analysis, in this case, to the recently released 1972 table. Benchmarking the raw output data takes account of the production of secondary products, which are treated as transfers to the primary producing industries under input–output conventions.

After benchmarking, the historical output data are converted into real dollar terms. To be consistent with the national income accounts, constant–dollar output is based on current–year–weighted deflators. These deflators are derived from the BLS industry, producer, and consumer price index series.

The final projections of industry output then become the principal input to the industry employment projections. The industry employment projections count the number of wage and salary workers, the self–employed, and the unpaid family workers. Historical wage and salary data are based on the BLS establishment series of employment published in *Employment and Earnings,* and the self–employed and unpaid family worker data are derived from the Bureau of the Census' *Current Population Survey*. (A detailed description of the output and employment data base is available in other publications.)[23]

[23] *Time Series Data for Input-Output Industries*, Bulletin 2018 (Bureau of Labor Statistics, March 1979), and an updated version to be published in 1981.

Factor demand model

The model used to project annual industry employment and productivity was a factor demand model, which takes into account the interdependence of both labor and capital requirements in each industry. In this model, the demand for labor is a function of the industry's output, capacity utilization (measured by the unemployment rate of last industry employed), technical change (as approximated by a time trend), and the stock of capital measured in efficiency units. The form of the model utilizes a CES (constant elasticity of substitution) production function, involving factor–augmenting technical change. Allowing for economies of scale, the production function can be written as follows:

$$(1)\quad Y = Cap^{u}[x(AL * L)^{-w} + y(BE * E)^{-w} + z(CP * P)^{-w}]^{v/w}$$

where Y = output
L = labor services
E = equipment stocks
P = plant stocks
AL = efficiency augmenting function for labor
BE = efficiency augmenting function for equipment stock
CP = efficiency augmenting function for plant stock
Cap = capacity utilization

and x, y, and z are distribution parameters which are greater than zero and sum to unity.

w = substitution parameter
v = economies of scale
u = utilization parameter

The elasticity of substitution is equal to $1/(1+w)$.

This model uses the concept of efficiency units. In essence, the concept assumes that labor and capital inputs are each a composite of quality and quantity, and one unit of quantity is not necessarily equal to one unit of quality. Quality and quantity are differentiated by the respective functions AL and L for labor; BE and E for equipment stock; and CP and P for plant stock.

The efficiency functions, AL, BE, and CP, are measured by technical change as approximated by a time trend. These efficiency functions are:

(2) $AL = a_0 e^{lt\ Time}$

(3) $BE = b_0 e^{et\ Time}$

(4) $CP = c_0 e^{pt\ Time}$

The parameter lt is the elasticity of labor efficiency with respect to pure technical change; et is the elasticity of equipment efficiency with respect to technical change; and pt is the elasticity of plant efficiency with respect to technical change. Assuming competitive factor imputations, it can be demonstrated that

(5) $L_t = a_0 + a_1 Y_t + a_2 Cap_t + a_3\ Time$

where L, Y, and Cap are expressed in natural logs
and a_0 = scalar
$a_1 = 1/v$
$a_2 = u/v$
$a_3 = lt/v$

(6) $E_t = b_0 + b_1 Y_t + b_2 Cap_t + b_3 Time$

where E, Y, and Cap are expressed in natural logs
and b_0 = scalar
$b_1 = 1/v$
$b_2 = u/v$
$b_3 = et/v$

(7) $P_t = c_0 + c_1 Y_t + c_2 Cap_t + c_3 Time$

where P, Y, and Cap are expressed in natural logs
and c_0 = scalar
$c_1 = 1/v$
$c_2 = u/v$
$c_3 = pt/v$

Estimation. There were several considerations in choosing an estimator of this aggregate multifactor product model. First, the structure of technology is characterized by the input demand equations (5), (6), and (7). A key element of this characterization is the concept of interrelated demand functions. The estimator of this model had to maintain this concept. To accomplish this, it was assumed that deviation of the labor, equipment stock, and plant stock services from the logarithmic factor demand equations were the result of random errors in cost minimizing behavior.

A second consideration was that the substitution parameter, v, appeared in equations (5), (6), and (7) in the a's, b's, and c's. Estimates of v with ordinary least squares would depend upon which equation was used. The estimation of this factor demand model had to ensure that identical values of v were obtained from each equation. Finally, degrees of freedom posed a problem. There were only 16 years of available data.

These considerations suggested that an estimator such as Zellner's minimum distance estimator should be used. Zellner's estimator involved stacking the regression, allowing the errors of the labor equation and the errors of the capital equation to interact to achieve consistent estimates. However, preliminary tests indicated severe problems in achieving convergence with the Zellner estimator.[24] To maintain the substitution parameter in both the capital and labor equations, and to conserve degrees of freedom, the two regressions were stacked and estimated with ordinary least squares. This meant that the errors of the labor equation and the capital equation were jointly minimized. This hybrid approach yielded 26 observations for each industry—two equations with 13 observations per equation.

In addition to the output and employment data base, this model also relied on industry capital stocks data from the Economic Growth industry data base. These stocks are documented in another BLS publication.[25]

Solving the model

Average weekly hours for each industry were projected by relating the change in the current year's workweek to the change in the current year's output plus a constant term. This is written:

(8) Change in workweek_t = constant + a * change in output_t

Finally, the employment estimates were an identity — labor hours derived in equation (5) divided by the workweek.

(9) $\text{Jobs}_t = \text{labor hours}_t / \text{workweek}_t * (52)$

Wage and salary employment was computed as a constant share of total jobs, based on the historical time trend.

After the equations of the model produced their initial values, the projections of jobs and hours were scaled to the total jobs and hours used in the macro model. Finally, the results were reviewed and, where they differed sharply from expectations with no valid reason for the deviation, an adjustment was made. These adjustments were usually required when the historical and projected output trends were very divergent, such as in the energy industries; when the output and employment series were unrelated, such as in some transportation industries; and when the labor productivity trend implied negative employment, such as for wooden containers, leather products, and leather tanning.

[24]Arnold Zellner, "An Efficient Method for Estimating Seemingly Unrelated Regressions and Tests for Aggregation," *Journal of the American Statistical Association*, No. 57, pp. 348-68.

[25]*Capital Stocks Estimates for Input-Output Industries: Sources and Data*, Bulletin 2034 (Bureau of Labor Statistics, September 1979).

Disaggregation of results

The factor demand model was estimated for only 76 industries, due to the limited amount of employee compensation data which is an input in the estimation of labor services. In order to expand the results to the 156 industries in the Economic Growth system, least squares time trends of labor productivity and average weekly hours were computed for each of the 156 industries and combined with the 156-order output projections to calculate hours and employment. Then, these estimates were scaled to the projections from the factor demand model.

Further disaggregations were required in order to develop occupational projections. Occupational forecasts were estimated at the 3-digit SIC level, totaling about 450 individual industries. Only wage and salary employment data were prepared at this level. The estimates of jobs at this level of detail were based on an equation for each industry expressing employment as a function of total civilian employment, the level of the Armed Forces, output of the corresponding economic growth sector (156-order), and employment at the appropriate aggregate 2-digit SIC level. An example of the form the equations took is:

$$\begin{aligned}\text{Wage and salary jobs} = a_0 &+ a_1\,(\text{total unemployment rate})\\ &+ a_2\,(\text{Armed Forces})\\ &+ a_3\,(\text{output of corresponding economic growth sector})\\ &+ a_4\,(\text{wage and salary employment at corresponding 2-digit industry})\end{aligned}$$

The coefficients were estimates using ordinary least squares. The results of these equations were scaled to the wage and salary employment projections of the 156-order industries.

Chapter 7. Occupational Employment Projections

The method used to develop the 1990 occupational projections incorporated the industry-occupational matrix as the basic analytical tool. The general approach was to develop current (1978) estimates of occupational staffing patterns of industries, project these patterns to the target year of the projections (1990), and multiply the projected patterns by projected industry employment levels. The products, projected occupational employment by industry, were then summed across industries to derive an estimate of projected total employment by occupation.

This basic approach has been used by the BLS to develop occupational projections since the mid-1960's. The step-by-step procedures used in developing the 1978-90 projections, however, were somewhat different than in previous years, in large part because the primary data base for occupational employment changed from the decennial census and the Current Population Survey to the Occupational Employment Statistics (OES) Surveys. Procedures had to be modified with the change in data base largely because the new data base resulted in a shorter historical series and because of changes in occupational and industry classifications. As a result of these changes, the size of the matrix in the 1978-90 projections increased to 1,678 detailed occupations in 378 industries (primarily the 3-digit SIC level detail) from 377 occupations and 201 industries in the 1970 census based-matrix.

Developing base year employment estimates and projections

Separate estimates of current employment were developed for wage and salary workers, self-employed workers, and unpaid family workers. Data on wage and salary worker occupational employment were developed in an industry-occupational matrix format. Estimates of occupational employment of self-employed and unpaid family workers were developed at the total (all-industry) level only. They were added to the total of wage and salary workers to derive total employment by detailed occupation for the entire economy. The method used required the development of base year employment estimates and then the projections.

Wage and salary workers in OES survey industries

Base year estimates. Data on occupational employment of wage and salary workers were derived from the OES surveys for all industries except agriculture and private households, which are not included in the OES survey program, and education, which is included but for which data were not yet tabulated when the matrix was developed. The OES surveys are conducted by mail from a sample of employers in each industry. They are conducted on a 3-year cycle—manufacturing industries 1 year and nonmanufacturing industries divided in the other 2 years of the cycle. To develop occupational employment estimates for 1978, the occupational staffing patterns from the most recent OES survey data for each industry were applied to 1978 estimates of total wage and salary employment in that industry. The Bureau's Federal-State cooperative establishment survey (CES) was the source of the annual average industry employment. The 1978 staffing patterns were based on OES surveys of manufacturing industries in 1977; nonmanufacturing, except trade, transportation, communication, and public utilities industries and State and local government, in 1978; and trade and regulated industries and State and local governments in 1979.

In some industries, employment data in some detailed occupations were not collected in the OES surveys because the numbers were too small to be measured accurately and because the survey questionnaire in each industry was limited to 200 occupations found in that industry. To develop total employment estimates for each occupation not included in a survey questionnaire, a procedure was used whereby detailed occupational employment could be disaggregated from the appropriate survey residual that included the detailed occupation. Data collected in the 1970 census provided the raw data to disaggregate the survey residuals.

In developing the procedures for preparing the OES-survey-based matrix, a decision was made to use the disaggregation procedure only for occupations for which OES survey data were believed to account for at least 90 percent of total wage and salary worker employment in the occupation. As a result of this decision, about 400 OES survey occupations were collapsed into residuals in the OES-survey-based matrix. The disaggregation procedure was used, however, to estimate employment in selected industries for 200 occupations. The proportion of total national employment estimated through the procedure was less than 4 percent.

Total wage and salary worker employment in the agriculture and private household industries was developed from data in the Current Population Survey. These data are not strictly comparable with data developed in the CES. The CPS is a count of persons where each person is counted once in his or her primary job; the CES and OES are counts of jobs and a person is counted in all jobs he or she holds. Also, in the CPS, data include workers only 16 years of age and older. In the CES and OES, workers younger than 16 may be included because the data are based on payroll records. Workers on unpaid absences are counted in the CPS, but excluded from the CES.

The occupational distributions of wage and salary workers in the agriculture and private household industries were based on the 1978 census-based matrix. Those estimates were based on 1970 census data modified by 1971-78 CPS trends in large occupations in these industries. Since the occupational configuration of the matrix was based on the OES survey classification scheme, the 1978 census matrix employment data for 377 detailed occupations were distributed into the 1,678 detailed occupations in the OES-based matrix. In this procedure, CPS data were generally used as control totals, which were distributed into appropriate detailed OES-survey-matrix occupations. This distribution was based on established relationships between the Census and OES occupational classifications. Many analytical judgments were necessary to establish relationships for many occupations because a perfect match between one or more OES and one or more CPS occupations was not always possible.

The initial 1978 matrix, which provided occupational employment by industry developed through the procedures indicated above, was reviewed in detail on a cell-by-cell basis. The focus of the review was on the estimates generated through the disaggregation procedure. A procedure was used to update computer generated estimates where necessary. In the review, virtually no detailed occupational cells derived from staffing patterns based on OES-survey data were changed, except for data in residual categories to which data were either added or subtracted as needed because of changes in cells for detailed occupations resulting from disaggregation procedures.

Projections. The basic procedure for projecting occupational employment was to develop data on past trends of the proportions of employment in each industry represented by each detailed occupation and extend this trend through an extrapolation technique to the target year. These initially developed mechanical projections were then reviewed in detail for consistency with knowledge about technological change and other factors affecting the occupational composition of industries. Changes in the ratios developed through analytical judgments were placed in an updated matrix which was iterated to force it to add to 100 percent in each industry. The final step in the procedure was to apply the projected staffing pattern to projected industry employment totals.

Difficulties encountered using the OES survey

The first step in developing the 1990 projections for employment covered in the OES surveys was to develop data for the last two OES survey rounds for each industry to use as a base for developing trends in ratios. The objective was to compile national data for each occupation in each industry from one survey round to the next. However, many difficulties were encountered in this procedure because of changes between the last two survey rounds in industry definitions, occupational changes on survey forms, and geographical coverage.

Industry definition. Periodically the Standard Industrial Classification System used as the basis for survey universes is changed. For the last two OES survey rounds providing data for the 1978-90 matrix, several industries were affected by an SIC change. As a result, trends could not be developed because data were not comparable. In these cases, the data from the last survey round were held constant at the 1978 level in 1990 for the initial projected matrix. Trends were developed only in industries in which 95 percent or more of employment was comparable in the 1967 and 1972 SIC revisions.

Occupational changes on survey forms. Between the last two survey rounds, definitions were changed for several survey occupational categories. When occupations were added, trends could not be developed for these occupations because data for two points in time were not available. Furthermore, the category in which the occupation had been included in the previous round could not be projected because of inconsistent definitions. Similar situations resulted when occupations were deleted from the survey.

Geographical coverage. The OES survey has been conducted since 1971 as a Federal-State cooperative program. All States are not in the program and the number in each survey round has changed. Since 1977, BLS has developed national data by surveying the nonparticipating States as a whole with funds provided by the National Science Foundation. Because national data were not available for the last two survey rounds in any industry, data from States that participated in both surveys for each industry were summed and used as a proxy for national data. The number of States in each survey round providing data used in developing trends to 1990 was as follows: Manufacturing, 1974 and 1977, 27; trade, 1975 and 1978, 19; and other nonmanufacturing, 1975 and 1978, 29. The development of trends, therefore, excluded some States that may have had significant employment in a specific occupation. In developing projections in the future, this weakness will be eliminated as national data will become available for two points in time beginning with the results of the 1980 survey.

Projecting the ratios in OES survey industries

In projecting occupational staffing patterns of industries in previous projection cycles, decennial census data were extrapolated into the future based on decade-to-decade changes. Considerable analysis and review to identify the factors that caused changes in staffing patterns resulted in many changes to the mechanically developed extrapolated ratios. A review of the 1975 occupational projections done just prior to the development of the most recent 1990 projections (based on OES survey data) indicated that the major cause of errors in the projections was incorrect projections of occupational ratios. An intensive effort, therefore, was devoted to research on methods of projecting OES-survey-based staffing patterns.

In general, the research tested the merits of a variety of extrapolation techniques. The results of these tests indicated that first approximations of the projected ratios could be developed better, on average, through an exponential method than other extrapolation techniques. In this method, an annual rate of change was estimated for the historical period, and this rate was applied to the most current year's slot to derive the projected year. There was, however, a question whether this method produced any better results than using current patterns in the projected matrix. In the tests, use of current staffing patterns in the projected years generally produced better results, on average, than any extrapolation technique. However, for large occupations that were not affected by any problems related to changes in survey definitions or SIC problems, the exponential extrapolation technique generally outperformed the constant ratio estimates. Since the tests were performed for data over a short period of time and the exponential method worked well for large occupations representing a very significant proportion of employment, this technique was chosen. However, the research also confirmed earlier convictions that ratios developed through mechanical means must undergo intensive analytical review.

To overcome the problems of comparability of surveys, only those occupations that did not change definitions between the last two surveys and were found in industries that did not change SIC content were projected through the exponential extrapolation technique to 1990. All other ratios were held constant at the 1978 level in the initial 1990 matrix.

The initial projected staffing pattern in each industry was then applied to projected industry employment totals for wage and salary workers to develop the preliminary 1990 occupational projections. These projections were analyzed in detail over a 6-month period based on studies of occupations and industries conducted during preparation of the *Occupational Outlook Handbook*. Factors considered included changes in production methods, technological changes affecting occupational mix, changes in product mix of industries, changes in average size of establishments in industries, and other economic factors affecting specific occupations.

In addition, some occupations were projected independently of the matrix based on the relationship of the occupation to more closely associated variables. For example, projections of elementary and secondary school teachers were based on estimates of the school-age population and pupil-teacher ratios. Projections developed in this manner were placed in the matrix and adjustments in the staffing patterns for other occupations were made when necessary.

In the analytical procedure, relationships were established between occupations in the census-based matrix and the OES-survey-based matrix to obtain the benefit of a longer time series. Changes were made in the initial projected OES matrix based on the analysis described above, and an iteration procedure was used to assure that the staffing patterns in each industry added to 100 percent. The resulting ratios were applied to total projected employment of wage and salary workers in each industry to develop the final occupational projections of wage and salary workers.

Wage and salary workers, non-OES survey industries

Developing past trends. For the agriculture, private households, and education industries, past trends in occupational distribution were developed based on data in the 1970 decennial census and Current Population Surveys conducted during the 1970's. Since 1971, the occupational configuration of this data series was that used in the 1970 census and, therefore, different from the OES survey configuration that was used in the 1978-90 OES-survey-based matrix. However, there was no need to adjust data within the historical series since the data were comparable for each year from 1971 to 1978. Some adjustments were made to the staffing patterns in education based on limited available OES survey data.

Projecting the ratios

The initial projected 1990 ratios for these two industry sectors were taken directly from the 1990 census-based matrix developed by the Bureau in 1978. These projected ratios were analyzed based on data that became available after the earlier matrix was developed and a few ratios were adjusted. The census-based occupational distribution was converted to the OES survey distribution based on the same distribution of census categories to OES survey categories used to develop the 1978 wage and salary base-year matrix described above.

The projected ratios were then applied to the 1990 industry projections developed for the 1978-90 OES-survey-based matrix. The resulting employment and ratios were reviewed in detail in the same manner as the wage and salary workers for OES-survey-based industries. Changes in patterns that resulted from this review were incorporated in the final matrix.

Self-employed and unpaid family workers

Base-year estimates. Estimates of self-employed and unpaid family workers by occupation were based on 1978 annual averages as in previous census-based matrices since no alternative data series exist. Similar to the procedure used for wage and salary workers in the agriculture and private household industries, the employment data in the detailed census matrix occupations were distributed to the 1,678 occupations in the OES-survey-based matrix. In general, CPS data were used as control totals that were distributed to appropriate detailed OES survey matrix occupations falling within the CPS definition. The distributions were based largely on the distribution of OES-survey-based wage and salary employment unless other data were available or analytical judgment indicated that this procedure resulted in incorrect data. For example, certain jobs found only in government often fell into a broader CPS category which contained self-employed and unpaid family workers. In such cases, a distribution was not made based on the wage and salary worker distribution.

Data for self-employed and unpaid family workers were developed only at the all-industry level because of the unreliability of these data at the detailed industry level.

Projections. To develop the projections, the percent distributions of self-employed and unpaid family workers by occupation from the 1971-78 CPS data were extrapolated to 1990 and forced to add to 100 percent. A distribution of these proportions was made to OES survey occupations based on the distribution of 1978 data. These distributions were then reviewed and changes made where deemed appropriate. The resulting distribution was applied to projected totals for self-employed and unpaid family workers developed through the Bureau's economic model. The resulting projected employment totals were reviewed for consistency with information developed in the course of other occupational research, and changes were made where necessary.

Total occupational employment

To develop total employment estimates by occupation, employment of wage and salary workers was added to totals of self-employed and unpaid family workers. Unlike previous estimates of total national employment, the totals represented the number of jobs by occupation, not the number of persons employed by occupation.[26] These totals are different because one person may have more than one job. The difference between the number of jobs and number of persons employed in 1990 is roughly 7 percent.

[26] The total number of jobs was even higher than the number shown because persons who were self-employed as a secondary job were in the wage and salary worker totals and not in the self-employed totals. They would report only their primary job in the CPS, which was the source of data on the self-employed. Similarly, wage and salary workers in agriculture and private households were only counted once even if they held more than one job because the CPS was also the source of data for these industries.

Chapter 8. Planned Changes in the Projection System

Labor force supply model

Research is currently underway to develop a labor force supply model. The objective is to examine the effect on labor force participation of economic and demographic factors in order to provide a behavioral model as an alternative future basis for deriving these projections.

The procedures being utilized involve estimation of labor force participation equations for various age, sex, and marital status cohorts. Specifications of these equations include wage, income, education, presence of children, and other explanatory variables. The data are derived primarily from the March Current Population Survey and are organized by geographic region in order to form a body of pooled time series-cross section observations. A typical labor force participation equation includes such variables as the unemployment rate, wages, nonearned income, industrial mix, taxes, and economic-demographic variables designed to capture the movements in labor force behavior of the various cohorts under examination.

In general, preliminary empirical results confirm many expectations about the effect of economic and demographic influences on labor force behavior. Several variables, such as wages, industry mix, and the population cohort are statistically important determinants of labor force variation. Other variables, such as presence of children, schooling, and pensions, contribute substantially to the explanation of labor force participation for specific population groups. These findings will facilitate an analysis of the underlying reasons for developments in labor force behavior.

Industry-occupational employment

With the merging of the labor force, economic, and occupational projection programs, efforts began to computerize the linkages and to introduce explicit feedbacks between the respective programs. Currently, the detailed economic projections of industry labor demand are the determinant of occupational demand projections. Should the initial industry employment projections be inconsistent with either the projected staffing patterns or total occupational projections, the projections would be reviewed and the inconsistency eliminated if necessary. This is usually the approach when the demand for a particular occupation is unique to an individual industry.

In line with this approach, a respecification of the labor demand equations for individual industries is under consideration. The current labor demand equations are based on a general specification: An industry's employment is related to the industry's output plus technical trends and capacity. Because of the final demand and input-output projections, this output projection should embody shifting demographic, energy, and government expenditure trends. However, for selected industries, such as education or medical services, occupational surpluses or shortages visibly affect the industry's projected employment as much as the demand factor. The surplus or shortage of people to fill specific occupations should affect relative wages, and these, in turn, should encourage either capital/labor substitution or technical innovations. Research is now underway to deal with such occupational supply phenomena.

Job openings

Projections of occupational employment require more detailed information about the number of people expected to have jobs at some future time. By comparing projected with current employment data, the number of job openings resulting from growth in an occupation, if employment increases—or the number lost, if employment declines—can be determined. While useful, employment-change data alone do not identify the total number of jobs available. Total job-openings data are an obvious part of the assessment of supply and demand relationships.

There are several sources of job openings in an occupation: (a) Increase in employment due to the economy's growth, and (b) the need to replace individuals who transfer to another occupation or who retire, die, or leave the labor force for some other reason. The labor force, macro, and industry models and the industry-occupation matrix, described earlier, were used in projecting employment and estimating growth. In the past, working-life tables were used to estimate replacement needs resulting from death and labor force separations. These replacement needs estimates had limitations, however, because:

1. The estimates of labor force separations were based on working- life tables that pertained to the entire population and, therefore, did not reflect actual differences in patterns among occupations.

2. The estimates did not include all persons who left the labor force temporarily.

3. The estimates did not include job openings resulting from occupational transfers.

Because replacement needs are a far more significant source of job openings than economic growth in almost all occupations, improved data have been the focus of recent research efforts. Data are being developed from the Current Population Survey on the need to replace individuals who transfer to another occupation, retire, die, or leave the labor force for some other reason. The BLS publication *Measuring Labor Force Movements: A New Approach* (Report 581) explained the need for improved data about replacement needs and described preliminary efforts to develop this information.

The longitudinal character of the CPS results in data being collected for the same individual in surveys 12 months apart. By tabulating occupational and labor force status data, annual data on movements into and out of occupations are obtained. Because individuals are identified by matching household, age, race, and sex information, these longitudinal data are termed CPS matched data.

However, CPS matched data overstate occupational changes. To overcome this weakness, CPS retrospective data from supplemental questions on occupational mobility were combined with CPS matched data to estimate occupational transfers. The longitudinal data which result from combining CPS matched and CPS retrospective data are termed merged CPS matched and retrospective data.

Since the 1974-75 data were published in Report 581, 1977-78 CPS matched and retrospective data have been developed. These more recent data are not only of interest for the information they provide about replacement needs, but are of special interest because they permit comparisons of matched and retrospective data for January 1977-78. These comparisons fostered additional confidence in the reliability of merged CPS matched and retrospective data about movements into, out of, and between occupations. As a result, the merged and retrospective data will be used in the preparation of the 1982-83 editions of the *Occupational Outlook Handbook* and *Occupational Projections and Training Data* to estimate replacement needs, to document descriptions of occupational movements already being presented, and to add information not currently available. For example, the data will document information about the large number of jobs for food counter workers resulting from the need to replace young people who temporarily leave the labor force. By using merged CPS matched and retrospective data about occupational movements and by describing how jobs are created and filled, information about employment opportunities is expected to improve significantly.

Evaluation of projections

As indicated, for over 15 years BLS has developed a series of labor force, economic, and occupational projections. The first set of these comprehensive projections were developed in 1965 for the year 1970. Subsequent projections were developed for 1975, 1980, 1985, and 1990. Recent evaluations of 1975 projections include, "An Evaluation of BLS Projections of 1975 Production and Employment," by Paul Christy and Karen Horowitz (*Monthly Labor Review*, August 1979) and "Evaluating the 1975 Projections of Occupational Employment," by Max Carey (*Monthly Labor Review*, June 1980). Work has recently begun on evaluating the 1980 projections. This work involves assembling the conceptual and benchmark changes which might affect the differences between actual and projected data and assembling the methodologies of each 1980 projection to determine the sources of errors.

Appendix A. Labor Force Projection Scenarios

Table A-1. Three alternative projection scenarios for women

Age	High growth[1]	Middle growth	Low growth	Measured rate of increase: 1960 to 1979	Measured rate of increase: 1972 to 1979
		White			
16 and 17	SR: RG	Short-run estimate	LR	1.20	1.30
18 and 19	SR: RG	Short-run estimate	LR	.81	1.31
20 to 24	SR: RG	LR: Relative growth[1]	SR	–	1.42
25 to 29	SR: RG	LR: Relative growth[1]	SR	–	2.55
30 to 34	SR: RG	LR: Relative growth[1]	SR	–	2.37
35 to 39	SR: RG	LR: Relative growth[1]	SR	–	1.91
40 to 44	SR: RG	LR: Relative growth[1]	SR	–	1.62
45 to 49	LR: RG	Long-run estimate	SR	.64	.92
50 to 54	LR: RG	Long-run estimate	SR	.32	.40
55 to 59	LR: RG	Long-run estimate	SR	.11	.08
60 to 64	LR: RG	Long-run estimate	SR	.25	–.23
65 to 69	Constant	Half of LR	SR	–.22	–.14
70 to 74	Constant	Half of LR	SR	–.15	–.08
75 and over	Constant	Half of LR	SR	–.05	–.12
		Black and other			
16 and 17	SR: RG	Short-run estimate	LR	0.29	0.75
18 and 19	SR: RG	Short-run estimate	LR	.06	.59
20 to 24	SR: RG	LR: Relative growth[1]	SR	–	.92
25 to 29	SR: RG	LR: Relative growth[1]	SR	–	1.38
30 to 34	SR: RG	LR: Relative growth[1]	SR	–	2.13
35 to 39	SR: RG	LR: Relative growth[1]	SR	–	1.32
40 to 44	SR: RG	LR: Relative growth[1]	SR	–	.95
45 to 49	LR: RG	Long-run estimate	SR	–.16	.93
50 to 54	LR: RG	Long-run estimate	SR	–.18	.26
55 to 59	LR: RG	Long-run estimate	SR	–.22	–.18
60 to 64	LR: RG	Long-run estimate	SR	–.24	.05
65 to 69	Constant	Half of LR	SR	–.22	–.11
70 to 74	Constant	Half of LR	SR	–.27	–.42
75 and over	Constant	Half of LR	SR	–.12	–.16

[1] Different from the 1978 projection.

NOTE: LR denotes estimated over the 1960 to 1979 period; SR denotes estimated over the 1972 to 1979 period; and RG denotes the use of a relative growth model.

Table A-2. Three alternative projections scenarios for men

Age	High growth	Middle growth	Low growth	Measured rate of increase	
				1960 to 1979	1972 to 1979
	White				
16 and 17	SR	Average of LR & SR	LR	0.66	0.88
18 and 19	SR	Average of LR & SR	LR	.51	.74
20 to 24	SR	Average of LR & SR	LR	.01	.28
25 to 29	LR: Up	Long-run estimate	SR	–.10	.05
30 to 34	LR: Up	Long-run estimate	SR	–.36	.20
35 to 39	LR: Up	Long-run estimate	SR	–.20	.14
40 to 44	Constant	Long-run estimate	SR	–.12	.01
45 to 49	Constant	Long-run estimate	SR	–.17	–.12
50 to 54	Constant	Long-run estimate	SR	–.31	–.06
55 to 59	Constant[1]	Half of LR	SR	–.27	–.75
60 to 64	Constant[1]	Half of LR	SR	–.55	–1.47
65 to 69	Constant[1]	Half of LR	SR	–.60	–1.80
70 to 74	Constant[1]	Half of LR	SR	–.26	–.56
75 and over	Constant[1]	Half of LR	SR	–.31	–.32
	Black and other				
16 and 17	Convergence	LR[2]	LR[3]	–0.67	–
18 and 19	Convergence	LR[2]	LR[3]	–.23	–
20 to 24	Convergence	LR[2]	LR[3]	–.74	–
25 to 29	Convergence	Long-run estimate	SR	–.34	.23
30 to 34	Convergence	Long-run estimate	SR	–.23	.01
35 to 39	Convergence	Long-run estimate	SR	–.34	.23
40 to 44	Convergence	Long-run estimate	SR	–.34	.23
45 to 49	Convergence	Long-run estimate	SR	–.44	.08
50 to 54	Convergence	Long-run estimate	SR	–.60	.02
55 to 59	Convergence	Long-run estimate	SR	–.56	–.59
60 to 64	Convergence	Half of LR	SR	–.66	–.71
65 to 69	Constant	Half of LR	SR	–.56	–.71
70 to 74	Constant	Half of LR	SR	–.25	–.57
75 and over	Constant	Half of LR	SR	–.14	–.14

[1] Different from the 1978 projection.
[2] Indicates the use of the higher 95-percent confidence interval for the rate of change; this reflects data limitations for young black men.
[3] Indicates the use of the lower 95-percent confidence interval for the rate of change; this reflects data limitations for young black men.

NOTE: LR denotes estimated over the 1970 to 1979 period; SR denotes estimated over the 1972 to 1979 period; RG denotes the use of a relative growth model, and convergence indicates moving the black labor force participation to the white rate in the year 2000.

Appendix B. Macroeconomic Model: Equations, Identities, and Variables

(Abbreviations for variables are explained at the end of the appendix.)

Supply sector

1. ECLF = LFC * (1.0 − U)

2. ECJOBS = −0.751 + 1.078 ECLF − 0.199 U − 0.344 DM59 + 0.303 DM67 − 0.37 DM72
   (−0.6) (51.1) (−4.5) (−1.7) (1.2) (−1.3)

   R-squared = 0.999 Estimation period: 1947–79
   D.W. = 1.458

3. EMPE/POP = −0.003 + 0.098 PUREC/POP
   (−8.6) (75.2)

   R-squared = 0.996 Estimation period: 1952–79
   D.W. = 1.061

4. ln(EMPNE/POP) = −4.469 + 1.921 ln(PURNEC/POP) − 0.186 ln(URBAN/POP)
   (−14.2) (9.5) (−0.3)

   R-squared = 0.988 Estimation period: 1952–79
   D.W. = 0.462

5. ENFJBS = ECJOBS − (EF + EMPE + EMPNE + EFJBS)

6. AAHF = 1965.150 − 13.656 U − 9.037 U(t−1) + 27.839 FPOP + 7.623 TIME
   (9.9) (−2.1) (−1.3) (3.3) (1.4)

   R-squared = 0.877 Estimation period: 1948–79
   D.W. = 0.960

7. AAHNF = 2392.730 − 7.728 U + 4.661 U(t−1) − 7.764 FLFPR − 3.365 TIME
   (54.2) (−8.1) (4.7) (−5.5) (−4.8)

   R-squared = 0.994 Estimation period: 1948–79
   D.W. = 1.950

8. $MHF = AAHF * EFJBS$

9. $MHNF = AAHNF * ENFJBS$

10. $MHIF = MHF/MHF(1972)$

11. $MHINF = MHNF/MHNF(1972)$

12. $KEF = KEF(t-1) + IEF - DEF$

13. $KENF = KENF(t-1) + IENF - DENF$

14. $KSF = KSF(t-1) + ISF - DSF$

15. $KSNF = KSNF(t-1) + ISNF - DSNF$

16. $KINV = KINV(t-1) + IVCHG$

17. $KHS = KHS(t-1) + IR - DRES$

18. $IKF = (KSF + KEF)/(KSF(1972) + KEF(1972))$

19. $IKNF = (KSNF + KENF)/(KSNF(1972) + KENF(1972))$

20. $$\ln(GNPFC/IKADJF) = \underset{(27.7)}{2.881} + \underset{(2.8)}{0.0002}\, U * U + \underset{(11.3)}{0.450} \ln(MHIF/IKADJF) + \underset{(5.5)}{0.013}\, T29$$

R-squared = 0.957   Estimation period: 1929–40, 1946–79
D.W. = 1.453

21. $$\ln(GNPNFC/IKADJNF) = \underset{(192.1)}{6.065} - \underset{(-5.0)}{0.0002}\, U * U + \underset{(22.0)}{0.805} \ln(MHINF/IKADJNF) + \underset{(31.0)}{0.020}\, T29$$

R-squared = 0.990   Estimation period: 1929–40, 1946–79
D.W. = 0.874

22. $$SERFCC = \underset{(1.1)}{0.922} + \underset{(24.1)}{0.855} * (EF * 13.588) - \underset{(-2.1)}{1.716}\, CREEP2 + \underset{(7.5)}{0.122}\, TIME$$

R-squared = 0.995   Estimation period: 1947–79
D.W. = 0.940

23. $$SERFMC = \underset{(-0.3)}{-0.221} + \underset{(37.6)}{1.090}\, (EMIPA * 6.613) - \underset{(-3.4)}{6.334}\, CREEP2 \underset{(-2.5)}{-0.085}\, TIME$$

R-squared = 0.989   Estimation period: 1947–79
D.W. = 1.072

24. SEREDC = 3.770 + 0.801 (EMPE * 8.288) + 0.219 TIME
(23.0) (39.6) (7.1)

R-squared = 0.999 Estimation period: 1947–79
D.W. = 1.281

25. SERNEC = −0.707 + 0.852 (EMPNE * 8.407) + 0.247 TIME −2.874 CREEP2
(−0.5) (12.5) (5.2) (−1.9)

R-squared = 0.999 Estimation period: 1947–79
D.W. = 0.980

26. GGP = SERFCC + SERFMC + SEREDC + SERNEC

27. GNPTC = GNPFC + GNPNFC + GGP

Income sector

28. CPCDA = 15.048 − 2.840 U + 1.078 (PRICE + PRICE(t − 1) + PRICE(t − 2)) + 0.166 GNPPK
(2.7) (−3.3) (3.1) (30.9)

Cochrane/Orcutt RHO = 0.523
R-squared = 0.993 Estimation period: 1949–79
D.W. = 1.365

29. CDACE = −10.353 + 0.051 KSTK(t − 1)
(−24.3) (125.1)

where KSTK = KEF + KSF + KENF + KSNF

R-squared = 0.998 Estimation period: 1947–79
D.W. = 0.143

30. CDACB = −7.089 + 0.036 KSTK(t − 1) + 0.007 KSTKD1(t − 1) + 0.008 KSTKD2(t − 1)
(−3.1) (10.2) (5.5) (7.2)

where KSTK = KEF + KSF + KENF + KSNF
and D1 is entered from 1954 on and D2 from 1962 on.

R-squared = 0.995 Estimation period: 1947–79
D.W. = 1.442

31. CPTFD = 2.925 + 0.731 TRCP * (CPCDA − CDAKB)
(6.0) (48.7)

R-squared = 0.989 Estimation period: 1947–79
D.W. = 0.824

32. DIV = −0.424 + 1.067 DIV(t − 1) + 0.106 (IFC − IFIX) * DEFI
(−1.4) (57.2) (3.6)

where IFIX = IEF + ISF + IENF + ISNF

R-squared = 0.993   Estimation period: 1947–79
D.W. = 1.472

33. $$IVA = \underset{(1.6)}{2.751} - \underset{(-3.3)}{97.123}\,((DGNPP - DGNPP(t-1))/DGNPP(t-1)) + \underset{(1.0)}{0.099}\,IVCHG - \underset{(-1.6)}{0.021}\,KINV(t-1) - \underset{(-7.5)}{20.380}\,EMBGO$$

R-squared = 0.890   Estimation period: 1948–79
D.W. = 3.203

34. $$IFK = CPCDA - (CPTFD + CPTST)$$

35. $$UCP = IFK - (CDAKE - CDAKB) - IVA - DIV$$

36. $$CCANCC = \underset{(0.4)}{1.787} + \underset{(3.7)}{0.025}\,KHS(t-1) + \underset{(1.1)}{0.0002}\,KHS(t-1) * TIME$$

R-squared = 0.993   Estimation period: 1947–79
D.W. = 0.253

37. $$CCANCK = CCANCC * DFNCCA$$

38. $$IBTFD = \underset{(23.2)}{6.134} + \underset{(2.8)}{0.004}\,GNPPK + \underset{(8.5)}{0.026}\,TRG * FU + \underset{(2.0)}{0.774}\,DMKW$$

R-squared = 0.984   Estimation period: 1947–79
D.W. = 1.470

39. $$IBTST = \underset{(4.1)}{4.284} + \underset{(107.0)}{0.710}\,(GDSTK + SERSTK + TRSTP - GAK)(t-1) - \underset{(-2.3)}{0.527}\,U$$

R-squared = 0.998   Estimation period: 1948–79
D.W. = 1.223

40. $$IPFD = \underset{(9.1)}{1.466} + \underset{(10.0)}{0.004}\,(I3Y5Y * DFP) + \underset{(2.8)}{0.002}\,(I3Y5Y * DFP)(t-1) - \underset{(-0.7)}{0.0004}\,(I3Y5Y * DFP)(t-2)$$

R-squared = 0.993   Estimation period: 1952–79
D.W. = 1.127

41. $$SICE = \underset{(3.4)}{0.431} + \underset{(167.7)}{0.529}\,SICTOT$$

R-squared = 0.999   Estimation period: 1947–79
D.W. = 0.376

42. SICU = 0.508 + 0.392 ((CEP + GGP) − SICE) * TRU
(5.0) (27.3)

R-squared = 0.966 Estimation period: 1947–79
D.W. = 1.445

43. SICO = 1.187 + 0.900 TRO * CSIC * (CEP + GGP) − SICE) * WB/MFI
(2.2) (49.8)

R-squared = 0.990 Estimation period: 1947–79
D.W. = 0.808

44. SICST = −0.070 + 0.136 (SERSTK − (ES * SICE/(ECLF + EMBLS)))
(−1.5) (129.5)

where ES = EMPE + EMPNE

R-squared = 0.999
D.W. = 0.789

45. SICTOT = SICU + SICO + SICST + SICFD

46. IPC = −2.325 + 0.019 PI + 0.419 I3M
(−8.7)) (16.3) (2.6)

R-squared = 0.989 Estimation period: 1947–79
D.W. = 0.429

47. PI = GNPTK − CDAKE − CCANCK − IBTFD − IBTST − SD + SLSFD + SLSST − CPIVA

+ (CDAKE − CDAKB) − SICTOT + TRAN + DIV + IPFD + IPST + IPC

48. ln(MFI) = 6.833 + 0.865 ln(1.0 − (U/100.0)) + 1.052 ln(GNPTK/(ECLF + EMBLS))
(87.5) (2.3) (78.2)

+ 1.291 ln((PI + SICTOT − SICE)/GNPTK)
(5.2)

R-squared = 0.998 Estimation period: 1947–79
D.W. = 1.679

49. PTFD = −5.865 + 0.051 PI + 0.362 PI * TRMFI
(−4.7) (2.9) (3.8)

R-squared = 0.992 Estimation period: 1947–79
D.W. = 1.373

50. PTST = −4.431 + 0.029 PI + 0.532 PTST(t − 1) − 0.253 TIME
(−2.5) (2.4) (2.2) (−1.9)

R-squared = 0.996 Estimation period: 1947–79
D.W. = 1.705

51. DPIK = PI − (PTFD + PTST)

52. $PS = -26.329 + 0.080\ DPIK - 0.321\ I3Y5Y + 20.070\ DFDPI/DFDPI(t-1)$
$(-0.8) \quad (8.5) \quad (-0.3) \quad (0.6)$

R-squared = 0.959 Estimation period: 1947–79
D.W. = 1.947

53. PCEK = DPIK − PS − IPC − PTR

Demand sector

54. $PCED = -80.295 + 0.190\ (PCEC) + 0.293\ IR(t-1) - 0.490\ U + 59.916\ (DPIK/DPIK(t-1))/$
$(-3.3) \quad (18.5) \quad (2.3) \quad (-0.9) \quad (2.5)$

$(DFDPI/DFDPI(t-1)) - 1098.710\ IPC/DPIK$
(-5.3)

where PCEC = PCEK/DFDPI

R-squared = 0.999 Estimation period: 1947–79
D.W. = 1.468

55. $PCEN = 50.886 + 0.319\ (PCEC) + 770.141\ IPC/DPIK - 0.460\ U$
$(26.7) \quad (69.5) \quad (6.0) \quad (-1.3)$

where PCEC = PCEK/DFDPI

R-squared = 0.999 Estimation period: 1947–79
D.W. = 0.964

56. $PCES = -38.429 + 0.397\ (PCEC) + 0.598\ U + 0.050\ KHS$
$(-11.1) \quad (11.2) \quad (1.2) \quad (2.4)$

where PCEC = PCEK/DFDPI

R-squared = 0.999 Estimation period: 1947–79
D.W. = 1.211

57. $IENF = -7.301 + 0.190\ IFC + 0.732\ IENF(t-1) + 0.0002\ KENF(t-1) + 118.350\ (IFC/(KENF + KSNF)/$
$(-1.9) \quad (2.9) \quad (4.2) \quad (0.01) \quad (0.8)$

$U)(t-1) + 0.083\ (GNPNFC - GNPNFC(t-1))$
(2.7)

R-squared = 0.988 Estimation period: 1947–79
D.W. = 1.349

58. $ISNF = 0.604 + 0.017\ GNPNFC + 0.618\ ISNF(t-1)$
$(0.5) \quad (2.3) \quad (3.8)$

R-squared = 0.967 Estimation period: 1947–79
D.W. = 1.161

59. IVCHG = −42.235 + 0.166 (GNPFC + GNPNFC) − 0.424 KINV(t−1) KINV(t−1) + 13.182/U − 1.197 TIME
(−7.1) (6.8) (−7.0) (1.2) (−2.8)

R-squared = 0.820 Estimation period: 1947–79
D.W. = 1.742

60. IR = −68.090 − 4.921 I3Y5Y + 1.448 HOUSE + 4.643 DPIC/HOUSE/HOUSE
(−7.9) (−4.1) (5.7) (3.8)

R-squared = 0.945 Estimation period: 1929–40, 1946–79
D.W. = 1.381

61. M = −6.165 + 0.027 DPIC(t−1) + 0.033 (DPIC − DPIC(t−1)) + 0.383 ((DEFM/DFDPI)
(−1.9) (2.0) (1.1) (0.3)

− (DEFM(t−1)/DFDPI(t−1))) + 5.123 CPSQR + 0.841 M(t−1)
(2.1) (7.9)

R-squared = 0.996 Estimation period: 1947–79
D.W. = 2.052

62. PURFDC = SERFMC + SERFCC + GDFDC

63. PUREC/POP = −0.184 + 0.071 (((GNPFC + GNPNFC)/POP)(t−1)) + 0.513 (GAC * GPCED/POP)
(−7.7) (13.3) (1.3)

+ 0.474 SCHL/POP
(5.0)

R-squared = 0.991 Estimation period: 1953–79
D.W. = 1.663

64. PURNEC/POP = −0.089 + 0.085 ((GNPFC + GNPNFC)/POP)(t−1) + 0.607 (GAC *
(−1.4) (4.4) (2.1) (0.9)

(1.0−GPCED)/POP) + 0.003U

R-squared = 0.973 Estimation period: 1953–79
D.W. = 0.538

Price/wage sector

65. ln(DGNPP) = 0.560 + 0.867 ln(ALUL(t−1)) + 0.132 ln(WPICR) −0.039 ln(U)
(17.0) (40.7) (5.7) (−2.1)

R-squared = 0.994 Estimation period: 1948–79
D.W. = 1.214

66. CEPM = 4.994 + 60.286 (((GNPFC + GNPNFC)/(MHF + MHNF)) − ((GNPFC + GNPFC)/

(MHF + MHNF))(t−1))/((GNPFC + GNPNFC)/(MHF + MHNF))(t− 1) + 119.426 ((DFDPI
(11.8)

− DFDPI(t−1))/ DFDPI(t−1)) −0.799U
(−4.5)

R-squared = 0.860 Estimation period: 1947–79
D.W. = 2.091

67. CPH = CPH(t – 1) * CEPM

68. CEP = CPH * (MHF + MHNF)

69. ALUL = CEP/(GNPFC + GNPNFC)

70. PRICE = percent change DGNPP – CEPM

71. DEFI = –0.008 + 1.005 DGNPP
(–0.3) (34.9)

Cochrane/Orcutt RHO = 0.723
R-squared = 0.997 Estimation period: 1948–74
D.W. = 1.661

72. DFIV = 0.212 + 0.810 DGNPP
(1.8) (5.5)

Cochrane/Orcutt RHO = 0.159
R-squared = 0.611 Estimation period: 1948–74
D.W. = 1.890

73. DEFRI = –0.272 + 1.229 DGNPP
(–1.6) (12.2)

Cochrane/Orcutt RHO = 0.968
R-squared = 0.993 Estimation period: 1948–74
D.W. = 1.836

74. (DFDPI – DFDPI(t – 1))/DFDPI(t – 1) = 0.003 + 0.901 ((DGNPP – DGNPP(t – 1))/DGNPP(t – 1))
(1.7) (19.7)

Cochrane/Orcutt RHO = 0.189
R-squared = 0.947 Estimation period: 1948–74
D.W. = 1.558

75. DEFX = 0.003 + 0.491 DGNPP + 0.536 DEFM
(0.2) (12.8) (23.2)

Cochrane/Orcutt RHO = 0.953
R-squared = 0.997 Estimation period: 1948–74
D.W. = 1.991

76. DFGDS = –0.584 + 1.529 DGNPP
(–6.7) (23.2)

Cochrane/Orcutt RHO = 0.953
R-squared = 0.998 Estimation period: 1948–74
D.W. = 2.096

77. $DFGDF = -0.016 + 1.021\ DGNPP$
$$\begin{array}{ll} (-0.8) & (38.8) \end{array}$$

Cochrane/Orcutt RHO = 0.260
R-squared = 0.990 Estimation period: 1948–74
D.W. = 1.651

78. $DFCCA = 0.028 + 0.818\ DEFI + 0.163\ DGNPP$
$$\begin{array}{lll} (1.5) & (9.4) & (1.8) \end{array}$$

Cochrane/Orcutt RHO = 0.872
R-squared = 0.999 Estimation period: 1948–74
D.W. = 1.571

79. $DFNCCA = -0.014 + 0.284\ DFDPI + 0.755\ DGNPP$
$$\begin{array}{lll} (-0.4) & (0.5) & (1.2) \end{array}$$

Cochrane/Orcutt RHO = 0.789
R-squared = 0.996 Estimation period: 1948–74
D.W. = 1.124

80. DEFSFC = DEFSFC(t − 1) * (percent change DFDPI)

81. DEFSFM = DEFSFM(t − 1) * (percent change DRDPI)

82. DEFSS = DEFSS(t − 1) * (percent change DRDPI)

83. DEFGA = DEFGA (t − 1) * (percent change DGNPP)

84. DGNPT = weighted average of DGNPP, DEFSFC, DEFSFM, and DEFSS

85. GNPDC = PCED + PCEN + PCES + IEF + IENF + ISF + ISNF + IVCHG + IR + EXPRT − M + PURFDC + PUREC + PURNEC

86. GAP = GNPTC − GNPDC

Explanation of variables
(* denotes an exogenous variable)

AAHF	Average annual private farm manhours, establishment basis
AAHNF	Average annual private nonfarm manhours, establishment basis
ALUL	Unit labor cost
CCANCC	Noncorporate capital consumption allowances, constant dollars
CCANCK	Noncorporate capital consumption allowances, current dollars
CDACB	Corporate depreciation allowances, constant dollars, book value definition, without capital consumption adjustment (CCA)
CDACE	Corporate depreciation allowances, constant dollars, with CCA
CDAKB	Corporate depreciation allowances, current dollars, without CCA (CDACE*DFCCA)
CDAKE	Corporate depreciation allowances, current dollars, with CCA (CDACE*DFCCA)
CEP	Compensation of employees, private economy
CEPM	Percent change in current dollars compensation per hour in the private sector
CPCDA	Corporate profits plus capital depreciation allowance minus inventory valuation adjustment
CPH	Private compensation per hour
CPIVA	Corporate profits plus inventory valuation adjustment (CPCDA+IVA-CDAKE)
CPSQR	Capacity pressure, defined as (((actual GNP/potential GNP)-0.98)*2)
CPTFD	Federal corporate profits taxes
CPTST*	State and local (S&L) corporate profits taxes
CREEP2*	Variable to account for unwarranted grade enhancement during the 1947-69 period
CSIC*	Social security coverage as a percent of paid employment
DEF*	Discards of producer durable equipment (PDE), farm
DEFGA	Deflator for Federal grants-in-aid
DEFI	Fixed nonresidential investment deflator, 1972=100
DEFM*	Imports of goods and services deflator, 1972=100
DEFRI	Residential structures deflator, 1972=100
DEFSFC	Federal civilian compensation deflator
DEFSFM	Military compensation deflator
DEFSS	S&L compensation deflator
DEFX	Exports of goods and services deflator, 1972=100
DENF*	Discards of PDE, nonfarm
DFCCA	Corporate consumption allowances deflator
DFDPI	Disposable personal income deflator
DFGDF	Federal purchases less compensation deflator, 1972=100
DFGDS	S&L purchases less compensation deflator, 1972=100
DFIV	Change in business inventories deflator, 1972=100
DFNCCA	Noncorporate consumption allowances deflator
DFP	Federal debt proxy
DGNPP	Private GNP deflator, 1972=100
DGNPT	Total GNP deflator, 1972=100
DIV	Net corporate dividend payments
DMKW*	Korean War dummy = 1 for 1951-53
DM59*	Establishment survey definitional shift = 1 from 1959
DM67*	Establishment survey definitional shift = 1 from 1967
DM72*	Establishment survey definitional shift = 1 from 1972
DPIC	Disposable personal income, constant dollars (DPIK/DFDPI)
DPIK	Disposable personal income, current dollars
DRES*	Discards of residential structures
DSF*	Discards of structures, farm
DSNF*	Discards of structures, nonfarm
ECJOBS	Civilian employment, establishment basis
ECLF	Civilian employment, labor force basis, age 16 and over
EF*	Average number of full- and part-time Federal Government general employees
EFJBS*	Private farm employment, establishment basis
EMBGO*	Oil embargo dummy = 1 in 1973-74
EMBLS*	Level of the Armed Forces, BLS basis
EMIPA*	Military employment including reserve forces, national income and product accounts (NIPA) basis
EMPE	S&L government employment in education
EMPNE	S&L government employment in noneducation
ENFJBS	Private nonfarm employment, establishment basis
EXPRT*	Exports of goods and services
FLFPR*	Female labor force participation rate, age 16 and over
FPOP*	Total farm population
FU*	Motor fuel usage

GAC* Federal grants-in-aid to S&L government, constant dollars
GAK Federal grants-in-aid to S&L government, current dollars (GAC*DEFGA)
GAP Supply GNP less demand GNP, constant dollars
GDFDC* Federal purchases of goods and services less compensation, constant dollars
GDSTK S&L government purchases of goods and services less compensation, current dollars ((PUREC + PURNEC)-(SEREDC + SERNEC)) *DFGDS
GNPDC Demand-side GNP, constant dollars
GNPFC Farm GNP, constant dollars
GNPNFC Private nonfarm GNP, constant dollars
GNPPK Private GNP, current dollars ((GNPFC+GNPNFC)*DGNPP)
GNPTC Total supply-side GNP, constant dollars
GNPTK Total supply-side GNP, current dollars (GNPPK + SERSTK + (SERFCC *DEFSFC) + (SERFMC*DEFSFM))
GPCED* Education's share of Federal grants
HOUSE* Number of households
IBTFD Federal indirect business taxes
IBTST S&L indirect business taxes
IEF* Investment in PDE, farm
IENF Investment in equipment, nonfarm
IFC Internal funds, constant dollars (IFK/DEFI)
IFK Internal funds, current dollars
IKF Index of farm capital stock, 1972 = 100
IKADJF Farm index of capital adjusted for utilization (IKF*(1.0-U))
IKADJNF Nonfarm index of capital adjusted for utilization (IKNF*(1.0-U))
IKNF Index of nonfarm capital stock, 1972 = 100
IPC Interest paid by consumers
IPFD Net interest paid by Federal Government
IPST* S&L net interest payments
IR Investment in residential structures
ISF* Investment in nonresidential structures, farm
ISNF Investment in nonresidential structures, nonfarm
IVA Inventory valuation adjustment
IVCHNG Change in the stock of business
I3M* Yield on 3-month Government bills
I3Y5Y* Yield on 3- and 5-year Government bonds
KEF Stock of PDE, farm
KENF Stock of PDE, nonfarm
KHS Stock of residential structures
KINV Stock of business inventories
KSF Stock of structures, farm
KSNF Stock of structures, nonfarm
LFC* Civilian labor force, 16 years and over
M Imports of goods and services
MFI Median family income
MHF Private farm manhours, establishment basis
MHIF Index of farm manhours, 1972 = 100
MHINF Index of nonfarm manhours, 1972 = 100
MHNF Private nonfarm manhours, establishment basis
PCED Personal consumption expenditures, durable goods, constant dollars
PCEK Personal consumption expenditures, current dollars
PCEN Personal consumption expenditures, nondurable goods, constant dollars
PCES Personal consumption expenditures, services, constant dollars
PI Personal income
POP* Total noninstitutional population including Armed Forces stationed abroad
PRICE Labor price/cost spread, private economy
PS Personal savings, current dollars
PTFD Federal personal income tax payments
PTR* Personal transfers to foreigners
PTST S&L personal income tax payments
PUREC S&L purchases, education, constant dollars
PURFDC Federal purchases of goods and services, constant dollars
PURNEC S&L government purchases, noneducation, constant dollars
SCHL* Total school enrollment, ages 5-34
SD* Statistical discrepancy
SEMP* Ratio of full-time equivalent employees in the service industries to full-time equivalent private employees
SEREDC S&L government education compensation, constant dollars
SERFCC Federal civilian compensation, constant dollars
SERFMC Federal military compensation, constant dollars
SERNEC S&L noneducation compensation, constant dollars
SERSTK S&L compensation, current dollars
SICE Employer contributions for social insurance
SICFD* Contributions for other Federal social insurance programs
SICO Old Age Survival and Disability and Health Insurance (OASDHI) contributions
SICST S&L insurance funds
SICTOT Total social insurance contributions
SICU Social insurance contributions for unemployment insurance
SLSFD* Subsidies less current surplus of Federal Government enterprises

SLSST*	Subsidies less current surplus of S&L government enterprises
TIME*	Time trend, 1946=0
TRAN*	Total government transfer payments to persons
TRCP*	Federal corporate profits tax rate
TRG*	Federal tax rate on gasoline
TRMFI	Federal tax rate on median family income
TRO*	Tax rate for OASDHI
TRSTP*	S&L government transfers to persons
TRU*	Average employer contribution rate for unemployment insurance
T29*	Time trend, 1928=0
U*	Unemployment rate of the civilian labor force, age 16 and over
UCP	Undistributed corporate profits
URBAN*	Total population living in urban areas
WB*	Wage base for OASDHI
WPICR*	WPI for crude materials for further processing, 1972=100

Appendix C. Personal Consumption Model: Variables and Equations

Explanation of variables

(Consumer durable goods are designated (D), nondurable goods (N), and services (S).)

	Group 1	**F Food and tobacco**
(N)	1 FOP	Food for off-premise consumption
(N)	2 FPM	Purchased meals
(N)	3 FOO	Food furnished employees
(N)	4 FFD	Food produced and consumed on farms
(N)	5 TOB	Tobacco products
(N)	6 ALC	Alcoholic beverages
	Group 2	**CL Clothing, accessories, and jewelry**
(N)	7 SHU	Shoes
(S)	8 SCL	Shoe cleaning and repair
(N)	9 CLO	Clothing and luggage
(N)	10 MIC	Military issue clothing
(S)	11 LAU	Laundering and drycleaning
(D)	12 JRY	Jewelry and watches
(S)	13 COT	Other clothing maintenance services
	Group 3	**PC Personal care**
(N)	14 TLG	Toilet articles and preparations
(S)	15 BBB	Barbershops, beauty parlors, and baths
	Group 4	**H Housing**
(S)	16 OWN	Owner-occupied nonfarm dwellings
(S)	17 TEN	Nonfarm rental expenditures
(S)	18 FAR	Rental value of farmhouses
(S)	19 OHO	Other housing
	Group 5	**HOP Household operation**
(D)	20 FNR	Household furniture
(D)	21 APP	Household appliances
(D)	22 CHN	China, glassware, and utensils
(D)	23 ODH	Other durable housefurnishings
(N)	24 SDH	Semidurable housefurnishings
(N)	25 CLP	Cleaning and lighting supplies
(N)	26 STY	Stationery and writing supplies
(S)	27 ELC	Electricity
(S)	28 NGS	Natural gas
(S)	29 WAT	Water and sanitary services
(N)	30 FUL	Other fuels
(S)	31 TEL	Telephone and telegraph

(S)	32 DMS	Domestic service
(S)	33 OPO	Other household services

Group 6 MED Medical care expenses

(N)	34 DRG	Drug preparations and sundries
(D)	35 OPT	Ophthalmic and orthopedic products
(S)	36 PHY	Physicians
(S)	37 DEN	Dentists
(S)	38 OPS	Other professional services
(S)	39 PHO	Private hospitals and sanitariums
(S)	40 HIN	Health insurance

Group 7 PB Personal business

(S)	41 BRO	Brokerage charges and investment counselling
(S)	42 BNK	Bank service charges
(S)	43 IMP	Imputed bank and credit union services
(S)	44 LIF	Expense of handling life insurance
(S)	45 GAL	Legal services
(S)	46 FUN	Funeral and burial expenses
(S)	47 PBO	Other business services

Group 8 TR Transportation

(D)	48 CAR	Motor vehicles
(D)	49 TBA	Auto parts
(S)	50 REP	Automobile repair
(N)	51 GAO	Gasoline and oil
(S)	52 TOL	Road tolls
(S)	53 AIN	Automobile insurance less claims paid
(S)	54 STR	Bus and trolley car transportation
(S)	55 TAX	Taxicabs
(S)	56 CRR	Commuter rail transportation
(S)	57 IRR	Railway transportation
(S)	58 IBU	Intercity bus
(S)	59 IAI	Airline transportation
(S)	60 TRO	Other intercity transportation

Group 9 REC Recreation

(D)	61 BKS	Books and maps
(N)	62 MAG	Magazines, newspapers, and sheet music
(N)	63 TOY	Nondurable toys and sporting goods
(D)	64 WHG	Wheel goods, durable toys, and sports equipment
(D)	65 RAD	Radio and television receivers, records, and musical instruments
(S)	66 RTV	Radio and television repair
(N)	67 FLO	Flowers, seeds, and potted plants
(S)	68 MOV	Motion picture admissions
(S)	69 LEG	Legitimate theater admissions
(S)	70 SPE	Admissions to sports events
(S)	71 CLU	Clubs and fraternal organizations
(S)	72 COM	Commercial participant amusements
(S)	73 PAR	Parimutuel net receipts
(S)	74 REO	Other recreation services

	Group 10	**PED Private education and research**
(S)	75 HED	Private higher education
(S)	76 EED	Private elementary and secondary education
(S)	77 OED	Other private education and research

	Group 11	**REL Religious and welfare activities**
(S)	78 REL	Religious and welfare activities

	Group 12	**FTR Foreign travel and other, net**
(S)	79 FTV	Foreign travel by U.S. residents
(N)	80 ABD	Expenditures abroad by Government personnel
(S)	81 EXF	Expenditures in the United States by foreigners
(N)	82 REM	Personal remittances to foreigners

Other variables used in consumption model equations:

1	DPI	Disposable personal income, 1972 constant dollars
2	PPCE	Implicit price deflators for personal consumption expenditures
3	POP	Total population
4	POP16&	Population aged 16 and over
5	POP1834	Population between the ages of 18 and 34
6	STKAPP	Gross stocks of household appliances, 1972 constant dollars
7	STKCAR	Gross stocks of motor vehicles, 1972 constant dollars
8	STKCHN	Gross stocks of china, glassware, and utensils, 1972 constant dollars
9	STKFNR	Gross stocks of household furniture, 1972 constant dollars
10	STKHOP	Gross stocks of household operation, 1972 constant dollars
11	STKJRY	Gross stocks of jewelry and watches, 1972 constant dollars
12	STKODH	Gross stocks of other durable housefurnishings, 1972 constant dollars
13	STKOPT	Gross stocks of ophthalmic and orthopedic products, 1972 constant dollars
14	STKREC	Gross stocks of recreation, 1972 constant dollars

Other variables used in price model equations:

1	TIME	Time trend, 1945 = 1
2	ULC	Unit labor costs, private economy
3	ENGY	Producer price index of fuels and related products, and power, 1967 = 100

Personal Consumption Model Equations

12 Major product groups

1. $$\underset{}{F/POP} = \underset{(5.128)}{532.742} + \underset{(2.057)}{0.297}(F(-1)/POP(-1)) + \underset{(6.009)}{0.052}(DPI/POP - DPI(-1)/POP(-1)) + \underset{(5.319)}{0.054}(DPI(-1)/POP(-1))$$
$$\underset{(-3.301)}{-3.171}(PF/PPCE - PF(-1)/PPCE(-1)) - \underset{(-3.316)}{3.343}(PF(-1)/PPCE(-1)) + \underset{(2.346)}{417.778}(POP\ 1834/POP16\&)$$

R-squared = 0.978
D.W. = 1.392

2. $$CL/POP = \underset{(-0.550)}{-5.444} + \underset{(10.980)}{0.904}(CL(-1)/POP(-1)) + \underset{(5.278)}{0.074}(DPI/POP - DPI(-1)/POP(-1)) + \underset{(2.064)}{0.009}(DPI(-1)/POP(-1))$$
$$\underset{(-2.321)}{-1.435}(PCL/PPCE - PCL(-1)/PPCE(-1))$$

Cochrane/Orcutt RHO = −0.006
R-squared = 0.988
D.W. = 2.300

3. $$PC/POP = \underset{(4.578)}{14.519} + \underset{(52.167)}{0.962}(PC(-1)/POP(-1)) + \underset{(2.865)}{0.009}(DPI/POP - DPI(-1)/POP(-1))$$

$$-\underset{(-2.112)}{0.301}(PPC/PPCE - PPC(-1)/PPCE(-1)) - \underset{(-3.954)}{36.361}(POP1834/POP16\&)$$

Cochrane/Orcutt RHO = −0.055
R-squared = 0.992
D.W. = 1.565

4. $$H/POP = \underset{(36.509)}{0.988}(H(-1)/POP(-1)) + \underset{(1.356)}{0.007}(DPI/POP - DPI(-1)/POP(-1)) + \underset{(2.232)}{0.011}(DPI(-1)/POP(-1))$$

$$-\underset{(-1.418)}{0.082}(PH/PPCE - PH(-1)/PPCE(-1)) - \underset{(-2.873)}{0.135}(PH(-1)/PPCE(-1))$$

R-squared = 0.999
D.W. = 1.135

5. $$HOP/POP = \underset{(0.900)}{84.049} + \underset{(0.657)}{0.079}(HOP(-1)/POP(-1)) + \underset{(8.030)}{0.140}(DPI/POP - DPI(-1)/POP(-1)) + \underset{(7.492)}{0.143}$$

$$(DPI(-1)/POP(-1)) - \underset{(-1.463)}{1.477}(PHOP/PPCE - PHOP(-1)/PPCE(-1)) - \underset{(-1.503)}{1.516}(PHOP(-1)/$$

$$PPCE(-1)) - \underset{(-1.356)}{0.041}(STKHOP(-1)/POP16\&(-1)) + \underset{(1.163)}{154.485}(POP1834/POP16\&)$$

R-squared = 0.997
D.W. = 1.630

6. $$MED/POP = \underset{(-0.570)}{-1.230} + \underset{(92.353)}{1.039}(MED(-1)/POP(-1)) + \underset{(2.451)}{0.025}(DPI/POP - DPI(-1)/POP(-1))$$

$$-\underset{(-2.025)}{0.936}(PMED/PPCE - PMED(-1)/PPCE(-1))$$

Cochrane/Orcutt RHO = 0.020
R-squared = 0.998
D.W. = 1.835

7. $$PB/POP = \underset{(7.411)}{0.858}(PB(-1)/POP(-1)) + \underset{(2.232)}{0.020}(DPI/POP - DPI(-1)/POP(-1)) + \underset{(1.455)}{0.008}(DPI(-1)/POP(-1))$$

$$-\underset{(-3.562)}{1.194}(PPB/PPCE - PPB(-1)/PPCE(-1))$$

Cochrane/Orcutt RHO = −0.015
R-squared = 0.992
D.W. = 1.746

8. $$TR/POP = \underset{(1.849)}{0.320}(TR(-1)/POP(-1)) + \underset{(5.650)}{0.226}(DPI/POP - DPI(-1)/POP(-1)) + \underset{(3.698)}{0.085}(DPI(-1)/POP(-1))$$
$$\underset{(-1.415)}{-68.428}(POP1834/POP16\&)$$

Cochrane/Orcutt RHO = 0.056
R-squared = 0.977
D.W. = 1.884

9. $$REC/POP = \underset{(2.869)}{90.604} + \underset{(3.045)}{0.422}(REC(-1)/POP(-1)) + \underset{(4.937)}{0.060}(DPI/POP - DPI(-1)/POP(-1)) + \underset{(4.950)}{0.061}(DPI(-1)/$$
$$POP(-1)) \underset{(-3.897)}{-1.626}(PREC/PPCE - PREC(-1)/PPCE(-1)) \underset{(-3.887)}{-1.645}(PREC(-1)/PPCE(-1))$$
$$\underset{(-1.260)}{-0.028}(STKREC(-1)/POP16\&(-1))$$

R-squared = 0.997
D.W. = 1.598

10. $$PED/POP = \underset{(3.044)}{8.525} + \underset{(66.645)}{1.007}(PED(-1)/POP(-1)) + \underset{(2.614)}{0.006}(DPI/POP - DPI(-1)/POP(-1))$$
$$\underset{(-2.731)}{-23.128}(POP1834/POP16\&)$$

Cochrane/Orcutt RHO = 0.092
R-squared = 0.996
D.W. = 1.846

11. $$REL/POP = \underset{(1.560)}{1.764} + \underset{(31.342)}{0.970}(REL(-1)/POP(-1)) + \underset{(1.456)}{0.004}(DPI/POP - DPI(-1)/POP(-1))$$
$$\underset{(-3.655)}{-0.525}(PREL/PPCE - PREL(-1)/PPCE(-1))$$

Cochrane/Orcutt RHO = −0.019
R-squared = 0.978
D.W. = 2.651

12. $$FTR/POP = \underset{(3.073)}{13.080} + \underset{(14.220)}{0.706}(FTR(-1)/POP(-1)) - \underset{(-5.600)}{0.182}(PFTR/PPCE - PFTR(-1)/PPCE(-1))$$
$$\underset{(-5.386)}{-0.197}(PFTR(-1)/PPCE(-1)) + \underset{(2.091)}{37.604}(POP1834/POP16\&)$$

Cochrane/Orcutt RHO = 0.080
R-squared = 0.967
D.W. = 2.296

82 Detailed product categories

1. $$FOP/POP = \underset{(3.890)}{276.855} + \underset{(4.296)}{0.365}(FOP(-1)/POP(-1)) + \underset{(7.290)}{0.430}(F/POP - F(-1)/POP(-1)) + \underset{(7.201)}{0.401}(F(-1)/$$

$$POP(-1)) - 3.024(PFOP/PF - PFOP(-1)/PF(-1)) - 2.821(PFOP(-1)/PF(-1))$$
$$(-4.799) \qquad (-4.575)$$

R-squared = 0.983
D.W. = 0.591

2. $$FPM/POP = -17.348 + 0.770(FPM(-1)/POP(-1)) + 0.224(F/POP - F(-1)/POP(-)) + 0.065(F(-1)/POP(-1))$$
$$(-1.223) \qquad (5.319) \qquad (6.299) \qquad (1.662)$$

$$-0.104(PFPM/PF - PFPM(-1)/PF(-1))$$
$$(-1.976)$$

Cochrane/Orcutt RHO = 0.564
R-squared = 0.977
D.W. = 1.859

3. $$FOO/POP = 0.873(FOO(-1)/POP(-1)) + 0.002(F/POP - F(-1)/POP(-1)) + 0.002(F(-1)/POP(-1))$$
$$(9.361) \qquad (1.378) \qquad (1.378)$$

Cochrane/Orcutt RHO = 0.289
R-squared = 0.743
D.W. = 1.607

4. $$FFD/POP = -2.061 + 0.953(FFD(-1)/POP(-1)) + 0.003(F/POP - F(-1)/POP(-1)) + 0.003(F(-1)/POP(-1))$$
$$(-1.087) \qquad (46.802) \qquad (1.114) \qquad (1.114)$$

Cochrane/Orcutt RHO = −0.006
R-squared = 0.997
D.W. = 1.862

5. $$TOB/POP = 21.853 + 0.627(TOB(-1)/POP(-1)) + 0.050(F/POP - F(-1)/POP(-1))$$
$$(2.669) \qquad (4.523) \qquad (2.282)$$

$$-0.213(PTOB/PF - PTOB(-1)/PF(-1))$$
$$(-2.604)$$

Cochrane/Orcutt RHO = 0.088
R-squared = 0.575
D.W. = 1.979

6. $$ALC/POP = 39.663 + 0.503(ALC(-1)/(POP(-1)) + 0.040(F/POP - F(-1)/POP(-1)) + 0.049(F(-1)/POP(-1))$$
$$(2.330) \qquad (4.892) \qquad (4.773) \qquad (4.416)$$

$$-0.252(PALC/PF - PALC(-1)/PF(-1)) - 0.306(PALC(-1)/PF(-1))$$
$$(-3.187) \qquad (-3.320)$$

R-squared = 0.957
D.W. = 1.593

7. $$SHU/POP = 17.625 + 0.385(SHU(-1)/POP(-1)) + 0.084(CL/POP - CL(-1)/POP(-1)) +$$
$$(3.129) \qquad (2.792) \qquad (5.025)$$

$$0.079(CL(-1)/POP(-1)) - 0.171(PSHU/PCL - PSHU(-1)/PCL(-1)) - 0.161(PSHU(-1)/PCL(-1))$$
$$\quad (4.719) \qquad\qquad (-2.928) \qquad\qquad (-2.793)$$

R-squared = 0.916
D.W. = 1.749

8. $$SCL/POP = 0.096 + 0.911(SCL(-1)/POP(-1)) - 0.003(PSCL/PCL - PSCL(-1)/PCL(-1))$$
$$(0.979) \quad (15.631) \qquad\qquad (-1.351)$$

Cochrane/Orcutt RHO = 0.425
R-squared = 0.973
D.W. = 1.943

9. $$CLO/POP = 100.411 + 0.173(CLO(-1)/POP(-1)) + 0.686(CL/POP - CL(-1)/POP(-1)) + 0.666(CL(-1)/POP(-1))$$
$$(4.241) \quad (2.014) \qquad\qquad (11.570) \qquad\qquad (10.895)$$

$$-1.275(PCLO/PCL - PCLO(-1)/PCL(-1)) - 1.238(PCLO(-1)/PCL(-1))$$
$$(-6.122) \qquad\qquad (-5.665)$$

R-squared = 0.997
D.W. = 0.630

10. $$MIC/POP = 0.193 + 0.714(MIC(-1)/POP(-1)) - 0.004(PMIC/PCL - PMIC(-1) - PCL(-1))$$
$$(1.333) \quad (5.395) \qquad\qquad (-0.687)$$

Cochrane/Orcutt RHO = 0.422
R-squared = 0.792
D.W. = 1.816

11. $$LAU/POP = 0.965(LAU(-1)/POP(-1)) + 0.032(CL/POP - CL(-1)/POP(-1))$$
$$(132.814) \qquad\qquad (3.532)$$

Cochrane/Orcutt RHO = 0.532
R-squared = 0.994
D.W. = 2.003

12. $$JRY/POP = -1.301 + 0.392(JRY(-1)/POP(-1)) + 0.096(CL/POP - CL(-1)/POP(-1)) + 0.094$$
$$(-0.600) \quad (4.141) \qquad\qquad (9.320) \qquad\qquad (8.593)$$

$$(CL(-1)/POP(-1)) - 0.102(PJRY/PCL - PJRY(-1)/PCL(-1)) - 0.100(PJRY(-1)/$$
$$(-5.550) \qquad\qquad (-5.101)$$

$$PCL(-1)) - 0.013(STKJRY(-1)/POP16\&(-1))$$
$$(-1.690)$$

R-squared = 0.966
D.W. = 1.292

13. $$COT/POP = 0.066 + 1.009(COT(-1)/POP(-1)) + 0.017(CL/POP - CL(-1)/POP(-1))$$
$$(0.807) \quad (46.608) \qquad\qquad (4.643)$$

$$-0.037(PCOT/PCL - PCOT(-1)/PCL(-1))$$
$$(-2.985)$$

Cochrane/Orcutt RHO = -0.081
R-squared = 0.992
D.W. = 2.289

14. $$TLG/POP = \underset{(-3.749)}{-2.196} + \underset{(23.108)}{0.900}(TLG(-1)/POP(-1)) + \underset{(8.285)}{0.500}(PC/POP - PC(-1)/POP(-1)) +$$

$$\underset{(3.324)}{0.115}(PC(-1)/POP(-1)) - \underset{(-2.759)}{0.161}(PTLG/PPC - PTLG(-1)/PPC(-1))$$

Cochrane/Orcutt RHO = 0.008
R-squared = 0.999
D.W. = 2.292

15 $$BBB/POP = \underset{(4.332)}{2.305} + \underset{(29.648)}{0.859}(BBB(-1)POP(-1)) + \underset{(10.387)}{0.563}(PC/POP - PC(-1)/POP(-1))$$

$$\underset{(-3.718)}{-0.206}(PBBB/PPC - PBBB(-1)/PPC(-1))$$

Cochrane/Orcutt RHO = -0.008
R-squared = 0.980
D.W. = 2.051

16. $$OWN/POP = \underset{(-1.993)}{-11.009} + \underset{(6.764)}{0.764}(OWN(-1)/POP(-1)) + \underset{(9.674)}{0.710}(H/POP - H(-1)/POP(-1)) + \underset{(2.119)}{0.180}(H(-1)/$$

$$POP(-1))$$

Cochrane/Orcutt RHO = 0.540
R-squared = 0.999
D.W. = 2.260

17. $$TEN/POP = \underset{(1.396)}{3.551} + \underset{(6.068)}{0.741}(TEN(-1)/POP(-1)) + \underset{(4.766)}{0.236}(H/POP - H(-1)/POP(-1)) + \underset{(2.137)}{0.063}(H(-1)/$$

$$POP(-1))$$

Cochrane/Orcutt RHO = 0.724
R-squared = 0.999
D.W. = 2.165

18. $$FAR/POP = \underset{(67.042)}{0.963}(FAR(-1)/POP(-1)) - \underset{(-0.699)}{0.001}(PFAR/PH - PFAR(-1)/PH(-1))$$

Cochrane/Orcutt RHO = 0.920
R-squared = 0.999
D.W. = 2.455

19. $$OHO/POP = \underset{(1.896)}{7.385} + \underset{(5.357)}{0.651}(OHO(-1)/POP(-1)) + \underset{(3.217)}{0.020}(H(-1)/POP(-1))$$

$$-0.113(POHO(-1)/PH(-1))$$
$$(-2.032)$$

Cochrane/Orcutt RHO = –0.030
R-squared = 0.986
D.W. = 1.947

20. $$FNR/POP = \underset{(3.755)}{36.214} + \underset{(1.718)}{0.229}(FNR(-1)/POP(-1)) + \underset{(5.735)}{0.084}(HOP/POP - HOP(-1)/POP(-1)) + \underset{(6.000)}{0.080}$$

$$(HOP(-1)/POP(-1)) - \underset{(-3.509)}{0.278}(PFNR/PHOP - PFNR(-1)/PHOP(-1)) - \underset{(-3.361)}{0.263}(PFNR(-1)/$$

$$PHOP(-1)) - \underset{(-1.746)}{0.018}(STKFNR(-1)/POP16\&(-1))$$

R-squared = 0.981
D.W. = 0.933

21. $$APP/POP = \underset{(-4.852)}{-6.678} + \underset{(5.621)}{0.649}(APP(-1)/POP(-1)) + \underset{(9.094)}{0.106}(HOP/POP - HOP(-1)/POP(-1)) + \underset{(3.924)}{0.047}$$

$$(HOP(-1)/POP(-1)) - \underset{(-6.085)}{0.311}(PAPP/PHOP - PAPP(-1)/PHOP(-1)) - \underset{(-2.355)}{0.007}(STKAPP(-1)/$$

$$POP16\&(-1))$$

Cochrane/Orcutt RHO = 0.007
R-squared = 0.996
D.W. = 2.120

22. $$CHN/POP = \underset{(9.5333)}{25.757} + \underset{(7.632)}{0.476}(CHN(-1)/POP(-1)) + \underset{(9.493)}{0.041}(HOP/POP - HOP(-1)/POP(-1)) + \underset{(9.278)}{0.041}$$

$$(HOP(-1)/POP(-1)) - \underset{(-7.810)}{0.295}(PCHN/PHOP - PCHN(-1)/PHOP(-1)) - \underset{(-7.689)}{0.296}(PCHN(-1)/$$

$$PHOP(-1)) - \underset{(-4.272)}{0.023}(STKCHN(-1)/POP16\&(-1))$$

R-squared = 0.979
D.W. = 1.268

23. $$ODH/POP = \underset{(3.106)}{27.423} + \underset{(8.500)}{0.764}(ODH(-1)/POP(-1)) + \underset{(9.943)}{0.125}(HOP/POP - HOP(-1)/POP(-1)) + \underset{(4.367)}{0.053}$$

$$(HOP(-1)/POP(-1)) - \underset{(-3.468)}{0.257}(PODH(-1)/PHOP(-1)) - \underset{(-4.046)}{0.027}(STKODH(-1)/POP16\&(-1))$$

Cochrane/Orcutt RHO = –0.070
R-squared = 0.998
D.W. = 2.237

24. $SDH/POP = \underset{(-0.214)}{-0.109} + \underset{(49.067)}{0.983}(SDH(-1)/POP(-1)) + \underset{(9.719)}{0.093}(HOP/POP - HOP(-1)/POP(-1))$

$\underset{(-3.526)}{-0.098}(PSDH/PHOP - PSDH(-1)/PHOP(-1))$

Cochrane/Orcutt RHO = 0.052
R-squared = 0.992
D.W. = 1.410

25. $CLP/POP = \underset{(1.527)}{2.028} + \underset{(23.196)}{0.923}(CLP(-1)/POP(-1)) + \underset{(6.607)}{0.109}(HOP/POP - HOP(-1)/POP(-1))$

Cochrane/Orcutt RHO = 0.532
R-squared = 0.990
D.W. = 1.980

26. $STY/POP = \underset{(2.189)}{0.723} + \underset{(23.775)}{0.921}(STY(-1)/POP(-1)) + \underset{(4.271)}{0.025}(HOP/POP - HOP(-1)/POP(-1))$

$\underset{(-3.302)}{-0.100}(PSTY/PHOP - PSTY(-1)/PHOP(-1))$

Cochrane/Orcutt RHO = −0.059
R-squared = 0.964
D.W. = 1.975

27. $ELC/POP = \underset{(-1.913)}{-1.540} + \underset{(40.566)}{0.960}(ELC(-1)/POP(-1)) + \underset{(3.556)}{0.028}(HOP/POP - HOP(-1)/POP(-1)) + \underset{(2.880)}{0.013}$

$(HOP(-1)/POP(-1))$

Cochrane/Orcutt RHO = −0.655
R-squared = 0.999
D.W. = 1.717

28. $NGS/POP = \underset{(6.231)}{1.583} + \underset{(90.286)}{0.964}(NGS(-1)/POP(-1)) - \underset{(-3.553)}{0.067}(PNGS/PHOP - PNGS(-1)/PHOP(-1))$

Cochrane/Orcutt RHO = −0.085
R-squared = 0.996
D.W. = 1.715

29. $WAT/POP = \underset{(1.135)}{0.372} + \underset{(42.650)}{0.995}(WAT(-1)/POP(-1)) + \underset{(2.348)}{0.014}(HOP/POP - HOP(-1)/POP(-1))$

$\underset{(-3.262)}{-0.096}(PWAT/PHOP - PWAT(-1)/PHOP(-1))$

Cochrane/Orcutt RHO = −0.030
R-squared = 0.987
D.W. = 1.302

30. $$FUL/POP = \underset{(1.189)}{2.493} + \underset{(12.797)}{0.880}(FUL(-1)/POP(-1)) + \underset{(5.072)}{0.087}(HOP/POP - HOP(-1)/POP(-1)) \underset{(-4.879)}{-0.115}(PFUL/PHOP - PFUL(-1)/PHOP(-1))$$

Cochrane/Orcutt RHO = 0.134
R-squared = 0.898
D.W. = 2.073

31. $$TEL/POP = \underset{(1.325)}{7.127} + \underset{(17.333)}{0.953}(TEL(-1)/POP(-1)) + \underset{(2.007)}{0.018}(HOP/POP - HOP(-1)/POP(-1)) + \underset{(1.985)}{0.016}(HOP(-1)/POP(-1)) - \underset{(-1.946)}{0.098}(PTEL/PHOP - PTEL(-1)/PHOP(-1)) - \underset{(-1.924)}{0.088}(PTEL(-1)/PHOP(-1))$$

R-squared = 0.999
D.W. = 2.215

32. $$DMS/POP = \underset{(4.174)}{39.027} + \underset{(3.125)}{0.440}(DMS(-1)/POP(-1)) + \underset{(1.690)}{0.031}(HOP/POP - HOP(-1)/POP(-1)) + \underset{(1.741)}{0.035}(HOP(-1)/POP(-1)) - \underset{(-3.304)}{0.377}(PDMS/PHOP - PDMS(-1)/PHOP(-1)) - \underset{(-3.608)}{0.432}(PDMS(-1)/PHOP(-1))$$

R-squared = 0.968
D.W. = 1.671

33. $$OPO/POP = \underset{(0.958)}{0.570} + \underset{(7.222)}{0.817}(OPO(-1)/POP(-1)) + \underset{(6.046)}{0.056}(HOP/POP - HOP(-1)/POP(-1)) + \underset{(1.601)}{0.010}(HOP(-1)/POP(-1)) - \underset{(-1.640)}{0.020}(POPO/PHOP - POPO(-1)/PHOP(-1)) - \underset{(-1.205)}{0.003}(POPO(-1)/PHOP(-1))$$

R-squared = 0.987
D.W. = 1.121

34. $$DRG/POP = \underset{(2.015)}{20.534} + \underset{(4.417)}{0.686}(DRG(-1)/POP(-1)) + \underset{(2.072)}{0.065}(MED/POP - MED(-1)/POP(-1)) \underset{(-1.798)}{-0.080}(PDRG/PMED - PDRG(-1)/PMED(-1)) - \underset{(-1.933)}{0.088}(PDRG(-1)/PMED(-1))$$

Cochrane/Orcutt RHO = 0.333
R-squared = 0.996
D.W. = 1.863

35. $$OPT/POP = \underset{(2.334)}{1.290} + \underset{(5.879)}{0.958}(OPT(-1)/POP(-1)) + \underset{(1.937)}{0.037}(MED/POP - MED(-1)/POP(-1))$$

$$-\underset{(-1.432)}{0.041}(POPT/PMED - POPT(-1)/PMED(-1)) - \underset{(-1.208)}{0.024}(STKOPT(-1)/POP16\&(-1))$$

Cochrane/Orcutt RHO = −0.075
R-squared = 0.796
D.W. = 1.839

36. $$PHY/POP = \underset{(2.544)}{6.168} + \underset{(4.096)}{0.619}(PHY(-1)/POP(-1)) + \underset{(5.316)}{0.276}(MED/POP - MED(-1)/POP(-1)) + \underset{(2.331)}{0.073}$$

$$(MED(-1)/POP(-1)) - \underset{(-2.681)}{0.388}(PPHY/PMED - PPHY(-1)/PMED(-1))$$

Cochrane/Orcutt RHO = 0.050
R-squared = 0.995
D.W. = 2.043

37. $$DEN/POP = \underset{(1.586)}{17.210} + \underset{(4.520)}{0.637}(DEN(-1)/POP(-1)) + \underset{(3.259)}{0.035}(MED/POP - MED(-1)/POP(-1)) + \underset{(3.073)}{0.032}$$

$$(MED(-1)/POP(-1)) - \underset{(-1.657)}{0.175}(PDEN/PMED - PDEN(-1)/PMED(-1)) - \underset{(-1.588)}{0.162}(PDEN(-1)$$

$$/PMED(-1))$$

R-squared = 0.984
D.W. = 1.928

38. $$OPS/POP = \underset{(1.315)}{1.529} + \underset{(7.984)}{0.815}(OPS(-1)/POP(-1)) + \underset{(2.402)}{0.089}(MED/POP - MED(-1)/POP(-1))$$

Cochrane/Orcutt RHO = 0.443
R-squared = 0.891
D.W. = 2.135

39. $$PHO/POP = \underset{(1.138)}{15.837} + \underset{(8.193)}{0.747}(PHO(-1)/POP(-1)) + \underset{(3.742)}{0.183}(MED/POP - MED(-1)/POP(-1)) + \underset{(3.396)}{0.166}$$

$$(MED(-1)/POP(-1)) - \underset{(-1.727)}{0.364}(PPHO/PMED - PPHO(-1)/PMED(-1)) - \underset{(-1.703)}{0.330}$$

$$(PPHO(-1)/PMED(-1))$$

R-squared = 0.998
D.W. = 1.098

40. $$HIN/POP = \underset{(4.018)}{7.020} + \underset{(4.579)}{0.430}(HIN(-1)/POP(-1)) + \underset{(4.463)}{0.043}(MED/POP - MED(-1)/POP(-1)) + \underset{(6.075)}{0.050}$$

$$(MED(-1)/POP(-1)) - \underset{(-3.024)}{0.046}(PHIN/PMED - PHIN(-1)/$$

$$PMED(-1)) - \underset{(-3.187)}{0.053}(PHIN(-1)/PMED(-1))$$

R-squared = 0.991
D.W. = 1.447

41. $BRO/POP = 5.088 + 0.801(BRO(-1)/POP(-1)) + 0.796(PB/POP - PB(-1)/POP(-1))$
(5.133) (15.472) (16.812)

$-0.056(PBRO(-1)/PPB(-1))$
(−5.207)

Cochrane/Orcutt RHO = 0.009
R-squared = 0.949
D.W. = 2.146

42. $BNK/POP = 4.223 + 0.460(BNK(-1)/POP(-1)) + 0.034(PB/POP - PB(-1)/POP(-1)) + 0.030$
(3.160) (4.086) (4.802) (4.576)

$(PB(-1)/POP(-1)) - 0.040(PBNK/PPB - PBNK(-1)/PPB(-1)) - 0.035(PBNK(-1)/PPB(-1))$
(−4.638) (−4.178)

R-squared = 0.994
D.W. = 1.563

43. $IMP/POP = -6.134 + 0.888(IMP(-1)/POP(-1)) + 0.065(PB/POP - PB(-1)/POP(-1)) + 0.086$
(−3.474) (12.011) (1.472) (2.516)
$(PB(-1)/POP(-1))$

Cochrane/Orcutt RHO = 0.090
R-squared = 0.997
D.W. = 1.788

44. $LIF/POP = 39.262 + 0.367(LIF(-1)/POP(-1)) + 0.051(PB/POP - PB(-1)/POP(-1)) + 0.054(PB(-1)/$
(4.253) (2.067) (2.339) (2.476)

$POP(-1)) - 0.232(PLIF/PPB - PLIF(-1)/PPB(-1)) - 0.244(PLIF(-1)/PPB(-1))$
(−3.695) (−4.040)

R-squared = 0.961
D.W. = 1.841

45. $GAL/POP = 3.359 + 0.659(GAL(-1)/POP(-1)) + 0.080(PB/POP - PB(-1)/POP(-1)) + 0.065$
(1.480) (5.307) (1.998) (3.000)

$(PB(-1)/POP(-1)) - 0.060(PGAL(-1)/PPB(-1))$
(−1.740)

Cochrane/Orcutt RHO = −0.161
R-squared = 0.973
D.W. = 1.898

46. $FUN/POP = 0.981(FUN(-1)/POP(-1)) + 0.054(PB/POP - PB(-1)/POP(-1))$
(74.740) (2.546)

$-0.060(PFUN/PPB - PFUN(-1)/PPB(-1))$
(−2.310)

Cochrane/Orcutt RHO = −0.031
R-squared = 0.845
D.W. = 1.445

47. $PBO/POP = \underset{(2.074)}{1.703} + \underset{(6.936)}{0.652}(PBO(-1)/POP(-1)) + \underset{(3.800)}{0.020}(PB/POP - PB(-1)/POP(-1)) + \underset{(3.431)}{0.021}(PB(-1)/POP(-1)) - \underset{(-2.988)}{0.011}(PPBO/PPB - PPBO(-1)/PPB(-1)) - \underset{(-2.851)}{0.012}(PPBO(-1)/PPB(-1))$

R-squared = 0.988
D.W. = 1.683

48. $CAR/POP = \underset{(-0.688)}{-2.276} + \underset{(12.919)}{0.712}(CAR(-1)/POP(-1)) + \underset{(38.215)}{0.862}(TR/POP - TR(-1)/POP(-1)) + \underset{(3.514)}{0.141}(TR(-1)/POP(-1)) - \underset{(-2.313)}{0.077}(PCAR/PTR - PCAR(-1)/PTR(-1)) - \underset{(-1.561)}{0.013}(PCAR(-1)/PTR(-1)) - \underset{(-1.497)}{0.006}(STKCAR(-1)/POP16\&(-1))$

R-squared = 0.998
D.W. = 1.685

49. $TBA/POP = \underset{(1.534)}{4.948} + \underset{(7.721)}{0.665}(TBA(-1)/POP(-1)) + \underset{(4.383)}{0.019}(TR/POP - TR(-1)/POP(-1)) + \underset{(3.843)}{0.024}(TR(-1)/POP(-1)) - \underset{(-2.656)}{0.046}(PTBA/PTR - PTBA(-1)/PTR(-1)) - \underset{(-2.785)}{0.057}(PTBA(-1)/PTR(-))$

R-squared = 0.988
D.W. = 1.919

50. $REP/POP = \underset{(0.505)}{0.657} + \underset{(26.961)}{0.994}(REP(-1)/POP(-1)) + \underset{(3.939)}{0.021}(TR/POP - TR(-1)/POP(-1)) + \underset{(1.905)}{0.012}(TR(-1)/POP(-1)) - \underset{(-1.741)}{0.035}(PREP(-1)/PTR(-1))$

Cochrane/Orcutt RHO = −0.400
R-squared = 0.999
D.W. = 2.011

51. $GAO/POP = \underset{(3.771)}{20.286} + \underset{(18.376)}{0.815}(GAO(-1)/POP(-1)) + \underset{(4.145)}{0.047}(TR/POP - TR(-1)/POP(-1)) + \underset{(4.046)}{0.047}(TR(-1)/POP(-1)) - \underset{(-4.105)}{0.169}(PGAO/PTR - PGAO(-1)/PTR(-1)) - \underset{(-3.762)}{0.167}(PGAO(-1)/PTR(-1))$

R-squared = 0.997
D.W. = 1.475

52. $$TOL/POP = \underset{(2.122)}{0.397} + \underset{(31.523)}{0.962}(TOL(-1)/POP(-1)) + \underset{(3.238)}{0.002}(TR/POP - TR(-1)/POP(-1))$$
$$\underset{(-1.704)}{-0.002}(PTOL(-1)/PTR(-1))$$

Cochrane/Orcutt RHO = 0.054
R-squared = 0.998
D.W. = 1.806

53. $$AIN/POP = \underset{(-1.498)}{-0.810} + \underset{(6.958)}{0.500}(AIN(-1)/POP(-1)) + \underset{(1.713)}{0.010}(TR/POP - TR(-1)/POP(-1)) + \underset{(6.852)}{0.029}$$
$$(TR(-1)/POP(-1)) \underset{(-5.044)}{-0.059}(PAIN/PTR - PAIN(-1)/PTR(-1))$$

Cochrane/Orcutt RHO = −0.033
R-squared = 0.985
D.W. = 1.658

54. $$STR/POP = \underset{(3.364)}{3.967} + \underset{(44.424)}{0.813}(STR(-1)/POP(-1)) - \underset{(-5.892)}{0.097}(PSTR/PTR - PSTR(-1)/PTR(-1))$$
$$\underset{(-2.262)}{-0.028}(PSTR(-1)/PTR(-1))$$

Cochrane/Orcutt RHO = 0.331
R-squared = 0.999
D.W. = 1.947

55. $$TAX/POP = \underset{(3.056)}{3.966} + \underset{(10.250)}{0.686}(TAX(-1)/POP(-1)) - \underset{(-4.042)}{0.078}(PTAX/PTR - PTAX(-1)/PTR(-1))$$
$$\underset{(-2.492)}{-0.028}(PTAX(-1)/PTR(-1))$$

Cochrane/Orcutt RHO = 0.095
R-squared = 0.973
D.W. = 1.712

56. $$CRR/POP = \underset{(3.219)}{0.555} + \underset{(14.168)}{0.760}(CRR(-1)/POP(-1)) - \underset{(-4.314)}{0.008}(PCRR/PTR - PCRR(-1)/PTR(-1))$$
$$\underset{(-2.668)}{-0.004}(PCRR(-1)/PTR(-1))$$

Cochrane/Orcutt RHO = 0.250
R-squared = 0.992
D.W. = 1.740

57. $IRR/POP = \underset{(1.357)}{0.166} + \underset{(17.266)}{0.852}(IRR(-1)/POP(-1)) - \underset{(-0.866)}{0.007}(PIRR/PTR - PIRR(-1)/PTR(-1))$

Cochrane/Orcutt RHO = 0.283
R-squared = 0.973
D.W. = 1.623

58. $IBU/POP = \underset{(2.891)}{2.641} + \underset{(6.445)}{0.703}(IBU(-1)/POP(-1)) + \underset{(1.592)}{0.002}(TR(-1)/POP(-1))$

$\quad - \underset{(-3.474)}{0.034}(PIBU/PTR - PIBU(-1)/PTR(-1)) - \underset{(-2.894)}{0.029}(PIBU(-1)/PTR(-1))$

Cochrane/Orcutt RHO = 0.639
R-squared = 0.976
D.W. = 1.933

59. $IAI/POP = \underset{(0.392)}{0.533} + \underset{(11.778)}{0.803}(IAI(-1)/POP(-1)) + \underset{(3.457)}{0.010}(TR/POP - TR(-1)/POP(-1)) + \underset{(3.097)}{0.011}$

$\quad (TR(-1)/POP(-1)) - \underset{(-2.292)}{0.025}(PIAI/PTR - PIAI(-1)/PTR(-1)) - \underset{(-2.251)}{0.027}(PIAI(-1)/$

$\quad PTR(-1))$

R-squared = 0.994
D.W. = 1.436

60. $TRO/POP = \underset{(1.555)}{0.137} + \underset{(16.641)}{0.982}(TRO(-1)/POP(-1)) - \underset{(-1.385)}{0.001}(PTRO(-1)/PTR(-1))$

Cochrane/Orcutt RHO = 0.216
R-squared = 0.942
D.W. = 1.985

61. $BKS/POP = \underset{(9.438)}{0.812}(BKS(-1)/POP(-1)) + \underset{(1.040)}{0.019}(REC/POP - REC(-1)/POP(-1)) + \underset{(2.342)}{0.013}$

$\quad (REC(-1)/POP(-1)) - \underset{(-1.501)}{0.140}(PBKS/PREC - PBKS(-1)/PREC(-1))$

Cochrane/Orcutt RHO = 0.011
R-squared = 0.952
D.W. = 1.930

62. $MAG/POP = \underset{(4.604)}{18.155} + \underset{(10.350)}{0.808}(MAG(-1)/POP(-1)) + \underset{(4.768)}{0.089}(REC/POP - REC(-1)/POP(-1))$

$\quad + \underset{(4.971)}{0.089}(REC(-1)/POP(-1))\ \underset{(-4.148)}{0.336}(PMAG/PREC - PMAG(-1)/PREC(-1)) - \underset{(-4.330)}{0.334}$

$\quad (PMAG(-1)/PREC(-1))$

R-squared = 0.903
D.W. = 1.851

63. $$TOY/POP = \underset{(1.476)}{0.552} + \underset{(14.905)}{0.781}(TOY(-1)/POP(-1)) + \underset{(9.605)}{0.149}(REC/POP - REC(-1)/POP(-1)) + \underset{(3.419)}{0.025}(REC(-1)/POP(-1))$$

Cochrane/Orcutt RHO = 0.173
R-squared = 0.988
D.W. = 1.940

64. $$WHG/POP = \underset{(0.661)}{2.069} + \underset{(2.997)}{0.386}(WHG(-1)/POP(-1)) + \underset{(5.774)}{0.111}(REC/POP - REC(-1)/POP(-1)) + \underset{(5.322)}{0.120}(REC(-1)/POP(-1)) - \underset{(-3.760)}{0.086}(PWHG/PREC - PWHG(-1)/PREC(-1)) - \underset{(-3.466)}{0.093}(PWHG(-1)/PREC(-1))$$

R-squared = 0.993
D.W. = 1.306

65. $$RAD/POP = \underset{(-4.637)}{-12.276} + \underset{(5.906)}{0.614}(RAD(-1)/POP(-1)) + \underset{(7.011)}{0.240}(REC/POP - REC(-1)/POP(-1)) + \underset{(4.222)}{0.148}(REC(-1)/POP(-)) - \underset{(-2.280)}{0.018}(PRAD/PREC - PRAD(-1)/PREC(-1)) - \underset{(-1.587)}{0.011}(PRAD(-1)/PREC(-1))$$

R-squared = 0.999
D.W. = 1.650

66. $$RTV/POP = \underset{(3.727)}{0.503} + \underset{(15.640)}{0.805}(RTV(-1)/POP(-1)) + \underset{(2.291)}{0.014}(REC/POP - REC(-1)/POP(-1)) + \underset{(2.254)}{0.002}(REC(-1)/POP(-1))$$

Cochrane/Orcutt RHO = −0.106
R-squared = 0.982
D.W. = 2.105

67. $$FLO/POP = \underset{(1.865)}{0.210} + \underset{(51.531)}{0.981}(FLO(-1)/POP(-1)) + \underset{(5.480)}{0.055}(REC/POP - REC(-1)/POP(-1)) - \underset{(-2.082)}{0.007}(PFLO/PREC - PFLO(-1)/PREC(-1))$$

Cochrane/Orcutt RHO = −0.631
R-squared = 0.993
D.W. = 1.944

68. $$\mathrm{MOV/POP} = \underset{(50.771)}{0.905}(\mathrm{MOV}(-1)/\mathrm{POP}(-1)) + \underset{(3.029)}{0.031}(\mathrm{REC/POP} - \mathrm{REC}(-1)/\mathrm{POP}(-1)) + \underset{(2.073)}{0.021}$$
$$(\mathrm{REC}(-1)/\mathrm{POP}(-1)) - \underset{(-2.066)}{0.059}(\mathrm{PMOV/PREC} - \mathrm{PMOV}(-1)/\mathrm{PREC}(-1)) - \underset{(-1.600)}{0.040}$$
$$(\mathrm{PMOV}(-1)/\mathrm{PREC}(-1))$$

R-squared = 0.985
D.W. = 1.989

69. $$\mathrm{LEG/POP} = \underset{(1.856)}{1.200} + \underset{(6.556)}{0.792}(\mathrm{LEG}(-1)/\mathrm{POP}(-1)) + \underset{(4.680)}{0.007}(\mathrm{REC/POP} - \mathrm{REC}(-1)/\mathrm{POP}(-1)) + \underset{(5.206)}{0.008}$$
$$(\mathrm{REC}(-1)/\mathrm{POP}(-1)) - \underset{(-3.623)}{0.021}(\mathrm{PLEG/PREC} - \mathrm{PLEG}(-1)/\mathrm{PREC}(-1)) - \underset{(-3.885)}{0.024}$$
$$(\mathrm{PLEG}(-1)/\mathrm{PREC}(-1))$$

R-squared = 0.902
D.W. = 1.754

70. $$\mathrm{SPE/POP} = \underset{(3.150)}{2.576} + \underset{(37.683)}{0.979}(\mathrm{SPE}(-1)/\mathrm{POP}(-1)) - \underset{(-2.821)}{0.029}(\mathrm{PSPE/PREC} - \mathrm{PSPE}(-1)/\mathrm{PREC}(-1))$$
$$-\underset{(-3.089)}{0.029}(\mathrm{PSPE/PREC} - \mathrm{PSPE}(-1)/\mathrm{PREC}(-1))$$

Cochrane/Orcutt RHO = 0.218
R-squared = 0.992
D.W. = 2.333

71. $$\mathrm{CLU/POP} = \underset{(3.251)}{4.796} + \underset{(3.852)}{0.555}(\mathrm{CLU}(-1)/\mathrm{POP}(-1)) + \underset{(2.301)}{0.002}(\mathrm{REC/POP} - \mathrm{REC}(-1)/\mathrm{POP}(-1)) + \underset{(2.144)}{0.002}$$
$$(\mathrm{REC}(-1)/\mathrm{POP}(-1)) - \underset{(-2.968)}{0.027}(\mathrm{PCLU/PREC} - \mathrm{PCLU}(-1)/\mathrm{PREC}(-1)) - \underset{(-2.711)}{0.026}$$
$$(\mathrm{PCLU}(-1)/\mathrm{PREC}(-1))$$

R-squared = 0.694
D.W. = 1.771

72. $$\mathrm{COM/POP} = \underset{(1.623)}{1.181} + \underset{(13.644)}{0.889}(\mathrm{COM}(-1)/\mathrm{POP}(-1)) + \underset{(3.627)}{0.032}(\mathrm{REC/POP} - \mathrm{REC}(-1)/\mathrm{POP}(-1))$$

Cochrane/Orcutt RHO = 0.733
R-squared = 0.989
D.W. = 1.961

73. $$\mathrm{PAR/POP} = \underset{(3.907)}{3.029} + \underset{(13.060)}{0.903}(\mathrm{PAR}(-1)/\mathrm{POP}(-1)) + \underset{(3.635)}{0.008}(\mathrm{REC/POP} - \mathrm{REC}(-1)/\mathrm{POP}(-1)) + \underset{(3.142)}{0.007}$$

$$(REC(-1)/POP(-1)) - \underset{(-4.685)}{0.047}(PPAR/PREC - PPAR(-1)/PREC(-1)) - \underset{(-3.884)}{0.040}$$

$$PPAR(-1)/PREC(-1))$$

R-squared = 0.970
D.W. = 1.579

74. $$REO/POP = \underset{(1.581)}{6.673} + \underset{(40.134)}{0.985}(REO(-1)/POP(-1)) + \underset{(3.093)}{0.050}(REC/POP - REC(-1)/POP(-1))$$

$$-\underset{(-1.198)}{0.060}(PREO/PREC - PREO(-1)/PREC(-1)) - \underset{(-1.429)}{0.063}(PREO(-1)/PREC(-1))$$

Cochrane/Orcutt RHO = 0.340
R-squared = 0.996
D.W. = 1.839

75. $$HED/POP = \underset{(2.230)}{1.175} + \underset{(1.641)}{0.294}(HED(-1)/POP(-1)) + \underset{(4.844)}{0.305}(PED/POP - PED(-1)/POP(-1)) + \underset{(3.926)}{0.290}$$

$$(PED(-1)/POP(-1))$$

Cochrane/Orcutt RHO = 0.548
R-squared = 0.996
D.W. = 1.585

76. $$EED/POP = \underset{(1.929)}{0.859} + \underset{(27.461)}{0.945}(EED(-1)/POP(-1)) + \underset{(4.593)}{0.156}(PED/POP - PED(-1)/POP(-1))$$

Cochrane/Orcutt RHO = 0.720
R-squared = 0.997
D.W. = 1.761

77. $$OED/POP = \underset{(49.851)}{0.976}(OED(-1)/POP(-1)) + \underset{(9.818)}{0.622}(PED/POP - PED(-1)/POP(-1))$$

$$-\underset{(-2.566)}{0.011}(POED/PPED - POED(-1)/PPED(-1))$$

Cochrane/Orcutt RHO = 0.700
R-squared = 0.993
D.W. = 1.959

78. $$REL/POP = \underset{(1.560)}{1.764} + \underset{(31.342)}{0.970}(REL(-1)/POP(-1)) + \underset{(1.456)}{0.004}(DIP/POP - DPI(-1)/POP(-1))$$

$$-\underset{(-3.655)}{0.525}(PREL/PPCE - PREL(-1)/PPCE(-1))$$

Cochrane/Orcutt RHO = −0.019
R-squared = 0.978
D.W. = 2.651

79. $FTV/POP = -0.548 + 1.058(FTV(-1)/POP(-1)) + 0.539(FTR/POP - FTR(-1)/POP(-1))$
$(-1.607)\quad(68.651)\qquad(7.774)$

Cochrane/Orcutt RHO = −0.308
R-squared = 0.993
D.W. = 2.223

80. $ABD/POP = 0.774 + 0.891(ABD(-1)/POP(-1)) + 0.375(FTR/POP - FTR(-1)/POP(-1))$
$(1.868)\quad(17.674)\qquad(6.220)$

$-0.022(PABD/PFTR - PABD(-1)/PFTR(-1))$
(-1.847)

Cochrane/Orcutt RHO = 0.085
R-squared = 0.947
D.W. = 2.012

81. $EXF/POP = 0.358 + 1.074(EXF(-1)/POP(-1)) - 0.008(FTR(-1)/POP(-1))$
$(1.374)\quad(47.302)\qquad(-0.526)$

Cochrane/Orcutt RHO = −0.082
R-squared = 0.989
D.W. = 1.962

82. $REM/POP = -0.442 + 0.290(REM(-1)/POP(-1)) - 0.024(FTR/POP - FTR(-1)/POP(-1))$
$(-3.451)\quad(6.364)\qquad(-1.772)$

$-0.014\ (FTR(-1)/POP(-1))$
(-2.456)

Cochrane/Orcutt RHO = 0.336
R-squared = 0.897
D.W. = 2.399

Price Model Equations

12 Major product groups

1. $PF = -0.053 - 0.002(TIME) + 2.141(ULC(-1))$
$(-1.163)\quad(-0.556)\qquad(9.958)$

Cochrane/Orcutt RHO = 0.629
R-squared = 0.989
D.W. = 1.415

2. $PCL = 0.159 + 0.018(TIME) + 0.589(ULC(-1))$
$(1.434)\quad(2.866)\qquad(2.882)$

Cochrane/Orcutt RHO = 0.909
R-squared = 0.993
D.W. = 2.075

3. $PPC = 0.125 + 0.006(TIME) + 1.057(ULC(-1)) + 0.00130(ENGY(-1))$
$\qquad (5.288) \quad (3.394) \quad (5.612) \quad (5.270)$

Cochrane/Orcutt RHO = 0.244
R-squared = 0.997
D.W. = 2.060

4. $PH = 0.192 + 0.005(TIME) + 1.213(ULC(-1)) + 0.00016(ENGY(-1))$
$\qquad (6.254) \quad (1.961) \quad (5.088) \quad (0.569)$

Cochrane/Orcutt RHO = 0.616
R-squared = 0.997
D.W. = 1.427

5. $PHOP = 0.165 + 0.0001(TIME) + 1.339(ULC(-1)) + 0.00110(ENGY(-1))$
$\qquad (6.059) \quad (0.067) \quad (6.155) \quad (3.835)$

Cochrane/Orcutt RHO = 0.160
R-squared = 0.995
D.W. = 1.902

6. $PMED = -0.171 + 0.006(TIME) + 1.671(ULC(-1)) + 0.00089(ENGY(-1))$
$\qquad (-4.791) \quad (2.037) \quad (6.016) \quad (2.653)$

Cochrane/Orcutt RHO = 0.594
R-squared = 0.998
D.W. = 1.873

7. $PPB = -0.174 + 0.012(TIME) + 1.519(ULC(-1))$
$\qquad (-8.123) \quad (6.768) \quad (14.794)$

Cochrane/Orcutt RHO = 0.512
R-squared = 0.997
D.W. = 1.738

8. $PTR = 0.126 + 0.009(TIME) + 0.925(UCL(-1)) + 0.00132(ENGY(-1))$
$\qquad (6.522) \quad (5.870) \quad (5.994) \quad (6.336)$

Cochrane/Orcutt RHO = −0.158
R-squared = 0.996
D.W. = 2.113

9. $PREC = 0.237 + 0.012(TIME) + 0.777(ULC(-1)) + 0.00008(ENGY(-1))$
$\qquad (18.126) \quad (11.496) \quad (7.508) \quad (0.647)$

Cochrane/Orcutt RHO = 0.404
R-squared = 0.999
D.W. = 1.763

10. $PPED = -0.301 + 0.023(TIME) + 1.174(ULC(-1)) + 0.00055(ENGY(-1))$
$\qquad (-3.070) \quad (3.011) \quad (2.528) \quad (1.163)$

Cochrane/Orcutt RHO = 0.896
R-squared = 0.997
D.W. = 1.875

11. $\text{PREL} = -0.059 - 0.0002(\text{TIME}) + 1.866(\text{ULC}(-1)) + 0.00069(\text{ENGY}(-1))$
$(-1.545) \quad (-0.059) \quad (6.119) \quad (1.732)$

Cochrane/Orcutt RHO = 0.217
R-squared = 0.994
D.W. = 1.817

12. $\text{PFTR} = -0.219 - 0.009(\text{TIME}) + 2.828(\text{ULC}(-1)) + 0.00040(\text{ENGY}(-1))$
$(-1.087) \quad (-0.517) \quad (1.775) \quad (0.215)$

Cochrane/Orcutt RHO = 0.605
R-squared = 0.956
D.W. = 1.544

82 Detailed product categories

1. $\text{PFOP} = -0.075 - 0.006(\text{TIME}) + 2.444(\text{ULC}(-1))$
$(-1.289) \quad (-1.275) \quad (8.934)$

Cochrane/Orcutt RHO = 0.576
R-squared = 0.981
D.W. = 1.311

2. $\text{PFPM} = -0.564 + 0.032(\text{TIME}) + 1.210(\text{ULC}(-1)) + 0.00032(\text{ENGY}(-1))$
$(-3.455) \quad (3.033) \quad (2.231) \quad (0.594)$

Cochrane/Orcutt RHO = 0.917
R-squared = 0.996
D.W. = 1.734

3. $\text{PFOO} = -0.595 + 0.031(\text{TIME}) + 1.128(\text{ULC}(-1)) + 0.00062(\text{ENGY}(-1))$
$(-1.490)(1.453) \quad (1.148) \quad (0.652)$

Cochrane/Orcutt RHO = 0.933
R-squared = 0.985
D.W. = 1.162

4. $\text{PFFD} = 0.033 - 0.012(\text{TIME}) + 2.434(\text{ULC}(-1))$
$(0.372) \quad (-1.639) \quad (5.791)$

Cochrane/Orcutt RHO = 0.522
R-squared = 0.930
D.W. = 1.701

5. $\text{PTOB} = -0.094 + 0.021(\text{TIME}) + 0.866(\text{ULC}(-1))$
$(-1.767) \quad (6.631) \quad (7.935)$

Cochrane/Orcutt RHO = 0.898
R-squared = 0.999
D.W. = 1.680

6. $PALC = 0.201 + 0.003(TIME) + 1.268(ULC(-1))$
$(13.051) \quad (2.497) \quad (17.414)$

Cochrane/Orcutt RHO = 0.542
R-squared = 0.997
D.W. = 1.862

7. $PSHU = 0.031 + 0.023(TIME) + 0.603(ULC(-1))$
$(0.338) \quad (4.140) \quad (3.149)$

Cochrane/Orcutt RHO = 0.895
R-squared = 0.995
D.W. = 2.031

8. $PSCL = 0.201 + 0.011(TIME) + 0.817(UCLC(-1)) + 0.00078(ENGY(-1))$
$(3.553) \quad (2.205) \quad (1.904) \quad (1.578)$

Cochrane/Orcutt RHO = 0.703
R-squared = 0.993
D.W. = 1.478

9. $PCLO = 0.209 + 0.016(TIME) + 0.575(ULC(-1))$
$(1.987) \quad (2.653) \quad (2.749)$

Cochrane/Orcutt RHO = 0.901
R-squared = 0.989
D.W. = 2.058

10. $PMIC = 0.424 - 0.005(TIME) + 1.306(ULC(-1))$
$(15.184) \quad (-1.994) \quad (9.770)$

Cochrane/Orcutt RHO = 0.459
R-squared = 0.975
D.W. = 1.995

11. $PLAU = 0.030 + 0.007(TIME) + 1.258(ULC(-1)) + 0.00089(ENGY(-1))$
$(0.954) \quad (2.983) \quad (4.997) \quad (2.757)$

Cochrane/Orcutt RHO = 0.367
R-squared = 0.997
D.W. = 1.815

12. $PJRY = 0.547 - 0.010(TIME) + 1.312(ULC(-1)) + 0.00007(ENGY(-1))$
$(10.036) \quad (-2.114) \quad (3.080) \quad (0.138)$

Cochrane/Orcutt RHO = 0.572
R-squared = 0.966
D.W. = 1.741

13. $PCOT = 0.124 + 0.003(TIME) + 1.415(ULC(-1)) + 0.00040(ENGY(-1))$
$\quad\quad (4.290) \quad (1.191) \quad (6.156) \quad (1.338)$

Cochrane/Orcutt RHO = 0.305
R-squared = 0.996
D.W. = 1.806

14. $PTLG = 0.327 - 0.0004(TIME) + 1.019(ULC(-1)) + 0.00129(ENGY(-1))$
$\quad\quad (9.560) \quad (-0.157) \quad (3.748) \quad (3.670)$

Cochrane/Orcutt RHO = 0.272
R-squared = 0.991
D.W. = 2.006

15. $PBBB = -0.143 + 0.008(TIME) + 1.500(ULC(-1)) + 0.00128(ENGY(-1))$
$\quad\quad (-3.260) \quad (2.277) \quad (4.324) \quad (2.896)$

Cochrane/Orcutt RHO = 0.373
R-squared = 0.996
D.W. = 1.714

16. $POWN = 0.243 + 0.004(TIME) + 1.220(ULC(-1)) + 0.00002(ENGY(-1))$
$\quad\quad (7.229) \quad (1.271) \quad (4.815) \quad (0.074)$

Cochrane/Orcutt RHO = 0.719
R-squared = 0.997
D.W. = 1.386

17. $PTEN = 0.244 + 0.004(TIME) + 1.216(UCL(-1)) + 0.00002(ENGY(-1))$
$\quad\quad (7.278) \quad (1.290) \quad (4.823) \quad (0.075)$

Cochrane/Orcutt RHO = 0.721
R-squared = 0.997
D.W. = 1.387

18. $PFAR = -0.931 - 0.009(TIME) + 3.373(ULC(-1)) + 0.00387(ENGY(-1))$
$\quad\quad (-5.769) \quad (-0.704) \quad (2.657) \quad (2.456)$

Cochrane/Orcutt RHO = 0.500
R-squared = 0.986
D.W. = 1.752

19. $POHO = -0.008 + 0.005(TIME) + 1.550(ULC(-1)) + 0.00021(ENGY(-1))$
$\quad\quad (-0.214) \quad (1.753) \quad (5.208) \quad (0.562)$

Cochrane/Orcutt RHO = 0.423
R-squared = 0.996
D.W. = 1.320

20. $PFNR = 0.246 - 0.002(TIME) + 1.497(ULC(-1))$
$\quad\quad (9.546) \quad (-0.931) \quad (12.192)$

Cochrane/Orcutt RHO = 0.554
R-squared = 0.991
D.W. = 1.741

21. PAPP = 0.797 − 0.030(TIME) + 1.862(ULC(−1)) + 0.00025(ENGY(−1))
(15.075) (−6.899) (4.511) (0.503)

Cochrane/Orcutt RHO = 0.569
R-squared = 0.965
D.W. = 1.784

22. PCHN = −0.008 + 0.012(TIME) + 0.918(ULC(−1)) + 0.00178(ENGY(−1))
(−0.220) (4.215) (3.263) (4.987)

Cochrane/Orcutt RHO = 0.404
R-squared = 0.997
D.W. = 1.387

23. PODH = 0.603 + 0.011(TIME) + 0.00115(ENGY(−1))
(37.140) (10.753) (8.632)

Cochrane/Orcutt RHO = 0.467
R-squared = 0.985
D.W. = 1.783

24. PSDH = 0.391 − 0.007(TIME) + 1.452(ULC(−1)) + 0.00039(ENGY(−1))
(4.381) (−0.979) (2.092) (0.472)

Cochrane/Orcutt RHO = 0.604
R-squared = 0.959
D.W. = 2.319

25. PCLP = 0.115 + 0.001(TIME) + 0.933(ULC(−1)) + 0.00351(ENGY(−1))
(2.660) (0.137) (2.698) (7.770)

Cochrane/Orcutt RHO = 0.199
R-squared = 0.993
D.W. = 2.120

26. PSTY = 0.023 + 0.004(TIME) + 1.489(ULC(−1)) + 0.00089(ENGY(−1))
(0.418) (1.010) (3.373) (1.570)

Cochrane/Orcutt RHO = 0.333
R-squared = 0.990
D.W. = 1.702

27. PELC = 0.171 − 0.009(TIME) + 1.741(ULC(−1)) + 0.00155(ENGY(−1))
(3.093) (−2.096) (4.000) (2.851)

Cochrane/Orcutt RHO = 0.464
R-squared = 0.990
D.W. = 1.767

28. PNGS = −0.044 + 0.006(TIME) + 0.727(ULC(−1)) + 0.00443(ENGY(−1))
(−0.522) (0.895) (1.150) (5.530)

Cochrane/Orcutt RHO = 0.399
R-squared = 0.989
D.W. = 1.691

29. PWAT = −0.270 + 0.009(TIME) + 1.698(ULC(−1)) + 0.00075(ENGY(−1))
(−6.231) (2.640) (4.963) (1.741)

Cochrane/Orcutt RHO = 0.419
R-squared = 0.996
D.W. = 1.277

30. PFUL = −0.525 − 0.018(TIME) + 3.395(ULC(−1)) + 0.00335(ENGY(−1))
(−3.350) (−1.486) (2.720) (2.054)

Cochrane/Orcutt RHO = 0.203
R-squared = 0.967
D.W. = 1.878

31. PTEL = 0.620 + 0.0004(TIME) + 0.670(ULC(−1))
(16.491) (0.125) (4.493)

Cochrane/Orcutt RHO = 0.782
R-squared = 0.984
D.W. = 1.297

32. PDMS = −0.542 + 0.024(TIME) + 1.612(ULC(−1)) + 0.00049(ENGY(−1))
(−4.753) (2.528) (2.697) (0.794)

Cochrane/Orcutt RHO = 0.876
R-squared = 0.996
D.W. = 1.896

33. POPO = −0.231 + 0.0001(TIME) + 2.242(ULC(−1)) + 0.00005(ENGY(−1))
(−7.720) (0.044) (9.412) (0.167)

Cochrane/Orcutt RHO = 0.150
R-squared = 0.996
D.W. = 2.089

34. PDRG = 0.700 − 0.006(TIME) + 0.708(ULC(−1)) + 0.00088(ENGY(−1))
(11.360) (−1.061) (2.013) (2.428)

Cochrane/Orcutt RHO = 0.861
R-squared = 0.987
D.W. = 1.104

35. POPT = −0.099 + 0.018(TIME) + 1.003(ULC(−1)) + 0.00020(ENGY(−1))
(−1.085) (3.239) (3.577) (0.735)

Cochrane/Orcutt RHO = 0.922
R-squared = 0.998
D.W. = 1.593

36. PPHY = −0.302 + 0.009(TIME) + 1.815(ULC(−1)) + 0.00058(ENGY(−1))
(−6.889) (2.388) (5.499) (1.555)

Cochrane/Orcutt RHO = 0.722
R-squared = 0.998
D.W. = 1.876

37. PDEN = −0.264 + 0.022(TIME) + 1.081(ULC(−1)) + 0.00042(ENGY(−1))
(−3.454) (4.237) (3.898) (1.518)

Cochrane/Orcutt RHO = 0.911
R-squared = 0.999
D.W. = 2.046

38. POPS = −0.302 + 0.009(TIME) + 1.836(ULC(−1)) + 0.00058(ENGY(−1))
(−7.032) (2.334) (5.651) (1.554)

Cochrane/Orcutt RHO = 0.716
R-squared = 0.998
D.W. = 1.890

39. PPHO = −0.362 + 0.007(TIME) + 1.960(ULC(−1)) + 0.00115(ENGY(−1))
(−7.406) (1.667) (5.181) (2.570)

Cochrane/Orcutt RHO = 0.634
R-squared = 0.998
D.W. = 1.863

40. PHIN = −0.324 − 0.002(TIME) + 2.408(ULC(−1)) + 0.00029(ENGY(−1))
(−2.314) (−0.159) (2.179) (0.211)

Cochrane/Orcutt RHO = 0.461
R-squared = 0.964
D.W. = 2.171

41. PBRO = −0.071 + 0.031(TIME)
(−0.697) (7.148)

Cochrane/Orcutt RHO = 0.760
R-squared = 0.972
D.W. = 1.522

42. PBNK = 0.693 + 0.0001(TIME) + 0.370(ULC(−1)) + 0.00130(ENGY(−1))
(2.654) (0.008) (0.634) (2.299)

Cochrane/Orcutt RHO = 0.937
R-squared = 0.990
D.W. = 0.991

43. $PIMP = -0.341 + 0.008(TIME) + 2.039(ULC(-1))$
$\quad\quad (-10.117) \quad (3.126) \quad (12.497)$

Cochrane/Orcutt RHO = 0.396
R-squared = 0.993
D.W. = 1.523

44. $PLIF = -0.095 + 0.012(TIME) + 1.334(ULC(-1)) + 0.00041(ENGY(-1))$
$\quad\quad (-2.958) \quad (4.429) \quad (5.319) \quad (1.345)$

Cochrane/Orcutt RHO = 0.587
R-squared = 0.998
D.W. = 1.684

45. $PGAL = -0.734 + 0.038(TIME) + 1.164(ULC(-1))$
$\quad\quad (-4.680) \quad (4.838) \quad (5.313)$

Cochrane/Orcutt RHO = 0.927
R-squared = 0.998
D.W. = 0.943

46. $PFUN = 0.007 + 0.025(TIME) + 0.450(ULC(-1)) + 0.00042(ENGY(-1))$
$\quad\quad (0.106) \quad (5.168) \quad (1.579) \quad (1.472)$

Cochrane/Orcutt RHO = 0.896
R-squared = 0.998
D.W. = 1.911

47. $PPBO = -0.018 - 0.001(TIME) + 1.902(ULC(-1)) + 0.00036(ENGY(-1))$
$\quad\quad (-0.634) \quad (-0.639) \quad (8.272) \quad (1.198)$

Cochrane/Orcutt RHO = 0.206
R-squared = 0.996
D.W. = 1.840

48. $PCAR = 0.270 + 0.011(TIME) + 0.471(ULC(-1)) + 0.00142(ENGY(-1))$
$\quad\quad (6.845) \quad (3.620) \quad (1.505) \quad (3.556)$

Cochrane/Orcutt RHO = 0.379
R-squared = 0.993
D.W. = 2.160

49. $PTBA = 0.449 - 0.002(TIME) + 0.992(ULC(-1)) + 0.00041(ENGY(-1))$
$\quad\quad (6.511) \quad (-0.364) \quad (1.906) \quad (0.683)$

Cochrane/Orcutt RHO = 0.717
R-squared = 0.976
D.W. = 1.620

50. $PREP = -0.186 - 0.001(TIME) + 2.175(ULC(-1)) + 0.00036(ENGY(-1))$
$\quad\quad (-9.592) \quad (-0.804) \quad (14.055) \quad (1.787)$

Cochrane/Orcutt RHO = 0.129
R-squared = 0.998
D.W. = 1.831

51. PGAO = 0.036 − 0.003(TIME) + 1.909(ULC(−1)) + 0.00134(ENGY(−1))
(0.340) (−0.391) (2.240) (1.235)

Cochrane/Orcutt RHO = 0.371
R-squared = 0.971
D.W. = 1.738

52. PTOL = 1.000

53. PAIN = 0.038 + 0.004(TIME) + 1.343(ULC(−1))
(0.317) (0.439) (2.329)

Cochrane/Orcutt RHO = 0.477
R-squared = 0.843
D.W. = 1.462

54. PSTR = −0.087 + 0.019(TIME) + 0.835(ULC(−1))
(−1.498) (3.888) (3.586)

Cochrane/Orcutt RHO = 0.777
R-squared = 0.933
D.W. = 1.340

55. PTAX = 0.026(TIME) + 0.180(ULC(−1)) + 0.00142(ENGY(−1))
(3.239) (0.364) (2.831)

Cochrane/Orcutt RHO = 0.858
R-squared = 0.995
D.W. = 1.748

56. PCRR = −0.104 + 0.019(TIME) + 0.854(ULC(−1))
(−1.881) (4.081) (3.744)

Cochrane/Orcutt RHO = 0.767
R-squared = 0.993
D.W. = 1.306

57. PIRR = 0.130 − 0.007(TIME) + 1.880(ULC(−1)) + 0.00050(ENGY(−1))
(2.552) (−1.677) (4.710) (1.013)

Cochrane/Orcutt RHO = 0.541
R-squared = 0.992
D.W. = 1.656

58. PIBU = −0.301 − 0.002(TIME) + 2.367(ULC(−1)) + 0.00055(ENGY(−1))
(−6.237) (−0.528) (6.207) (1.157)

Cochrane/Orcutt RHO = 0.441
R-squared = 0.996
D.W. = 1.930

59. PIAI = 0.081 − 0.003(TIME) + 1.838(ULC(−1))
(1.688) (−0.681) (8.837)

Cochrane/Orcutt RHO = 0.736
R-squared = 0.991
D.W. = 1.559

60. PTRO = −0.417 + 0.022(TIME) + 1.405(ULC(−1)) + 0.00023(ENGY(−1))
(−3.414) (2.708) (3.342) (0.546)

Cochrane/Orcutt RHO = 0.915
R-squared = 0.997
D.W. = 1.799

61. PBKS = 0.136 + 0.010(TIME) + 1.026(ULC(−1)) + 0.00013(ENGY(−1))
(9.196) (8.646) (8.837) (0.926)

Cochrane/Orcutt RHO = 0.531
R-squared = 0.999
D.W. = 1.725

62. PMAG = −0.238 + 0.018(TIME) + 1.170(ULC(−1)) + 0.00087(ENGY(−1))
(−4.700) (4.178) (4.224) (3.064)

Cochrane/Orcutt RHO =0.870
R-squared = 0.999
D.W. = 1.949

63. PTOY = 0.318 + 0.004(TIME) + 1.015(ULC(−1))
(16.161) (2.462) (10.869)

Cochrane/Orcutt RHO = 0.575
R-squared = 0.994
D.W. = 1.668

64. PWHG = 0.425 + 0.003(TIME) + 0.798(ULC(−1)) + 0.00049(ENGY(−1))
(12.557) (1.254) (3.004) (1.510)

Cochrane/Orcutt RHO = 0.525
R-squared = 0.992
D.W. = 2.014

65. PRAD = 1.252 − 0.026(TIME) + 0.810(ULC(−1)) + 0.00025(ENGY(−1))
(14.013) (−3.402) (1.189) (0.321)

Cochrane/Orcutt RHO = 0.682
R-squared = 0.939
D.W. = 0.827

66. $PRTV = 1.271 - 0.006(TIME) + 0.00056(ENGY(-1))$
$(5.351) \quad (-0.726) \quad (2.034)$

Cochrane/Orcutt RHO = 0.933
R-squared = 0.981
D.W. = 0.628

67. $PFLO = 0.244 - 0.006(TIME) + 1.654(ULC(-1))$
$(4.346) \quad (-1.280) \quad (6.319)$

Cochrane/Orcutt RHO = 0.634
R-squared = 0.965
D.W. = 2.022

68. $PMOV = -0.508 + 0.037(TIME) + 0.774(ULC(-1))$
$(-8.125) \quad (9.291) \quad (5.551)$

Cochrane/Orcutt RHO = 0.893
R-squared = 0.999
D.W. = 1.123

69. $PLEG = -0.407 + 0.036(TIME) + 0.622(ULC(-1))$
$(-5.598) \quad (7.701) \quad (3.766)$

Cochrane/Orcutt RHO = 0.891
R-squared = 0.998
D.W. = 1.141

70. $PSPE = 0.237 + 0.009(TIME) + 0.924(ULC(-1)) + 0.00025(ENGY(-1))$
$(6.555) \quad (2.693) \quad (3.384) \quad (0.802)$

Cochrane/Orcutt RHO = 0.713
R-squared = 0.996
D.W. = 1.686

71. $PCLU = -0.024 + 0.003(TIME) + 1.750(ULC(-1)) + 0.00009(ENGY(-1))$
$(-0.878) \quad (1.306) \quad (7.995) \quad (0.323)$

Cochrane/Orcutt RHO = 0.222
R-squared = 0.996
D.W. = 1.850

72. $PCOM = -0.060 + 0.014(TIME) + 1.180(ULC(-1)) + 0.00027(ENGY(-1))$
$(-2.802) \quad (8.208) \quad (6.936) \quad (1.290)$

Cochrane/Orcutt RHO = 0.461
R-squared = 0.999
D.W. = 1.811

73. $PPAR = -0.079 + 0.012(TIME) + 1.279(UCL(-1))$
$(-0.980) \quad (2.323) \quad (6.618)$

Cochrane/Orcutt RHO = 0.884
R-squared = 0.996
D.W. = 1.395

74. PREO = 0.148 + 0.014(TIME) + 0.819(ULC(−1)) + 0.00003(ENGY(−1))
(2.753) (3.292) (3.125) (0.104)

Cochrane/Orcutt RHO = 0.884
R-squared = 0.998
D.W. = 1.754

75. PHED = −0.572 + 0.038(TIME) + 0.778(ULC(−1)) + 0.00046(ENGY(−1))
(−5.406) (5.687) (2.295) (1.391)

Cochrane/Orcutt RHO = 0.919
R-squared = 0.998
D.W. = 1.714

76. PEED = −0.254 − 0.001(TIME) + 2.337(ULC(−1)) + 0.00041(ENGY(−1))
(−4.928) (−0.128) (5.758) (0.817)

Cochrane/Orcutt RHO = 0.479
R-squared = 0.996
D.W. = 1.602

77. POED = 0.003 + 0.006(TIME) + 1.338(ULC(−1)) + 0.00117(ENGY(−1))
(0.061) (1.828) (3.872) (2.648)

Cochrane/Orcutt RHO = 0.346
R-squared = 0.994
D.W. = 1.847

78. PREL = −0.059 − 0.0002(TIME) + 1.866(ULC(−1)) + 0.00069(ENGY(−1))
(−1.545) (−0.059) (6.119) (1.732)

Cochrane/Orcutt RHO = 0.217
R-squared = 0.994
D.W. = 1.817

79. PFTV = −0.052 − 0.002(TIME) + 2.115(ULC(−1)) + 0.00007(ENGY(−1))
(−0.470) (−0.181) (2.511) (0.074)

Cochrane/Orcutt RHO = 0.666
R-squared = 0.982
D.W. = 1.518

80. PABD = −0.230 − 0.019(TIME) + 3.121(ULC(−1)) + 0.00111(ENGY(−1))
(−1.923) (−1.951) (3.325) (0.962)

Cochrane/Orcutt RHO = 0.520
R-squared = 0.979
D.W. = 1.399

81. PEXF = −0.010 − 0.003(TIME) + 2.001(ULC(−1)) + 0.00016(ENGY(−1))
(−0.300) (−1.021) (7.737) (0.496)

Cochrane/Orcutt RHO = 0.380
R-squared = 0.996
D.W. = 1.668

82. PREM = 0.106 − 0.006(TIME) + 1.979(ULC(−1)) + 0.00008(ENGY(−1))
(2.043) (−1.365) (4.839) (0.158)

Cochrane/Orcutt RHO = 0.450
R-squared = 0.990
D.W. = 1.586

Appendix D. Federal Government Equations

Regression equations were used to derive the levels of defense purchases and defense compensation, using variables supplied from the macro model. Since only total civilian compensation and total Federal purchases were available, they had to be allocated to the defense and nondefense sectors. Regression equations were also used for estimating defense and nondefense new construction. Equations used in the Federal Government sector are given below:

1. Defense civilian compensaton = 122.3 + 0.4093 military compensation + 198.8 time
   R-squared = 0.9819

2. Total defense purchases = 16850.4 + 2.606 military compensation + 125.5 time
   R-squared = 0.9426

3. Nondefense total new construction = −3825.5 + 7.845 nondefense civilian employment
   + 0.0232 nondefense other purchases − 69.01 time

4. Nondefense nonresidential construction = −1731 + 3.30013 nondefense civilian employment
   − 0.013 nondefense other purchases − 35.981 time
   R-squared = 0.4515

5. Nondefense highway construction = −116.344 + 0.261 nondefense civilian employment
   − 0.0032 nondefense other purchases + 8.298 time
   R-squared = 0.9462

6. Nondefense industrial construction = −1977.4 + 4.284 nondefense civilian employment
   + 0.039 nondefense other purchases − 41.323 time
   R-squared = 0.9318

7. Defense new construction = 3662.4 − 1.047 military employment
   + 0.086 defense other purchases − 130.3 time
   R-squared = 0.5452

8. Defense nonresidential construction = 727.6 − 0.276 military employment
   + 0.0116 defense other purchases − 14.543 time
   R-squared = 0.4382

9. Defense nonresidential construction = 641.2 − 0.270 military employment + 0.0182 defense other purchases − 1.716 time

R-squared = 0.7723

10. Defense industry construction = 2794.7 − 0755 military employment + 0.0392 defense other purchases − 64.986 time

R-squared = 0.8468

Appendix E. Labor Demand Equations

1. Livestock and livestock products (EG 1, 2)

$$\text{Hours} = \underset{(6.91231)}{13.6008} - \underset{(-0.128739)}{0.0034\ UR} - \underset{(-1.43117)}{0.2729\ O} + \underset{(8.46595)}{0.0288\ E} + \underset{(9.37601)}{0.0319\ P} - \underset{(-13.0415)}{0.0444\ L} - \underset{(-26.0707)}{0.3969\ CD} - \underset{(-128.648)}{1.9584\ LD}$$

R-squared = 0.9997

2. Other agricultural products (EG 3-5)

$$\text{Hours} = \underset{(6.47470)}{14.3160} + \underset{(1.79880)}{0.0787\ UR} - \underset{(-1.69568)}{0.3692\ O} + \underset{(6.87544)}{0.0338\ E} + \underset{(7.50514)}{0.0369\ P} - \underset{(-5.32942)}{0.0262\ L} - \underset{(-15.1853)}{0.3969\ CD} - \underset{(-71.5102)}{1.8690\ LD}$$

R-squared = 0.9990

3. Forestry and fishery products (EG 6)

$$\text{Hours} = \underset{(27.7360)}{10.6621} + \underset{(1.06852)}{0.0750\ UR} - \underset{(-0.177016)}{0.0100\ O} + \underset{(9.33735)}{0.0260\ E} + \underset{(10.4496)}{0.0291\ P} + \underset{(0.441836)}{0.0012\ L} - \underset{(-11.0334)}{0.3969\ CD} - \underset{(-172.964)}{6.2216\ LD}$$

R-squared = 0.9998

4. Agricultural, forestry, and fishery services (EG 7)

$$\text{Hours} = \underset{(12.4061)}{13.3900} + \underset{(1.21591)}{0.0638\ UR} - \underset{(-2.68407)}{0.3570\ O} + \underset{(9.40896)}{0.0344\ E} + \underset{(10.2552)}{0.0375\ P} + \underset{(8.94229)}{0.0327\ L} - \underset{(-13.3616)}{0.3969\ CD} - \underset{(-155.234)}{4.6109\ LD}$$

R-squared = 0.9997

5. Iron and ferroalloy ores mining (EG 8)

$$\text{Hours} = \underset{(3.30527)}{4.5327} - \underset{(-0.058401)}{0.0054\ UR} + \underset{(0.825382)}{0.1548\ O} + \underset{(8.07832)}{0.0807\ E} + \underset{(8.11388)}{0.0810\ P} - \underset{(-1.36613)}{0.0136\ L} + \underset{(15.0406)}{1.1977\ CD} - \underset{(-16.6230)}{1.3237\ LD}$$

R-squared = 0.9950

6. Nonferrous metal ores mining (EG 9, 10)

$$\text{Hours} = \underset{(6.34762)}{4.2638} - \underset{(-1.63999)}{0.0689\ UR} + \underset{(2.73376)}{0.2603\ O} + \underset{(12.3301)}{0.0762\ E} + \underset{(9.76253)}{0.0603\ P} - \underset{(-1.31604)}{0.0081\ L} + \underset{(34.4806)}{1.4226\ CD} - \underset{(-28.6154)}{1.1806\ LD}$$

R-squared = 0.9985

7. Coal mining (EG 11)

$$\text{Hours} = \underset{(1.37960)}{3.8374} + \underset{(2.16080)}{0.1821\ UR} + \underset{(1.17085)}{0.3728\ O} + \underset{(9.86153)}{0.0672\ E} + \underset{(9.86751)}{0.0673\ P} + \underset{(0.613626)}{0.0042\ L} + \underset{(0.159835)}{0.0090\ CD} - \underset{(-27.3833)}{1.5497\ LD}$$

R-squared = 0.9951

8. Crude petroleum and natural gas (EG 12)

$$\text{Hours} = 8.7156 - 0.0207\,UR + 0.0692\,O - 0.0028\,E + 0.0130\,P - 0.0214\,L + 1.5518\,CD - 3.2333\,LD$$

(6.40493) (−0.667125) (0.491384) (−0.713211) (3.36521) (−5.53421) (60.9724) (−127.044)

R-squared = 0.9998

9. Stone and clay mining and quarrying (EG 13)

$$\text{Hours} = 4.6830 + 0.0184\,UR + 0.2604\,O + 0.0679\,E + 0.0650\,P - 0.0058\,L - 0.2872\,CD - 1.2337\,LD$$

(3.05384) (0.523130) (1.31982) (12.1197) (11.6065) (−1.03041) (−9.03203) (−38.8002)

R-squared = 0.9979

10. Chemical and fertilizer mineral mining (EG 14)

$$\text{Hours} = 5.1830 - 0.2028\,UR + 0.1620\,O + 0.0418\,E + 0.0742\,P - 0.0244\,L - 0.2596\,CD - 1.9247\,LD$$

(6.31509) (−3.15457) (1.34253) (5.82662) (10.3392) (−3.40316) (−4.37166) (−32.4108)

R-squared = 0.9963

11. New construction (EG 152)

$$\text{Hours} = 6.0836 - 0.0423\,UR + 0.2887\,O + 0.0291\,E + 0.0781\,P + 0.0095\,L - 1.7520\,CD - 0.5320\,LD$$

(4.31199) (−1.35295) (2.41042) (9.29871) (24.9696) (3.03425) (−62.9406) (−19.1113)

R-squared = 0.9965

12. Maintenance and repair construction (EG 15)

$$\text{Hours} = 5.3183 - 0.0744\,UR + 0.3992\,O + 0.0317\,E + 0.0807\,P + 0.0153\,L - 1.7520\,CD - 2.1620\,LD$$

(2.96814) (−2.86776) (2.32627) (13.0844) (33.2934) (6.33084) (−63.8638) (−78.8091)

R-squared = 0.9987

13. Ordnance and accessories (EG 16, 17)

$$\text{Hours} = 3.1448 + 0.0294\,UR + 0.3522\,O + 0.0461\,E + 0.0037\,P - 0.0009\,L + 0.6777\,CD - 0.3016\,LD$$

(2.70101) (0.316957) (2.93040) (6.05276) (0.488010) (−0.113898) (6.88238) (−3.06287)

R-squared = 0.9340

14. Food and kindred products (EG 18–27)

$$\text{Hours} = 8.8792 - 0.0016\,UR + 0.0353\,O + 0.0315\,E + 0.0145\,P - 0.0049\,L + 0.0792\,CD - 1.0027\,LD$$

(4.16032) (−0.124796) (0.186519) (6.15069) (2.83517) (−0.957202) (6.85121) (−86.7477)

R-squared = 0.9994

15. Tobacco manufactures (EG 28)

$$\text{Hours} = 1.5655 - 0.0114\,UR + 0.5101\,O + 0.0310\,E + 0.0382\,P - 0.0181\,L - 0.5084\,CD - 0.8863\,LD$$

(1.48673) (−0.485025) (4.37784) (19.0565) (23.4586) (−11.0995) (−23.0646) (−40.2107)

R-squared = 0.9976

16. Broad and narrow fabrics, yarn and thread mills (EG 29)

$$\text{Hours} = 9.2822 - 0.0508\,UR - 0.0893\,O + 0.0193\,E + 0.0283\,P + 0.0010\,L - 0.8725\,CD - 1.1998\,LD$$

(5.82461) (−1.42139) (−0.546087) (5.22876) (7.66117) (0.272988) (−37.5934) (−51.6932)

R-squared = 0.9973

17. Miscellaneous textile goods and floor coverings (EG 30, 31)

$$\text{Hours} = \underset{(1.86091)}{2.0156} + \underset{(4.62258)}{0.1531\,UR} + \underset{(4.14193)}{0.5673\,O} + \underset{(0.267436)}{0.0024\,E} + \underset{(0.944787)}{0.0085\,P} - \underset{(-1.14546)}{0.0103\,L} - \underset{(-21.3907)}{0.7053\,CD} - \underset{(-39.2407)}{1.2938\,LD}$$

R-squared = 0.9951

18. Apparel (EG 32, 33)

$$\text{Hours} = \underset{(0.222410)}{0.9133} + \underset{(2.15553)}{0.1706\,UR} + \underset{(1.50163)}{0.6108\,O} + \underset{(2.27588)}{0.0309\,E} + \underset{(2.36958)}{0.0322\,P} - \underset{(-0.558559)}{0.0076\,L} - \underset{(-10.8482)}{0.5044\,CD} + \underset{(11.6777)}{0.5430\,LD}$$

R-squared = 0.9724

19. Miscellaneous fabricated textile products (EG 34)

$$\text{Hours} = \underset{(2.82293)}{3.7940} + \underset{(1.24656)}{0.0743\,UR} + \underset{(1.16044)}{0.1937\,O} + \underset{(5.69237)}{0.0541\,E} + \underset{(2.78834)}{0.0265\,P} + \underset{(1.00359)}{0.0095\,L} + \underset{(0.132210)}{0.0066\,CD} + \underset{(3.82449)}{0.1910\,LD}$$

R-squared = 0.9330

20. Lumber and wood products, except containers (EG 35–37)

$$\text{Hours} = \underset{(5.63328)}{6.4703} + \underset{(0.167066)}{0.0033\,UR} + \underset{(1.40066)}{0.1686\,O} + \underset{(8.16557)}{0.0332\,E} + \underset{(4.37993)}{0.0178\,P} - \underset{(-0.518689)}{0.0021\,L} - \underset{(-9.92489)}{0.2081\,CD} - \underset{(-39.7951)}{0.8342\,LD}$$

R-squared = 0.9971

21. Wood containers (EG 38)

$$\text{Hours} = \underset{(7.49817)}{4.8624} - \underset{(-0.821236)}{0.0415\,UR} + \underset{(2.77851)}{0.2374\,O} - \underset{(-20.4344)}{0.0792\,E} + \underset{(1.85919)}{0.0072\,P} - \underset{(-7.15993)}{0.0277\,L} - \underset{(-40.0025)}{1.3149\,CD} - \underset{(-53.3055)}{1.7521\,LD}$$

R-squared = 0.9948

22. Household furniture (EG 39)

$$\text{Hours} = \underset{(3.37712)}{3.2963} + \underset{(0.732097)}{0.0169\,UR} + \underset{(3.06709)}{0.3565\,O} + \underset{(5.68664)}{0.0268\,E} + \underset{(7.51702)}{0.0354\,P} + \underset{(1.69677)}{0.0080\,L} - \underset{(-2.22233)}{0.0667\,CD} - \underset{(-1.74979)}{0.0525\,LD}$$

R-squared = 0.9698

23. Other furniture and fixtures (EG 40)

$$\text{Hours} = \underset{(0.877395)}{1.8642} + \underset{(1.19511)}{0.0655\,UR} + \underset{(1.75683)}{0.4782\,O} + \underset{(1.81666)}{0.0225\,E} + \underset{(1.94321)}{0.0241\,P} - \underset{(-0.322818)}{0.0040\,L} + \underset{(6.95322)}{0.2351\,CD} - \underset{(-0.347798)}{0.0118\,LD}$$

R-squared = 0.9764

24. Paper and allied products, except containers (EG 41)

$$\text{Hours} = \underset{(9.47887)}{11.4240} - \underset{(-5.58110)}{0.0917\,UR} - \underset{(-1.99604)}{0.2542\,O} + \underset{(9.97459)}{0.0528\,E} + \underset{(8.25491)}{0.0437\,P} + \underset{(3.65087)}{0.0193\,L} - \underset{(-63.5316)}{0.9117\,CD} - \underset{(-143.590)}{2.0606\,LD}$$

R-squared = 0.9997

25. Paperboard containers and boxes (EG 42)

$$\text{Hours} = \underset{(2.74605)}{4.6944} - \underset{(-1.91986)}{0.0696\,UR} + \underset{(1.63550)}{0.3210\,O} + \underset{(3.67429)}{0.0282\,E} + \underset{(3.33732)}{0.0256\,P} + \underset{(0.203776)}{0.0016\,L} - \underset{(-27.5545)}{0.5515\,CD} - \underset{(-65.3491)}{1.3080\,LD}$$

R-squared = 0.9985

26. Printing and publishing (EG 43–45)

$$\text{Hours} = \underset{(1.87830)}{5.4383} + \underset{(0.485899)}{0.0246\ UR} + \underset{(1.02668)}{0.2970\ O} + \underset{(2.94533)}{0.0279\ E} + \underset{(3.01958)}{0.0286\ P} + \underset{(0.642763)}{0.0061\ L} + \underset{(6.76459)}{0.1821\ CD} - \underset{(-32.3730)}{0.8713\ LD}$$

R-squared = 0.9964

27. Chemicals and selected chemical products (EG 46–48)

$$\text{Hours} = \underset{(6.64606)}{12.2840} - \underset{(-4.10280)}{0.1323\ UR} - \underset{(-1.66836)}{0.3256\ O} + \underset{(6.22081)}{0.0637\ E} + \underset{(5.38730)}{0.0551\ P} + \underset{(2.47368)}{0.0253\ L} - \underset{(-26.6406)}{0.6056\ CD} - \underset{(-103.889)}{2.3618\ LD}$$

R-squared = 0.9994

28. Plastics and synthetic materials (EG 49, 50)

$$\text{Hours} = \underset{(6.01647)}{6.5891} - \underset{(-3.21263)}{0.1022\ UR} + \underset{(1.42187)}{0.1880\ O} + \underset{(5.11852)}{0.0521\ E} + \underset{(3.85139)}{0.0392\ P} + \underset{(1.40439)}{0.0143\ L} - \underset{(-34.4645)}{0.8771\ CD} - \underset{(-85.9998)}{2.1187\ LD}$$

R-squared = 0.9991

29. Drugs, cleaning and toilet preparations (EG 51, 52)

$$\text{Hours} = \underset{(2.11004)}{4.9239} + \underset{(3.26408)}{0.0742\ UR} + \underset{(1.00559)}{0.2692\ O} + \underset{(1.16926)}{0.0220E} + \underset{(1.69481)}{0.0319\ P} + \underset{(0.665064)}{0.0125\ L} + \underset{(1.04765)}{0.0276\ CD} - \underset{(-53.8526)}{1.4202\ LD}$$

R-squared = 0.9981

30. Paints and allied products (EG 53)

$$\text{Hours} = \underset{(6.30485)}{6.7258} - \underset{(-0.686122)}{0.0223\ UR} - \underset{(-0.815002)}{0.1090\ O} + \underset{(8.32502)}{0.0384\ E} + \underset{(8.62067)}{0.0397\ P} + \underset{(2.56928)}{0.0118\ L} + \underset{(0.281589)}{0.0078\ CD} - \underset{(-35.9648)}{0.9908\ LD}$$

R-squared = 0.9966

31. Petroleum refining and related industries (EG 54)

$$\text{Hours} = \underset{(1.18002)}{4.5834} + \underset{(4.50709)}{0.2197\ UR} + \underset{(0.828256)}{0.3257\ O} + \underset{(1.22176)}{0.0177\ E} + \underset{(0.354877)}{0.0051\ P} - \underset{(-0.941718)}{0.0136\ L} + \underset{(28.4878)}{1.3573\ CD} - \underset{(-43.9415)}{2.0936\ LD}$$

R-squared = 0.9984

32. Rubber and miscellaneous plastics products (EG 55–57)

$$\text{Hours} = \underset{(5.17595)}{7.8685} - \underset{(-0.910362)}{0.0309\ UR} + \underset{(0.081024)}{0.0133\ O} + \underset{(6.81074)}{0.0669\ E} + \underset{(7.32732)}{0.0720\ P} + \underset{(4.42288)}{0.0435\ L} - \underset{(-46.5702)}{1.0853\ CD} - \underset{(-59.2870)}{1.3816\ LD}$$

R-squared = 0.9983

33. Leather tanning and finishing (EG 58)

$$\text{Hours} = \underset{(2.94074)}{3.6835} + \underset{(0.193339)}{0.0087\ UR} + \underset{(1.04962)}{0.1764\ O} + \underset{(2.28535)}{0.0079\ E} + \underset{(2.05912)}{0.0071\ P} - \underset{(-6.99006)}{0.0241\ L} - \underset{(-11.8930)}{0.4201\ CD} - \underset{(-16.9496)}{0.5988\ LD}$$

R-squared = 0.9853

34. Footwear and other leather products (EG 59)

$$\text{Hours} = \underset{(1.25535)}{3.5505} + \underset{(0.517285)}{0.0426\ UR} + \underset{(0.889554)}{0.2830\ O} + \underset{(5.33099)}{0.0140\ E} + \underset{(3.10942)}{0.0082\ P} - \underset{(-5.26285)}{0.0138\ L} - \underset{(-7.31095)}{0.2399\ CD} + \underset{(15.8967)}{0.5216\ LD}$$

R-squared = 0.9699

35. Glass and glass products (EG 60)

$$\text{Hours} = 7.0440 - 0.0375\ UR + 0.0163\ O + 0.0528\ E + 0.0365\ P + 0.0199\ L - 0.3030\ CD - 1{,}4043\ LD$$
$$(9.36470)\ (-2.66054)\ (0.178361)\ (14.9031)\ (10.2802)\ (5.62122)\ (-21.2361)\ (-98.4292)$$

R-squared = 0.9994

36. Stone and clay products (EG 61-64)

$$\text{Hours} = 6.5720 - 0.0130UR + 0.2120\ O + 0.0172\ E + 0.0156\ P + 0.0033\ L - 0.3079\ CD - 1.6663LD$$
$$(9.51766)\ (-1.10592)\ (2.87121)\ (7.57050)\ (6.84357)\ (1.44762)\ (-21.0470)\ (-113.912)$$

R-squared = 0.9994

37. Primary iron and steel manufacturing (EG 65, 66)

$$\text{Hours} = 9.6868 - 0.0339\ UR - 0.0136\ O + 0.0330\ E + 0.0018\ P + 0.0069\ L + 0.0536\ CD - 2.0155\ LD$$
$$(6.83919)\ (-1.35926)\ (-0.101250)\ (9.77175)\ (0.524092)\ (2.03228)\ (1.87778)\ (-70.5423)$$

R-squared = 0.9987

38. Primary nonferrous metals manufacturing (EG 67-69)

$$\text{Hours} = 9.1374 - 0.0237\ UR - 0.0881\ O + 0.0484\ E + 0.0388\ P + 0.0216\ L - 0.3860\ CD - 1.7815\ LD$$
$$(5.52458)\ (-0.950302)\ (-0.518528)\ (7.48121)\ (5.99761)\ (3.34683)\ (-12.2833)\ (-56.6887)$$

R-squared = 0.9979

39. Metal containers (EG 70)

$$\text{Hours} = 2.8267 + 0.0219\ UR + 0.4741\ O + 0.0293\ E + 0.0057\ P - 0.0022\ L - 0.8238\ CD - 1.5989\ LD$$
$$(5.49407)\ (2.59985)\ (7.32983)\ (10.7829)\ (2.11723)\ (-0.824418)(-63.4256)\ (-123.100)$$

R-squared = 0.9996

40. Heating, plumbing, and structural metal products (EG 71, 72)

$$\text{Hours} = 3.7643 + 0.0377\ UR + 0.3793\ O + 0.0236\ E + 0.0231\ P + 0.0068\ L - 0.0238\ CD - 0.5625\ LD$$
$$(3.76899)\ (2.40861)\ (3.50391)\ (5.44062)\ (5.32441)\ (1.56185)\ (-1.26305)\ (-29.8857)$$

R-squared = 0.9958

41. Screw machine products and stampings (EG 73, 74)

$$\text{Hours} = 6.4888 - 0.0577\ UR + 0.1406\ O + 0.0199\ E + 0.0255\ P + 0.0157\ L - 0.6740\ CD - 1.3083\ LD$$
$$(4.71249)\ (-1.39467)\ (0.955580)\ (4.68727)\ (6.01209)\ (3.69587)\ (-21.9807)\ (-42.6654)$$

R-squared = 0.9952

42. Other fabricated metal products (EG 75, 76)

$$\text{Hours} = 4.7401 - 0.0149\ UR + 0.3194\ O + 0.0301\ E + 0.0297\ P + 0.0109\ L - 0.4965\ CD - 0.9954\ LD$$
$$(2.98904)\ (-0.479572)\ (1.86230)\ (4.36390)\ (4.30320)\ (1.57504)\ (-24.2211)\ (-48.5610)$$

R-squared = 0.9974

43. Engines and turbines (EG 77)

$$\text{Hours} = 2.4235 + 0.0707\ UR + 0.4909\ O + 0.0373\ E + 0.0169\ P - 0.0012\ L - 0.2952\ CD - 1.1839\ LD$$
$$(3.75733)\ (4.39233)\ (5.78988)\ (6.07928)\ (2.75860)\ (-0.187541)(-8.89214)\ (-35.6588)$$

R-squared = 0.9962

44. Farm and garden machinery (EG 78)

$$\text{Hours} = \underset{(8.67798)}{4.7659} - \underset{(-0.521196)}{0.0103\ UR} + \underset{(3.46775)}{0.2317\ O} + \underset{(4.12825)}{0.0156\ E} + \underset{(5.51149)}{0.0208\ P} + \underset{(1.76264)}{0.0066\ L} - \underset{(-11.1736)}{0.4062\ CD} - \underset{(-30.2937)}{1.1012\ LD}$$

R-squared = 0.9918

45. Construction and mining machinery (EG 79)

$$\text{Hours} = \underset{(4.93452)}{3.7526} + \underset{(2.73460)}{0.0517\ UR} + \underset{(4.11630)}{0.3676\ O} + \underset{(5.32296)}{0.0249\ E} + \underset{(6.07852)}{0.0285\ P} + \underset{(3.40269)}{0.0159\ L} - \underset{(-16.6734)}{0.5476\ CD} - \underset{(-37.3316)}{1.2260\ LD}$$

R-squared = 0.9946

46. Materials handling machinery and equipment (EG 80)

$$\text{Hours} = \underset{(2.42657)}{2.5465} + \underset{(0.940534)}{0.0317\ UR} + \underset{(2.40149)}{0.3357\ O} + \underset{(4.75064)}{0.0363\ E} + \underset{(1.40991)}{0.0108\ P} + \underset{(2.11660)}{0.0162\ L} + \underset{(19.5749)}{0.7116\ CD} - \underset{(-5.15835)}{0.1875\ LD}$$

R-squared = 0.9869

47. Metalworking machinery and equipment (EG 81)

$$\text{Hours} = \underset{(1.18056)}{2.2360} + \underset{(1.33777)}{0.0900\ UR} + \underset{(2.80954)}{0.5925\ O} + \underset{(2.73540)}{0.0177\ E} + \underset{(0.962646)}{0.0062\ P} + \underset{(0.267561)}{0.0017\ L} - \underset{(-7.87024)}{0.3373\ CD} - \underset{(-25.8447)}{1.1077\ LD}$$

R-squared = 0.9897

48. Special industry machinery and equipment (EG 82)

$$\text{Hours} = \underset{(4.03606)}{5.7346} - \underset{(-0.944480)}{0.0365\ UR} + \underset{(0.744430)}{0.1241\ O} + \underset{(5.80711)}{0.0325\ E} + \underset{(7.34807)}{0.0411\ P} + \underset{(1.31880)}{0.0074\ L} - \underset{(-14.1391)}{0.4646\ CD} - \underset{(-25.3705)}{0.8336\ LD}$$

R-squared = 0.9921

49. General industrial machinery and equipment (EG 83)

$$\text{Hours} = \underset{(4.32158)}{6.3487} - \underset{(-0.934518)}{0.0376\ UR} + \underset{(0.504309)}{0.0842\ O} + \underset{(6.94789)}{0.0459\ E} + \underset{(6.65007)}{0.0439\ P} + \underset{(2.85843)}{0.0189\ L} - \underset{(-12.0326)}{0.3861\ CD} - \underset{(-28.4386)}{0.9124\ LD}$$

R-squared = 0.9939

50. Miscellaneous machinery, except elecrical (EG 84)

$$\text{Hours} = \underset{(3.81756)}{3.1817} - \underset{(-1.60017)}{0.0407\ UR} + \underset{(3.74872)}{0.3891\ O} + \underset{(10.2121)}{0.0548\ E} + \underset{(8.71370)}{0.0467\ P} + \underset{(1.15650)}{0.0062\ L} - \underset{(-13.2734)}{0.4773\ CD} - \underset{(-7.18471)}{0.2583\ LD}$$

R-squared = 0.9885

51. Office, computing, and accounting machines (EG 85-86)

$$\text{Hours} = \underset{(4.95590)}{4.4281} + \underset{(1.23509)}{0.0269\ UR} + \underset{(1.82346)}{0.2079\ O} + \underset{(7.15927)}{0.0789\ E} + \underset{(3.21694)}{0.0355\ P} + \underset{(3.23206)}{0.0356\ L} + \underset{(4.91727)}{0.1727\ CD} - \underset{(-13.3307)}{0.4681\ LD}$$

R-squared = 0.9923

52. Service industry machines (EG 87)

$$\text{Hours} = \underset{(2.69108)}{2.4574} + \underset{(3.79476)}{0.0730\ UR} + \underset{(4.05958)}{0.4904\ O} + \underset{(0.388016)}{0.0047\ E} + \underset{(0.440303)}{0.0053\ P} - \underset{(-0.094667)}{0.0011\ L} - \underset{(-3.39648)}{0.1298\ CD} - \underset{(-28.3829)}{1.0844\ LD}$$

R-squared = 0.9925

53. Electric industrial equipment and apparatus (EG 88, 89)

$$\text{Hours} = 3.4693 + 0.0644\ \text{UR} + 0.4008\ \text{O} + 0.0298\ \text{E} + 0.0196\ \text{P} + 0.0032\ \text{L} + 0.0005\ \text{CD} - 0.5371\ \text{LD}$$
$$(1.79041)\quad(1.32354)\quad(1.84710)\quad(2.92778)\quad(1.92703)\quad(0.316287)\quad(0.014774)\quad(-15.4072)$$

R-squared = 0.9873

54. Household appliances (EG 90)

$$\text{Hours} = 7.1620 - 0.0049\ \text{UR} - 0.0683\ \text{O} + 0.0334\ \text{E} + 0.0223\ \text{P} + 0.0214\ \text{L} - 0.0300\ \text{CD} - 0.8966\ \text{LD}$$
$$(4.18275)\quad(-0.111250)\quad(-0.332826)\quad(3.14145)\quad(2.09656)\quad(2.01344)\quad(-1.00173)\quad(-29.9648)$$

R-squared = 0.9931

55. Electric lighting and wiring equipment (EG 91)

$$\text{Hours} = 3.6073 - 0.0125\ \text{UR} + 0.3478\ \text{O} + 0.0360\ \text{E} + 0.0342\ \text{P} + 0.0207\ \text{L} - 0.5277\ \text{CD} - 0.7943\ \text{LD}$$
$$(1.77763)\quad(-0.318578)\quad(1.39823)\quad(3.31318)\quad(3.14128)\quad(1.90372)\quad(-15.8689)\quad(23.8852)$$

R-squared = 0.9910

56. Radio, television, and communication equipment (EG 92–94)

$$\text{Hours} = 5.2123 - 0.0275\ \text{UR} + 0.1823\ \text{O} + 0.0725\ \text{E} + 0.0417\ \text{P} + 0.0070\ \text{L} + 0.2659\ \text{CD} + 0.1425\ \text{LD}$$
$$(6.90274)\quad(-9676843)\quad(2.29905)\quad(12.2863)\quad(7.07512)\quad(1.18065)\quad(5.97506)\quad(3.20241)$$

R-squared = 0.9760

57. Electronic components and accessories (EG 95)

$$\text{Hours} = 5.0243 - 0.1583\ \text{UR} + 0.1863\ \text{O} + 0.1073\ \text{E} + 0.0686\ \text{P} + 0.0244\ \text{L} - 0.1208\ \text{CD} - 0.1312\ \text{LD}$$
$$(4.09080)\quad(-2.64959)\quad(1.25091)\quad(7.63724)\quad(4.87907)\quad(1.73891)\quad(-2.56355)\quad(-2.78474)$$

R-squared = 0.9897

58. Miscellaneous electrical machinery and supplies (EG 96)

$$\text{Hours} = -0.1909 + 0.1706\ \text{UR} + 0.7548\ \text{O} + 0.0171\ \text{E} + 0.0138\ \text{P} - 0.0188\ \text{L} - 0.4495\ \text{CD} - 0.4559\ \text{LD}$$
$$(-0.078609)(3.24880)\quad(2.41385)\quad(0.978065)\quad(0.789043)\quad(-1.07500)\quad(-10.2960)\quad(-10.4421)$$

R-squared = 0.9805

59. Motor vehicles and equipment (EG 97)

$$\text{Hours} = 7.6538 - 0.0127\ \text{UR} + 0.111\ \text{O} + 0.0268\ \text{E} + 0.0309\ \text{P} + 0.0180\ \text{L} - 0.6323\ \text{CD} - 1.5499\ \text{LD}$$
$$(5.12740)\quad(-0.473320)\quad(0.794313)\quad(3.93478)\quad(4.53269)\quad(2.64707)\quad(-14.6492)\quad(-35.9084)$$

R-squared = 0.9937

60. Aircraft and parts (EG 98)

$$\text{Hours} = 0.7045 + 0.0728\ \text{UR} + 0.6786\ \text{O} + 0.0488\ \text{E} + 0.0182\ \text{P} - 0.0194\ \text{L} + 0.5444\ \text{CD} - 0.1330\ \text{LD}$$
$$(0.622703)\quad(1.62612)\quad(6.19148)\quad(12.8435)\quad(4.78590)\quad(-5.11866)\quad(10.2990)\quad(-2.51536)$$

R-squared = 0.9799

61. Other transportation equipment (EG 99–102)

$$\text{Hours} = 3.3285 + 0.1155\ \text{UR} + 0.3468\ \text{O} + 0.0214\ \text{E} - 0.0116\ \text{P} + 0.0216\ \text{L} + 0.9453\ \text{CD} - 0.4124\ \text{LD}$$
$$(2.46187)\quad(3.16697)\quad(2.17915)\quad(1.76423)\quad(-0.953124)\quad(1.78304)\quad(16.8219)\quad(-7.33835)$$

R-squared = 0.9777

62. Scientific and controlling instruments (EG 103–104, 107)

$$\text{Hours} = 6.8865 - 0.0523\,\text{UR} - 0.0432\,\text{O} + 0.0511\,\text{E} + 0.0678\,\text{P} + 0.0316\,\text{L} - 0.2551\,\text{CD} - 0.5165\,\text{LD}$$
$$(7.44723)\ (-3.34672)\ (-0.392407)\ (10.3087)\ (13.6724)\ (6.36368)\ (-8.94246)\ (-18.1056)$$

R-squared = 0.9917

63. Optical, ophthalmic, and photographic equipment (EG 105, 106)

$$\text{Hours} = 3.3484 + 0.0583\,\text{UR} + 0.3818\,\text{O} + 0.0389\,\text{E} + 0.0376\,\text{P} - 0.0116\,\text{L} - 0.1798\,\text{CD} - 0.6272\,\text{LD}$$
$$(6.90956)\ (3.74925)\ (5.94866)\ (6.59703)\ (6.36965)\ (-1.96511)\ (-5.61340)\ (-19.5838)$$

R-squared = 0.9945

64. Miscellaneous manufacturing (EG 108–110)

$$\text{Hours} = 6.9081 - 0.0209\,\text{UR} - 0.0289\,\text{O} + 0.0529\,\text{E} + 0.0529\,\text{P} + 0.0105\,\text{L} - 0.2012\,\text{CD} + 0.0965\,\text{LD}$$
$$(6.10093)\ (-1.69765)\ (-0.225030)\ (9.83592)\ (9.83685)\ (1.95074)\ (-11.6485)\ (5.58724)$$

R-squared = 0.9918

65. Transportation and warehousing (EG 111–117)

$$\text{Hours} = 9.7853 - 0.0089\,\text{UR} + 0.1061\,\text{O} + 0.0269\,\text{E} - 0.0115\,\text{P} - 0.0006\,\text{L} + 0.2011\,\text{CD} - 2.2262\,\text{LD}$$
$$(6.45064)\ (-0.855953)\ (0.751633)\ (5.40736)\ (-2.31799)\ (-0.129051)\ (14.7808)\ (-163.640)$$

R-squared = 0.9998

66. Radio and television broadcasting (EG 118)

$$\text{Hours} = 6.9223 - 0.0932\,\text{UR} - 0.0817\,\text{O} + 0.0894\,\text{E} + 0.0828\,\text{P} + 0.0312\,\text{L} + 0.3552\,\text{CD} - 0.9647\,\text{LD}$$
$$(8.23618)\ (-2.70448)\ (-0.806311)\ (32.0578)\ (29.7142)\ (11.1787)\ (10.7664)\ (-29.2446)$$

R-squared = 0.9976

67. Communications, except radio and television (EG 119)

$$\text{Hours} = 3.6459 + 0.0009\,\text{UR} + 0.6067\,\text{O} + 0.0506\,\text{E} + 0.0077\,\text{P} - 0.0194\,\text{L} + 0.7159\,\text{CD} - 2.0151\,\text{LD}$$
$$(1.98253)\ (0.057214)\ (3.03905)\ (3.38110)\ (0.513385)\ (-1.29281)\ (36.0664)\ (-101.519)$$

R-squared = 0.9997

68. Electric, gas, water, and sanitary services (EG 120–122)

$$\text{Hours} = 16.2056 + 0.0805\,\text{UR} - 0.6404\,\text{O} + 0.0982\,\text{E} + 0.0836\,\text{P} + 0.0520\,\text{L} + 1.3283\,\text{CD} - 2.6286\,\text{LD}$$
$$(6.29216)\ (2.87725)\ (-2.51998)\ (6.89201)\ (5.86418)\ (3.64760)\ (41.8917)\ (-82.8999)$$

R-squared = 0.9995

69. Wholesale and retail trade (EG 123–125)

$$\text{Hours} = 7.5527 - 0.0095\,\text{UR} + 0.2231\,\text{O} + 0.0439\,\text{E} + 0.0534\,\text{P} + 0.0059\,\text{L} + 0.1637\,\text{CD} + 0.0045\,\text{LD}$$
$$(3.26262)\ (-0.379661)\ (1.15739)\ (5.62240)\ (6.83613)\ (0.761329)\ (9.51478)\ (0.259608)$$

R-squared = 0.9958

70. Finance and insurance (EG 126–128)

$$\text{Hours} = 17.2737 - 0.2367\,\text{UR} - 1.0387\,\text{O} + 0.3002\,\text{E} + 0.1051\,\text{P} + 0.0696\,\text{L} + 3.5167\,\text{CD} + 2.3514\,\text{LD}$$
$$(2.57278)\ (-1.87710)\ (-1.64790)\ (12.2407)\ (4.28656)\ (2.83659)\ (37.2821)\ (24.9283)$$

R-squared = 0.9878

71. Real estate and rental (EG 129, 130)

$$\text{Hours} = 7.9091 + 0.1184\,UR + 0.0515\,O + 0.0240\,E + 0.0578\,P + 0.0183\,L + 1.2531\,CD + 1.3589\,LD$$

(1.19588) (0.469198) (−0.875903) (0.900736) (2.09085) (1.00259) (−12.1084) (−10.1148)

R-squared = 0.9224

72. Hotels; personal and repair services except auto (EG 131–133)

$$\text{Hours} = -0.6222 + 0.0041\,UR + 0.9247\,O + 0.0064\,E + 0.0098\,P - 0.0272\,L + 1.6454\,CD + 0.0859\,LD$$

(−0.285511)(0.090010) (4.33230) (1.05156) (1.61527) (−4.47190) (73.3688) (3.83018)

R-squared = 0.0

73. Business services (EG 134–136)

$$\text{Hours} = 5.0285 - 0.0634\,UR + 0.3501\,O + 0.0801\,E + 0.0732\,P + 0.0302\,L - 1.7523\,CD - 0.5648\,LD$$

(2.09731) (−1.15104) (1.55362) (6.80547) (6.22051) (2.56859) (−54.1671) (−17.4597)

R-squared = 0.9976

74. Automobile repair and services (EG 137)

$$\text{Hours} = 7.8774 - 0.1020\,UR + 0.0250\,O + 0.0872\,E + 0.0762\,P + 0.0234\,L - 0.1600\,CD - 1.1922\,LD$$

(5.35361) (−3.74399) (0.163979) (16.5724) (14.4917) (4.44650) (−7.44163) (−55.4426)

R-squared = 0.9990

75. Amusements (EG 138, 139)

$$\text{Hours} = 8.9309 - 0.0403\,UR - 0.0932\,O + 0.0696\,E + 0.0725\,P + 0.0252\,L + 0.5733\,CD - 1.1442\,LD$$

(10.8057) (−1.24950) (−0.993733) (20.4597) (21.3059) (7.41229) (25.0105) (−49.9158)

R-squared = 0.9990

76. Medical and educational services and nonprofit organizations (EG 140–144)

$$\text{Hours} = 8.3694 - 0.0679\,UR + 0.0743\,O + 0.0854\,E + 0.0547\,P + 0.0316\,L + 1.7871\,CD - 0.1766\,LD$$

(2.22602) (−3.09157) (0.210561) (5.29626) (3.39493) (1.96221) (102.013) (−10.0821)

R-squared = 0.9995

UR = Unemployment rate
O = Output
E = Equipment time trend
P = Plant time trend
L = Labor time trend
CD = Dummy variable – capital
LD = Dummy variable – labor

Appendix F. Economic Growth Sectoring Plan

Appendix F. Economic Growth Sectoring Plan

Industry sector title	Industry sector number	Bureau of Economic Analysis input-output sector	Standard Industrial Classification(SIC) 1972
Agriculture, forestry, and fisheries			
Dairy and poultry products	1	1.01—102	pt.01, pt. 02
Meat animals and livestock	2	1.03	pt. 01, pt. 02
Cotton	3	2.01	pt. 01, pt. 02
Food and feed grains	4	2.02	pt. 01, pt. 02
Agricultural products, n.e.c	5	2.02—20.7	pt. 01, pt. 02
Forestry and fishery products	6	3.00	08 (except 085), 091, 0971
Agricultural, forestry,and fishery services	7	4.00	071, 072, 075, 078, 085, 092
Mining			
Iron and ferroalloy ores mining	8	5.00	101, 106
Copper ore mining	9	6.01	102
Nonferrous metal ores mining, except copper	10	6.02	10 (except 101, 102, 106, pt. 108, 109)
Coal mining	11	7.00	11, 12
Crude petroleum and natural gas	12	8.00	13 (except pt. 138)
Stone and clay mining and quarrying	13	9.00	14 (except 147, pt. 148)
Chemical and fertilizer mineral mining	14	10.00	147
Maintenance and repair construction			
Maintenance and repair construction	15	12.01—12.02	pt. 15, pt. 16, pt. 17, pt. 138
Manufacturing			
Ordnance	16	13.02—13.07	348, 3795
Complete guided missiles and space vehicles	17	13.01	3761
Meat products	18	14.01	201
Dairy products	19	14.02—14.06	202
Canned and frozen foods	20	14.07—14.13	203, 2091 2092
Grain mill products	21	14.14—14.17	204
Bakery products	22	14.18	205
Sugar	23	14.19	2061—2063
Confectionery products	24	14.20	2065—2067
Alcoholic beverages	25	14.21	208 (except 2086—2087)
Soft drinks and flavorings	26	1422—14.23	2086-2087
Food products, n.e.c	27	14.24—14.32	207, 209 (except 2091—2092)
Tobacco manufacturing	28	15.01—15.02	21
Fabric, yarn, and thread mills	29	16.01—16.04	221—224, 226, 228
Floor covering mills	30	17.01	227
Textile mill products, n.e.c	31	17.02—17.10	229
Hosiery and knit goods	32	18.01—18.03	225
Apparel	33	18.04	23 (except 239), 39996
Fabricated textile products, n.e.c	34	19.01—19.03	239
Logging	35	20.02	241
Sawmills and planing mills	36	20.02—20.04	242
Millwork, plywood, and wood products, n.e.cn.e.c.	37	20.05—20.09	243, 2448, 245 (except 2451), 249
Wooden containers	38	21.00	244 (except 2448)
Household furniture	39	22.01—22.04	251
Furniture and fixtures, except household	40	23.01—23.07	25 (except 251)
Paper products	41	24.01—24.07	26 (except 265)
Paperboard	42	25.00	265
Newspaper printing and publishing	43	26.01	271
Periodical and book printing, publishing	44	26.02—26.04	272—274
Printing and publishing, n.e.c	45	26.05—26.08	275—279
Industrial inorganic and organic chemicals	46	27.01	281 (except 28195), 2865, 2869
Agricultural chemicals	47	27.02—27.03	287
Chemical products, n.e.c	48	27.04	2861, 289
Plastic materials and synthetic rubber	49	28.01—28.02	2821—2822
Synthetic fibers	50	28.03—28.04	2823—2824
Drugs	51	29.01	293
Cleaning and toilet preparations	52	29.02—29.03	284
Paints and allied products	53	30.00	285

See footnotes at end of table.

Appendix F. Economic Growth Sectoring Plan—Continued

Industry sector title	Industry sector number	Bureau of Economic Analysis input-output sector	Standard Industrial Classification (SIC) 1972
Petroleum refining and related products	54	31.01—31.03	29
Tires and inner tubes	55	32.01	301
Rubber products, except tires and tubes	56	32.02—32.03,32.05	302—306
Plastic products	57	32.04	307
Leather tanning and industrial leather	58	33.00	311
Leather products, including footwear	59	34.01—34.03	31 (except 311)
Glass	60	35.01—35.02	321—323
Cement and concrete products	61	36.01,36.10—36.14	324, 327
Structural clay products	62	36.02—36.05	325
Pottery and related products	63	36.06—39.09	326
Stone and clay products, n.e.c	64	36.15—36.22	328, 329
Blast furnaces and basic steel products	65	37.01	331
Iron and steel foundries and forgings	66	37.02—37.04	332, 339, 3462
Primary copper and copper products	67	38.01, 38.07, 38.10, 38.12	3331, 3351, 3357, 3362
Primary aluminum and aluminum products	68	38.04, 38.08, 38.11	3334, 28195, 3353-55, 3361
Primary nonferrous metals and products, n.e.c	69	38.02, 38.03, 38.05, 38.06	3332, 3333, 3339, 334, 3356, 3369, 3463
Metal containers	70	39.01—39.02	341
Heating apparatus and plumbing fixtures	71	40.01—40.03	343
Fabricated structural metal products	72	40.04—40.09	344
Screw machine products	73	41.01	345
Metal stampings	74	41.02	346 (except 3462—3463)
Cutlery, handtools, and general hardware	75	42.01—42.03	342
Fabricated metal products, n.e.c	76	42.04—42.11	347, 349
Engines, turbines, and generators	77	43.01—43.026	351
Farm machinery	78	44.00	352
Construction, mining, and oilfield machinery	79	45.01—45.03	3531-3533
Material handling equipment	80	46.01—46.04	353 (except 3531—3533)
Metalworking machinery	81	47.01—47.04	354
Special industry machinery	82	48.01—48.06	355
General industrial machinery	83	49.01—49.07	356
Nonelectrical machinery, n.e.c	84	50.00	359
Computers and peripheral equipment	85	51.01	3573—3574
Typewriters and other office equipment	86	51.02—51.04	357 (except 3573, 3574)
Service industry machines	87	52.01—52.05	358
Electric transmission equipment	88	53.01—53.03	361, 3825
Electrical industrial apparatus	89	53.04—53.08	362
Household appliances	90	54.01—54.07	363
Electric lighting and wiring	91	55.01—55.03	364
Radio and television receiving sets	92	56.01—56.02	365
Telephone and telegraph apparatus	93	56.03	3661
Radio and communication equipment	94	56.04	3662
Electronic components	95	57.01—57.03	367
Electrical machinery and equipment, n.e.c	96	58.01—58.05	369
Motor vehicles	97	59.01—59.03	371
Aircraft	98	60.01—60.04	372, 376 (except 3761)
Ship and boat building and repair	99	61.01—61.02	373
Railroad equipment	100	61.03	374
Motorcycles, bicycles, and parts	101	61.05	375
Transportation equipment, n.e.c	102	61.06—61.07	379 (except 3795), 2451
Scientific and controlling instruments	103	62.01—62.03	381, 382 (except 3825)
Medical and dental instruments	104	62.04—62.06	384
Optical and ophthalmic equipment	105	63.01—63.02	383, 385
Photographic equipment and supplies	106	63.03	386
Watches, clocks, and clock-operated devices	107	62.07	387
Jewelry and silverware	108	64.01	391, 3961
Musical instruments and sporting goods	109	64.02—64.04	393, 394
Manufactured products, n.e.c.	110	64.05—64.12	395, 396 (except 3961), 399 (except 39996)
Transportation			
Railroad transportaion	111	65.01	40, 474, pt. 4789
Local transit and intercity buses	112	65.02	41
Truck transportation	113	65.03	42, pt. 4789
Water transportation	114	65.04	44
Air transportation	115	65.05	45
Pipeline transportation	116	65.06	46
Transportation services	117	65.07	47 (except 474, pt. 4789)

See footnotes at end of table.

Appendix F. Economic Growth Sectoring Plan—Continued

Industry sector title	Industry sector number	Bureau of Economic Analysis input-output sector	Standard Industrial Classification(SIC) 1972
Communication			
Radio and television broadcasting	118	67.00	483
Communications, except radio and television	119	66.00	48 (except 483)
'Electric, gas, sanitary services			
Electric utilities, public and private	120	68.01, 78.02, 79.02	491, pt. 493
Gas utilities, excluding public	121	68.02	492, pt. 493
Water and sanitary services, excluding public	122	68.03	49 (except 491, 492, pt. 493)
Trade			
Wholesale trade	123	69.01	50, 51
Eating and drinking places	124	74.01	58
Retail trade, except eating and drinking places	125	69.02	52-57, 59, 7396, pt. 8042
Finance, insurance, and real estate			
Banking	126	70.01	60
Credit agencies and financial brokers	127	70.02—70.02	61, 62, 67
Insurance	128	70.04—70.05	63, 64
Owner-occupied real estate	129	71.01	n.a.
Real estate	130	71.02	65, 66, pt. 1531
Other services			
Hotels and lodging places	131	72.01, 77.08	70, 836
Personal and repair services	132	72.02	72 (except 723, 724), 76 (except 7692, 7694, and pt. 7699)
Barber and beauty shops	133	72.03	723, 724
Business services, n.e.c.	134	73.01	73 (except 731, 7396), 7692, 7694, pt. 7699
Advertising	135	73.02	731
Professional services, n.e.c.	136	73.03	81, 89 (except 8922)
Automobile repair	137	75.00	75
Motion pictures	138	76.01	78
Amusements and recreation services	139	76.02	79
Doctors" and dentists" services	140	77.01	801-803, 8041
Hospitals	141	77.02	806
Medical services, except hospitals	142	77.03	074, 8049, 805, 807—809
Educational services	143	77.04, 77.06—77.07	82, 833, 835
Nonprofit organizations	144	77.05, 77.09	832, 839, 84, 86, 8922
Government enterprises			
Post office	145	78.01	43
Commodity Credit Corporation	146	78.03	n.a.
Federal enterprises, n.e.c.	147	78.04	n.a.
Local government passenger transit	148	79.01	n.a.
State and local government enterprises, n.e.c.	149	79.03	n.a.
Special industries			
Noncomparable imports	150	80.00	n.a.
Scrap, used and secondhand goods	151	81.00	n.a.
Construction industry	152	n.a.	n.a.
Government industry	153	82.00	n.a.
Rest of the world industry	154	83.00	n.a.
Households	155	84.00	n.a.
Inventory valuation adjustment	156	85.00	n.a.

n.e.c. = not elsewhere classified. n.a. = not applicable.

Appendix G. Occupations Included in the Industry-Occupational Model

Appendix G. Occupations included in the industry-occupational model

Occupation title

- Total, all occupations
  - Professional, technical, and related workers
    - Engineers
      - Aeronautical and astronautical engineers
      - Chemical engineers
      - Civil engineers
      - Electrical engineers
      - Industrial engineers
      - Mechanical engineers
      - Metallurgical engineers
      - Mining engineers
      - Petroleum engineers
      - All other engineers
    - Life and physical scientists
      - Argricultural scientists
      - Biological scientists
      - Chemists
      - Geologists
      - Medical scientists
      - Physicists
      - All other life and physical scientists
    - Mathematical specialists
      - Actuaries
      - Mathematicians
      - Statisticians
      - All other mathematical scientists
    - Engineering and science technicians
      - Broadcast technicians
      - Civil engineering technicians
      - Drafters
      - Electrical and electronic technicians
      - Industrial engineering technicians
      - Mechanical engineering technicians
      - Surveyors
      - All other engineering and science technicians
    - Medical workers, except technicians
      - Chiropractors
      - Dentists
      - Dietitians
      - Nurses, professional
      - Optometrists
      - Pharmacists
      - Physicians, medical and osteopathic
      - Podiatrists
      - Therapists
        - Inhalation therapists
        - Manual arts, music, recreational therapists
        - Occupational therapists
        - Physical therapists
        - Speech and hearing clinicians
        - All other therapists
      - Veterinarians
    - Health technologists and technicians
      - Cytotechnologists
      - Dental hygienists
      - Dietetic technicians
      - EKG technicians
      - Health records technologists
      - Licensed practical nurses
      - Medical technicians
      - Medical lab technologists
      - Pharmacy helpers
    - Physical therapy technicians
    - Radiologic and nuclear medical technicians
    - Health technologists and technicians—Continued
      - Surgical technicians
      - X-ray technicians
      - All other health technologists and technicians
    - Technicians, except health, science, and engineering
      - Airplane pilots
      - Air traffic controllers
      - Embalmers
      - Flight engineers
      - Radio operators
      - Technical assistants, library
      - Tool programmers, numerical control
      - Other technicians, except health, science, engineering
    - Computer specialists
      - Computer programmers
      - Computer systems analysts
    - Social scientists
      - Economists
      - Financial analysts
      - Psychologists
      - Sociologists
      - Urban and regional planners
      - All other social scientists
    - Teachers
      - Adult education teachers
      - College and university teachers
      - Dance instructors
      - Elementary school teachers
      - Extension service specialists
      - Graduate assistants
      - Preschool and kindergarten teachers
      - Secondary school teachers
      - Vocational education teachers
      - All other teachers
    - Selected writers, artists, and entertainers
      - Actors
      - Athletes
      - Commercial artists
      - Dancers
      - Designers
      - Film editors
      - Music directors
      - Musicians, instrumental
      - Painters, artistic
      - Photographers
      - Public relations specialists
      - Radio and TV announcers
        - Announcers
        - Broadcast news analysts
      - Reporters and correspondents
      - Singers
      - Sports instructors
      - Writers and editors
      - Writers, artists, entertainers, n.e.c.
    - Other professional and technical workers
      - Accountants and auditors
      - Architects
      - Archivists and curators
      - Assessors
      - Audio visual specialists, education
      - Broker''s floor reps and security traders
      - Buyers, retail and wholesale trade

Appendix G. Occupations included in the industry-occupational model—Continued

Occupation title
Other technical and professional workers—Continued
Claim examiners, property/casualty insurance
Claims takers, unemployment benefits
Clergy
Cost estimators
Credit analysts, chief
Credit analysts
Directors, religious education and activities
Employment interviewers
Foresters
Insurace investigators
Judges
Law clerks
Lawyers
Paralegal personnel
Librarians
Magistrates
Media buyers
Personnel and labor relations specialists
Purchasing agents and buyers
Recreation workers, group
Safety inspectors
Social workers
Caseworkers
Community organization workers
Special agents, insurance
Tax examiners, collectors, and revenue agents
Tax preparers
Title examiners and abstractors
Underwriters
Vocational and educational counselors
Welfare investigators
All other professional workers
Managers, officials, and proprietors
Auto parts department managers
Auto service department managers
Construction inspectors, public administration
Inspectors, except construction, public administration
Postmasters and mail superintendents
Railroad conductors
Restaurant, cafe, and bar managers
Sales managers, retail trade
Store managers
Wholesalers
All other managers
Sales workers
Broker and market operators, commodities
Contribution solicitors
Crafting and moving estimators
Real estate appraisers
Real estate brokers
Sales agents and representatives, real estate
Sales agents and representatives, insurance
Sales agents and representatives, security
Sales clerks
Travel agents and accommodations appraisers
Vendors
All other sales workers
Clerical workers
Adjustment clerks

Occupation title
Clerical workers—Continued
Admissions evaluators
Bank tellers
New accounts tellers
Tellers
Bookkeepers and accounting clerks
Accounting clerks
Bookkeepers, hand
Brokerage clerks
Car rental clerks
Cashiers
Checking clerks
Circulation clerks
Claims adjusters
Claims clerks
Claims examiner, insurance
Clerical supervisors
Collectors, bill and account
Court clerks
Credit authorizers
Credit clerks, banking and insurance
Credit reporters
Customer service representatives, printing, publishing
Desk clerks, bowling floor
Desk clerks, except bowling floor
Dispatchers, police, fire, and ambulance
Dispatchers, vehicle, service, or work
Eligibility workers, welfare
File clerks
General clerks, office
In-file operators
Insurance checkers
Insurance clerks, except medical
Library assistants
Loan closers
Mail carriers, postal service
Mail clerks
Marking clerks, trade
Messengers
Meter readers, utilities
Mortgage closing clerks
Office machine operators
Bookkeeping and billing operators
Bookkeeping, billing machine operators
Proof machine operators
Transit clerks
Computer, peripheral equipment operators
Computer operators
Peripheral EDP equipment operators
Duplicating machine operators
Keypunch operators
Tabulating machine operators
All other office machine operators
Order clerks
Payroll and timekeeping clerks
Personnel clerks
Policy change clerks
Postal clerks
Procurement clerks
Production clerks
Proofreaders
Rate clerks, freight
Raters
Real estate clerks
Receptionists
Reservation agents
Safe deposit clerks
Secretaries, stenographers, and typists
Secretaries

Appendix G. Occupations included in the industry-occupational model—Continued

Occupation title
Clerical workers—Continued
Stenographers
Typists
Service clerks
Service representatives
Shipping and receiving clerks
Shipping packers
Statement clerks
Statistical clerks
Stock clerks, stockroom and warehouse
Survey workers
Switchboard operators/receptionists
Teacher''s aides, except monitors
Telephone ad takers, newspapers
Telegraph operators
Telephone operators
Switchboard operators
Central office operators
Directory assistance operators
All other telephone operators
Ticket agents
Title searchers
Town clerks
Traffic agents
Traffic clerks
Transportation agents
Travel counselors, auto club
Weighers
Worksheet clerks
Yard clerks
All other clerical workers
Crafts and related workers
Construction crafts workers
Air-hammer operators
Asbestos and insulation workers
Brickmasons
Carpenters
Carpet cutters and layers
Ceiling tile installers and floor layers
Concrete and terrazzo finishers
Dry wall installers and lathers
Dry wall applicators
Lathers
Tapers
Electricians
Fitters, pipelaying
Glaziers
Highway maintenance workers
Painters, construction and maintenance
Paperhangers
Plasterers
Plumbers and pipefitters
Refractory materials repairers
Roofers
Shipwrights
Stonemasons
Structural steel workers
Tile setters
Mechanics, repairers, and installers
Air-conditioning, heating, and refrigeration mechanics
Aircraft mechanics
Auto body repairers
Auto seat cover and top installers
Automotive mechanics
Auto repair service estimators
Bicycle repairers
Coin machine servicers and repairers
Data processing machine mechanics
Diesel mechanics

Occupation title
Machanics, repairs, and installers—Continued
Electrical instrument and tool repairers
Electric motor repairers
Electric powerline installers and repairers
Cable splicers
Line installers and repairers
Trouble shooters, powerline
Engineering equipment mechanics
Farm equipment mechanics
Gas and electric appliance repairers
Gas and electric meter installers
Household appliance installers
Hydroelectric machine mechanics
Instrument repairers
Knitting machine fixers
Laundry machine mechanics
Locksmiths
Loom fixers
Maintenance mechanics
Maintenance repairers, general utility
Marine mechanics and repairers
Millwrights
Mine machinery mechanics
Mobile home repairers
Musical instrument repairers
Office machine and cash register servicers
Pinsetter mechanics, automatic
Radio and television repairers
Railroad car repairers
Railroad signal and switch maintainers
Section repairers and setters
Sewing machine mechanics
Shoe repairers
Telephone installers and repairers
Cable repairers
Cable installers
Central office repairers
Frame wirers
Installers, repairers, and section maintainers
Station installers
Trouble locators, test desk
All other telephone installers and repairers
Water meter installers
All other mechanics, repairers, and installers
Metalworking crafts workers, except mechanics
Blacksmiths
Boilermakers
Coremakers, hand, bench, and floor
Forging press operators
Header operators
Heat treaters, annealers, and temperers
Layout markers, metal
Machine tool setters, metalworking
Machinists
Molders, metal
Molders, bench and floor
Molders, machine
All other molders, metal
Patternmakers, metal
Punch press setters, metal
Rolling mill operators and helpers
Shear and slitter setters
Sheet metal workers and tinsmiths
Tool-and-die-makers
All other metalworking crafts workers

Appendix G. Occupations included in the industry-occupational model—Continued

Occupation title
Metalworking crafts workers, except mechanics—Continued
Printing trades crafts workers
Bookbinders, hand and machine
Bindery machine setters
Compositors and typesetters
Electrotypers and stereotypers
Etchers and engravers
Photoengravers and lithographers
Camera operators, printing
Photoengravers
Strippers, printing
Press and plate printers
Letter press operators
Offset lithographic press operators
Platemakers
Press operators and plate printers
All other press and plate printers
Other crafts and related workers
Auxiliary equipment operators
Bakers
Blue-collar worker supervisors
Cabinetmakers
Control room operators, steam
Crane, derrick, and hoist operators
Dental lab technicians
Food shapers, hand
Furniture finishers
Furniture upholsterers
Glass installers
Heavy equipment operators
Inspectors
Jewelers and silversmiths
Lens grinders
Locomotive engineers
Locomotive engineer helpers
Log inspectors, graders, and sclaers
Logging tractor operators
Lumber graders
Machine setters, paper goods
Machine setters, plastic materials
Machine setters, woodworking
Merchandise displayers and window trimmers
Millers
Motion picture projectionists
Opticians
Oil pumpers
Patternmakers, wood
Patternmakers, n.e.c.
Power station operators
Pumpers, head
Pumping station operators, waterworks
Sewage plant operators
Shipfitters
Ship engineers
Other crafts and related workers
Stationary engineers
Stonecutters and stone carvers
Tailors
Testers
Upholsterers
Upholstery cutters
Upholstery workers, n.e.c.
Veneer graders
Watchmakers
Water treatment plant operators
All other crafts and related workers
Operatives
Assemblers
Aircraft structure and surfaces assemblers
Clock and watch assemblers
Electrical and electronic assemblers
Electro-mechanical equipment assemblers
Instrument makers and assemblers
Machine assemblers
All other assemblers
Bindery operatives
Bindery workers, assembly
Bindery workers, stitching
All other bindery operatives
Laundry, drycleaning, and pressing machine operatives
Drycleaners, hand and machine
Folders, laundry
Laundry operators, small establishment
Markers, classifiers, and assemblers
Pressers, hand
Pressers, machine
Pressers, machine laundry
Rug cleaners, hand and machine
Shapers and pressers
Spotters, drycleaning and washable materials
Washers, machine and starchers
All other laundry and drycleaning operatives
Meat cutters and butchers
Boners, meat
Boners, poultry
Butchers, all-round
Carcass splitters
Fish cleaners, hand and butchers, fish
Metalworking operatives
Dip platers, nonelectrolytic
Drill press and boring machine operators
Electroplators
Furnace chargers
Furnace operators, cupola tenders
Grinding and abrading machine operators, metal
Heaters, metal
Lathe machine operators, metal
Machine-tool operators, combination
Machine-tool operators, numerical control
Machine-tool operators, toolroom
Milling and planing machine operators
Metalworking operatives
Pourers, metal
Power brake and bending machine operators, metal
Punch press operators, metal
Welders and flamecutters
All other metalworking operatives
Mine operatives, n.e.c.
Continuous mining machine operators
Derrick operators, petroleum and gas
Gagers
Loading machine operators
Mill and grinder operators, minerals

Appendix G. Occupations included in the industry-occupational model—Continued

Occupation title	Occupation title
Mine operatives, n.e.c.—Continued	Textile operatives
Roof bolters	Parking attendants
Roustabouts	Railroad brake operators
Service unit operators, oil well	Rental car delivery workers
Shuttle car operators	Sailors and deckhands
Well pullers	Streetcar operators
All other mine operatives, n.e.c.	Taxi drivers
	Truckdrivers
Packing and inspecting operatives	Transport equipment operatives,
Baggers	All other operatives
Bundlers	Batch plant operators
Cloth graders	Blasters
Graders, food and skins	Boring machine operators, wood
Production packagers	Coil finishers
Selectors, glassware	Cutters, machine
All other packing and inspecting operatives	Cutters, portable machine
	Cutter-finisher operators, rubber goods
Painters, manufactured articles	Cutting machine operators, food
Painters, automotive	Die cutters and clicking machine operators
Decorators, hand	Dressmakers, except factory
Rubbers	Drillers, hand and machine
Painters, production	Dyers
	Exterminators
Sawyers	Filers, grinders, buffers, and chippers
Cut-off-saw operators, lumber	Floor sanding machine operators
Edgers, automatic and pony	Fuel pump attendants and lubricators
Head sawyers	Furnace operators and tenders, except metal
Ripsaw operators	Kiln operators, minerals
Sawyers, metal	Stationary boiler firers
Trim-saw operators	All other furnace operators and tenders, except metal
All other sawyers	Furniture assemblers and installers
	Lathe operators, except metal
Sewers and stitchers	Miscellaneous machine operatives, meat and dairy
Garment repairers	Miscellaneous machine operatives, all other food
Menders	Miscellaneous machine operatives, tobacco
Sewing machine operators, regular equipment, garment	Miscellaneous machine operatives, lumber and furniture
Sewing machine operators, special equipment, garment	Miscellaneous machine operatives, paper
Sewing machine operators, regular equipment, nongarment	Miscellaneous machine operatives, chemicals
Sewing machine operators, special equipment,nongarment	Miscellaneous machine operatives, petroleum and coal
	Miscellaneous machine operatives, rubber and plastics
Textile operatives	Miscellaneous machine operatives, leather
Battery loaders	Miscellaneous machine operatives, stone, clay, glass
Beam warper tenders and beamers	Miscellaneous machine operatives, primary metals
Boarding machine operators, hosiery	Miscellaneous machine operatives, manufacturing, n.e.c.
Card tenders and comber tenders	Miscellaneous machine operatives, nonmanufacturing
Cloth feeders and back tenders	Miscellaneous operatives, n.e.c., durable goods
Cloth finishing range operators and tenders	Miscellaneous operatives, n.e.c., nondurable goods
Creelers, yarn	Mixing operatives
Doffers	Nailing machine operators
Drawing frame and gill box tenders	Oilers
Folders, hand	Photographic process workers
Folding machine operators	Power screwdriver operators
Knitting machine operators	Punch and stamping press operators, except metal
Seamless hosiery knitters	Riveters
Slubber tenders	Rotary drill operators
Spinners, frame	Rotary drill operator helpers
Spooler operators, automatic	
Texturizers and crimp setters	
Turners	
Twister tenders	
Weavers	
Winder operators, automatic	
Yarn winders	
All other textile operatives	
Transport equipment operatives	
Ambulance drivers and ambulance attendants	
Bus drivers	
Chauffeurs	
Delivery and route workers	
Industrial truck operators	
Log handling equipment operators	

Appendix G. Occupations included in the industry-occupational model—Continued

Occupation title
All other operatives—Continued
Sandblasters and shotblasters
Sanders, wood
Shaper and rubber operators
Shear and slitter operators, metal
Shoemaking machine operators
Surveyor helpers
Termite treaters and helpers
Tire changers and repairers
Winding operatives, n.e.c.
Coil winders
Paper reel and rewinder operators
Winders, paper machine
All other winding operatives, n.e.c.
Wirers, electronic
Wood machinists
Operatives, n.e.c.
Service workers
Food service workers
Bakers, bread and pastry
Bartenders
Butchers and meat cutters
Cooks, except private households
Cooks, institutional
Cooks, restaurant
Cooks, short order and specialty fast foods
Food service workers, fast food restaurants
Hosts/hostesses, restaurant, lounge, coffee shop
Kitchen helpers
Pantry, sandwich, and coffee makers
Waiters and waitresses
Waiters assistants
All other food service workers
Janitors and sextons
Selected health service workers
Dental assistants
Health aides, except nursing
Medical assistants
Nurses aides and orderlies
Psychiatric aides
Selected personal service workers
Barbers
Baggage handlers and porters
Bellhops, bag porters, and doorkeepers
Checkroom and locker room attendants
Child care attendants
Child care workers
Cosmetologists and women''s hairstylists
Elevator operators
Flight attendants
Funeral attendants
Game and ride operators and concession workers
Guides, sightseeing and establishment
Housekeepers, hotel and motel
Manicurists
Masseurs and masseuses
Pin chasers
Recreation facility attendants
Reducing instructors
Scalp treatment operators
School monitors
Shampooers
Ushers, lobby attendants, and ticket takers
Welfare service aides
Personal service workers, n.e.c.

Occupation title
Selected personal service workers—Continued
Protective service workers
Bailiffs
Checkers, fitting room
Correction officials and jailers
Crossing or bridge tenders
Crossing guards, school
Firefighters
Fire inspectors
Fire officers
Fish and game wardens
Guards and doorkeepers
Lifeguards
Parking enforcement officers
Police detective
Police officers
Police patrolmen/women
Sheriffs
Store detectives
All other protective service workers
Private household workers
Child care workers, private household
Cooks, private household
Housekeepers, private household
Laundresses, private household.
Maids and servants, private household
Supervisors, nonworking, service
All other service workers
Laborers, except farm
Animal caretakers
Construction laborers, except carpenter helpers
Asphalt rakers
Fence erectors
Pipelayers
Reinforcing-iron workers
All other construction laborers
Cannery workers
Chain offbearers, lumber
Cleaners, vehicle
Conveyor operators and tenders
Forest conservation workers
Furnace operators and heater helpers
Garbage collectors
Gardeners and groundskeepers, except farm
Helper, trades
Line service attendants
Loaders, cars and trucks
Loaders, tank cars and trucks
Off-bearers
Riggers
Septic tank servicers
Setters and drawers
Shakeout workers, foundry
Stock handlers
Order fillers
Stock clerk, sales floor
Timber cutting and logging workers
Choker setters, lumber
Fallers and buckers
All other timber cutting and logging workers
Work distributors
All other laborers, except farm
Farmers and farm workers
Farmers and farm managers
Farmers (owners and tenants)
Farm managers
Farm supervisors and laborers
Farm supervisors
Farm laborers

Appendix H. Industries Included in the Industry-Occupational Model

Appendix H. Industries included in the Industry-Occupational Model

Industry title
Total, all industries
Agriculture, forestry, and fishing, total
Agricultural production, crops
Agricultural production, livestock
Agricultural services
Forestry
Fishing, hunting, and trapping
Mining, total
Metal mining, total
Iron ores
Copper ores
Lead and zinc ores
Gold and silver ores
Bauxite and other aluminum ores
Ferroalloy ores, except vanadium
Metal mining services
Miscellaneous metal ores
Anthracite mining, total
Bituminous coal and lignite mining, total
Crude petroleum and natural gas, total
Crude petroleum and natural gas
Natural gas liquids
Oil and gas field services
Nonmetallic mining and quarrying, total
Dimension stone
Crushed and broken stone
Sand and gravel
Clay and related minerals
Chemical and fertilizer minerals
Nonmetallic minerals services
Miscellaneous nonmetallic minerals
Construction, total
General building contractors, total
Residential building construction
Operative building
Nonresidential building construction
General contractors, except building, total
Highway and street construction
Heavy construction, except highway
Special trade contractors, total
Plumbing, heating, air-conditioning
Painting, paper hanging, and decorating
Electrical work
Masonry, stonework, and plaster
Carpentering and flooring
Roofing and sheet metal work
Concrete work
Water well drilling
Miscellaneous special trade contractors
Manufacturing, total
Durable goods manufacturing, total
Lumber and wood products, total
Logging camps and logging contractors
Sawmills and planing mills
Millwork, plywood, and structural members
Wooden containers
Wood building and mobile homes
Miscellaneous wood products
Furniture and fixtures, total
Household furniture
Office furniture
Public building and related furniture

Industry title
Durable goods manufacturing, total —Continued
Partitions and fixtures
Miscellaneous furniture and fixtures
Stone, clay, and glass products, total
Flat glass
Glass and glassware, pressed or blown
Products of purchased glass
Cement, hydraulic
Structural clay products
Pottery and related products
Concrete, gypsum, and plaster products
Cut stone and stone products
Miscellaneous nonmetallic mineral products
Primary metal industries, total
Blast furnaces and basic steel products
Iron and steel foundries
Primary nonferrous metals
Secondary nonferrous metals
Nonferrous rolling and drawing
Nonferrous foundries
Miscellaneous primary metal products
Fabricated metal products, total
Metal cans
Cutlery, handtools, and hardware
Plumbing and heating, except electrical
Fabricated structural metal products
Screw machine products, bolts, nuts
Metal stampings
Metal services, n.e.c.
Ordnance and accessories, n.e.c.
Miscellaneous fabricated metal products
Machinery, except electrical, total
Engines and turbines
Farm and garden machinery
Construction and related machinery
Metalworking machinery
Special industry machinery
General industrial machinery
Office, computing machinery
Refrigeration and service machinery
Miscellaneous machinery, except electrical
Electric machinery, equipment, and supplies, total
Electric distributing equipment
Electrical industrial apparatus
Household appliances
Electric lighting and wiring equipment
Radio and TV receiving equipment
Communication equipment
Electronic components and accessories
Miscellaneous electrical equipment and supplies
Transportation equipment, total
Motor vehicles and equipment
Aircraft and parts
Ship and boat building and repairing
Railroad equipment
Motorcycles, bicycles, and parts
Guided missiles, space vehicles
Miscellaneous transportation equipment

Appendix H. Industries included in the Industry-Occupational Model—Continued

Industry title
Durable goods manufacturing, total—Continued
Professional, scientific instruments, total
Engineering and scientific instruments
Mechanical measuring and controlling
Optical instruments and lenses
Medical instruments and supplies
Ophthalmic goods
Photographic equipment and supplies
Watches, clocks, and watchcases
Miscellaneous manufacturing industries, total
Jewelry, silverware, an plated ware
Musical instruments
Toys and sporting goods
Pens, pencils, and office and art supplies
Costume jewelry and notions
Miscellaneous manufacturing
Nondurable goods manufacturing, total
Food and kindred products, total
Meat products
Dairy products
Preserved fruits and vegetables
Grain mill products
Bakery products
Sugar and confectionery products
Fats and oils
Beverages
Miscellaneous foods and kindred products
Tobacco manufacturing, total
Cigarettes
Cigars
Tobacco (chewing and smoking)
Tobacco steaming and redrying
Textile mill products, total
Weaving mills, cotton
Weaving mills, synthetic fibers
Weaving and finishing mills, wool
Narrow fabrics mills
Knitting mills
Textile finishing, except wool
Floor covering mills
Yarn and thread mills
Miscellaneous textile goods
Apparel and textile products, total
Men's and boys' suits and coats
Men's and boys' furnishings
Women's and misses' outerwear
Women's and children's undergarments
Hats, caps, and millinery
Children''s outerwear
Fur goods
Miscellaneous apparel and accessories
Miscellaneous fabricated textile products
Paper and allied products, total
Pulp mills
Paper mills, except building paper
Paperboard mills
Miscellaneous converted paper products
Paperboard containers and boxes
Building paper and board mills
Printing and publishing industries, total
Newspapers
Periodicals

Industry title
Nondurable goods manufacturing, total—Continued
Books
Miscellaneous publishing
Commercial printing
Manifold business forms
Greeting card publishing
Blankbooks and bookbinding
Printing trade services
Chemicals and allied products, total
Industrial inogranic chemicals
Plastics materials and synthetics
Drugs
Soaps, cleaners, and toilet goods
Paints and allied products
Industrial organic chemicals
Agricultural chemicals
Petroleum and coal products, total
Petroleum refining
Paving and roofing materials
Miscellaneous petroleum and coal products
Rubber and miscellaneous plastics products, total
Tires and inner tubes
Rubber and plastics footwear
Reclaimed rubber
Rubber and plastics hose and belting
Fabricated rubber products, n.e.c.
Miscellaneous plastics products
Leather and leather products, total
Leather tanning and finishing
Boot and shoe cut stock and findings
Footwear, except rubber
Leather gloves and mittens
Luggage
Handbags and personal leather goods
Leather goods, n.e.c.
Transportation, communications, and utilities
Transportation, total
Railroad transportation, total
Local and interurban transit, total
Local and suburban transportation
Taxicabs
Intercity highway transportation
Transportation charter service
School buses
Bus terminal and service facilities
Trucking and warehousing, total
Trucking, local and long distance
Public warehousing
Trucking terminal facilities
U.S. postal service
Water transportation, total
Deep sea foreign transportation
Deep sea domestic transportation
Great Lakes transportation
Transportation on rivers and canals
Local water transportation
Water transportation services
Air transportation, total
Certificated air transportation
Noncertificated air transportation
Air transportation services
Pipelines, except natural gas, total
Transportation services, total
Freight forwarding
Arrangement of transportation

Appendix H. Industries included in the Industry-Occupational Model—Continued

Industry title
Transportation, communications, and utilities—Continued
Rental of railroad cars
Miscellaneous transportation services
Communications and utilities, total
Communications, total
Telephone communication
Telegraph communication
Radio and television broadcasting
Communication services, n.e.c.
Utilities and sanitary services, total
Electric companies and systems
Gas companies and systems
Combination companies and systems
Water supply
Sanitary services
Steam supply
Irrigation systems
Wholesale and retail trade, total
Wholesale trade, durable goods, total
Motor vehicle and auto parts and supplies
Furniture and home furnishings
Lumber and other construction materials
Sporting, toy, photographic, and hobby goods
Metals and minerals, except petroleum
Electrical goods
Hardware, plumbing, and heating supplies
Machinery, equipment, and supplies
Miscellaneous durable goods
Wholesale trade, nondurable goods, total
Paper and paper products
Drugs, proprietaries, and sundries
Apparel, piece goods, and notions
Groceries and related products
Farm-product raw materials
Chemical and allied products
Petroleum and petroleum products
Beer, wine, and distilled alcholic beverages
Miscellaneous nondurable goods
Retail trade, total
Building materials, garden supplies, mobile homes, total
Lumber and other building materials dealers
Paint, glass, and wallpaper stores
Hardware stores
Retail nurseries, lawn and garden supplies
Mobile home dealers
Retail trade, general merchandise, total
Department stores
Variety stores
Miscellaneous general merchandise stores
Food stores, total
Grocery stores
Meat and fish (seafood) markets
Fruit stores and vegetable markets
Candy, nut, and confectionery stores
Dairy products stores
Retail bakeries
Miscellaneous food stores

Industry title
Retail trade, total—Continued
Automobiles and recreational vehicles, total
Motor vehicle dealers (new and used)
Motor vehicle dealers (used only)
Auto and home supply stores
Gasoline service stations
Boat dealers
Recreational and utility trailer dealers
Motorcycle dealers
Automotive dealers, n.e.c.
Apparel and accessories stores, total
Men's and boys' clothing and furnishings
Women's and misses' ready-to-wear stores
Women's and misses' accessory and specialty stores
Children's and infants' wear stores
Family clothing stores
Shoe stores
Furriers and fur shops
Miscellaneous apparel and accessories
Furniture and home furnishings stores, total
Furniture and home furnishing, except appliances
Household appliance stores
Radio, television, and music stores
Eating and drinking places, total
Miscellaneous retail stores, total
Drug stores and proprietary stores
Liquor stores
Used merchandise stores
Miscellaneous shopping goods stores
Nonstore retailers
Fuel and ice dealers
Retail stores, n.e.c.
Finance, insurance, and real estate, total
Banking, total
Federal Reserve Banks
Commercial and stock savings banks
Mutual savings banks
Trust companies, nondeposit
Functions closely related to banking
Credit agencies other than banks, total
Rediscount and financing institutions
Savings and loan associations
Agricultural credit institutions
Personal credit
Business credit institutions
Mortgage bankers and brokers
Security and commodity brokers, dealers, total
Security brokers and dealers
Commodity contracts brokers and dealers
Security and commodity exchanges
Security and commodity services
Insurance carriers, total
Life insurance
Medical service and health insurance
Fire, marine, and casualty insurance
Surety insurance

Appendix H. Industries included in the Industry-Occupational Model—Continued

Industry title	Industry title
Finance, insurance, and real estate, total—Continued	Services,total—Continued
Title insurance	Motion picture production and services
Pension, health, and welfare funds	Motion picture distribution and services
Insurance carriers, n.e.c.	Motion picture theaters
Insurance agents, brokers, and services, total	Amusement and recreation, except motion pictures, total
Real estate, total	Dance halls, studios, and schools
Real estate operators and lessors	Theatrical producers, bands, and entertainers
Real estate agents and managers	Bowling alleys and billard and pool establishments
Title abstract offices	Commercial sports
Subdividers and developers	Miscellaneous amusement and recreation services
Combined real estate, insurance, loan, and law offices	Health services, total
Holding and other investment offices, total	Offices of physicians
Holding offices	Offices of dentists
Investment offices	Offices of osteopathic physicians
Trusts	Offices of other health practitioners
Miscellaneous investing	Nursing and personal care facilities
Services,total	Hospitals
Hotels and other lodging places, total	Medical and dental laboratories
Hotels, motels, and tourist courts	Outpatient care facilities
Rooming and boarding houses	Health and allied services, n.e.c.
Camps and trailering parks	Legal services, total
Organization hotels and lodging houses	Educational services, total
Personal services, total	Social services, total
Laundry, cleaning, and garment services	Individual and family social services
Photographic studios, portrait	Job training and vocational rehabilitation services
Beauty shops	Child day care services
Barber shops	Residential care
Shoe repair, shoe shine, and hat cleaning shops	Social services, n.e.c.
Funeral service and crematories	Museums, art gallaries, and zoos, total
Miscellaneous personal services	Museums and art gallaries
Miscellaneous business services, total	Arboreta, botanical, zoological gardens
Advertising	Membership organizations, total
Consumer credit reporting and collection	Business associations
Mailing, reproduction, commercial art, and stenography	Professional membership organizations
Services to dwelling and other buildings	Labor unions and fraternal associations
News syndicates	Political organizations
Personal supply services	Religious organizations
Computer and data processing services	Membership organizations, n.e.c.
Miscellaneous business services	Private households, total
Automobile repair, services, and garages, total	Miscellaneous services, total
Automobile rentals, leasing, without drivers	Engineering, architectural, and surveying services
Automobile parking	Noncommercial educational and research organizations
Automobile repair shops	Accounting, auditing, and bookkeeping services
Automobile services, except repair	Services, n.e.c.
Miscellaneous repair services, total	Government, total
Electrical repair shops	Federal Government
Watch, clock, and jewelry repair	State government, except education and hospitals
Reupholstery and furniture repair	Local government, except education and hospitals
Miscellaneous repair shops and related services	
Motion pictures, total	

Appendix I. Data Sources

Source documen s, for the most part, are continuing publication, and all issues have been examined.

Labor force projections

Current Population Reports, Bureau of the Census, U.S. Department of Commerce.

Employment and Earnings, Bureau of Labor Statistics, U.S. Department of Labor.

Macroeconomic projections

Aggregate Labor Force Projections, Bureau of Labor Statistics.

Business Conditions Digest, Bureau of Economic Analysis, U.S. Department of Commerce.

Current Population Reports, Bureau of the Census.

Employment and Earnings, Bureau of Labor Statistics.

Farm Income Statistics, U.S. Department of Agriculture.

National Income and Product Accounts, Bureau of Economic Analysis.

Social Security Bulletin, Annual Statistical Supplement, Social Security Administration, U.S. Department of Health and Human Resources.

Statistical Abstract of the United States, Bureau of the Census.

Statistics of Income Report, Internal Revenue Code, Internal Revenue Service, U.S. Department of the Treasury.

Survey of Current Business, Bureau of Economic Analysis.

Final demand projections

Capital Stocks Data Base, Bureau of Labor Statistics.

Census of Governments, Bureau of the Census.

Census of Manufactures, 1967 and *1972*, Bureau of the Census.

Construction Review, Industry and Trade Administration, U.S. Department of Commerce.

Current Population Reports, Bureau of the Census.

Input-Output Structure of the U.S. Economy, 1958; *1963*; *1967*; and *1972*, Bureau of Economic Analysis.

Interindustry Transactions in New Structures and Equipment, 1963 and *1967*, Bureau of Economic Analysis.

Military Prime Contract Awards by Federal Supply Classification, OASD-Comptroller, U.S. Department of Defense.

Monthly Status of Funds, OASD-Comptroller, U.S. Department of Defence.

National Income and Product Accounts, Bureau of Economic Analysis.

Public Employment, Bureau of the Census. *Shipments of Defense Oriented Industries, MA-175*, Bureau of the Census.

Survey of Current Business, Bureau of Economic Analysis.

U.S. Budget Appendix, 1963-78, Office of Management and Budget, Executive Office of the President.

U.S. Exports by 8-Digit SIC FT610, Bureau of the Census.

U.S. Exports, Commodity Schedule FT410, Bureau of the Census.

U.S. Exports by 2-, 3-, and 4-Digit SIC EA675, unpublished data, Bureau of the Census.

U.S. Imports TSUSA, Commodity by Country, FT246, Bureau of the Census.

U.S. Imports for Consumption and General Imports, IA275, Bureau of the Census.

Intermediate demand projections

Annual Survey of Manufactures, Bureau of the Census.

Census of Business, Bureau of the Census.

Census of Manufactures, 1963 and *1967*, Bureau of the Census.

Current Industrial Reports, Bureau of the Census.

Input-Output Structure of the U.S. Economy, 1958; *1963*; *and 1967*,

Bureau of Economic Analysis.

Minerals Yearbook, Bureau of Mines, U.S. Department of Interior.

Statistical Abstract of the United States, Bureau of the Census.

Industry output and employment

Agricultural Statistics, U.S. Department of Agriculture.

Annual Survey of Manufactures, Bureau of the Census.

Best's Aggregates and Averages, A. M. Best Co.

Business Income Tax Receipts, Internal Revenue Service. *Census of Manufactures*, Bureau of the Census.

Compendium of National Health Expenditures, U.S. Department of *Health and Human Resources*.

Construction Reports, Bureau of the Census.

County Business Patterns, Bureau of the Census.

Employment and Earnings, Bureau of Labor Statistics.

Farm Income Statistics, U.S. Department of Agriculture.

Gas Facts, American Gas Association.

Governmental Finances, Bureau of the Census.

Highway Statistics, U.S. Department of Transportation.

Hospital Statistics, American Hospital Association.

Minerals Yearbook, Bureau of Mines.

National Income and Product Accounts, Bureau of Economic Analysis. *Office of Productivity and Technology Data Base*, Bureau of Labor Statistics.

Statistical Abstract of the United States, Bureau of the Census.

Statistics of Communications, Common Carriers, U.S. Federal Communications Commission.

Statistics of Privately-Owned Electric Utilities, U.S. Federal Power Commission.

Statistics of Publicly-Owned Electric Uilities, U.S. Federal Power Commission.

The Franchised New Car and Truck Dealer Story, National Automobile Dealers Association.

Transport Statistics in the U.S., U.S. Interstate Commerce Commission.

Occupational employment projections

Current Population Survey, Bureau of the Census.

Employment and Earnings, Bureau of Labor Statistics.

Industry Employment Projections, Bureau of Labor Statistics.

Occupational Employment Statistics Survey, Bureau of Labor Statistics.

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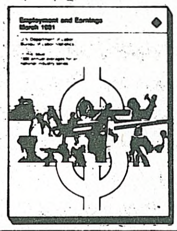

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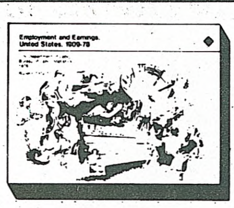

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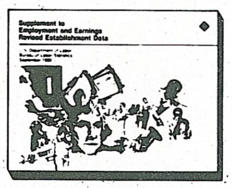

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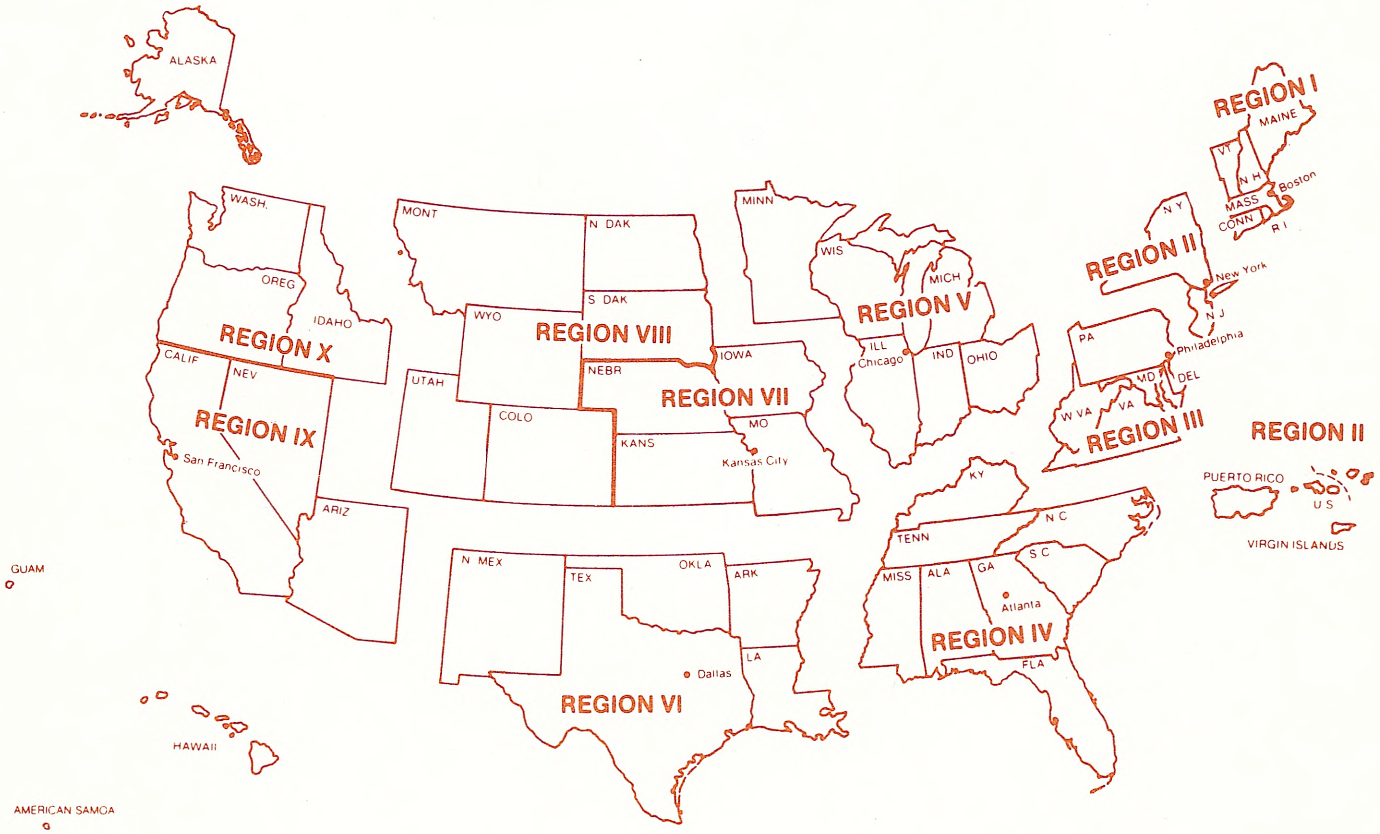

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