Methodology for Projections of Industry Employment to 1990

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Preface

This bulletin presents a description of the Bureau of Labor Statistics (BLS) Economic Growth model system used to develop the 1990 industry employment projections. It is intended primarily for those analysts who desire detailed information on the BLS projections methods, models, and techniques. The text covers the components of the Economic Growth system used to develop these projections and the sequence of their application. The appendixes provide the detailed equations used in the various model systems as well as a description of the software solution package.

The results of the 1990 projections were presented in three articles published in the *Monthly Labor Review*: "The U.S. Economy to 1990: Two Projections for Growth," December 1978, by Norman Saunders; "Changing Patterns of Demand: BLS Projections to 1990," December 1978, by Authur Andreassen; and "Output and Employment by Industry; Projections to 1990," April 1978, by Valerie Personick.

These articles covered the results and analytical aspects of the macroeconomic scenarios, the demand projections, and the industry output and employment estimates. Industry employment projections are primarily used within the Bureau as a basis for the occupational projections developed by the Occupational Outlook program. These are used by the Department of Labor and a variety of other groups in planning training programs and in counseling students and workers. The industry projections also 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, under the supervision of Ronald E. Kutscher, Assistant Commissioner for Economic Growth. The report was written by Thomas Fleming and Richard Oliver. Norman Saunders contributed the methodology on the macroeconomic projections. Material on the techniques of projecting interindustry coefficients was provided by Joanne Hepburn and Tom Mooney. Methodologies used in projecting the major final demand sectors were provided by Arthur Andreassen, Robert Sylvester, Karen Horowitz, and David Frank. Valerie Personick developed the estimates of industry employment. John Tschetter provided the section on prospective areas of new development. Sandy Proctor assisted in the preparation of the manuscript.

Contents

Chapter 1. Overview of the BLS Projections System

The 1990 industry employment projections are the latest in a series that started in the mid-1960's as the product of an interagency project to study the conditions and requirements for balanced economic growth in the United States. Since that time, projections studies have been completed for 1970, 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, more rigorous analytical techniques, and a more automatic system for processing calculations. Since that time, the interagency character of the projections has also changed. Although certain data and assumptions are still coordinated with other agencies, the projections have become more a BLS responsibility.

Earlier versions

The first version of the Economic Growth model system was formulated in 1963 for the 1970 projections. This version represented a conventional application of the input-output technique and was used for both the 1970 projections and the first set of 1980 projections. In this version, supply GNP (gross national product) was first projected exogenously based upon independent projections of aggregate labor force, hours, and productivity. Several distributions of demand GNP were then developed through a combination of trend analysis and assumption. In the next stage, analysts projected industry purchases for major categories of demand GNP. A model was used in only one case to assist in the projection of the bill of goods. This was a consumption demand model developed by H. S. Houthakker and L. D. Taylor discussed in the following text. Simultaneously, the coefficients of an input-output table were projected. The table used was the Bureau of Economic Analysis' (BEA) 1958 table of 82 sectors. This table was updated and then projected to 1970 and later to 1980. The projected bills of goods were used with the projected tables to develop estimates of gross output by industry. Employment estimates for each industry were then developed from projected employment-output ratios. These were based upon industry projections of hours and productivity.

A second version of the system was used for the 1975 projections and a second set of 1980 projections. The principal change was the introduction of a macroeconomic model for the purpose of projecting more balanced and consistent demand levels. The macro model's key function was to develop estimates of the distribution of demand GNP in real terms for the major demand categories. In addition, this model added other analytical features. Among these were the capability to be more explicit about fiscal policy assumptions, to examine the factors influencing the derivation of income projections at a macro level, and to derive projected revenues of the Federal and State and local government sectors. It also permitted the development of a time path for the projections and not just the projection of a point in the future. The macro model provided an aggregate production function which could be used to project supply GNP from both labor and capital inputs. However, in its early use of this model, BLS continued to use the procedures of the first version to project supply GNP. Initially, the aggregate production function overpredicted potential growth, in part because of its inability to account for shifts between the agricultural and nonagricultural sectors of the economy.

Another change in the second version of the system was the addition of a very crude capital component which evaluated an initial final demand vector for investment in equipment and nonresidential structures in total and by type. This process involved using: (1) Investment-output relationships, (2) capital flows tables, and (3) projected changes in industry outputs. Capital flows tables convert investment by purchasing industry into investment by type of capital good. While this provided a crude check on the amount and type of capital required in each industry based on its projected rate of growth, it was simplistic. Investment in each industry was then determined only by the growth in its output with no consideration of capital replacement requirements.

[1] "Revised BLS Projections to 1980 and 1985," *Monthly Labor Review*, Mar., Aug., and Nov. 1978; and the following Bureau of Labor Statistics bulletins, *The Structure of the U.S. Economy in 1980 and 1985*, Bulletin 1831, (1975); *The U.S. Economy in 1985*, Bulletin 1809, (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).

The second version of the Economic Growth System, as in the first, had a limited feedback from the micro or industry level to the macro level. This feedback was not directly modeled. It generally took the forms of balancing the industry employment estimates with total employment, reviewing the initial stipulation of investment requirements against the generated investment level, and comparing the industry structure of generated imports with the macro stipulation.

The input-output tables used in the second version were based upon the BEA's 1963 table aggregated to 134 sectors. This base was updated by BLS to 1970 and then projected to future years. The third version of the Economic Growth system described in this bulletin was based upon the BEA's 1967 table aggregated to 162 industry sectors. This table was updated to 1973 and then projected to 1980, 1985, and 1990.

In the third, or current version, a major change was made in the production function of the macro model to cover only the private nonfarm economy rather than the total private economy to capture shifts between the farm and nonfarm sectors. An equation was also added to the model to project hours. Also, a small price-wage sector was introduced. Two new final demand models were included for the first time: One for State and local government purchases and the other covering Federal Government revenue and outlays. While not fully integrated in the system, these were used in a limited manner. In addition, a labor demand model was introduced to replace the ad hoc procedures used in the earlier versions to project industry productivity.

Current methodology

BLS industry employment projections currently are produced using a variety of models and analytical methods. There are five major steps in projecting industry employment levels: 1) A macro model projection of the aggregate economy; 2) a disaggregation of GNP to detailed demand categories; 3) a distribution of each demand category to producing industries; 4) projection of an input-output table and its use in solving for industry outputs; and 5) a projection of productivity, hours, and employment at the industry level of detail.

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 feedbacks from a later step to an earlier one. However, results at certain stages are compared analytically with earlier controls, and adjustments are made. Linkage of the various steps is accomplished with a software package known as the Potential Economic Growth Assessment System for the United States (PEGASUS). This software system is described in appendix B in terms of its impact on these projections. More detailed system descriptions and users' guides are available upon request.

Industry projections start with a set of assumptions, or a scenario, describing the expected conditions of growth. Various policy targets and other assumptions are formulated and fed into a macroeconometric model, along with base period data. This model uses these assumptions to develop consistent projections of supply or potential GNP growth and the resulting income flows. Income flows are next used by the model in projecting demand GNP by major components. Supply and demand GNP are balanced, providing control totals for the purchases of various final demand sectors which are consistent with all conditions and assumptions. The industry employment projections usually assume that government goals for reduced unemployment, control of inflation, and a more favorable trade balance will generally be achieved or approximated. Policy variables and exogenous demand levels are adjusted to permit the economy to achieve potential levels of output consistent with these goals.

Control totals for each of the categories of demand GNP developed in the macro model are then used with various techniques and submodels to distribute sector demand to functional categories of demand or product groups. For example, personal consumption expenditures for nondurable goods are distributed to various product groups, such as food purchased for use at home, while investment in producers' durable equipment is distributed by purchasing industry.

The next step is to distribute the functional or product level demand in each sector to specific purchases of goods and services produced by 162 different industries using projected factors or bridge tables. This industry classification is consistent with the interindustry models used to project intermediate demand. The coefficients of the input-output models are projected separately based upon such things as expected changes in technology, shifts in inputs, and changes in the mix of products. They provide the framework for estimating the purchases each industry must make to support its projected sales. The projected interindustry tables, or matrices, provide estimates of the projected output needed from each industry for all final and intermediate demand requirements. At this stage, each industry's output level is 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 vary significantly from past experience, the analytical reasons are reexamined. As a result, changes may be made in final demand purchases or coefficients.

The projections sequence then proceeds to estimating industry employment requirements. A labor demand model is used to project productivity changes in each industry. Industry output requirements are then converted to industry employment requirements. Finally, the industry employment changes are compared to historical change. If the growth in employment appears

reasonable, it is aggregated and compared with levels used at the macro stage. At all steps in this process, the disaggregated estimates are made consistent with their macro counterparts.

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

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

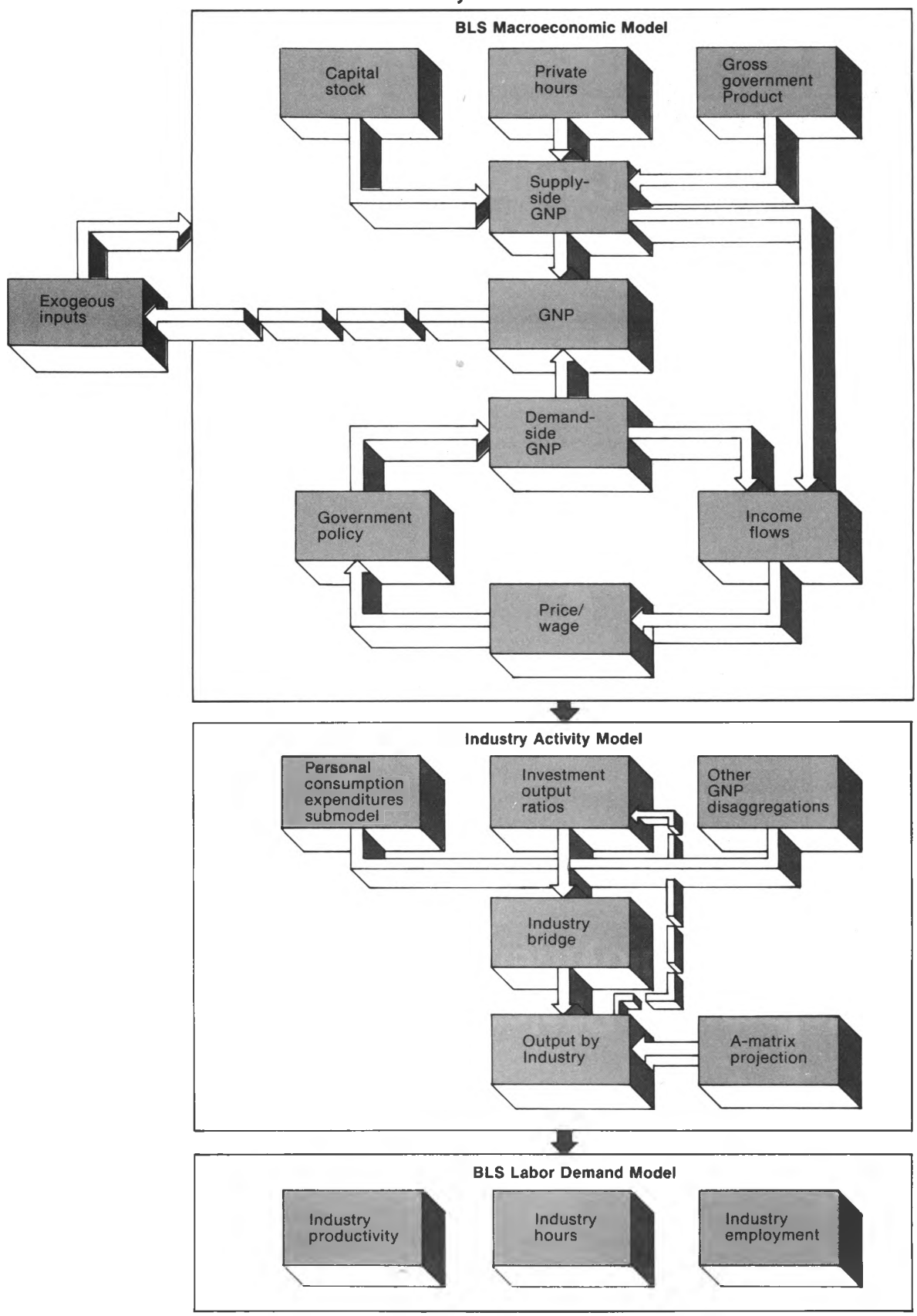
B. Final demand purchases
   1. Functional levels
   2. Industry purchases

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

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

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

Chart 1. Economic Growth System



Chapter 2. Aggregate Economic Projections

Overview

The 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.

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.[2] 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 as well. Major exogenous variables are pointed out as necessary. All of the behavioral equations and major model identities referred to in the text are detailed in appendix A.

The four computational blocks of the 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 must be estimated externally in various ways for the projected periods. From a solution point of view, all exogenous variables are assumptions. From a structural approach, however, the exogenous variables may be grouped in three ways. First are those items projected with sophisticated techniques outside the Office of Economic Growth, such as the population or labor force estimates. Second are those items which represent either policy instruments

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

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, are the result of such measures. Finally, there are those exogenous variables which are assumptions in the narrowest sense; i.e., they represent 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 are projected and considered as a whole, they present a picture of the economic conditions assumed for a particular set of projections. All of the projection results are heavily influenced by the initial assumptions required to operate the macro model. These follow from the nature of the scenario or the conditions being examined for their effects on employment. Four categories of explicit assumptions are developed for each scenario: Demographic, fiscal policy, price, and productivity and employment assumptions. In addition, certain general goals or guidelines affect the projections process. For example, the effects of rising energy prices and potential energy shortages were considered and were assumed, or expected, not to be sufficient to affect 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 include 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 are the current and expected level and age distribution of the population. Three projected population series were available, differing primarily in the assumed fertility rate.[3] The series II projections were accepted for the base projections. Projections of the number of households and the number of students were also available from the Bureau of the Census.[4] It was assumed that recent trends in urban population growth would continue throughout the projected period.

Fiscal policy. These include 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 taxes were assumed to be cut in 1979, consistent with the Revenue Act of 1978. Further 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. Extimates 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 consist 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 are 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 do not directly affect the determination of real GNP, they do affect the projections in several important ways. First, wage rates and interest rates are influenced to a great extent by price changes. These in turn affect consumption expenditures and residential investment. Second, price changes affect the Federal budget. They enter implicitly into the determination of various expenditure levels, while, on the revenues side, they affect personal income taxes because of the progressive tax structure. The movement of prices in the future, of course, can not be adequately projected. Price assumptions used in the projections are judgments that may 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 1968-77, but below that for 1955-68. Very little growth in productivity was assumed through 1980. Thereafter, a slow recovery to rates of growth typical of the 1960's was assumed. This increase was predicated upon the reversal of some previously depressing factors. Members of the post-World War II baby boom will be more experienced as workers during the 1980's. Also, recent rapid growth in the

[3] *Current Population Reports*, Series P-25, No. 704 (Bureau of the Census, July 1977 and 1978).

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

levels of investment in environmental and energy conservation equipment is expected to slow down by 1985, allowing a greater proportion of investment funds to be spent on more productive plant and equipment.

Aggregate labor force projections were obtained from studies made by the BLS Office of Current Employment Analysis.[5] Their moderate labor force projection was adopted for the base case, while the higher labor force estimate was used for the high employment alternative case. From these levels, assumptions were then made as to 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. Unemployment rates were selected to show a realistic recovery path from the 1975 recession to 1980. After recovery, unemployment was assumed to achieve a stable long-run rate close to full-employment goals.

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 deflator

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

Statistical discrepancy
Unemployment insurance contribution rate
Combined Social Security contribution rate
OASDI coverag 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. Projections of the labor force by the Office of Current Employment Analysis are now included in lieu of the original participation rate equations.[6] Labor force projections start with population projections made by the Bureau of the Census.[7] 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 is set exogenously as a target variable. Thus, civilian employment as a count of persons is determined by multiplying the civilian labor force by the unemployment rate (equation 1, appendix A).

Employment data at the industry level of detail are available from the monthly BLS survey of business establishments.[8] 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 A), is used to relate establishment based civilian employment to civilian employment on a persons basis and the unemployment rate. A major

[5] The projections of the U.S. labor force are fully detailed in the article by Howard N. Fullerton and Paul O. Flaim, "Labor Force Projections to 1990: Three Possible Paths," *Monthly Labor Review*, Dec. 1978, pp. 25-35.

[6] Ibid.

[7] *Current Population Reports*, P-25, No. 704.

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

difference between the two series arises from individuals who hold more than one job, who would be counted only once in the household survey but more than once in the establishment survey. Other differences between the two series have been examined in detail elsewhere.[9] 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 as 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. Purchases 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 are 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 has been 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 is, however, 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 to 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 currently in use 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 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 estimated 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. 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

[9] Gloria P. Green, "Comparing Employment Estimates from Household and Payroll Surveys," *Monthly Labor Review*, Dec. 1969.

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 yields 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 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, last 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 last 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 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.[10]

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 unemployment 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 may 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 sector incomes necessarily equals the supply-side 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.

[10] Richard C. Barth, "The Development of Wage and Price Relation-collect ships for a Long-Term Econometric Model," *Survey of Current Business*, Aug. 1972, pp. 15-20.

Chapter 3. Final Demand Projections

Gross national product (GNP) 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 involve estimating the future purchases of each demand sector, by industry of origin. For the 1990 projections, the economy was disaggregated into 162 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, and 1967)[11] and 1973, which became the base year of the projections. In addition, many data series were available through 1976, providing recent trends. These historical data were used with a variety of techniques and submodels to project purchases.

Overview

Final demand projections, or the estimation of purchases within the control totals provided by the macro model, in most cases started with the functional levels or broader groups of products purchased by each demand sector. These levels were then distributed to each of the 162 different industries. Industry purchases were then converted from purchasers' values to producers' values by separating out distribution costs. All purchases were then converted to a constant price level.

In the case of personal consumption, expenditures were first distributed to 82 major product categories using a consumption demand model. For each of these 82 products, a distribution pattern was used to allocate each total to its appropriate producing industries.

In the business or investment sector, four major subsectors were defined: Nonresidential construction, producers' durable equipment, residential construction, and change in business inventories. Investment was treated as a function of the level of sales in each industry or the ratio of investment to output in each industry. Residential construction was estimated in the macro model. In the case of foreign trade, projections were based largely upon historical data. Import and export projections relied heavily on least-squares time trends or growth rate extensions with modifications. Special studies were also made of expected import penetration ratios and expected demand for exports of selected products.

The Federal Government sector was initially divided into six subsectors while State and local government purchases were distributed into 20. The Federal sector was split into two defense subsectors and four nondefense subsectors with each of the six bills of goods dependent on historical input-output data and other government data on industry purchases. The State and local government sector was disaggregated to 20 major functions, such as primary education, higher education, health, hospitals, and general government, with each of the 20 bills of goods based upon past distributions of purchases and other conditions.

Assumptions

Various assumptions underlie projections of the detailed purchases of the final demand sectors. In general, these assumptions follow 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 jointly developed by members of the final demand group.

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 government participation through 1990 had to be examined. Since information at the time was limited, it was assumed that government participation would increase slightly, but that no comprehensive

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

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 will decline, but the post-World War II baby boom members will 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. The impact of increasing energy costs and shortages on purchases of different types of transportation services were also 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. In this case, the Data Resources, Inc., (DRI) energy model was used with the assumptions of the BLS macro model to project total British Thermal Unit (BTU) use by type of energy and by domestic or foreign source. These demand figures were used as a check on the output figures derived from the projected energy coefficients. In addition to total energy consumption by type, the DRI model also provided estimates of the direct use by households and governments, affecting the personal consumption and Federal and State and local government bills of goods. The prices from the model were used to project the coefficients. All of the assumptions inherent in the DRI energy model, therefore, became those used in the projected BLS energy industries. These included such things as price increases for domestic and OPEC oil, deregulation of natural gas, and the rate of development of nuclear and other sources of electric power. In general, these conditions assumed that the prices of natural gas and oil would increase more rapidly than the prices of coal and electricity. Coal and electricity were assumed to be more readily available through 1990.

Personal consumption expenditures

Personal consumption expenditures (PCE) are the value of goods and services purchased by individuals and nonprofit institutions. Purchases of dwellings are not included, although the rental value of owner-occupied dwellings is imputed to consumption outlays. The distribution of personal consumption expenditures 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 major type of expenditure, such as food, housing, or medical care. There were 82 categories projected, and they were forced to sum to the projected consumption controls of the macro model. Historical data for each of these categories were available from the Department of Commerce as part of the National Income and Product Accounts.[12] These data were used to develop a set of behavioral equations to project the 82 categories. The second step was to distribute these 82 product expenditures to the producing industries. This was accomplished with the use of projected bridge tables which distribute each category to its component industries as well as to the transportation, insurance, and trade industries. The result was the personal consumption expenditure bill of goods, the largest component of final demand.

Each historical input-output table produced by the Department of Commerce (1958, 1963, and 1967 existed for this project)[13] has an associated bridge table which distributes expenditures for the 82 consumption aggregates. Each expenditure item is assigned to one or more of the Bureau of Economic Analysis (BEA) industries (367 order). The BEA estimates these products for each year and benchmarks them to new bridge tables as they become available.

Product projections. A consumption submodel was used to project the 82 product categories. This model, developed by H. S. Houthakker and L. Taylor consists of a set of 82 demand-oriented consumption functions.[14] These equations, which were originally estimated in 1958 constant dollars from 1929 to 1964, distribute total PCE to major 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 are also used extensively. The lag structure of the equations allows changes in explanatory variables to be distributed over time.

For these projections, the model was reestimated in 1972 dollars from 1929 to 1975. The new equations were simulated over the projected period using preliminary controls for purchases of durables, nondurables, and services from the macro model. Many of the model equations produced projections which were inconsistent with past trends. As time and resources permitted, additional research was done for these products. Some of the alternatives used were growth rates, time polynomials, and variations of other consumption models.

[12] *Survey of Current Business*, July issues, Tables 2.6 and 2.7 (Department of Commerce, Bureau of Economic Analysis).

[13] *The Input-Output Structure of the United States.*

[14] H. S. Houthakker and L. D. Taylor, *Consumer Demand in the U.S., Analyses and Projections* (Cambridge, Harvard University Press, 1964).

More specifically, new estimators were generated using the BEA data in 1972 dollars through 1975, the latest available year at the time, and the model specifications published by Houthakker and Taylor. The equations used are given in appendix C. Product projections were then made using the preliminary macro PCE projections, the assumed population projections series, and trend extrapolations of relative price. In addition, the original period (1929-64) was used to create estimators, and ex post simulations were made from 1965 to 1975. There were three measures to evaluate the initial estimates: 1) The statistical fit of the model, 2) the ex post simulation results, and 3) the ex ante projections using the preliminary controls. The statistical fits varied, but, for most products, there were problems of significance in some of the parameters. The ex post simulations for almost all equations produced directional biases as well as errors increasing over time, even with the correct lagged consumption value. Ex ante projections proved important since some of the better fits and/or ex post simulations produced unacceptable conditional projections to 1990.

Finally, the sum of the projected product levels was brought into balance with macro consumption totals by allocating the difference to categories according to the relative change in their value. Twenty-three of the original Houthakker-Taylor equations remained in the solution set. Of those, six were add-factored for various reasons. Four estimators were respecifications of the Houthakker-Taylor model. Seven products had new equations specified with item-specific explanatory variables. Eleven projections came from other government or private projections. Twelve of the products had time polynomial extrapolators, and five used other extrapolators, such as population and the death rate. Exogenous projections, including growth rate extrapolators, accounted for the other 20 projections. Of the 82 projections, 20 involved add factors.

Industry projections. The product expenditure categories were then transformed to a set of final demands consistent with the input-output framework. Each of these categories was made up of many types of goods, produced by different industries. A matrix or bridge table was used to transform the product forecasts into the 162 industries used in the projections.

A bridge table distributes product aggregates to component goods and services and to margin industries. The product projections are expressed in purchasers' values, while the bills of goods 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 such items as transportation costs and wholesale and retail trade markups. The bridge table accomplishes two tasks at once—it allocates each category or product expenditure to its producing industry, and removes the trade and transportation 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, and 1967. Each bridge table had been prepared in current dollars. For this project, the 1963 and 1967 tables were reestimated in constant (1972) dollars and further modified in the way imports were handled.[15] First, imports were valued at domestic port value instead of foreign port value, decreasing the margin entries by the amount of the margins associated with transporting the goods between the foreign and domestic ports and increasing the producers' value by a similar amount. Second, imports were assigned to the relevant domestic industry based on the nature of the product. Because of a lack of information, this was not possible for three areas: Military food abroad, land travel overseas, and purchases by government employees overseas.

A bridge table for 1973 was estimated by the BLS. As a first estimate, the relationships from the 1967 bridge table were used. Where this method produced results inconsistent with other data, changes were made in the bridge relationship. Detailed study was made of the relationship between the 1967 bridge table and the 1967 *Census of Manufactures*, and like relationships were assumed for 1972. Unpublished shipments data were used to extrapolate these relationships to 1973. The difference was scaled back to the industries, and the estimates were reevaluated. In cases where the estimates were still inconsistent with other data, additional extrapolators were developed.

For the projections, the 1973 bridge table was used as an initial estimate of the projected bridge table. Feedback from the final demand-output review identified products which were in need of further study. "Food on and off premise" required extensive work, changing the relationships among industries producing these goods. In total, only about 12 of the 82 categories required changes, so the 1973 bridge table was used for most of the products in the projected years.

Gross private domestic investment

Gross private domest ivestment (GPDI) is composed of fixed investment and the change in business inventories. Fixed investment represents purchases of durable equipment and structures by 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

[15] The OEG treatment of foreign trade was changed in these projections to yield domestic rather than total output. Imports that are competitive are now 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 of final demand.

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 1976 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.

The process for developing the historical equipment bill of goods series was more complicated. As part of the national income accounts, product expenditures are published annually for equipment types, such as tractors, special industry machinery, or general industrial equipment. Each of these products can include goods produced by more than one industry. They are also expressed in purchasers' value. As in the case of PCE, bridge tables are available to split these product expenditures into producing industries, and to remove the margins. The 1963 and 1967 bridge tables prepared by BEA were aggregated to Economic Growth industry sectors and then inflated to 1972 constant dollars. A 1973 bridge table was estimated in constant dollars, using the 1967 relationships as a first estimate. For products where information was available, the bridge table relationships for a specific product were changed. These data were checked for consistency with other estimates being made, and revisions were made as necessary. By interpolating between the bridge tables to create an annual series of bridge tables, it was possible to convert these product data into a time series from 1958 to 1976 for equipment by producing industry in producers' values.

In addition, capital flows tables were used to provide historical data on plant and equipment. A capital flows table shows the flows of investment goods to the various industries which purchase them. For each industry, it is possible to examine the types of investment goods purchased, and to determine the relative importance of these goods among their total investment purchases. For each good, it is possible to examine the industries which purchase it, and the relative importance of each of the industries in making up total purchases. Capital flows tables are developed for input-output years, and at the time of this study, were available for 1958, 1963, and 1967, in current dollars. The 1958 table was developed by the BLS, while the 1963 and 1967 tables were developed by the BEA. Some inconsistencies are apparent among the methodologies used to prepare the tables, so the 1958 table was not used in this study. The tables were repriced to 1972 constant dollars. Using detailed bills of goods developed for 1973 along with data on investment by industry, a capital flows table for 1973 was estimated in constant dollars based on the 1967 table. This table estimates the distribution of purchases of investment goods by each industry in 1973.

Historical data for the inventory change bill of goods are available only for the input-output years. Input-output conventions allocate inventory change to the producing industry, no matter which industry holds it. However, data available from the national income accounts are on a holder basis, not a producer basis.

There are three major components of residential construction that must be projected: 1) Mobile homes, 2) nonfarm residential structures, and 3) farm residential structures. Mobile homes, which are allocated to the "other transportation equipment" sector, have wholesale and retail trade and rail and truck transportation margins associated with them. Farm residential structures are allocated to the "all other new construction" sector, while nonfarm residential structures are allocated to "new residential construction." Associated with farm and nonfarm residential structures are brokers' commissions on their sales (allocated to "other real estate") and net purchases of used structures (allocated to the "scrap, used and secondhand goods industry"). These sectors are aggregates of the more detailed level of the historical data.

Projected business investment in nonresidential structures was distributed chiefly to "nonresidential buildings," "public utilities," "oil and gas well drilling and exploration," and "all other new construction." There are also small purchases of "residential buildings" (nurses' housing) and "mobile homes," as well as associated margins, and a small purchase of "used structures."

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 oilfield 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 input-output 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 1976 were used to project the movement of these detailed categories into the future. These individual projections were aggregated and then 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, is 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 is 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 then 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 then adjusted to be more in line with the 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.

Net exports

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 are obtained from the detailed merchandise trade statistics published annually by the Bureau of the Census. For exports, this includes Standard Industrial Classification (SIC) product codes and schedule B commodity codes. For imports, data are available by SIC-based produce codes and by special U.S. tariff schedule (TSUSA) codes. Data requirements after aggregation involve modification and augmentation to reflect balance-of-payments and input-output conventions.

Exports are treated as any other component of final demand in the input-output system; imports, on the other hand, require a unique treatment. Total imports are projected by an equation in the macroeconometric model. This total is then divided into two categories in the input-output system. The first category consists of all imports of final users, as well as intermediate imports which are competitive with domestic products.

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. In previous BLS projections and in the published input-output tables of the BEA prior to 1972, a different treatment of imports was used. Intermediate imports which were competitive with U.S. products were transferred to their corresponding domestic industries. Intermediate imports which were not competitive were allocated to the consuming U.S. industry. Each type of intermediate import formed a row of coefficients in the input-output table, one called "transferred imports," the other "directly allocated imports." All final demand imports, whether competitive or noncompetitive, were allocated to each of the final demand sectors and appeared only in the cells where each final

demand column intersected the directly allocated import row. The value of all imports (both types of intermediate plus final demand) was then subtracted from the export column of final demand to arrive at a net export figure. The result of this method was to yield an input-output table reflecting total, not domestic output, since imports were not subtracted by industry. (See *The Structure of the U.S. Economy in 1980 and 1985*, BLS Bulletin 1831, for more information on this method.)

As an illustration of the treatment in the input-output system of imports not subject to further processing, consider the automobile industry. 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 is mainly based on analysis of existing and expected shares of the domestic market. Trade agreements which may restrict imports are 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 are initially projected, the level of exports is 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 is in turn distributed by industry, primarily on the basis of time trends and expected world conditions. It was necessary to rely on naive forecasting techniques to project exports by industry because long-term estimates of foreign income and prices are generally not available.

Aggregate projections. The first estimate of the aggregate level of imports and exports was derived from the macroeconometric model. An equation in the model projected constant-dollar total imports as a function of disposable income, lagged disposable income, relative prices, and capacity pressure (measured by the ratio of actual GNP to potential GNP). Imports were then converted to current dollars, based on the assumption that the import deflator would grow from 1976 through 1990 at the same rate as the private GNP deflator. A policy target of a close-to-zero current-dollar trade balance implied that current-dollar exports would be close to current-dollar imports. The export deflator was also assumed to grow at the same rate as the private GNP deflator. By applying the resulting export deflator to current-dollar exports, constant-dollar total exports were derived. (Although the export and import deflators were projected to grow by the same rate over the period 1976 to 1990, the indexes with 1972 as a base were different because of differing price rises for exports and imports between 1972 and 1976.)

This first projection of total imports and total exports was then distributed among the 162 industries in the system. A review of the industry level forecasts revealed that, while import growth rates appeared reasonable in light of past trends, export projections by industry appeared unrealistically high for many sectors. It did not seem likely that U.S. exports would match the high rate of growth of the initial import projections in order to yield a roughly equal current-dollar trade balance through the 1980's. It was decided at this point to modify the aggregate forecast produced by the macro model with a micro analysis of export and import trends and conditions. Since the export data base was much more extensive than the import base, the micro analysis began with exports.

Industry projections. For most industries, a least-squares trend was computed from 1963-74 export data (or some subset of this data in the case of recent growth accelerations or decelerations), and this trend line or growth rate was simply carried out to 1980, 1985, and 1990. Where possible, the resulting export projection was modified based on analysis of more current (1975 and 1976) export statistics or by relying on forecasts from other agencies, such as the Department of Agriculture's (DOA) projections of agricultural exports.[16] A more detailed description of specific export assumptions follows; industries not mentioned were projected based strictly on historical trends through 1976.

The projections of food and feed grains exports depended entirely on estimates from DOA. For wheat and corn, the chief export components of the food and feed grains industry, the long-range forecast showed a return to a more normal growth path following the abnormally high export years of 1973 and 1974. Exports of other agricultural products, chiefly soybeans and meat products, also followed levels projected by DOA. The soybean industry showed only small increases through the 1980's.

[16] The projection model of the Economic Research Service was run using the BLS macro assumptions to estimate rates of change in export levels for particular products.

Coal exports were assumed to rise slightly in the next decade, despite recent declines. This projected turnaround was based on the assumption that total U.S. coal production would rise because of energy demands, and, as output picked up, so would exports.

Ordnance and complete guided missile exports consist mainly of military sales. These projections were based on analysis of expected U.S. policy on military sales contracts over the coming decade.

The "rest of the world" industry is the last for which a specific export assumption was made. In the export bill of goods, the rest of the world industry represents receipts of income on U.S. assets abroad (about 75 percent of total rest of world payments in 1973), travel in the United States by foreigners (about 23 percent), and some small miscellaneous items such as charity donations (about 2 percent). The investment portion was projected by an equation based on 1960-73 constant-dollar GNP. The travel portion was projected based on personal consumption forecasts.

After this micro analysis, total constant-dollar exports were summed for the years 1980, 1985, and 1990, converted to current dollars, and equated to imports. Imports were then deflated into constant dollars, and a new distribution of this import control total was developed. Like exports, import projections at the industry level were based mainly on past trends, except for those industries discussed below.

Imports of the forestry and fishery products category were projected to decline by the DOA due to the new 200-mile U.S. fishing boundary. However, these projections were modified somewhat to make the decline less severe.

Crude petroleum imports were projected using a ratio of imported crude petroleum to total crude consumed, which was developed by DRI. This ratio was applied to the projection of total crude petroleum imports to slow dramatically between 1977 and 1980, and to petroleum imports to slow dramatically between 1977 and 1980, and rise only slightly through the 1990's. This slowdown was based on an assumption that the United States will be able to develop new domestic energy supplies, including more production of oil from Alaska. Imports of natural gas and refined petroleum were projected by the same method applied to crude petroleum.

Apparel import projections assumed a slight increase in the ratio of imports to total output.

Projections of tire imports were based on the expectation that imports would account for an increasing share of total tire output, but that the import share would not grow as rapidly as it did between 1967 and 1973.

Imports of miscellaneous rubber products consist mainly of rubber and plastic footwear. The projections for this industry reflect recent orderly marketing agreements with Taiwan and South Korea, the chief exporters of rubber and plastic footwear, to limit the number of shoes imported into the United States. The agreements will remain in effect until 1981 and will cause imports of miscellaneous rubber products to drop sharply.

Leather footwear imports, on the other hand, are not yet subject to any restrictive trade agreement. It was assumed, however, that the import share of total leather goods output would not grow as rapidly as in the past.

Typewriter imports, too, were projected on the basis of a slowly rising market share in contrast to rapid market gains during the 1960's and 1970's. Imports were expected to hold about a 30-percent share of total typewriter and office equipment output throughout the 1980's, about as much as in 1973.

A trade agreement with Japan was recently concluded to limit the number of color television sets imported from that country. This agreement, however, had little impact on the aggregate import projections of the radio/television industry because of the small share (about 10 percent in 1973) of this industry's total output that consists of Japanese color television sets. Balancing this import restriction was an assumption of continued growth in video tape recorder imports. Overall, a constant import share of about 30 percent of total radio and television output was assumed to hold through the 1980's.

The projection of auto imports was also based on a constant market share assumption. For motorcycle imports, however, the market share was assumed to rise slightly, from 53 percent in 1973 to 63 percent by 1990.

The projection of directly allocated imports was based on several explicit assumptions. Noncompetitive, intermediate products (about 37 percent of total directly allocated imports in 1973) were assumed to represent a declining share of all imports, based on past trends. Land travel abroad (28 percent of all directly allocated imports in 1973) was projected as a function of income, lagged income, and relative prices. The projections of defense and nondefense purchases abroad (17 percent and 0.4 percent, respectively, of all directly allocated imports in 1973) assumed a reduction in troop strength abroad through 1980 to a level which will be stable through the decade. Nondefense expenditures abroad were assumed to hold steady at the 1973 level through 1990. Government personnel consumption expenditures abroad (in 1973, 8 percent of directly allocated imports) were projected as a function of income and relative prices. It was assumed that current levels of civilian government personnel abroad would not change. Imports from the rest of the world industry are payments on foreign investment in the United States. A regression equation based on 1960-73 current-dollar GNP was used to project this industry.

After individual industry imports were projected, they were summed, converted to current dollars, and compared to total current dollar exports. The micro projections for both imports and exports were reviewed

and modified several times before the targeted current dollar trade balance was attained. Informal feedbacks to the macro level projections ensured consistency at all levels of the projections.

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 are education, health, welfare and sanitation, public safety, and all other. Each of these functional categories are further distributed to a total of 20 different sublevels. Each of the 20 is further divided into employment, compensation, construction, and an all other purchases category.

The projection of State and local government purchases starts with overall control totals generated by the macroeconomic model. Next, a State and local government submodel is used to project expenditures for 3 types of education and for 14 other functions.[17] Historical data for 20 functions are maintained by BEA for compensation, construction, and all other purchases. These are separately projected based upon trends and special analyses. The results of these 3 systems are then compared and reconciled to provide acceptable levels for the 20 separate State and local functions. Each of the projected functional levels is allocated to individual industries.

The macroeconomic model estimates of projected State and local government purchases are 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 also divided into compensation and all other purchases.

The State and local government submodel predicts expenditures and employment in current dollars for 17 functions. These functions, estimated from census data by fiscal year, include: Elementary and secondary education, higher education, other education, highways, health and hospitals, sewerage, water utilities, other utilities, natural resources, police, fire, sanitation, public welfare, local parks and recreation, general control, financial administration, and other general expenditures. The model structure was based upon data for the years 1961-71 but has since been updated to 1976. Equations for each function were estimated for general expenditures, capital expenditures, and employment. Expenditures in the model are in current dollars and apply to all outlays, not just purchases of goods and services. Employment is 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 includes interest rates, prices, and unemployment rates.

Commerce Department data provide the primary 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 submodel, and the projections of the functional BEA data base. In order to make the results of the submodel comparable with the BEA functional series, several adjustments had to be made. First, the results of the submodel were deflated to a 1972-dollar base and converted to a calendar-year format. Next, where possible, model functions were made compatible with the data series on functions by estimating what the proportion of a function (such as corrections or libraries) was to the larger, more inclusive, model function. Model expenditures included outlays for more than purchases of goods and services and had to be adjusted. Where compatibility was obtained, model results were used. Other functions, such as other sectors and public housing, where the submodel did not provide estimates, were simply extrapolated from the BEA data series. Employment projections from the submodel were converted to compensation and converted to the desired format. Compensation was also 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 then 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.

[17] Terry Morlan, "An Application of Micro Data for Forecasting Aggregate State and Local Government Expenditures and Employment," *Small Area Statistics Paper*, GE-41, No. 3 (Bureau of the Census, Aug. 1976), pp. 35-45.

These levels of functional purchases were distributed to the purchases projected to be made from 162 different industries. This was accomplished by projecting base-period purchases for each function. Detailed purchase data by function were obtained from BEA worksheets fro 1963 and 1967. Estimates for 1973 were developed using a variety of analytical techniques. These years provided a limited basis for projecting detailed industry purchases. The projections of purchases for each function were then 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. In 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 to two subsectors: Defense nuclear activities and other defense purchases. In addition, foreign military sales were examined and projected jointly with the foreign trade analyst. 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 periods. Principal data sources were the Department of Commerce input-output studies and various unpublished records of agency purchases. Employment data were obtained from Civil Service Commission 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 are 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, and the number of civilian and military employees. The levels are established jointly by the analysts working in the macro and final demand areas to insure levels consistent with overall projections assumptions. Assumptions are of major importance in the Federal sector since, in many cases, past experience is not useful for projection. For example, the projections always assume peaceful conditions without international tensions. A contrary assumption of war would result in unpredictably larger Federal purchases and a much larger defense share. In these projections, defense was assumed to grow less rapidly than GNP, as was the nondefense sector.

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 1952-76 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.

Purchases, excluding compensation and new construction, for each of the six subsectors were then 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. From available data, a base-1973 bill of goods was constructed for each of the six subfunctions.

In order to insure consistency of the data base with the projections, it was necessary to incorporate both the benchmark changes that became available since the last projections and the conversions to 1972 deflators from 1958 deflators. The 1967 input-output table was available on a rebenchmarked basis along with a description of the conceptual and statistical changes that were made. These two sources were used to rebenchmark the 1963 table and to insure that the 1973 table reflected the revised National Income and Product Accounts. All past tables were converted to 1972 dollars. Consistency in purchase data required that data after 1972, which were published on a new SIC basis, be adjusted to a 1967 SIC basis.

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 4. Intermediate Demand Projections

After final demand purchases are projected, the intermediate demand, or the additional output of each industry that is required to support the projected final demands, is calculated using interindustry models. These models provide the framework for projecting gross industry outputs, or the total of final and intermediate sales required of each industry. The following section describes the interindustry, or input-output, system used in computing the projected outputs for 1980, 1985, and 1990.

An input-output transactions 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 the producing industry's output to every consuming industry, including itself, and final demand. The sum of all the entries in a row gives the industry's output. Each column of the matrix shows the input to the consuming industry from each industry, including itself, necessary to produce its output. The sum of the purchased input plus value added (returns to capital, labor, and entrepreneurial ability) equals the output of the industry.

Industry classification

Two benchmark input-output studies of the BEA were used for this set of projected tables. Both the 1963 and the 1967 BEA tables were available with 367 separate industries. The industries in the SIC manual which are contained within a sector may vary due to differences between the 1957 and the 1967 SIC, but this does not affect the comparability of the two tables. The 162-order tables used by BLS for the projections were aggregated from BEA's 367-order industry tables. The current-dollar tables were aggregated directly from BEA's tables, while the constant-dollar tables were repriced at the 367-order level and then aggregated into the 162 industry tables. The SIC content of the 162-order industry sectoring plan used in the projections was based on the 1967 interindustry classifications system. The relationship between SIC and the Economic Growth industry sectors is given in appendix G.

Industry conventions of the input-output

The 1963 and 1967 benchmark input-output studies followed essentially the same definitions and conventions, so the following description is applicable to both years. In the input-output industry classification system, there are three industries which do not actually exist. These industries, called dummy industries, are included to simplify the treatment of certain product flows. Output of these dummy industries represents an aggregation of commodities or services which are produced in other industries. Generally, the information available on the consumption of these commodities is for total consumption only, so the products are treated as being sold to the dummy industries, which are assumed to sell them to the consuming industries. One such dummy industry is Economic Growth (EG) sector 157, "office supplies," which buys office supplies from the producing industries and then sells them to the consuming industries. The other two dummy industries which perform similar functions are "business, travel, entertainment, and gifts" (EG industry 156), and "scrap, used and second-hand goods" (EG industry 158). Purchases from the dummy industries generate employment or output in the industries which actually produce the products and services, rather than in the dummy industries.

In addition to being a dummy industry, the scrap industry presents a special problem. An increase in scrap demand would, by virtue of the nature of the input-output model, generate output in other industries to produce the scrap. To eliminate this problem, and to make scrap generation a function of output, BEA adopted, and BLS followed, the following procedure: The scrap industry is dropped from the table by adding the scrap industry column entries to the diagonal cell of the industry actually generating the scrap. In addition, the scrap row, i.e., the input of scrap, is deleted from the matrix. This creates an imbalance in the column sum since the scrap input and output are rarely, if ever, equal for any one industry. To correct this, another row, entitled scrap and byproduct adjustment, is added which is precisely the negative of the imbalance.

Economic Growth industry 160, "rest of the world," is modified to exclude travel receipts from foreign visitors and personal remittances, in kind to foreigners. This adjustment affects the industry detail of final demand in the personal consumption expenditures and export categories.

The two government sectors, State and local and Federal, are classified into two major categories, government enterprises and general government. All Federal, State, and local enterprises, i.e., agencies deriving 50 percent or more of their revenue from sales to the

public, are included in EG industries 150 through 154, along with their respective employment and total receipts. EG industry 151, Commodity Credit Corporation (CCC), is modified by adding all of its intermediate inputs to the nondefense Federal Government final demand category. The employment associated with the CCC and the employment involved with general government activities, such as teaching or administration, at both the Federal and State level, are included in EG industry 159, "general government industry."

EG industry 155, "directly allocated imports," covers U.S. payments to foreigners for merchandise, services, and factors of production. Items classified in this industry have no equivalent domestic products or are consumed in final demand. The service of domestics is classified in EG industry 161, "households."

In one respect, the input-output data developed by BLS differ from the benchmark input-output studies of BEA. The change from a total output base to a domestic output base resulted in changes in the methodology for intermediate demand as well as in final demand. This difference required two changes in the transactions data of the interindustry matrix, both of which involved transferred imports. The transferred imports industry was deleted from the transactions table and, instead, incorporated into the final demand estimates. Since the input-output data are valued in producers' prices, the margins on the transferred imports had to be subtracted from the trade and transportation industries transactions and included in the final demand purchases.

Valuation of transactions

Input-output relationships may be expressed either in producers' value or in purchasers' value. In other words, the inputs for making a product can be valued at the price received by the producer or the price paid by the purchaser. Both the BEA and BLS tables value inputs purchased by a consuming industry at the price the producer receives. Trade margins and transportation costs associated with these inputs appear as direct purchases by the consuming industry from the trade and transportation industries. The purchase price for an item is still contained within the matrix, but the demand is divided into components which are purchased separately.

Since the input-output table is in producers' value, all trade and transportation margins must be stated as demand on these sectors in the final demand estimates. In the estimates of final demand, margins are separated from the estimates of purchases of goods and services. These estimated margins are aggregated to be used as the final demand estimates for the trade and transportation industries. Margin ratios associated with each transaction and final demand category were developed by BEA as part of the input-output studies. This information was used to convert final demand expenditures in purchasers' value into producers' value for the years covered by these projections.

If the input-output table were stated in purchasers' value, the connection between producing and consuming industries would be lost. In a purchasers' value table, the trade sectors would purchase most products from the producing industries and sell these products to the consuming industries. In producers' value, the materials or services can be sold directly to the consuming industry. This method also has the added advantage of showing the relationships between the producing industry and final demand categories on a comparable (producers' value) basis. Using a producers' value system eliminates the sale of products to the trade sectors. The output of these trade sectors is, as a consequence, measured in terms of total margins, i.e., operating expenses plus profit.

Secondary product transfers

The transactions recorded in an input-output table are based on data contained in the Census of Manufactures, the transportation census, and other economic censuses. The Bureau of the Census assigns establishments to an industry based on the industry's primary output, that is, those products or services which produce the largest portion of its revenue. However, in addition to primary products, many establishments also produce other products which are different from the primary output, called secondary products (or services).

Input-output work would be simplified if all output of a given product or service were sold by a single industry. To accomplish the same thing, an artificial sale, called a transfer, is introduced into the input-output table; the industry which produces the output as a secondary product is shown as selling it to the industry which produces it as a primary product. In this process, the output of the primary product industry is increased by the amount of this transfer since it becomes an input, albeit an artificial input. For example, electric power is produced in the "electric utility industry," EG industry 126, (the primary industry) and EG industries 152 and 154, "other Federal enterprises" and "other State and local government." In this situation, the electric power output of Federal Government and State and local government power plants is transferred to the private electric utility industry for distribution to the consuming industries and final demand sectors. In this way, the final demand for a product generates production in both the primary producing industry and in the industries where the product is secondary.

This transfer approach is used to distribute the output of a number of industries. Three industries in the table, the dummy industries, receive all of their output as transfers from the producing industries. A table is compiled, based on BEA's data, which details the transfers from one industry to another.

An alternative treatment of transfers is used when secondary production is large and inherently different from the primary output of an industry, such as bakery products produced by small retail establishments. In these instances, the industries are redefined; the secondary products and their associated inputs are removed permanently from the producing industries and assigned to the primary industries. Therefore, the various goods, services, and value-added components used to produce the baked goods and the resulting output of those items are taken from the trade sector and placed in the food industry. Primary examples of the use of this alternative are the redefinition of trade margin output out of all industries other than trade, and the redefinition of service activities, especially auto repair, out of trade.

BLS input-output system

The projections of the Office of Economic Growth for 1990 involved nine sets of input-output tables: Six sets of historical tables for 1963, 1967, and 1973; and three sets of projected tables for 1980, 1985, and 1990. The historical tables were done in both current and 1972 constant dollars, while the projected tables were done only in 1972 dollars. The projections are done in constant prices so that changes in output, demand, or input-output coefficients represent changes in quantities. This use of base-year prices does not ignore changes in relative prices because such changes are implicit in projections of input-output relationships. The substitution of one material for another, due to relative price change, may affect input-output coefficients in the same way as technological change.

There are three sets of constant-dollar historical tables, two of which are for years that have input-output tables developed by the Bureau of Economic Analysis. For those 2 years (1963 and 1967), the BEA 367-order tables were repriced and then aggregated to form the BLS tables.

Repricing the BEA tables required several steps to deflate each of the different parts of the tables. First, the transaction values were summed to obtain output for an industry. The outputs were deflated using unpublished 4-digit industry deflators that were developed as part of the gross product originating data. Transfers were repriced using the output deflator of the primary producing industry. The transfers and sales to consumption and investment were subtracted from total output in both current and constant dollars. Then an implicit deflator was constructed to reprice the intermediate sales and the other types of final demand. A deflated transactions value was then computed by adding the deflated components—direct sales, transfers, margins, and transferred imports. This repriced table was then aggregated to form a 162-sector table, with adjustments made to eliminate secondary product transfers between the input-output sectors being collapsed into one industry.

For the 1973 historical tables, BEA's 1967 table was updated to the latest year for which reasonably complete data were available, and then repriced into 1972 dollars. Developing the 1973 tables allowed for incorporation of recent structural changes which provided a better basis for projecting.

When an updated input-output table is developed for a nonbenchmark year, such as 1973, only part of the necessary data are available. Output levels by industry were estimated from Bureau of the Census data and other sources. These industry outputs were adjusted for secondary product transfers to be consistent with input-output conventions and deflated to 1972 prices. Final demand and price data were taken from Department of Commerce estimates, published annually in the July issue of the *Survey of Current Business*. Final demands were deflated and translated into industry demands. All of these data were then converted from purchasers' to producers' value with some adjustments for changing trade, transportation, and insurance margins. Developing an input-output table for a nonbenchmark historical year (or a year that does not have a complete set of economic censuses) is a problem of assembling and restructuring existing data into proper form, although estimating techniques must also be used.

The first step in developing the 1973 set of input-output tables was to estimate output and final demand for each industry. The existing data required a number of adjustments due to input-output conventions and the need to state input-output data in base-year prices. The 1967 BEA 367-order table was updated by scaling the transaction values by the ratio of the industry's 1973 current-dollar output to its 1967 current-dollar output. Secondary product transfers were scaled by the output ratio of their primary industry. The scaling of the 1967 current-dollar table yielded a first approximation of the 1973-current dollar table. The 1973 367-order table was then deflated to 1972 dollars, using the same procedure used to deflate the 1967 BEA table. Both current- and constant-dollar 1973 tables were then aggregated to 162 order.

The aggregated constant-dollar transactions table was divided by the independent output estimates to create a coefficients matrix. These direct coefficients were replaced by the independently updated estimates for 1973, where such estimates had been made. Estimates of 1973 coefficients were developed using the methods described in the section on projecting coefficients. This updated coefficients matrix was then used to compute industry outputs using the Gauss-Seidel method.

The derived output, which had been computed from the updated coefficients matrix, was compared to the independent estimates of output. In this comparison, a difference of plus or minus 2 percent was accepted while larger differences were analyzed. During this process, problems were uncovered in virtually every area; final demand, deflators, output, and coefficients

were each found to contribute to the difference in the measures of output. Changes in the transportation and trade margins that had occurred since the 1967 table was constructed, but had not been captured in the initial estimates for 1973, caused differences in the output measures.

Whenever a number of changes were made to the underlying data, outputs were recomputed and the analysis of output differences was redone. If the appropriate changes had been made, the total gaps, on the average, became progressively smaller, and many individual gaps were eliminated.

When time, resources, and/or data were exhausted, a number of industries remained where the derived output deviated by more than plus or minus 2 percent from the independently estimated value of output. At this point, an estimate was made of value added by industry, or the difference between real output and the sum of purchases of material and services inputs, in real terms. By the nature of the input-output system, total derived value added will always equal total final demand. Further, the procedure used by BLS in estimating the intermediate matrix and outputs is almost the same as the double deflation procedure used in estimating the gross product originating by industry in the Bureau of Economic Analysis. Thus a rough reconciliation of value added and GNP originating by industry could be made. This could be done only at very aggregative levels, so only a few, rather large, adjustments were made as a result of this analysis.

In order to insure that the intermediate demand yielded by the coefficients matrix is equal to the difference between output and final demand, a balancing procedure is used. This is an iterative procedure, known as RAS, which will balance the transactions matrix while independently estimated data are held constant.

If this scaling procedure is done accurately, the system will be in balance, i.e.:

$X - Y = AX = T,$

where X is an n by 1 vector of domestic outputs,
where Y is an n by 1 vector of final demands,
where A is an n by n matrix of direct coefficients,
where T is an n by 1 vector representing the row sums of the intermediate transaction matrix.

Projecting coefficients

The need to project input-output coefficients arises because of changes that that have taken place or are expected to take place in these coefficients. Technological change is one of the important factors underlying changes in coefficients from period to period. Other factors, such as a change in product mix or prices, can also cause significant changes in coefficients. Product-mix problems are inherent in a system that uses fixed classifications and aggregative industry groups. In dividing the U.S. economy into 162 sectors, broad industry groupings are created which are usually combinations of 4-digit SIC industries. These large sectors include different commodities and services, each of which has its own set of input requirements. If the production of the various commodities changes at different rates, thereby changing the product mix of the sector's output, then the total input coefficients of the sector may also change. This can occur even if there are no technological changes in the producing industries.

Industry coefficients were projected as part of an input-output system which consisted of four interrelated parts: 1) The matrix of intermediate interindustry transactions, which are converted to direct coefficients; 2) the set of value added by industry; 3) the set of industry final demands; and 4) the set of industry outputs. Each part is dependent on the others, and all the parts must be mutually consistent. Certain coefficients may be projected independently, but the overall projection of coefficients must be made in conjunction with the projection of industry final demands.

When projecting input-output tables, all the problems involved in updating a matrix exist as well as the need to project changes. Industry structures, growth rates, and production processes may change due to factors unforeseen or imperfectly understood. Development of an input-output system for a projected year requires estimating all parts of the system and the integration of those parts into a balanced system.

The projection of input-output coefficients involved four different techniques. The coefficients for the energy sectors (EG industries 11, 60, 126, and 127) were projected using a logit share model. A reweighting technique was used to project the six construction industries' coefficients. Other industry coefficients were projected using specific data changes for selected coefficients. The fourth method of coefficient projection was a general technique which focused on interindustry relationships with the added objective of achieving a balanced system.

The projection of the energy coefficients was based on the assumption that the different energy products (coal, refined petroleum, natural gas, and electricity) could be substituted for each other in the majority of end-use applications. It was also assumed that the distribution of constant-dollar energy input-output coefficients would be influenced by projected changes in current-dollar energy costs after an adjustment for existing stocks of energy-using equipment that could not be converted to alternative fuels. The total energy input into each manufacturing sector was defined as the sum of the coal, refined petroleum, natural gas, and electricity coefficients. This total energy input was distributed to alternative fuels for the projected years based upon assumptions about future energy prices. (The price assumptions for this set of projections were discussed in

the assumption section of the methodology.) This distribution technique used price elasticities estimated from a pooled cross-sectional time series data base.

Energy data were obtained from the Fuels and Electric Energy Consumed tables of the 1963 and 1972 *Census of Manufactures*, and the 1974 *Annual Survey of Manufactures*. Quantity and price data were available for the manufacturing industries, by State. These data were distributed to the corresponding Economic Growth industries and converted to BTU's. The following regressions were then run for each industry:

$$1.\quad \ln \frac{Q\ gas}{Q\ coal} = f\left(\frac{P\ gas}{P\ coal,\ time}\right)$$

$$2.\quad \ln \frac{Q\ coal}{Q\ elec} = f\left(\frac{P\ coal}{P\ elec,\ time}\right)$$

$$3.\quad \ln \frac{Q\ oil}{Q\ coal} = f\left(\frac{P\ oil}{P\ coal,\ time}\right)$$

where Q = quantity
and P = price.

The resulting equations were used in conjunction with energy prices projected by DRI, to project the quantity ratios to 1980, 1985, and 1990. The ratios obtained were converted from logarithms and used to project the share of total fuel, in ratio form, that was to be provided by each of the four energy sectors. These data were developed for each manufacturing industry, in each of the projected years. The following equations were used:

$$1/\left[1+\left(\frac{Q\ gas}{Q\ coal}\times\frac{Q\ coal}{Q\ elec}\right)+\left(\frac{Q\ oil}{Q\ coal}\times\frac{Q\ coal}{Q\ elec}\right)+\frac{Q\ coal}{Q\ elec}\right]=TE$$

Share of electricity

$$TE\times\frac{Q\ coal}{Q\ elec}=TC \qquad \text{Share of coal}$$

$$TC\times\frac{Q\ oil}{Q\ coal}=TO \qquad \text{Share of oil}$$

$$TC\times\frac{Q\ gas}{Q\ coal}=TG \qquad \text{Share of gas}$$

The resulting shares for the years 1980, 1985, and 1990 were used to distribute the summed energy coefficients. A subsequent adjustment was made to reflect the necessary adjustment of the existing capital stocks. With the demand figures from the DRI energy model used as a control, the individual coefficients were adjusted to reflect changes in the total (summed) energy coefficients.

In the projection of the construction industry coefficients, the method used was an attempt to adjust the input coefficients for projected changes in the product mix of the industries. The six new construction industries were further subdivided into 32 types of structures purchased by final demand. This investment in structures was projected as part of final demand purchases. The types of structures purchased determined the product mix of the new construction industries, since their entire output was sold to final demand. Shifts in the product mix of the six construction industries were revealed in changes in the purchases of different types of structures. Using the output of a type of structure relative to the output of its construction industry, weights were constructed which were used to aggregate the 1967 input coefficients for the six construction industries. This weighting was done for each projected year, generating different industry coefficients as the distribution of investment by final demand varied.

Other industries were projected using the changes in the coefficients between 1963, 1967, and 1973. The changes that occurred were analyzed to determine the cause of the change. Possible reasons for changes in coefficients included changing product mix, price changes, and/or technological changes. Research was done to determine the probability of past changes continuing and the possibility of new factors being introduced which would affect an industry's output.

The fourth technique used to estimate coefficients was a general approach which took account of the other data and control totals at the industry level. In this method, changes over time in the sales of an industry to other sectors were analyzed; i.e., an industry was viewed as a row in the conventional input-output table.

The 1973 coefficients matrix was adjusted using the different techniques described above to generate a first approximation of the projected tables. The projected coefficients tables were combined with the projected industry final demands to yield output. These outputs were compared with independent estimates of output and evaluated against past sector trends in output. This evaluation process is described in the section on updating the matrix.

Chapter 5. Employment Projections

The industry employment projections consist of wage and salary workers, unpaid family workers, and the self-employed. These are estimates of the number of full- and part-time jobs required to meet the projected sales of each industry to all final demand or intermediate users. Historical wage and salary employment data are based on the BLS establishment series of employment published in *Employment and Earnings*. Unpaid family-worker jobs and the number of self-employed are based on time series from BLS's Office of Productivity and Technology.

The principal input to the industry employment projections was the projected gross output in each industry. These were obtained by multiplying total projected final demand purchases by the projected input-output matrices. Gross output includes the production needed in all supporting industries as well as that required to satisfy final users. Historical output data series were derived from a variety of sources. Manufacturing data were obtained from the *Census of Manufactures* and *Annual Surveys of Manufactures*. Nonmanufacturing data were compiled from sources such as the *Minerals Yearbook, Agricultural Statistics*, and *Business Income Receipts*. These various output measures were benchmarked to the output data provided in the BEA input-output studies for 1963 and 1967 and to the matrix for 1973. (A detailed description of the output and employment data base is provided in *Time Series Data for Input-Output Industries; Output, Price, and Employment*, BLS Bulletin 2018 (1979).)

In addition to levels of output, the industry employment estimates required projections of output per hour and average annual hours worked. In each industry, the projected gross output was divided by an estimated output-per-hour ratio in order to arrive at total projected hours in each industry. Total hours were divided by projected average annual hours, yielding projected employment requirements for each industry.

Output per hour

Several alternative methods of projecting industry productivity were used: (1) A regression approach relating output per hour to the domestic output of the industry and a labor quality variable, defined as the ratio of blue-collar workers to all workers; (2) a least-squares time trend of the ratio, output per hour; (3) an adjustment method, adjusting the historical least-squares time trend of labor productivity by industry for the difference between projected and historical output and labor-mix trends; and (4) an ad hoc projection of the output-per-hour ratio. While the industry projections did not completely conform to any particular means, method (3) dominated. While the specific form of the first three methods differed, their economic foundations were identical, following a Cobb-Douglas production function.

$$\text{Output} = A(t) + a \text{ labor} + (1-a) \text{ capital services},$$

where A(t) is a technology variable which is approximated by a time trend, and the variables are expressed as natural logs.

Because of different assumptions about explanatory variables or estimating techniques, the forms of the respective labor-demand models varied. For example, if it is assumed that capital services can be approximated by a time trend, then the initial production function collapses to two inputs, a time trend and labor. Several alternative forms of the production functions yield the methods described below.

Method 1, the regression approach, expresses the demand for labor services, output per hour, as a function of time, output, and the ratio of white-collar workers to total workers (labor mix):

$$\text{Output/hour} = a0 + a1 \text{ output} + a2 \text{ time} + a3 \text{ labor mix}$$

This approach accounts for the cyclical movements in labor demand via the output variable and for the secular movements via the time and labor-mix variables. The equation assumes that capital stock and technology can be approximated by a time trend. The equation, by industry, is estimated with annual observations for 15 years and with ordinary least squares. This approach was used infrequently because the estimated coefficients were considered unreliable, principally due to a multicollinearity problem.

Method 2, a least-squares time trend, expresses the demand for labor, output per hour, as a function of time only:

$$\text{Output/hour} = a + a2 \text{ time}$$

where output/hour is expressed in natural logs.

This approach assumes that the long-term trends in industry output per hour can be approximated by a time trend and that these trends are unaffected by long-term fluctuations in output trends. This approach was also

infrequently used. Since long-term trends in output and labor productivity do vary by subperiod, it is reasonable to assume that projected trends will also vary. While output fluctuations are an important explanatory variable of labor productivity fluctuations, this method does not suggest any mechanism for adjusting labor productivity trends for output trends which differ by subperiods.

Method 3, the adjustment approach to projecting the labor demand variable, output per hour, adjusts the historical labor demand trend for changes between the projected and historical output trends and for changes between the projected and historical labor mix trends:

$$\text{Output/hour}(p) = \text{output/hour}(h) + a1\,[\text{output}(p) - \text{output}(h)] + a3\,[\text{labor mix}(p) - \text{labor mix}(h)]$$

where p denotes projected trends, h denotes historical trends, a 1958-76 least-squares growth rate.

The coefficients a1 and a3 used in this approach are estimated in the following equation:

$$\text{Output/hour}(h) = a1\ \text{output}(h) + a3\ \text{labor mix}(h).$$

This approach duplicates method 1, except that cross-sectional data rather than time-series data are used to estimate the coefficients a(1) and a(3). This approach, which was used most frequently, reflects several considerations. First, many empirical results of models which are based on time-series data alone yield results which contradict classical economic theory; for example, a marginal product of labor which exceeds unity. These results often reflect the collinearity problems of time-series data. Second, sufficient information is needed to discern the true coefficient of a particular coefficient; otherwise the results might represent spurious effects. A larger volume of data, such as cross-sectional data, minimizes these spurious effects.

The implicit assumption was that economic data are composites of business, seasonal, and secular cycles. A model which does not discern these cycles might yield incorrect analyses. However, the annual data base of only 19 observations used loses much of its business cycle component.

Because the last equation of method 3 was estimated with cross-sectional data, industry-specific coefficients are lost, but more degrees of freedom are gained. But the growth model deals with industry projections. For example, assume that the estimated output coefficient of this equation, a1, was 0.5. Next, suppose an industry's output and labor productivity over the past several years had been growing, on the average, 5 percent and 2 percent, respectively, per year, but over the next year, the industry expects its output to grow 8 percent, or 3 percentage points faster than its historical rate. How fast will the industry's productivity grow? According to this model, 3.5 percent in the next year. This 3.5 percent forecast change is derived as follows: 2 percent (the historical productivity growth) plus 0.5 (the output coefficient) times 3 percentage points (the acceleration in output).

Method 4, largely ad hoc or judgmental, was necessary in three cases: When the historical and projected output trends differed sharply, energy industries being good examples; when the historical and projected output and employment series were unrelated, such as the water transportation and crude petroleum industries; and when the historical employment and output series implied a negative labor productivity trend, such as barber shops and beauty salons.

Average weekly hours

Average weekly hours for each industry were projected by first assuming that the hours paid for would change at the same rate as they would for the sector to which the industry belongs. The rates of change in average weekly hours were then projected for each sector, such as agriculture or manufacturing, based on the number of hours paid historically. For the most part, the sector level projections simply followed historical trends. Since a trend approach seemed inappropriate in the case of mining, trade, and other services, they were subjected to further analysis, with different factors used.

Industry employment

The employment projections started with the interindustry model runs that produced gross output for each industry in the projected years. These output levels were evaluated in two ways before they were accepted. First, the annual average rates of growth were compared with those in historical periods, and the shares of an industry's output going to intermediate and final demand were compared with those in the base year 1973 and in 1958, 1963, and 1967. Where significant variations were found, data and analytical reasoning were rechecked. Acceptable output levels for each of the 162 industries were divided in turn by the projected output-per-hour ratios to obtain the total projected hours in each industry. These total hours were next divided by the projected average annual hours to provide employment by industry requirements. The projected rates of change in industry employment were compared with historical average annual growth rates, and the projected industry employment levels were totaled and compared with the aggregate labor force projections used in the macroeconomic projections. Changes were made to achieve correspondence, usually in the productivity estimates. Finally, the industry employment estimates were circulated for comment by occupational specialists in BLS, and final adjustments were made.

Chapter 6. Planned Changes in the Projections System

A number of research efforts are now planned or underway, within the Office of Economic Growth or under its sponsorship, to develop techniques and the required additional data to improve projections of economic growth.

Macro model

For the next set of projections, work is underway to respecify selected blocks and reestimate the remainder of the existing macro model. The respecification will center on the production, employment, and business investment blocks. The new approach will stress the interdependence of firms' decisions on capital and labor inputs to the production process, commonly called a factor-demand approach. These capital-labor-production tradeoffs will be modeled for five sectors—farm, manufacturing, nonprofit institutions and households, housing, and other private nonmanufacturing—using factor-demand equations based on marginal productivity conditions and incorporating relative prices. The current macro model treats employment and investment independently and only disaggregates production for farm and private nonfarm sectors.

This respecification is desirable for several reasons. One explanation for the recent slowdown in labor productivity trends is the shift in employment from high-productivity sectors to low-productivity sectors. The movement of labor from farm to nonfarm employment is an example of such a shift. A second reason offered for the slowdown is the 1973-74 jump in energy prices which affected labor usage and capital usage differently. A third explanation is the shortfall in research and development expenditures during the past decade which, in turn, has led to a slowdown in technological improvements. Testing these and other hypotheses requires a model which can specify, by sector, the mix or bundle of capital, labor, energy, and technological inputs to the production process.

A second important respecification of the existing model will deal with Federal transfer payments. These payments go to many different groups, such as individuals and State and local governments, and are under many different programs, such as social security and highway programs. Because of this diversity, industry employment estimates would be affected differently. Further, many of these programs are endogenous rather than being implemented via policy decisions.

The final substantial change in specifications for the next projections will occur in the residential and nonresidential construction demand blocks of the macro model. Residential construction will be modeled in terms of housing units, single-family versus multifamily units, mortgage rates, and other variables. Nonresidential construction will be modeled by function, educational versus commercial versus industrial construction. Previously, these blocks were modeled with one equation each.

Time and resources permitting, other respecifications will deal with (1) business inventories, disaggregating this single-demand component to separate components for farm, automobile, and other goods; (2) exports and imports, disaggregating these two demand components to components for farm products, petroleum, capital goods, and other goods; and (3) the monetary sector, currently dealt with by assumption, changing to behavioral, policy-oriented equations.

The data base of the macro model will be updated to 1978, adding 3 years to the observations. Because of the new factor demand and construction detail, the number of variables included in the macro data base will be expanded.

Finally, implicit in the factor-demand respecification is a change in the solution procedure of the model. The model is now balanced, or in equilibrium, when the gap between supply GNP and demand GNP is zero. The new model will be balanced when the demand for labor equals the supply of labor (or a target unemployment rate).

Factor demand in industry detail

The new factor-demand approach of the macro model will also be used at the industry level during the next projections. In the current methodology, estimation of rates of growth in output per hour and employment relied primarily on past trends for most industries, and, except for a time variable, no use was made of capital requirements. Further, business investment relied primarily upon past trends in investment products, for example, trucks versus lathes or stamping machines, rather than on existing capital stock in each industry. In the next set of projections, the approach to these two components, employment and investment, will stress the interdependence of labor and capital requirements

in each industry. This new approach is, in part, possible because of the development of an industry-level capital stocks data base.[18]

This new approach will require several substantial changes in the interindustry solution procedure:

(1) The starting point for estimates of employment and investment will be elasticities of substitution between labor and capital in each industry. These elasticities, combined with projected industry outputs, will yield projected industry labor and capital requirements.

(2) The estimates of labor requirements, or labor hours, combined with an average workweek trend, will yield projected industry employment or jobs. The aggregate labor constraint upon these industry estimates would be the sector labor requirements developed in the revised macro model.

(3) The estimated capital requirements, or capital services, combined with the existing capital stock less discards, will yield projected industry investment trends. The aggregate constraint upon these industry investment trends would be sector capital requirements developed in the revised macro model.

(4) The estimates of industry investment, combined with an investment flow table, will yield projected investment by product, a final demand component.

(5) The estimates of investment by product, combined with the other projected final demands, will yield projected output levels, when used with the projected input-output table.

(6) A solution of this factor-demand model would involve iterating between alternative output, investment, and employment mixes until an internal consistency between the three elements is achieved. This internal consistency, by industry, is a capability not formally contained in the existing model.

Macro and micro relationships

The factor-demand specification outlined for both the macro and industry projections lends itself to an interesting possibility, that aggregate economic growth might be determined by the industry detail. Presently, aggregate growth is determined by the macro model, which abstracts from the economy's detail. The existing model emphasizes those variables and processes which are the more important for determining the medium-term or 5- to 15-year growth path of the U.S. economy. What is an appropriate model for fore-casting such variables as total consumption, total investment, or total employment? These are currently forecast via individual econometric equations within the macro model; a single equation yields a forecast total consumption value; a second equation, total investment; and so on. With inclusion in a macro model, the direct and indirect responses of these endogenous variables to changes in policy instruments or other exogenous variables can be estimated. Explicit in these single-equation specifications is that the components of these aggregate variables are all perfect substitutes for one another.

This alternative specification would permit industry and product detail to determine aggregate forecasts. In the past, the model has depended upon the aggregate variables for practical reasons; i.e., the industry and product detail did not have sufficient observations to yield stable estimates of time series coefficients. These projections are based on annual observations, a technique which limits the degree of freedom; this is particularly critical when the number of historical observations barely exceeds the number of years being projected. These practical problems are being surmounted and, as a consequence, this alternative specification will be tested in the next set of projections.

[18] *Capital Stock Estimates for Input-Output Industries: Methods a Data*, Bulletin 2034 (Bureau of Labor Statistics, 1979).

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

Supply sector

1. ECLF = LCF * (1.0 – U)

2. ECJOBS = – 0.751 + 1.078 ECLF – 0.199U – 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
D.W. = 1.458
Estimation period: 1947-76

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

R-squared = 0.996
D.W. = 1.061
Estimation period: 1952-74

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
D.W. = 0.462
Estimation period: 1952-74

4. ENFJBS = ECJOBS – (EF + EMPE + EMPNE + EFJBS)

6. AAHF = 1965.150 – 13.656 U – 9.037 U(t–1) + 27.893 FPOP + 7.623 TIME
(9.9) (–2.1) (–1.3) (3.3) (1.4)

R-squared = 0.877
D.W. = 0.960
Estimation period: 1948-76

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
D.W. = 1.950
Estimation period: 1948-76

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) = 2.881 + 0.0002 U * U + 0.450 ln(MHIF/IKADJF) + 0.013 T29
(27.7) (2.8) (11.3) (5.5)

R-squared = 0.957
D.W. = 1.453
Estimation period: 1929-40, 1946-74

21. ln(GNPNFC/IKADJNF) = 6.065 − 0.0002 U * U + 0.805 ln(MHINF/IKADJNF) + 0.020 T29
(192.1) (-5.0) (22.0) (31.0)

22. SERFCC = 0.922 + 0.855 * (EF * 13.588) − 1.716 CREEP2 + 0.122 TIME
(1.1) (24.1) (−2.1) (7.5)

R-squared = 0.995
D.W. = 0.940
Estimation period: 1947-74

23. SERFMC = −0.221 + 1.090 (EMIPA * 6.613) − 6.334 CREEP2 − 0.085 TIME
(−0.3) (37.6) (−3.4) (−2.5)

R-squared = 0.989
D.W. = 1.072
Estimation period: 1947-74

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

R-squared = 0.999
D.W = 1.281
Estimation period: 1947-74

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
D.W. = 0.980
Estimation period: 1947-74

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)

Cochrane/Orcutt RHO = 0.523
R-squared = 0.993
D.W. = 0.143
Estimation period: 1949-74

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

where KSTK = KEF + KSF + KENF + KSNF

R-squared = 0.998
D.W. = 0.143
Estimation period: 1947-74

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
D.W. = 1.442
Eatimation period: 1947-74

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

R-squared = 0.989
D.W. = 0.824
Estimation period: 1947-74

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
D.W. = 1.472
Estimation period: 1947-74

33. IVA = 2.751 – 97.123 ((DGNPP – DGNPP(t–1))/DGNPP(t–1)) + 0.099 IVCHG – 0.021 KINV(t–1) – 20.380 EMBGO
(1.6) (–3.3) (1.0) (–1.6) (–7.5)

R-squared = 0.890
D.W. = 3.203
Estimation period: 1948-75

34. IFK = CPCDA – (CPTFD + CPTST)

35. UCP = IFK – (CDAKE – CDAKB) – IVA – DIV

36. CCANCC = 1.787 + 0.025 KHS(t–1) + 0.0002 KHS(t–1) * TIME
(0.4) (3.7) (1.1)

R-squared = 0.993
D.W. = 0.253
Estimation period: 1947-74

37. CCANCK = CCANCC * DFNCCA

38. IBTFD = 6.134 + 0.004 GNPPK + 0.026 TRG * FU + 0.774 DMKW
(23.2) (2.8) (8.5) (2.0)

R-squared = 0.984
D.W. = 1.470
Estimation period: 1947-74

39. IBTST = 4.284 + 0.710 (GDSTK + SERSTK + TRSTP – GAK(t–1) - 0.527 U
(4.1) (107.0) (–2.3)

R-squared = 0.998
D.W. = 1.223
Estimation period: 1948-75

40. IPFD = 1.466 + 0.004 (13Y5Y * DFP) + 0.002 (13Y5Y * DFP)(t–1) – 0.0004 (13Y5Y * DFP)(t–2)
(9.1) (10.0) (2.8) (–0.7)

R-squared = 0.993
D.W. = 1.127
Estimation period: 1952 - 75

41. SICE = 0.431 + 0.529 SICTOT
(3.4) (167.7)

R-squared 0.999
D.W. = 0.376
Estimation period: 1947-74

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

R-squared = 0.966
D.W. = 1.445
Estimation period: 1947-74

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

R-squared = 0.990
D.W. = 0.808
Estimation period: 1947-74

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
Estimation period: 1947-74

45. SICTOT = SICU + SICO + SICST + SICFD

46. IPC = −2.325 + 0.019 PI + 0.419 13M
(−8.7) (16.3) (2.6)

R-squared = 0.989
D.W. = 0.429
Estimation period: 1947-74

47. PI = GNPTK − CDAKE − CCANK − 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)) + 1.291 ln((PI + SICTOT − SICE)/GNPTK)
(87.5) (2.3) (78.2) (5.2)

R-squared = 0.998
D.W. = 1.679
Estimation period: 1947-74

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

R-squared = 0.992
D.W. = 1.373
Estimation period: 1947-74

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
D.W. = 1.705
Estimation period: 1947-74

51. DPIK = PI − (PTFD + PTST)

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

R-squared = 0.959
D.W. = 1.947
Estimation period: 1947-74

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))/DFDPI/DFDPI(t−1))
(−3.3) (18.5) (2.3) (−0.9) (2.5)

−1098.710 IPC/DPIK
(−5.3)

where PCEC = PCEK/DFDPI

R-squared = 0.990
D.W. = 1.468
Estimation period: 1947-74

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

where PCEC = PCEK/DFDPI

R-squared = 0.999
D.W. = 0.964
Estimation period: 1947-74

56. PCES = –38.429 + 0.397 (PCEC) + 0.598 U + 0.050 KHS
(–11.1) (11.2) (1.2) (2.4)

where PCEC = PCEK/DFDPI

R-squared = 0.999
D.W. = 1.211
Estimation period: 1947-74

57. IENF = –7.301 + 0.190 IFC + 0.732 IENF(t–1) + 0.0002 KENF(t–1) + 118.350 (IFC/KENF + KSNF)/U)(t–1)
(–1.9) (2.9) (4.2) (0.01) (0.8)

+0.083 (GNPNFC – GNPNFC(t–1))
(2.7)

R-squared = 0.988
D.W. = 1.349
Estimation period: 1947-74

58. ISNF = 0.604 + 0.017 GNPNFC + 0.618 ISNF(t–1)
(0.5) (2.3) (3.8)

R-squared = 0.967
D.W. = 1.161
Estimation period: 1947-74

59. IVCHG = –42.234 + 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
D.W. 1.742
Estimation period: 1947-74

60. IR = –68.090 – 4.921 13Y5Y + 1.448 HOUSE + 4.643 DPIC/HOUSE/
(–7.8) –(4.1) (5.7) (3.8)

R-squared = 0.945
D.W. = 1.381
Estimation period: 1929-40, 1946-74

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

+ 5.123 CPSQR + 0.841 M(t–1)
(2.1) (7.9)

R-squared = 0.996
D.W. = 1.052
Estimation period: 1947-74

62. PURFDC = SERFMC + SERFCC + GDFDC

63. PUREC/POP = –0.184 + 0.071 ((GNPFC + GNPNEC)/POP)(t–1) + 0.513 (GAC * GPCED/POP) + 0.474 SCHL/POP
(–7.7) (13.3) (1.3) (5.0)

R-squared = 0.991
D.W. = 1.663
Estimation period: 1953-74

64. PURNEC/POP = −0.089 + 0.085 ((GNPFC + GNPNFC)/(POP)(t−1)
(−1.4) (4.4)

+ 0.607 (GAC * (1.0−GPCED)/POP) + 0.003 U
(2.1) (0.9)

R-squared = 0.973
D.W. 0.538
Estimation period: 1953-74

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
D.W. = 1.214
Estimation period: 1948-75

66. CEPM = 4.994 + 60.286 (((GNPFC+GNPNFC)/(MHF+MHNF))−
(4.7) (3.8)

((GNPFC+GNPNFC)/(MHF+MHNF))(t−1))/((GNPFC+GNPNFC)/(MHF+MHNF))(t−1)
+119.426 ((DFDPI−DFDPI(t−1))/DFDPI(t−1)−0.799 U
(11.8) (−4.5)

R-squared = 0.860
D.W. = 2.091
Estimation period: 1947-76

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
D.W. = 1.661
Estimation period: 1948-74

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

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

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

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

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
D.W. = 1.558
Estimation period: 1948-74

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

Cochrane/Orcutt RHO = 0.428
R-squared = 0.997
D.W. = 1.991
Estimation period: 1949-74

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

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

77. DFGDF = −0.016 + 1.021 DGNPP
(−0.8) (38.8)

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

78. DFCCA = 0.028 + 0.818 DEFI + 0.163 DGNPP
(1.5) (9.4) (1.8)

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

79. DFNCCA = −0.014 + 0.284 DFDPI + 0.755 DGNPP
(−0.4) (0.5) (1.2)

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

80. DEFSFC = DEFSFC(t−1) * (% ch DFDPI)

81. DEFSFM = DEFSFM(t−1) * (% ch DFDPI)

82. DEFSS = DEFSS(t−1) * (%ch DFDPI)

83. DEFGA = DEFGA (t−1) * (% change in 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 CCA)
CDACE	Corporate depreciation allowances, constant dollars, with capital consumption adjustment (CCA),(CDACB*DFCCA)
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 (B66)
CPCDA	Corporate profits + capital depreciation allowance − inventory valuation adjustment
CPH	Private compensation per hour (67L, 68)
CPIVA	Corporate profits + 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 profit 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 (see text)
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 (38)
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 (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
GGP	Gross government product, constant dollars
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)+(SERFM*DEFSFM))
GPCED*	Education's share of Federal grants
HOUSE*	Number of households
IBTFB	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
IPFC	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- 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 employment
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	OASDHI contributions
SICST	State and local 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 B. Potential Economic Growth Assessment System for the United States (PEGASUS)

PEGASUS is a software system designed to formalize and automate the links among the various projection processes in the BLS Economic Growth model such as the aggregate economic projection, distribution of final demand by industry, and the determination of industry employment and output estimates. The system insures consistency across segments of the process and allows for rapid inclusion of data revisions or changes in assumptions. The purpose of this appendix is to present a general description of the capabilities of PEGASUS and a list of available documentation.

PEGASUS is divisible into three segments, or groups of programs. These are the solution segment, data base management, and the data display and analysis segment. The solution segment allows for a continuous solution of the entire projection model or for solution of discrete elements of that model. Models or processes currently available are as follows:

BLS macroeconomic model
Houthakker/Taylor consumption model
Investment by consuming industry
Industry final demand bridge
Input-output solution
Industry employment, hours, and productivity model

Individual portions of the process may be solved alone as long as exogenous data from prior steps are available in the data base. The solution segment of the model also allows for dynamic constant adjustment terms or for the override of all behavioral equations.

The data base management segment allows the user to update or otherwide modify either the PEGASUS time series data base or the bridge/input-output matrix data bases. Commands are also available to copy or print all or part of the various data bases.

The data display/analysis segment allows for more specialized presentation of data than is available in the data base management segment. The following reports are currently available:

1. Aggregate analysis—12 tables presenting various aspects of the aggregate data are produced. Many analytical ratios and user selected compound growth rates accompany each table.

2. Industry summary package—final demand by major national income categories as well as total and intermediate output are produced for 3 historical and 3 projected years for each industry. Either growth rates or percent distributions of output may be chosen by the user. Major sector aggregations are also presented.

3. Industry employment/output package—several categories of employment and total output series are presented for each industry with selected growth rates. Major sector aggregates are also presented.

This segment of PEGASUS also contains more analytically oriented report generators. Currently, two options are available.

1. Simulation analysis—actual and estimated time series, a plot of these series over time, and selected summary statistics are presented for a selected range of variables and years.

2. Aggregate multiplier analysis—multipliers of selected variables on all aggregate variables are computed for a specified year. A summary table presents the multipliers of all selected variables on major demand GNP components.

Documentation of PEGASUS is available in four volumes: 1) System Review; 2) Source Listings; 3) Historical Data Sources; and 4) Behavioral Equations. This material is available on request from the Bureau of Labor Statistics, Office of Economic Growth. The system itself, which is currently operational on the IBM 370, is available on magnetic tape for the cost of generating such a tape.

Appendix C. Personal Consumption Model Equations

Variable 201 – CAR

$$CAR-CAR(-1) = -144.379 + 0.239\ (PCE-PCE(-1)) - 0.089\ (PCE(-1)-PCE(-2)) - 0.071\ (PCE(-2)-PCE(-3))$$
$$(.258) \qquad (8.620) \qquad (2.761) \qquad (2.536)$$

R-squared = 0.701
D.W. = 2.343

CAR – new cars, net used cars, trucks, recreation vehicles and trailers
PCE – personal consumption expenditures; national income and product accounts

Variable 202 – TBA

$$TBA = -9015.0 + 212.624 * (YR)$$

TBA – tires, tubes, accessories, and parts
YR – year (e.g., 1976=76)

Variable 203 – FNR

$$FNR/POP = 1.413 + 0.774\ (FNR(-1)/POP(-1)) + 0.311\ (PCE/POP) - 0.029\ (PCE(-1)/POP(-1))$$
$$(1.963) \quad (9.743) \qquad (111.071) \qquad (8.008)$$

R-squared = 0.98
D.W. = 1.4

FNR – furniture and bedsprings
POP – total population
PCE – personal consumption expenditures, national income and product accounts

Variable 204 – APP

$$APP/POP = -23.822 + 0.018\ (PCE/POP) + 0.019\ (PR-APP) - 1.645\ (D)$$
$$(3.972) \quad (12.858) \qquad (1.166) \qquad (2.069)$$

R-squared = 0.9852
D.W. = 0.576

APP – kitchen and other household appliances
PCE – personal consumption expenditures
POP – total population
PR-APP – relative price of APP
D – dummy variable 1930-41 = 1

Variable 205 – CHN

$$CHN/POP = 26.232 + 0.323\ (CHN(-1)/(POP(-1)) + 0.004\ (PCE/POP) - 0.252\ (PR-CHN)$$
$$(81.975) \quad (4.359) \qquad (7.378) \qquad (6.142)$$

Cochrane/Orcutt RHO = 0.461
R-squared = 0.9647
D.W. = 1.51

CHN – china, glassware, tableware, and utensils
POP – total population
PCE – personal consumption expenditures
PR–CHN – relative price of CHN

Variable 206 – RAD

RAD/HH = 12.749 + 0.008(PCE/HH) – 0.189(PR–RAD) + 138.351 (COLOR)
(0.386) (2.940) (3.512) (18.479)

R-squared = 0.9936
D.W. = 0.8223

RAD – radio, television sets, and musical instruments
PCE – personal consumption expenditures
HH – households
PR–RAD – relative price of RAD
COLOR – color television sets in HH

Variable 207 – ODH

ODH/POP = −4.262 + 0.916 (ODH(−1)/POP(−1)) + 0.023 (PCE/POP) – 0.020 (PCE(−1)/POP(−1))
(1.544) (11.432) (4.134) (3.088)

R-squared = 0.9878
D.W. = 1.1641

ODH – other durable housefurnishings
POP – total population
PCE – personal consumption expenditures

Variable 208 – JRY

JRY/POP = 0.839 (JRY(−1)/POP(−1)) + .0070 (PCE/POP)– 0.0056 (PCE(−1)/POP(−1)) – 0.0434 (PR–JRY)
(10.622) (4.758) (3.289) (3.445)
+ 0.034 (PR–JRY(−1))
(2.774)

R-squared = 0.9914
D.W. = 1.52

JRY – jewelry
POP – total popluation
PCE – personal consumption expenditures
PR–JRY – relative price of jewelry

Variable 209 OPT

OPT =1.0269(OPT(−1)

OPT – opthalmic and orthopedic appliances

Variable 210 – BKS

BKS/POP = –0.477 + 0.631 (BKS(−1)/POP(−1)) + 0.0041 (PCE/POP) – 0.0026 (PCE(−1)/POP(−1))
(1.705) (6.783) (3.419) (1.845)

Cochrane/Orcutt RHO = –0.10
R-squared = 0.9715
D.W. = 1.83

BKS – books and maps
PCE – personal consumption expenditures
POP – total population

Variable 211 – WHG

$$\frac{WHG}{POP} = \underset{(6.454)}{0.839}\left(\frac{WHG(-1)}{POP(-1)}\right) + \underset{(4.015)}{0.016}\left(\frac{PCE}{POP}\right) - \underset{(2.591)}{0.013}\left(\frac{PCE(-1)}{POP(-1)}\right) - \underset{(0.264)}{0.0193}\,(PR\text{–}WHG) - \underset{(0.413)}{0.028}\,(PR\text{–}WHG(-1))$$

Cochrane/Orcutt RHO = 0.272
R-squared = 0.9914
D. W. = 2.19

WHG – wheeled goods, durable toys, sports equipment
PCE – personal consumption expenditures
POP – total population
PR–WHG – relative price of WHG

Variable 212 – FOP

$$\frac{FOP}{POP} = \underset{(3.103)}{70.145} + \underset{(12.946)}{0.143}\left(\frac{PCE}{POP} - \frac{PCE(-1)}{POP(-1)}\right) + \underset{(0.854)}{0.0059}\left(\frac{PCE(-1)}{POP(-1)}\right) + \underset{(8.861)}{0.784}\left(\frac{FOP(-1)}{POP(-1)}\right)$$

R-squared = 0.953
D.W. = 1.094

FOP – food and beverages for off-premise consumption excluding alcohol
POP – total population
PCE – personal consumption expenditures

Variable 213 – FPM

$$\frac{FPM}{POP} = \underset{(4.236)}{42.909} + \underset{(3.174)}{0.416}\left(\frac{FPM(-1)}{POP(-1)}\right) + \underset{(7.622)}{0.037}\left(\frac{PCE}{POP} - \frac{PCE(-1)}{POP(-1)}\right) + \underset{(3.911)}{0.0103}\left(\frac{PCE(-1)}{POP(-1)}\right)$$

R-squared = 0.9343
D.W. = 1.2282

FPM – food and beverages, on-premise consumption excluding alcohol
PCE – personal consumption expenditures
POP – total population

Variable 214 – ALC

$$\frac{ALC}{POP} = \underset{(1.240)}{-22.225} + \underset{(9.712)}{0.582}\left(\frac{ALC(-1)}{POP(-1)}\right) + \underset{(4.650)}{0.006}\left(\frac{PCE}{POP}\right) + \underset{(2.410)}{0.634}\left(\frac{POP\ 18}{POP}\right)$$

R-squared = 0.940
D.W. = 2.030

ALC – alcoholic beverages
POP – total population
PCE – personal consumption expenditures
POP 18 – population age 18 and over

Variable 215 – FOO

$$FOO = 361.0 + 1965.0 * (1.02) ** ((YR) - 76)$$

FOO – food furnished government and commercial employees
YR – year

Variable 216 – FFD

$$FFD/FPOP = -2.151 + 1.070 * (FFD(-1)/FPOP(-1)) + 0.0003 * FDPI + 0.0003 * FDPI(-1)$$
$$(1.802)\quad (13.244)\qquad\qquad (3.191)\qquad\quad (3.191)$$

R-squared = 0.9141
D.W. = 2.2460

FFD – food produced and consumed on farms
FPOP – total farm population
FDPI – farm disposable personal income

Variable 217 – SHU

$$SHU = 200 + SHU(-1)$$

SHU – shoes and other footwear

Variable 218 – CLO

$$CLO/POP = 0.590 + 0.796\ (CLO(-1)/POP(-1)) + 0.074\ (PCE/POP - PCE(-1)/POP(-1)) + 0.013\ (PCE(-1)/POP(-1))$$
$$(0.113)\ (7.409)\qquad\qquad (26.234)\qquad\qquad (2.283)$$

$$- 6.489\ (D)$$
$$(3.272)$$

R-squared = 0.9901
D.W. = 2.302

CLO – clothing and luggage
POP – total population
PCE – personal consumption expenditures
D – dummy representing effects of Vietnam War on clothing:

1966 = 0.501
1967 = 1.000
1968 = 0.987
1969 = 0.889
1970 = 0.625
1971 = 0.136

Variable 219 – MIC

MIC – clothing issued to military
Projections – constant value over the projected period

Variable 220 – GAO

GAO – gasoline and oil
Projection process – exogenously determined

Variable 221 – FUL

FUL – fuel oil, coal, and farm wood
Projections process – exogenously determined

Variable 222 – TOB

TOB – tobacco
Projections process – growth rate over projections period equal to USDA growth rate

Variable 223 – ABD

$$\ln ABD = -2.868 - 1.058\,(\ln (DEFM/DFDPI)) + 0.783\,(\ln (PCE/HH)) + 0.458\,(\ln EAB)$$
$$(1.422) \quad (4.191) \qquad\qquad (4.699) \qquad\qquad (3.466)$$

R-squared = 0.901
D.W. = 0.730

ABD – expenditures abroad by U.S. Government personnel
DEFM – imports of goods and services deflator, 1972 = 100
DFDPI – disposable personal income deflator, 1972 = 100
PCE – personal consumption expenditures
HH – households
EAB – employees abroad

Variable 224 – REM

$$REM/POP = 0.788\,(REM(-1)/POP(-1)) - 0.005\,(PCE/POP) + 0.005\,(PCE(-1)/POP(-1)) - 0.094\,(PR-REM)$$
$$(10.447) \qquad\qquad (3.564) \qquad\qquad (3.564) \qquad\qquad (2.458)$$

R-squared = 0.5549

D.W. = 1.2239

REM – remittances in kind
POP – total population
PCE – personal consumption expenditures
PR–REM – relative price of REM

Variable 225 – SDH

$$SDH/POP = 0.156\,(SDH(-1)/POP(-1)) + 0.018\,(PCE/POP) - 0.009\,(PCE(-1)/POP(-1)) + 3.572\,(D)$$
$$(1.043) \qquad\qquad (8.482) \qquad\qquad (3.218) \qquad\qquad (0.575)$$

Cochrane/Orcutt RHO = 0.960
R-squared = 0.9859
D.W. = 1.7213

SDH – semidurable house furnishing
POP – total population
PCE – personal consumption expenditures
D – dummy variable, 1930-41 = 1

Variable 226 – DRG

$$DRG/POP = 31.787 - 1.375\,(YR) + 0.020\,(YR * YR)$$
$$(3.653) \quad (4.810) \qquad (8.639)$$

R-squared = 0.9930
D.W. = 0.7951

DRG – drug preparation and sundries
POP – total population
YR – year

Variable 227 – TLG

$$TLG/POP = 0.830\,(TLG(-1)/POP(-1)) + 0.003\,(PCE/POP) - 0.031\,(PR-TLG) + 1.845\,(D)$$
$$(15.552) \qquad\qquad (4.074) \qquad\qquad (3.937) \qquad\qquad (2.853)$$

R-squared = 0.9950
D.W. = 1.1247

TLG – toilet articles and preparations
POP – total population
PCE – personal consumption expenditures
PR–TLG – relative price of TLG
D – dummy variable, 1930-40 = 1

Variable 228 – STY ((YR)–76)

STY – stationery and writing supplies
YR – year

Variable 229 – TOY

TOY/POP = 0.731 (TOY(−1)/POP(−1)) + 0.008 (PCE/POP) − 0.004 (PCE(−1)/POP(−1)) − 0.029 (PR-TOY) − 0.008 (PR-TOY(−1))
(6.100) (5.024) (1.990) (0.894) (0.238)

Cochrane/Orcutt RHO = 0.30
R-squared = 0.9966
D.W. = 1.62

TOY – nondurable toys and sport supplies
POP – total population
PCE – personal consumption expenditures
PR-TOY – relative price of TOY

Variable 230 – FLO

FLO/POP = − 29.049 + 0.576 (YR)
(13.154) (18.394)

R-squared = 0.9713
D.W. = 2.263

FLO – flowers, seeds, and potted plants
POP – total population
YR – year

Variable 231 – CLP

CLP/POP = − 0.928 + 0.930 (CLP(−1)/POP(−1)) + 0.012 (PCE/POP) − 0.011 (PCE(−1)/POP(−1)) − 0.335 (D)
(0.244) (9.298) (4.489) (3.862) (0.390)

R-squared = 0.9945
D.W. = 1.76

CLP – cleaning, polishing, paper, miscellaneous
POP – total population
PCE – personal consumption expenditures
D – dummy variable, 1927-46 = 1

Variable 232 – MAG

MAG = 1.023 * (MAG(−1))

MAG – magazines and newspapers

Variable 233 – OWN

OWN/HH = 29.808 + 1.0 * (OWN(−1)/HH(−1))

OWN – owner-occupied nonfarm space rental value
HH – households

Variable 234 – TEN

TEN/HH = 11.734 + 1.00 * (TEN(−1)/HH(−1))

TEN – tenant occupied nonfarm space rent
HH – households

Variable 235 – FAR

FAR = FAR (−1) * (FPOP/FPOP(−1))

FAR – rental valued farm houses
FPOP – total farm population

Variable 236 – OHO

OHO/POP = − 6.899 − 0.089 (OHO(−1)/POP(−1)) + 0.004 (PCE/POP + PCE(−1)/POP(−1))
(4.423) (0.646) (7.700)

Cochrane/Orcutt RHO = 0.8
R-squared = 0.989
D.W. = 2.010

OHO – other housing
POP – total population
PCE – personal consumption expenditures

Variable 237 – ELC

ELC = (DELC/DELC(−1)) * ELC(−1)

ELC – electricity
DELC – exogenously determined level of usage

Variable 238 – NGS

NGS = (DNGS/DNGS(−1)) * NGS(−1)

NGS – natural gas
DNGS – exogenously determined level of usage

Variable 239 – WAT

WAT/POP = − 0.266 + 0.662 (WAT(−1)/POP(−1)) + 0.003 (PCE/POP) − 0.001 (PCE(−1)/POP(−1)) − 0.031 (PRICE)
(0.475) (5.216) (3.095) (1.146) (2.057)
+ 0.040 (PRICE(−1))
(2.695)

Cochrane/Orcutt RHO = 0.376
R-squared = 0.99
D.W. = 1.87

WAT – water and other sanitary services
POP – total population
PCE – personal consumption expenditures
PRICE – labor price/cost spread, private economy

Variable 240 – TEL

TEL/POP−TEL(−1)/POP(−1) = 0.005 (PCE/POP) − 0.003 (PCE(−1)/POP(−1)) − 0.031 (PRICE) + 0.009 (PRICE(−1)) + 1.67
(3.299) (2.075) (2.079) (0.592) (3.999)

R-squared = 0.8519
D.W. = 1.93

TEL – telephone and telegraph
PCE – personal consumption expenditures
POP – total population
PRICE – labor price/cost spread, private economy
D – prewar dummy = 1

Variable 241 – DMS

$$DMS/POP = 0.963 * (DMS(-1)/POP(-1)) + 0.019\ (PCE/POP) - 0.019\ (PCE(-1)/POP(-1))$$
$$(88.310) \qquad (3.078) \qquad (3.078)$$
$$- 0.144\ (PR-DMS) + 0.144\ ((PR-DMS)(-1))$$
$$(0.710) \qquad (0.710)$$

R-squared = 0.9489
D.W. = 1.8711

DMS – domestic service
POP – total population
PCE – personal consumption expenditures
PR–DMS – relative price of domestic services

Variable 242 – OPO

$$OPO = -1839.043 + 79.486(YR) + 9.229(POP)$$

OPO – other household operations
POP – total population
YR – year

Variable 243 – REP

$$REP/POP = -12.916 + 0.376\ (REP(-1)/POP(-1)) + 0.018\ (PCE/POP) - 0.003\ (PCE(-1)/POP(-1))$$
$$(4.334) \quad (4.979) \qquad (7.400) \qquad (1.833)$$
$$- 0.144\ (PRICE) + 0.181\ (PRICE(-1)) - 6.823\ (D)$$
$$(2.022) \qquad (2.791) \qquad (4.771)$$

R-squared = 0.9977
D.W. = 1.47

REP – auto repairs
POP – total population
PCE – personal consumption expenditures
PRICE – labor price/cost spread, private economy
D – prewar dummy = 1

Variable 244 – TOL

$$TOL = DGAO(-1) * TOL\ (-1)$$

TOL – road tolls
DGAO – exogenously determined gasoline extrapolator

Variable 245 – AIN

$$AIN/POP = -2.566 + 0.647\ (AIN(-1)/POP(-1)) + 0.006\ (PCE/POP - PCE(-1)/POP(-1)) + 0.002\ (PCE(-1)/POP(-1))$$
$$(1.893) \quad (5.295) \qquad (7.597) \qquad (2.801)$$

R-squared = 0.9732
D.W. = 1.7774

AIN – auto insurance premiums less claims paid
POP – total population
PCE – personal consumption expenditures

Variable 246 – STR

STR = 25 + STR(−1)

STR – street, electric railroad, and local bus

Variable 247 – TAX

TAX = 1.027**((YR)−73) * 842

TAX – taxicab
YR – year

Variable 248 – CRR

CRR/POP = 4.255 + 0.0005(PCE/POP) − 0.0001 (PCE(−1)/POP(−1)) − 0.064(YR)
(23.295) (3.698) (2.525) (7.645)

R-squared = 0.9596
D.W. = 0.9626

CRR – commuter rail transportation
POP – total population
PCE – personal consumption expenditures
YR – year

Variable 249 – IRR

IRR = 1.015 * IRR(−1)

IRR – railway excluding transportation

Variable 250 – IBU

IBU/POP = 0.946 (IBU(−1)/POP(−1)) + 0.001 (PCE/POP) − 0.0009 (PCE(−1)/POP(−1))
(41.895) (2.149) (1.817)

− 0.006 (PR−IBU) + 0.002 ((PR−IBU(−1))
(1.856) (0.683)

R-squared = 0.9822
D.W. = 1.7561

IBU – intercity bus
POP – population
PCE – personal consumption expenditures
PR−IBU – relative price of IBU

Variable 251 – IAI

IAI/POP = − 19.978 + 0.006 (PCE/POP) + 0.002 (PCE(−1)/POP(−1)) + 0.160 (YR)
(21.436) (9.338) (8.542) (3.484)

R-squared = 0.9914
D.W. = 1.0580

IAI – airlines
POP – total population

PCE – personal consumption expenditures
YR – year

Variable 252 – TRO

TRO = 167 + 4.333 ((YR) –73)

TRO – other purchases intercity transporation
YR – year

Variable 253 – SCL

SCL/POP = 2.619 + 0.586 (SCL(−1)/POP(−1)) + 0.0005 (PCE/POP) – 0.0008 (PCE(−1)/POP(−1))
(3.097)(6.669) (1.450) (2.413)

–0.019 (PR–SCL) + 0.008 ((PR–SCL)(−1))
(2.547) (1.018)

Cochrane/Orcutt RHO = 0.2825
R-squared = 0.9807
D.W. = 1.3247

SCL – shoe cleaning and repair
POP – population
PCE – personal consumption expenditures
PR–SCL – relative price of SCL

Variable 254 – LAU

LAU = .9726 * LAU(−1)

LAU – cleaning, dyeing, pressing, alteration, and laundering in establishments

Variable 255 – COT

COT = – 3016.80 + 58.2821 (YR)

COT – other clothing, accessories, and jewelry
YR – year

Variable 256 – BBB

BBB = BBB(−1) * POP/POP(−1)

BBB – barbershops, beauty parlors, and baths
POP – total population

Variable 257 – RTV

RTV = – 2.080 + 0.001 (PCE/POP – PCE(−1)/POP(−1)) + 0.0003 (PCE(−1)/POP(−1)) + 0.046 (YR) – 0.013 (D)
(4.049) (3.129) (0.973) (2.096) (4.274)

R-squared = 0.9846
D.W. = 0.9189

RTV – radio and television repair
PCE – personal consumption expenditures
POP – total population
D – dummy variable, 1947-50 = 1
YR – year

Variable 258 – MOV

$$MOV/POP = \underset{(35.729)}{0.929}\ (MOV(-1)/POP(-1)) + \underset{(4.378)}{0.016}\ (PCE/POP) - \underset{(4.372)}{0.016}\ (PCE(-1)/POP(-1)) - \underset{(1.247)}{0.132}\ (PRICE) + \underset{(1.271)}{0.124}\ (PRICE(-1))$$

R-squared = 0.978
D.W. = 2.370

MOV – motion picture admissions
PCE – personal consumption expenditures
POP – total population
PRICE – labor price/cost spread, private economy

Variable 259 – LEG

$$LEG = LEG(-1) * POP/POP(-1)$$

LEG – legitimate theaters, etc.
POP – total population

Variable 260 – SPE

$$SPE = \underset{(2.245)}{-1.078} + \underset{(4.886)}{0.538}\ (SPE(-1)/POP(-1)) + \underset{(3.333)}{0.001}\ (PCE/POP)$$

Cochrane/Orcutt RHO = 0.817
R-squared = 0.99
D.W. = 1.68

SPE – spectator sports
POP – total population
PCE – personal consumption expenditures

Variable 261 – CLU

CLU – clubs and fraternal organizations
Projections process – determined exogenously

Variable 262 – COM

$$COM = 2126.0 + 818.0\ (POP/POP(-1)) + 66.163 * ((YR) - 76)$$

COM – commercial participant amusements
POP – total population
YR – year

Variable 263 – PAR

$$PAR = PAR(-1) + 25$$

PAR = pari-mutuel net receipts

Variable 264 – REO

$$REO = -16652.848 + 347.281(YR) - 0.721(YR * YR)$$

REO – other recreation
YR – year

Variable 265 – BRO

BRO – brokerage fees and investment counseling
Projection process – exogenously determined

Variable 266 – BNK

$$BNK = -2.272 + 0.651\ (BNK(-1)/POP(-1)) + 0.003\ (PCE/POP) - 0.001\ (PCE(-1)/POP(-1))$$
$$(2.885)\quad (1676.778)\quad (5.052)\quad (0.010)$$

R-squared = 0.9879
D.W. = 1.62

BNK – bank service charges
POP – total population
PCE – personal consumption expenditures

Variable 267 – IMP

$$IMP = -8.422 + 0.584\ (IMP(-1)/POP(-1)) + 0.010\ (PCE/POP) + 4.464\ (D)$$
$$(5.199)\quad (7.781)\quad (6.438)\quad (4.555)$$

Cochrane/Orcutt RHO = 0.370
R-squared = 0.994
D.W. = 1.93

IMP – financial service charges furnished without pay
POP – total population
PCE – personal consumption expenditures
D – dummy = 1, if year is less than or equal to 1941

Variable 268 – LIF

$$LIF/POP = 5.046 + 0.360\ (LIF(-1)/POP(-1)) + 0.003\ (PCE/POP) + 0.003\ (PCE(-1)/POP(-1))$$
$$(2.951)\ (2.281)\quad (4.113)\quad (4.113)$$

R-squared = 0.950
D.W. = 1.98

LIF – expense of handling life insurance
POP – total population
PCE – personal consumption expenditure

Variable 269 – GAL

$$GAL - GAL(-1) = 1.158 - 162.272\ (DE) + 40.482\ (U) - 162.661\ (I) + 248.011\ (D)$$
$$(0.015)\ (4.208)\quad (2.906)\quad (4.388)\quad (2.869)$$

R-squared = 0.7903
D.W. = 3.01

GAL – legal services
DE – dummy, election years = 1
U – unemployment rate
I – intercept = 1, if year is less than or equal 1956
D – dummy = 1, in 1966, 0 in all other years

Variable 270 – FUN

$$FUN = FUN(-1) * DEATHS/DEATHS(-1)$$

FUN – funeral and burial expenses
DEATHS – number of deaths

Variable 271 – PBO

$$PBO/POP - PBO(-1)/POP(-1) = \underset{(4.617)}{0.003}\ (PCE/POP - PCE(-1)/POP(-1)) - \underset{(2.270)}{0.059}\ (PRICE - PRICE(-1)) + \underset{(2.553)}{0.296}\ (D)$$

R-squared = 0.4124
D.W. = 2.07

PBO – other personal business services
POP – population
PCE – personal consumption expenditures
PRICE – labor price/cost spread, private economy
D – dummy = 1, if year less than or equal to 1941; 0, if greater than 1941

Variable 272 – PHY

$$PHY/POP = \underset{(8.308)}{148.711} - \underset{(7.871)}{4.644}\ (YR) + \underset{(10.449)}{0.050}\ (YR * YR)$$

R-squared = 0.9853
D.W. = 1.14

PHY – physicians
YR – year

Variable 273 – DEN

$$Ln\ DEN = \underset{(15.025)}{6.626} + \underset{(0.399)}{0.006}\ (YR) + \underset{(2.583)}{0.0003}\ (YR * YR)$$

R-squared = 0.9884
D.W. = 0.9134

DEN – dentists
YR – year

Variable 274 – OPS

$$OPS = 1.03 * OPS(-1)$$

OPS – other professional services

Variable 275 – PHO

$$PHO = \underset{(2.538)}{-17.005} + \underset{(12.775)}{0.894}\ (PHO(-1)/POP(-1)) + \underset{(2.442)}{0.012}\ (PCE/POP) - \underset{(0.497)}{0.003}\ (PCE(-1)/POP(-1))$$

R-squared = 0.997
D.W. = 1.61

PHO – privately controlled hospitals and sanitariums
POP – total population
PCE – personal consumption expenditures

Variable 276 – HIN

$$HIN/POP = \underset{(8.823)}{0.686}\ (HIN(-1)/POP(-1)) + \underset{(4.191)}{0.007}\ (PCE/POP) - \underset{(2.214)}{0.003}\ (PCE(-1)/POP(-1)) - \underset{(5.489)}{0.060}\ (PRICE) + \underset{(1.560)}{0.025}\ (PRICE(-1))$$

Cochrane/Orcutt RHO = −0.213
R-squared = 0.9965
D.W. = 1.54

HIN – health insurance
POP – total population
PCE – personal consumption expenditures
PRICE – labor price/cost spread, private economy

Variable 277 – HED

HED = 1097.78 + 433.838 (HEW HED)
(28.366) (74.800)

R-squared = 0.9962
D.W. = 1.72

HED – higher education
HEW HED – HEW projection of private education costs – held at constant level 1984-1990

Variable 278 – EED

EED = 693.838 + 1687.85 (HEW EED)
(9.239) (26.497)

R-squared = 0.9709
D.W. = 0.8501

EED – elementary and secondary schools
HEW EED – Office of Education projections used as extrapolators

Variable 279 – OED

OED = OED(−1) * GNP/GNP(−1)

OED – other education and research
GNP – gross national product

Variable 280 – RAW

RAW = − 8706.871 + 258.134 (YR)
(282.6) (4.53)
R-squared = 0.9936
D.W. = 2.27

RAW – religious and welfare expenditures
YR – year

Variable 281 – FTR

$$FTR/POP = 0.8\ (FTR(-1)/POP(-1)) + 0.003\ (PCE/POP) - 0.030\ (PRICE)$$
$$\qquad\qquad (12.903) \qquad\qquad (3.971) \qquad\quad (3.893)$$

Cochrane/Orcutt RHO = 0.032
R-squared = 0.9817
D.W. = 1.85

FTR – foreign travel by U.S. residents
POP – total population
PCE – personal consumption expenditures
PRICE – labor price/cost spread, private economy

Variable 282 – EXP

$EXP = 1.065 * EXP(-1)$

EXP – expenditures in United States by foreigners

Appendix D. Investment-Output Ratios

Table D-1. Equipment

	Industry	1967	1973	Projected base case			Projected alternate case		
				1980	1985	1990	1980	1985	1990
1.00	Livestock and livestock products	0.0175	0.0167	0.0174	0.0166	0.0167	0.0172	0.0163	0.0165
2.00	Other agricultural products	.1559	.1235	.1539	.1449	.1481	.1520	.1424	.1466
3.00	Forestry and fishery products	.0379	.0377	.0575	.0521	.0531	.0568	.0512	.0526
4.00	Agricutural, forestry, and fishery services	.0951	.0762	.0879	.0839	.0847	.0868	.0824	.0839
5.00	Iron and ferroalloy ores mining	.0626	.0308	.0959	.0993	.1008	.0947	.0976	.0999
6.00	Nonferrous metal ores mining	.0918	.1823	.1456	.1483	.1489	.1438	.1457	.1475
7.00	Coal mining	.0608	.1447	.0958	.0953	.0973	.0947	.0936	.0963
8.00	Crude petroleum and natural gas	.0559	.0383	.0871	.0889	.0911	.0860	.0874	.0903
9.00	Stone and clay mining and quarrying	.0876	.2170	.1043	.1071	.1084	.1030	.1052	.1074
10.00	Chemical and fertilizer mineral mining	.1501	.3608	.1852	.1785	.1809	.1829	.1753	.1792
11.00	New construction	.0286	.0339	.0374	.0446	.0388	.0370	.0377	.0384
12.00	Maintenance and repair construction	.0357	.0510	.0482	.0533	.0508	.0476	.0490	.0503
13.00	Ordnance and accessories	.0157	.0160	.0120	.0146	.0142	.0119	.0134	.0141
14.00	Food and kindred products	.0161	.0149	.0173	.0187	.0170	.0171	.0165	.0168
15.00	Tobacco manufactures	.0081	.0167	.0080	.0082	.0080	.0079	.0077	.0080
16.00	Broad and narrow fabric, yarn, and thread mills	.0320	.0263	.0315	.0347	.0314	.0311	.0303	.0311
17.00	Miscellaneous textile goods and floor coverings	.0235	.0243	.0335	.0413	.0332	.0331	.0321	.0328
18.00	Apparel	.0127	.0166	.0153	.0180	.0152	.0152	.0147	.0150
19.00	Miscellaneous fabricated textile products	.0109	.0114	.0155	.0177	.0150	.0154	.0145	.0148
20.00	Lumber and wood products, except containers	.0292	.0414	.0383	.0466	.0372	.0379	.0366	.0369
21.00	Wooden containers	.0129	.0139	.0154	.0151	.0151	.0153	.0148	.0149
22.00	Household furniture	.0208	.0263	.0270	.0266	.0270	.0267	.0262	.0268
23.00	Other furniture and fixtures	.0197	.0168	.0185	.0198	.0200	.0182	.0195	.0198
24.00	Paper and allied products, except containers	.0625	.0403	.0600	.0587	.0594	.0593	.0576	.0588
25.00	Paperboard containers and boxes	.0339	.0232	.0399	.0390	.0393	.0394	.0383	.0389
26.00	Printing and publishing	.0314	.0288	.0311	.0304	.0309	.0307	.0299	.0306
27.00	Chemicals and selected chemical products	.0646	.0425	.0675	.0629	.0638	.0667	.0618	.0632
28.00	Plastics and synthetic materials	.0691	.0368	.0637	.0610	.0614	.0629	.0599	.0609
29.00	Drugs, cleaning and toilet preparations	.0224	.0191	.0268	.0252	.0256	.0265	.0248	.0254
30.00	Paints and allied products	.0197	.0175	.0290	.0222	.0225	.0287	.0218	.0223
31.00	Petroleum refining and related industries	.0153	.0126	.0176	.0149	.0182	.0174	.0146	.0180
32.00	Rubber and misc. plastics products	.0456	.0434	.0483	.0469	.0474	.0477	.0461	.0469
33.00	Leather tanning and industrial leather products	.0124	.0081	.0132	.0131	.0133	.0130	.0128	.0132
34.00	Footwear and other leather products	.0158	.0212	.0180	.0177	.0180	.0177	.0174	.0178
35.00	Glass and glass products	.0371	.0425	.0435	.0426	.0433	.0430	.0418	.0429
36.00	Stone and clay products	.0347	.0451	.0433	.0422	.0427	.0428	.0415	.0423
37.00	Primary iron and steel manufacturing	.0378	.0255	.0430	.0419	.0426	.0425	.0412	.0421
38.00	Primary nonferrous metal manufacturing	.0212	.0151	.0248	.0246	.0250	.0245	.0241	.0248
39.00	Metal containers	.0289	.0275	.0331	.0320	.0326	.0327	.0315	.0323
40.00	Heating, plumbing, and structural metal products	.0230	.0315	.0259	.0251	.0254	.0256	.0246	.0252
41.00	Stampings, screw machine products, and bolts	.0273	.0274	.0302	.0291	.0295	.0298	.0286	.0293
42.00	Other fabricated metal products	.0238	.0240	.0252	.0245	.0249	.0249	.0241	.0246
43.00	Engines and turbines	.0285	.0278	.0306	.0307	.0313	.0302	.0301	.0310
44.00	Farm machinery and equipment	.0213	.0187	.0251	.0222	.0225	.0248	.0218	.0223
45.00	Construction, mining, and oilfield mechinery	.0272	.0265	.0234	.0245	.0249	.0231	.0241	.0247
46.00	Material handling machinery and equipment	.0121	.0134	.0119	.0126	.0127	.0118	.0124	.0126
47.00	Metalworking machinery and equipment	.0328	.0271	.0334	.0351	.0355	.0330	.0344	.0352
48.00	Special industry machinery and equipment	.0241	.0268	.0227	.0247	.0251	.0225	.0242	.0248
49.00	General industrial machinery and equipment	.0278	.0305	.0311	.0314	.0319	.0307	.0308	.0316
50.00	Machine shop products	.0456	.0404	.0351	.0347	.0352	.0346	.0341	.0348
51.00	Office, computing, and accounting machines	.0385	.0444	.0544	.0570	.0578	.0538	.0560	.0573
52.00	Service industry machines	.0217	.0225	.0240	.0230	.0233	.0237	.0226	.0231
53.00	Electric industrial equipment and apparatus	.0295	.0240	.0286	.0299	.0303	.0283	.0294	.0300
54.00	Household appliances	.0185	.0183	.0224	.0224	.0226	.0221	.0220	.0224
55.00	Electric lighting and wiring equipment	.0323	.0325	.0366	.0363	.0368	.0362	.0357	.0365
56.00	Radio, TV, and communication equipment	.0265	.0277	.0252	.0272	.0277	.0249	.0267	.0274
57.00	Electronic components and adcessories	.0509	.0654	.0544	.0559	.0568	.0537	.0549	.0563
58.00	Miscellaneous electrical machinery, equipment, and supplies	.0264	.0328	.0295	.0278	.0282	.0292	.0273	.0280
59.00	Motor vehicles and equipment	.0127	.0234	.0204	.0181	.0184	.0202	.0178	.0182
60.00	Aircraft and parts	.0311	.0142	.0188	.0207	.0214	.0186	.0204	.0212
61.00	Other transportation equipment	.0192	.0217	.0235	.0243	.0245	.0233	.0239	.0243
62.00	Scientific and controlling instruments	.0262	.0317	.0288	.0272	.0277	.0285	.0267	.0275
63.00	Optical, ophthalmic, and photographic equipment	.0399	.0304	.0379	.0380	.0386	.0374	.0373	.0382
64.00	Miscellaneous manufacturing	.0238	.0250	.0259	.0255	.0259	.0256	.0251	.025[illegible]

Table D-1. Equipment—Continued

Industry		1967	1973	Projected base case			Projected alternate case		
				1980	1985	1990	1980	1985	1990
65.00	Transportation and warehousing	.1277	.1665	.1487	.1456	.1485	.1469	.1431	.1471
66.00	Communications, except radio and TV broadcasting	.2089	.2015	.1944	.1617	.1461	.1920	.1588	.1447
67.00	Radio and TV broadcasting	.1711	.1063	.1285	.1251	.1271	.1269	.1229	.1258
68.00	Electric, gas, water, and sanitary services	.0753	.1076	.0911	.0883	.0897	.0900	.0867	.0889
69.00	Wholesale and retail trade	.0363	.0423	.0450	.0435	.0441	.0444	.0427	.0437
70.00	Finance and insurance	.0214	.0479	.0251	.0242	.0247	.0248	.0238	.0245
71.00	Real estate and rental	.0119	.0101	.0129	.0123	.0126	.0127	.0121	.0124
72.00	Hotels, personal and repair services, except auto	.0563	.0488	.0734	.0710	.0721	.0725	.0698	.0714
73.00	Business services	.0235	.0328	.0265	.0256	.0260	.0262	.0252	.0258
75.00	Automobile repair and services	.0854	.1408	.1294	.1240	.1278	.1278	.1218	.1247
76.00	Amusements	.0434	.0824	.0747	.0741	.0770	.0738	.0728	.0762
77.00	Medical, educational services, and nonprofit organizations	.0556	.0454	.0625	.0601	.0611	.0618	.0590	.0605

Table D-2. Structures

	Industry	1967	1973	Projected base case			Projected alternate case		
				1980	1985	1990	1980	1985	1990
1	Agriculture	0.0255	0.0220	0.0185	0.0179	0.0193	0.0183	0.0177	0.0193
2	Mining, except crude petroleum and natural gas	.0537	.0841	.0544	.0503	.0554	.0537	.0498	.0556
3	Crude petroleum and natural gas	.2262	.1625	.2423	.2606	.2961	.2393	.2581	.2972
4	Construction	.0023	.0024	.0018	.0016	.0018	.0018	.0016	.0018
5	Manufacturing	.0116	.0062	.0075	.0070	.0076	.0074	.0070	.0076
6	Transportation and warehousing	.0217	.0173	.0237	.0211	.0200	.0234	.0209	.0201
7	Communications, except radio and TV broadcasting	.1159	.1144	.0695	.0572	.0492	.0686	.0566	.0494
8	Radio and TV broadcasting	.0297	.0109	.0132	.0120	.0130	.0130	.0119	.0130
9	Electric, gas, water, and sanitary services	.1614	.1642	.1401	.1341	.1477	.1384	.1328	.1483
10	Wholesale and retail trade	.0228	.0233	.0142	.0131	.0141	.0141	.0130	.0141
11	Finance and insurance	.0233	.0386	.0197	.0180	.0195	.0195	.0179	.0195
12	Real estate and rental	.0037	.0044	.0024	.0022	.0025	.0024	.0022	.0025
13	Hotels, personal and repair services, except auto	.0410	.0466	.0365	.0335	.0361	.0360	.0332	.0362
14	Business services	.0083	.0087	.0061	.0057	.0062	.0060	.0057	.0062
15	Automobile repair and services	.0106	.0258	.0156	.0141	.0152	.0154	.0140	.0153
16	Amusements	.0382	.0561	.0355	.0333	.0367	.0350	.0330	.0368
17	Medical, educational services, and nonprofit organizations	.0985	.0621	.0518	.0474	.0425	.0511	.0469	.0426

Appendix E. Federal Government Equations

Regression equations derived the levels of defense purchases and defense compensation using variables supplied from the macro model. Only total civilian compensation and total Federal purchases were available and these had to be allocated to the defense and nondefense sectors. Regression equations were used for estimating defense and nondefense new construction. Equations used in the Federal Government sector are given below:

1) Defense civilian compensation = 122.3 + .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 employment
+0.0232 nondefense other purchases −69.01 time

4) Nondefense nonresidential construction = − 1731 + 3.30013 nondefense employment
−0.013 nondefense other purchases − 35.981 time
R-squared = 0.4515

5) Nondefense highway construction = −116.344 +0.261 nondefense employment
−0.0032 nondefense other purchases+8.298
R-squared = 0.9462

6) Nondefense industrial construction = −1977.4 +4.284 nondefense 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 F. Labor Demand Coefficients

Table F-1. Method 1: Dependent variable: Hours of all persons, private nonfarm nonmanufacutring industries

	Industry number and title	Constant term	Coefficients of the variable		Lagged dependent variable
			Time trend	Domestic output	
6	Forestry and fishery products	1.66728	−0.04169	−0.19806	0.86170
7	Agricultural, forestry, and fishery services	1.26249	−0.06031	−0.17978	0.92448
8	Iron and ferroalloy ores mining	3.76873	0.27069	−0.86319	0.04183
9	Copper ore mining	1.99556	0.82155	−0.55863	0.34729
10	Other nonferrous ore mining	3.12880	−0.05869	−0.33215	0.40968
11	Coal mining	1.82517	0.90875	−0.94831	0.32907
12	Crude petroleum and natural gas	0.57593	0.70426	−0.77543	0.12543
13	Stone and clay mining and quarrying	0.06670	0.65827	−0.65105	0.23609
14	Chemical and fertilizer mineral mining	0.84549	0.17465	−0.32710	0.58558
117	Railroad transportation	0.67996	0.49226	−0.59900	0.37882
118	Local transit, intercity buses	1.75689	0.02361	0.08416	0.61683
119	Truck transportation	2.04485	0.92657	−0.95509	0.25680
120	Water transportation	0.56897	0.91199	−0.90250	0.05849
121	Air transportation	1.48245	1.11758	−1.08225	0.01352
122	Pipeline transportation	0.86493	0.79343	−0.77801	0.27593
123	Transportation services	1.02944	1.00750	−1.04438	0.07438
124	Communication, except radio and TV	1.43850	0.79116	−0.79252	0.33270
125	Radio and TV broadcasting	0.11468	0.67350	−0.75056	0.30138
126	Electric utilities	0.88425	0.06798	−0.09019	0.79935
127	Gas utilities	1.67482	0.28658	−0.30682	1.00082
128	Water and sanitary services	0.21148	0.04376	0.03115	0.94567
129	Wholesale trade	2.45549	0.47074	−0.40663	0.74858
130	Retail trade	2.71504	0.67637	−0.48259	0.53212
131	Banking	0.22739	0.05878	−0.07613	0.98289
132	Credit agencies and financial brokers	0.73410	0.29629	−1.06830	0.86991
133	Insurance	0.18231	−0.02068	−0.00559	1.06115
135	Real estate	0.65615	−0.00144	0.08227	1.04864
136	Hotels and lodging places	0.19363	0.06410	0.05435	0.93550
137	Personal and repair services	1.03371	0.22171	−0.47138	0.95412
138	Barber and beauty shops	1 03352	0.20537	−0.27040	0.96329
139	Miscellaneous business services	0.53478	0.57546	−0.32390	0.38006
140	Advertising	0.17199	0.24056	0.23775	0.33051
141	Miscellaneous professional services	1.15164	0.20761	−0.06701	0.89609
142	Automobile repair	3.49633	0.71278	−0.61165	0.65790
143	Motion pictures	0.94311	0.08167	−0.22776	0.78664
144	Amusements and recreation services	0.45094	−0.11538	0.17122	1.04338
145	Doctors' and dentists' services	1.38954	0.27917	−0.28111	0.88247
146	Hospitals	0.36487	−0.01783	−0.23689	1.04428
147	Other medical services	1.46906	0.92358	−1.66358	0.46844
148	Educational services	0.37765	0.16854	−0.39581	0.92346
149	Nonprofit organizations	1.12806	0.45448	0.02030	0.25518

Table F-2. Method 1: Dependent variable: Hours of production workers in manufacturing industries

	Industry number and title	Constant term	Coefficients of the variable		Ratio, production to total workers	Lagged dependent variable
			Time trend	Domestic output		
22	Ordnance	3.34047	0.46191	−1.38233	0.99814	−0.93574
23	Complete guided missiles	1.98924	0.03972	−0.34853	1.20231	−0.48012
24	Meat products	0.84908	0.06648	0.00069	0.85344	0.23368
25	Dairy products	2.79522	0.00768	−0.32457	0.73477	−0.10724
26	Canned and frozen foods	0.50611	0.31091	−0.51187	0.75350	0.17104
27	Grain mill products	0.36362	0.07285	0.01046	0.58137	0.23062
28	Bakery products	4.63471	0.13696	0.13786	1.16482	0.43283
29	Sugar	3.28421	0.16701	−0.32297	0.07007	−0.19996
30	Confectionery products	1.08827	0.44775	−0.46460	0.79262	−0.04775
31	Alcoholic beverages	0.91081	0.31178	−0.56632	0.82605	−0.34291
32	Soft drinks and flavorings	0.04123	0.08786	−0.29210	0.33946	0.64189
33	Miscellaneous food products	3.21752	0.17813	0.10369	0.35983	−0.59452
34	Tobacco manufacturing	0.93590	0.95714	−0.96346	0.13297	−0.09595
35	Fabric, yarn, and thread mills	4.67521	1.01531	−1.16893	0.57904	0.17351
36	Floor coverings	6.35328	0.26887	−0.53729	−0.11117	−0.17455
37	Miscellaneous textile goods	1.74437	0.26617	−0.40387	0.41430	−0.03696
38	Hosiery and knit goods	1.97941	0.44558	−0.88149	0.54145	−0.25410
39	Apparel	0.88977	0.63116	−0.55069	0.23052	0.21993
40	Miscellaneous fabricated textile products	3.05061	0.04388	0.22757	0.72881	−0.77611
41	Logging	3.40725	−0.05783	−0.15847	0.46028	−0.05473
42	Sawmills and planing mills	0.76814	0.63222	−0.53390	0.35220	0.02939
43	Millwork, plywood, and other wood products	0.76618	0.73111	−0.57142	0.32798	−0.16661
44	Wooden containers	0.89940	0.25713	−0.07360	0.89524	−0.17350
45	Household furniture	1.01799	0.88214	−0.71008	0.04917	0.06656
46	Other furniture and fixtures	0.16825	0.53069	−0.72043	−0.04842	0.59186
47	Paper products	0.68156	0.69498	−0.68833	0.43238	−0.19076
48	Paperboard	2.26398	0.89203	−0.67849	0.74939	−0.65971
49	Newspaper printing and publishing	0.99372	0.39556	−0.19381	0.41646	−0.19332
50	Periodicals and book printing, publishing	1.31010	0.62779	−0.63340	0.72745	−0.33169
51	Miscellaneous printing and publishing	1.26868	0.65644	−0.71669	0.63526	−0.20323
52	Industrial inorganic and organic chemicals	0.53977	0.35504	−0.34546	0.87791	−0.26553
53	Agricultural chemicals	0.01125	0.57776	−0.47781	0.34950	−0.31258
54	Miscellaneous chemical products	5.73061	1.51378	−1.26428	0.31421	−0.15057
55	Plastic materials and synthetic rubber	0.17342	0.10329	−0.08688	1.07943	−0.31028
56	Synthetic fibers	0.09259	0.51237	−0.34320	0.26955	−0.04113
57	Drugs	0.14611	0.43333	−0.16804	0.72479	−0.47240
58	Cleaning and toilet preparations	0.47646	0.44111	−0.19600	0.62870	−0.35350
59	Paints and allied products	2.29370	0.08245	−0.03643	−0.13104	0.37738
60	Petroleum refining and related products	2.08164	1.07227	−1.11579	0.21120	−0.09513
61	Tires and inner tubes	1.99385	0.78161	−0.87437	0.54370	−0.09516
62	Miscellaneous rubber products	0.92279	0.45493	−0.06231	0.06660	0.00082
63	Plastic products	0.15485	0.94626	−1.06772	0.01573	−0.04758
64	Leather tanning and industrial leather	3.80174	0.52768	0.01187	1.15488	−0.39364
65	Footwear and other leather products	0.65681	0.80120	−1.02153	0.16310	−0.14812
66	Glass	1.97056	0.19584	0.52355	0.47914	−0.59219
67	Cement and concrete products	0.83451	0.37452	−0.56223	0.94779	−0.38455
68	Structural clay products	3.58501	0.60246	0.09975	0.97627	−0.41888
69	Pottery and related products	0.24739	0.52026	−0.17320	0.30992	−0.02194
70	Miscellaneous stone and clay products	1.57287	0.08229	0.49044	0.38794	−0.13155
71	Blast furnaces and basic steel products	1.08317	0.73485	−0.83806	0.02518	−0.01521
72	Iron and steel foundries and forgings	0.21982	0.69173	−0.62206	0.23235	−0.08844
73	Primary copper and copper products	1.17740	0.35132	−0.14212	0.03718	0.17084
74	Primary aluminum and aluminum products	0.36758	0.53398	−0.52089	0.59270	−0.48855
75	Other primary nonferrous products	1.17157	0.89559	−0.76794	0.24581	−0.34240
76	Metal containers	0.17284	0.57916	−0.61620	0.23957	−0.05107
77	Heating apparatus and plumbing fixtures	0.84084	0.54397	−0.80325	−0.04164	0.46234
78	Fabricated structural metal	0.39734	0.60220	−0.52581	−0.03884	0.44156
79	Screw machine products	1.79000	0.56803	0.10633	0.32617	−0.05720
80	Metal stampings	2.02211	0.88588	−1.04510	0.07064	0.48022
81	Cutlery, handtools, and general hardware	0.09964	0.77332	−0.69964	0.42092	−0.48836
82	Other fabricated metal products	1.01470	0.80336	−0.79606	0.47016	−0.33337
83	Engines, turbines, and generators	0.53118	0.81470	−0.98046	0.33118	−0.56295
84	Farm machinery	0.64113	0.72549	−0.75205	0.51905	−0.36935
85	Construction, mining, and oilfield machinery	1.97768	0.68177	−0.18261	0.10545	0.20252
86	Material handling equipment	1.17571	0.87014	−0.57070	−0.09504	0.03082
87	Metalworking machines	0.79179	0.72610	−0.39749	0.15580	−0.02034
88	Special industry machinery	0.20368	0.66861	−0.57509	0.14744	0.01247
89	General industrial machinery	0.05593	0.51518	−0.16007	0.37910	−0.20885
90	Machine shop products	0.13897	0.48322	0.20625	0.62798	−0.67113
91	Computers and peripheral equipment	3.54725	0.30229	1.28235	1.15690	−0.72881
92	Typewriters and other office equipment	2.59802	0.93516	−1.45102	−0.21674	−0.46056
93	Service industry machines	0.33155	0.51313	−0.24163	0.30017	−0.24573
94	Electric transmission equipment	0.19911	0.48955	−0.23741	0.77861	−0.63939
95	Electrical industrial apparatus	0.21117	0.52802	−0.22475	0.31067	−0.18439
96	Household appliances	0.92769	0.55124	−0.43308	0.56051	−0.66879
97	Electric lighting and wiring	1.39955	0.56471	−0.06807	0.42102	−0.09112

Table F-2. Method 1: Dependent variable: Hours of Production workers in manufacturing industries—Continued

Industry number and title		Constant term	Coefficients of the variable		Ratio, production to total workers	Lagged dependent variable
			Time trend	Domestic output		
98	Radio and TV receiving sets	1.83115	0.76008	−1.20983	0.37423	−0.59633
99	Telephone and telegraph apparatus	0.14729	0.87234	−1.13683	−0.03555	0.16469
100	Radio and communication equipment	0.17712	0.73250	−0.62012	0.58395	−0.56907
101	Electronic components	0.37426	0.44564	0.36566	0.57323	−0.62446
102	Miscellaneous electrical products	1.73081	0.94133	−1.17030	0.12062	0.27324
103	Motor vehicles	1.00188	0.91414	−1.00669	−0.04575	0.23560
104	Aircraft	2.79180	0.68212	−0.25235	0.74679	−0.33107
105	Ship and boat building and repair	0.62047	0.39394	−0.10051	0.63000	−0.14891
106	Railroad equipment	0.86198	0.57244	−0.05045	−0.00456	0.03229
107	Motorcycles, bicycles, and parts	0.26469	0.22749	0.13472	0.36498	0.04047
108	Other transportation equipment	1.96251	1.10363	−0.96932	−0.23507	0.36596
109	Scientific and controlling instruments	1.45289	0.54513	−0.10050	0.88892	−0.53796
110	Medical and dental instruments	0.35773	0.39936	0.01234	0.63131	−0.59567
111	Optical and ophthalmic equipment	1.78955	0.53105	−0.67113	0.18102	−0.24544
112	Photographic equipment and supplies	0.84255	0.41935	−0.49324	−0.00026	0.23878
113	Watches, clocks, and clock-operated devices	2.51737	0.84318	−0.32529	0.47459	−0.42859
114	Jewelry and silverware	0.43990	0.77583	−0.86115	0.29832	−0.09718
115	Musical instruments and sporting goods	0.59308	0.06648	0.00069	0.85344	0.23368
116	Other miscellaneous manufactured products	2.51322	0.00768	−0.32457	0.73477	−0.10724

Table F-3. Method 1: Dependent variable: Hours of nonproduction workers in manufacturing industries

Industry number and title	Constant term	Coefficients of the variable: Time trend	Coefficients of the variable: Domestic output	Ratio, production to total workers	Lagged dependent variable
22. Ordnance	1.57409	0.33707	−1.02452	0.08140	0.46065
23 Complete guided missilles	2.61203	−0.00436	−0.30238	0.31915	0.34110
24 Meat products	4.75400	0.06088	0.07847	−0.62279	0.47576
25 Dairy products	1.55121	0.28138	−0.31839	0.00206	0.97147
26 Canned and frozen foods	1.73203	0.07615	0.34896	0.51308	0.23021
27 Grain mill products	1.63242	−0.06407	0.08674	0.01221	0.62695
28 Bakery products	0.94450	0.13461	−0.20714	0.18663	0.49077
29 Sugar	7.95262	−1.09582	1.27247	−0.51985	0.11427
30 Confectionery products	1.65634	−0.36902	0.09735	0.62845	0.40235
31 Alcoholic beverages	0.42289	0.18831	−0.07419	0.38157	0.22574
32 Soft drinks and flavorings	0.37700	−0.02566	−0.00200	0.08921	0.89092
33 Miscellaneous food products	0.70144	0.13133	−0.07278	−0.13918	0.73140
34 Tobacco manufacturing	2.04220	−0.18970	0.02668	−0.02176	0.87866
35 Fabric, yarn, and thread mills	7.73328	1.02312	−0.57947	0.12621	0.69378
36 Floor coverings	0.17623	0.31340	−0.31303	0.21076	0.21891
37 Miscellaneous textile goods	3.33705	0.22117	0.06223	0.90960	0.05137
38 Hosiery and knit goods	0.25913	0.24053	−0.47180	−0.00189	0.80885
39 Apparel	1.93023	0.51671	−0.27234	−0.32325	0.91938
40 Miscellaneous fabricated textile products	2.13808	−0.17743	0.50616	0.12696	0.30170
41 Logging	6.78247	2.27705	−1.93618	−1.39084	0.36555
42 Sawmills and planning mills	2.70002	0.23551	0.05011	0.32022	0.59878
43 Millwork, plywood, and other wood products	1.11427	0.35434	−0.15139	−0.13540	0.75339
44 Wooden containers	6.21264	0.30731	0.85833	0.91247	0.38403
45 Household furniture	1.84827	0.48466	−0.19747	0.02878	0.45805
46 Other furniture and fixtures	0.42355	0.36079	−0.29245	−0.06555	0.56032
47 Paper products	2.73531	0.73551	−0.84972	−0.12367	0.70137
48 Paperboard	0.62911	0.20985	−0.13116	0.17173	0.53577
49 Newspaper printing and publishing	0.42480	0.08168	0.14506	−0.04795	0.76113
50 Periodicals and book printing, publishing	1.97514	0.43443	−0.26193	0.26130	0.47470
51 Miscellaneous printing and publishing	2.89882	0.84590	−1.22440	−0.17209	0.79524
52 Industrial inorganic and organic chemicals	6.97792	0.73561	−0.62561	1.27232	−0.00385
53 Agricultural chemicals	2.95924	0.19141	0.36009	0.86652	0.11249
54 Miscellaneous chemical products	2.05172	0.61600	−0.59180	−0.30927	0.96272
55 Plastic materials and synthetic rubber	2.87543	0.29512	−0.57223	1.46522	−0.12862
56 Synthetic fibers	1.50747	0.43395	−0.98427	0.86289	0.16254
57 Drugs	1.48813	0.71401	−0.54963	0.12921	0.11352
58 Cleaning and toilet preparations	0.98336	0.09993	−0.15154	0.40874	0.70298
59 Paints and allied products	0.11333	0.26716	−0.22190	−0.45124	1.07186
60 Petroleum refining and related products	0.17122	0.63061	−0.61427	−0.20145	0.36171
61 Tires and inner tubes	0.32037	0.29401	−0.30731	−0.21508	0.87702
62 Miscellaneous rubber products	0.57009	0.20936	−0.13733	0.16424	0.54838
63 Plastic products	0.16814	0.44955	−0.73455	−0.01822	0.55863
64 Leather tanning and industrial leather	4.84264	0.46300	0.10635	0.73939	0.06987
65 Footwear and other leather products	2.62655	0.37333	−0.21954	0.05323	0.91607
66 Glass	1.17245	−0.24839	0.74758	0.15046	0.54945
67 Cement and concrete products	6.89182	0.72307	−0.59168	0.52819	0.91495
68 Structural clay products	0.05808	−0.17121	0.33643	0.48160	0.29655
69 Pottery and related products	0.11126	0.18375	−0.03079	0.00427	0.63535
70 Miscellaneous stone and clay products	0.28975	−0.19962	0.32017	0.52218	0.58492
71 Blast furnance and basic steel products	1.94192	0.53489	−0.58062	−0.21307	0.89822
72 Iron and steel foundries and forgings	1.44436	0.17665	−0.12052	−0.31551	0.61471
73 Primary copper and copper products	1.55489	0.18819	−0.19790	0.26322	0.75725
74 Primary aluminum and aluminum products	0.45729	0.26753	−0.44824	0.29937	0.42646
75 Other primary nonferrous products	2.64250	0.77640	−0.80618	0.21003	0.20403
76 Metal containers	0.21052	0.72161	−1.17869	−0.61149	0.82311
77 Heating apparatus and plumbing fixtures	0.01437	0.16311	−0.25345	0.07862	0.70037
78 Fabricated structural metal	0.36792	0.11296	0.09043	−0.05934	0.88062
79 Screw machine products	1.12137	0.26327	−0.15314	0.09356	0.67986
80 Metal stampings	1.65397	0.41097	−0.47525	0.14596	0.60546
81 Cutlery, handtools, and general hardware	1.24741	0.30641	0.01916	0.48174	−0.05136
82 Other fabricated metal products	1.11073	0.34349	−0.33349	0.14505	0.53959
83 Engines, turbines, and generators	0.23865	0.01553	0.13472	0.27843	0.61046
84 Farm machinery	0.19495	0.21871	−0.10779	0.27580	0.28075
85 Construction, mining, and oilfield machinery	1.75013	0.34060	−0.17745	−0.03801	0.86059
86 Material handling equipment	0.87592	0.32160	−0.14954	0.02930	0.60332
87 Metalworking machines	0.75726	0.33927	−0.06366	0.03220	0.47474
88 Special industry machinery	1.23686	0.37037	−0.16887	−0.03350	0.66749
89 General industrial machinery	1.31414	0.40272	−0.38517	0.11813	0.57599
90 Machine shop products	0.25675	0.30743	−0.03306	0.17012	0.19642
91 Computers and peripheral equipment	1.67174	0.41506	−0.28277	0.16812	0.58438
92 Typewriters and other office equipment	1.06880	0.58926	−0.49885	−0.09002	0.43867
93 Service industry machines	0.02620	0.15068	−0.01447	−0.05039	0.74034
94 Electric transmission equipment	0.11652	0.27961	−030753	0.47734	0.02880
95 Electrical industrial apparatus	0.45197	0.20659	−0.26396	0.26978	0.51596
96 Household appliances	1.74685	0.07245	0.01195	0.16945	0.11443
97 Electric lighting and wiring	1.01797	0.17101	0.01789	0.34021	0.42540

Table F-3. Method 1: Dependent variable: Hours of nonproduction workers in manufacturing industries—Continued

Industry number and title	Constant term	Coefficients of the variable		Ratio, production to total workers	Lagged dependent variable
		Time trend	Domestic output		
98 Radio and TV receiving sets	0.10851	0.56067	−1.23280	−0.05982	0.69063
99 Telephone and telegraph apparatus	1.31511	0.78591	−1.46448	0.03798	0.60962
100 Radio and communication equipment	0.79589	0.61786	−0.51458	0.16576	0.14624
101 Electronic components	0.60691	0.49473	−0.70496	−0.04033	0.64669
102 Miscellaneous electrical products	0.73929	0.26986	−0.38494	0.34898	0.37066
103 Motor vehicles	0.82022	0.41936	−0.40212	0.11886	0.40075
104 Aircraft	1.48118	0.44855	−0.15166	0.08905	0.44618
105 Ship and boat building and repair	2.85033	0.34851	−0.05381	0.35068	0.53972
106 Railroad equipment	0.46036	0.11227	−0.01517	0.01571	0.44375
107 Motorcycles, bicycles, and parts	1.49977	0.58415	0.10303	−0.92210	0.80664
108 Other transportation equipment	2.50493	0.77365	−0.81943	−0.49633	1.20188
109 Scientific and controlling instruments	1.56076	0.38979	−0.31106	0.51462	0.24141
110 Medical and dental instruments	0.41770	0.23338	−0.12943	0.16815	0.48129
111 Optical and ophthalmic equipment	1.14907	0.18779	−0.36671	0.36671	0.01079
112 Photographic equipment and supplies	0.92626	0.24721	−0.13242	0.11160	0.68678
113 Watches, clocks, and clock-operated devices	1.55294	0.31386	0.15938	−0.03479	0.44266
114 Jewelry and silverware	3.38537	0.50920	−0.60753	0.30672	0.88798
115 Musical instruments and sporting goods	4.07200	0.06088	0.07847	−0.62279	0.47576
116 Other miscellaneous manufactured products	1.52721	0.28138	−0.31829	0.00206	0.97147

Table F-4. Method 3: Least-squares growth rates for all industries, 1958-76

	Industry	Output	Variables		Ratio of production worker hours to wage and salary hours
			Output per hour all persons	Average weekly hours	
1	Dairy and poultry products	0.35	7.21	−9.18	0.0
2	Meat animals and livestock	2.35	5.45	0.18	0.0
3	Cotton	−1.02	7.56	−0.18	0.0
4	Food and feed grains	3.38	5.95	−0.18	0.0
5	Other agricultural products	3.06	5.40	−0.17	0.0
6	Forestry and fishery products	−0.97	−2.63	−0.15	0.0
7	Agricultural, forestry, and fishery services	3.01	−0.42	−0.15	0.0
8	Iron and ferroalloy ores mining	3.13	3.49	0.67	0.0
9	Copper ore mining	2.61	0.33	−0.19	0.0
10	Other nonferrous ore mining	−0.09	0.81	−0.07	0.0
11	Coal mining	2.63	2.09	0.68	0.0
12	Crude petroleum and natural gas	2.23	3.42	−0.00	0.0
13	Stone and clay mining and quarrying	2.72	2.92	0.04	0.0
14	Chemical and fertilizer mineral mining	4.71	4.76	0.07	0.0
15	New residential building construction	1.37	0.98	0.01	0.0
16	New nonresidential building construction	2.02	−0.85	0.01	0.0
17	New public utility construction	4.23	0.42	0.01	0.0
18	New highway construction	−0.84	0.07	0.01	0.0
19	All other new construction	0.12	0.79	0.01	0.0
20	Oil and gas well drilling and exploration	−0.70	−2.00	0.27	0.0
21	Maintenance and repair construction	1.56	−0.18	0.01	0.0
22	Ordnance	3.54	3.18	0.09	1.02
23	Complete guided missiles	−2.57	−0.21	−0.02	−2.09
24	Meat products	2.56	2.09	−0.08	0.12
25	Dairy products	1.29	4.44	−0.10	−0.39
26	Canned and frozen foods	3.72	2.35	0.03	−0.15
27	Grain mill products	3.64	3.30	−0.06	0.01
28	Bakery products	0.96	2.40	−0.08	−0.13
29	Sugar	2.77	3.22	−0.36	−0.58
30	Confectionery products	3.57	3.73	−0.03	−0.14
31	Alcoholic beverages	4.86	5.75	0.19	−0.48
32	Soft drinks and flavorings	5.63	4.16	−0.16	−0.43
33	Miscellaneous food products	2.25	2.22	−0.10	−0.45
34	Tobacco manufacturing	1.10	2.54	−0.13	−0.49
35	Fabric, yarn, and thread mills	2.95	3.11	0.02	−0.17
36	Floor coverings	10.29	6.05	0.05	−0.36
37	Miscellaneous textile goods	3.71	3.57	0.13	−0.15
38	Hosiery and knit goods	7.73	6.17	0.04	−0.33
39	Apparel	3.30	2.91	−0.05	−0.26
40	Miscellaneous fabricated textile products	5.48	3.97	−0.01	0.05
41	Logging	3.72	4.78	0.36	−0.94
42	Sawmills and planing mills	0.77	2.57	0.16	−0.12
43	Millwork, plywood, and other wood products	5.43	3.02	−0.05	−0.27
44	Wooden containers	−1.15	2.48	−0.20	−0.21
45	Household furniture	2.89	1.21	−0.20	−0.14
46	Other furniture and fixtures	5.06	3.28	−0.10	−0.10
47	Paper products	4.49	3.59	−0.02	−0.37
48	Paperboard	4.42	3.07	−0.09	−0.17
49	Newspaper printing and publishing	2.81	1.80	−0.12	−1.08
50	Periodicals and book printing, publishing	4.38	3.08	−0.13	−1.15
51	Miscellaneous printing and publishing	4.62	3.17	−0.05	−0.31
52	Industrial inorganic and organic chemicals	6.49	5.38	0.05	−0.60
53	Agricultural chemicals	5.32	4.40	−0.01	−0.87
54	Miscellaneous chemical products	2.95	2.10	−0.04	−0.74
55	Plastic materials and synthetic rubber	10.13	8.34	0.05	−0.19
56	Synthetic fibers	9.81	6.35	−0.03	−0.05
57	Drugs	8.53	5.31	0.03	−0.76
58	Cleaning and toilet preparations	6.20	3.91	0.00	−0.40
59	Paints and allied products	3.56	2.87	−0.03	−0.42
60	Petroleum refining and related products	4.73	5.01	0.11	−0.10
61	Tires and inner tubes	4.72	3.29	0.34	−0.11
62	Miscellaneous rubber products	3.66	2.80	−0.05	−0.02
63	Plastic products	12.26	4.40	−0.11	0.02
64	Leather tanning and industrial leather	−0.31	2.80	−0.04	−0.12
65	Footwear and other leather products	−0.09	1.57	0.03	−0.27
66	Glass	4.55	2.86	0.15	−0.13
67	Cement and concrete products	3.21	2.18	0.05	−0.14
68	Structural clay products	1.22	3.50	−0.01	−0.42
69	Pottery and related products	2.59	2.53	0.14	−0.08
70	Miscellaneous stone and clay products	2.85	1.87	0.04	0.09
71	Blast furnaces and basic steel products	1.84	2.00	0.23	−0.11
72	Iron and steel foundries and forgings	3.83	2.28	0.24	−0.10
73	Primary copper and copper products	2.76	1.84	0.04	−0.18
74	Primary aluminum and aluminum products	6.00	3.87	0.05	−0.09
75	Other primary nonferrous products	2.47	1.82	0.03	0.06

Table F-4. Method 3: Least-squares growth rates for all industries, 1958-76—Continued

	Industry	Output	Variables		Ratio of production worker hours to wage and salary hours
			Output per hour all persons	Average weekly hours	
76	Metal containers	4.03	2.89	0.18	0.03
77	Heating apparatus and plumbing fixtures	2.55	2.85	0.04	−0.10
78	Fabricated structural metal	3.41	1.15	−0.01	−0.08
79	Screw machine products	1.06	−0.08	0.06	−0.02
80	Metal stampings	4.07	2.52	−0.05	0.02
81	Cutlery, handtools, and general handward	3.72	2.15	0.00	−0.11
82	Other fabricated metal products	4.58	2.43	−0.02	−0.15
83	Engines, turbines, and generators	6.40	4.04	0.10	0.09
84	Farm machinery	4.40	2.63	0.07	−0.03
85	Construction, mining, and oilfield machinery	4.77	1.38	0.15	0.12
86	Material handling equipment	4.96	2.10	−0.00	−0.19
87	Metalworking machines	2.84	1.17	0.01	−0.13
88	Special industry machinery	3.06	2.21	−0.03	−0.52
89	General industrial machinery	4.00	1.94	0.08	−0.17
90	Machine shop products	5.32	2.44	0.06	0.11
91	Computers and peripheral equipment	9.91	4.31	0.00	−1.99
92	Typewriters and other office equipment	3.87	0.97	−0.16	−2.83
93	Service industry machines	7.80	3.85	−0.06	0.05
94	Electric transmission equipment	4.47	2.59	−0.01	0.17
95	Electrical industrial apparatus	3.80	2.18	0.01	0.18
96	Household appliances	5.30	4.19	−0.02	0.12
97	Electric lighting and wiring	3.66	0.70	−0.05	−0.10
98	Radio and TV receiving sets	8.44	6.78	−0.10	−0.20
99	Telephone and telegraph apparatus	7.37	4.57	−0.07	−0.02
100	Radio and communication equipment	4.25	3.37	−0.02	−0.92
101	Electronic components	8.49	4.47	−0.04	−0.95
102	Miscellaneous electrical products	5.66	3.64	0.11	0.20
103	Motor vehicles	4.43	2.56	0.09	0.08
104	Aircraft	0.07	1.79	−0.02	−0.71
105	Ship and boat building and repair	4.53	2.38	−0.08	−0.38
106	Railroad equipment	4.64	3.19	0.02	0.40
107	Motorcycles, bicycles, and parts	12.09	9.36	−0.16	0.16
108	Other transportation equipment	13.11	0.88	−0.32	−0.15
109	Scientific and controlling instruments	2.52	1.42	0.57	−0.07
110	Medical and dental instruments	9.21	3.40	−0.08	−0.38
111	Optical and ophthalmic equipment	9.42	6.23	−0.14	−0.58
112	Photographic equipment and supplies	10.74	6.03	0.00	−1.15
113	Watches, clocks, and clock-operated devices	5.78	5.08	−0.02	0.06
114	Jewelry and silverware	3.67	3.20	−0.32	−0.39
115	Musical instruments and sporting goods	4.38	2.91	−0.10	−0.40
116	Other miscellaneous manufactured products	4.70	4.64	−0.06	−0.32
117	Railroad transportation	2.42	5.37	0.39	0.0
118	Local transit, intercity buses	−1.05	0.14	−1.13	0.0
119	Truck transportation	3.30	1.63	−0.13	0.0
120	Water transportation	5.31	8.03	−1.51	0.0
121	Air transportation	9.55	5.02	−0.84	0.0
122	Pipeline transportation	5.82	8.24	0.17	0.0
123	Transportation services	2.61	−1.64	−0.42	0.0
124	Communication, except radio and TV	7.93	5.73	−0.09	0.0
125	Radio and TV broadcasting	3.39	−0.37	0.14	0.0
126	Electric utilities	6.11	4.52	0.10	0.0
127	Gas utilities	3.93	3.80	0.02	0.0
128	Water and sanitary services	3.16	−0.74	0.10	0.0
129	Wholesale trade	4.91	3.14	−0.25	0.0
130	Retail trade	2.85	1.39	−1.05	0.0
131	Banking	4.38	0.02	−0.10	0 0
132	Credit agencies and financial brokers	0.99	−2.81	−0.04	0.0
133	Insurance	3.60	1.55	−0.04	0.0
134	Owner-occupied real estate	4.32	0.0	0.0	0.0
135	Real estate	5.09	3.00	−0.25	0.0
136	Hotels and lodging places	3.92	1.79	−1.34	0.0
137	Personal and repair services	0.64	0.97	−0.30	0.0
138	Barber and beauty shops	−0.89	−1.92	−0.46	0.0
139	Miscellaneous business services	8.26	1.76	−0.37	0.0
140	Advertising	2.30	1.90	−0.41	0.0
141	Miscellaneous professional services	3.97	0.13	−0.20	0.0
142	Automobile repair	4.32	2.76	−0.07	0.0
143	Motion pictures	3.76	2.70	0.40	0.0
144	Amusements and recreation services	3.35	0.76	−0.53	0.0
145	Doctors' and dentists' services	4.94	1.20	−0.81	0.0
146	Hospitals	7.99	3.44	−0.81	0.0
147	Other medical services	8.39	−1.73	−0.80	0.0
148	Educational services	4.48	1.20	0.21	0.0
149	Nonprofit organizations	3.97	1.48	−0.27	0.0

Table F-4. Method 3: Least-squares growth rates for all industries, 1958-76—Continued

	Industry	Output	Variables		Ratio of production worker hours to wage and salary hours
			Output per hour all persons	Average weekly hours	
150	Post office	1.52	0.28	−0.16	0.0
151	Commodity Credit Corporaton	0.0	0.0	0.0	0.0
152	Other Federal enterprises	3.34	0.36	−0.16	0.0
153	Local government passenger transit	1.71	−1.11	−0.26	0.0
154	Other State and local government	4.41	1.17	−0.31	0.0
161	Private households	−2.44	0.16	−0.63	0.0

NOTE: For total manufacturing industries:
OPH = 1.529 + .376 OUT + .083 PWR
(6.1) (8.5) (.32)
R-squared = .4405
D.W. = 1.9270
OPH = output per hour all persons
OUT = constant (1972) dollar output
PWR = production worker hours/wage and salary hours

Appendix G: Economic Growth Sectoring Plan

	Industry sector number and title	Bureau of Economic Analysis input-output sector	Standard Industrial Classification (SIC) 1967
	Agriculture, forestry, and fishery		
1	Dairy and poultry products	1.01-1.02	01
2	Meat animals and livestock	1.03	01
3	Cotton	2.01	01
4	Food and feed grains	2.02	01
5	Other agricultural products	2.03-2.07	01
6	Forestry and fishery products	3.00	074, 08, 091
7	Agricultural, forestry, and fishery services	4.00	071, 0723, 073, pt. 0729, 085, 098
8			
	Mining		
8	Iron and ferroalloy ores mining	5.00	1011, 106
9	Copper ore mining	6.01	102
10	Other nonferrous ore mining	6.02	103-109 (except 106)
11	Coal mining	7.00	11, 12
12	Crude petroleum and natural gas	8.00	1311, 1321
13	Stone and clay mining and quarrying	9.00	14 (except 147)
14	Chemical and fertilizer mineral mining	10.00	147
	Construction		
15	New residential building construction	11.01	pt. 15, pt. 16, pt. 17
16	New nonresidential building construction	11.02	pt. 15, pt. 16, pt. 17, pt. 6561
17	New public utility construction	11.03	pt. 15, pt. 16, pt. 17
18	New highway construction	11.04	pt. 16, pt. 17
19	All other new construction	11.05	pt. 15, pt. 16, pt. 17
20	Oil and gas well drilling and exploration	11.0503-11.0504	pt. 138
21	Maintenance and repair construction	12.01-12.02	pt. 15, pt. 16, pt. 17, 138
	Manufacturing		
22	Ordnance	13.02-13.07	19 (except 1925)
23	Complete guided missiles	13.01	1925
24	Meat products	14.01	201
25	Dairy products	14.02-14.06	202
26	Canned and frozen foods	14.07-14.13	203
27	Grain mill products	14.14-14.17	204
28	Bakery products	14.18	205
29	Sugar	14.19	206
30	Confectionery products	14.20	207
31	Alcoholic beverages	14.21	2082-2085
32	Soft drinks and flavorings	14.22-14.23	2086-2087
33	Miscellaneous food products	14.24-14.32	209
34	Tobacco manufacturing	15.01 15.02	21
35	Fabric, yarn, and thread mills	16.01-16.04	2211, 2221, 2231, 2241, 226, 228
36	Floor coverings	17.01	227
37	Miscellaneous textile goods	17.02-17.10	229
38	Hosiery and knit goods	18.01-18.03	225
39	Apparel	18.04	23 (except 239), 399996
40	Miscellaneous fabricated textile products	19.01-19.03	239
41	Logging	20.01	2411
42	Sawmills and planing mills	20.02-20.04	242
43	Millwork, plywood, and other wood products	20.05-20.09	243,249
44	Wooden containers	21.00	244
45	Household furniture	22.01-22.04	251
46	Other furniture and fixtures	23.01-23.07	252-259
47	Paper products	24.01-24.07	26 (except 265)
48	Paperboard	25.00	265
49	Newspaper printing and publishing	26.01	2711
50	Periodicals and book printing, publishing	26.02-26.04	272-274

Economic Growth Sectoring Plan—Continued

Industry sector number and title		Bureau of Economic Analysis input-output sector	Standard Industrial Classification (SIC) 1967
51	Miscellaneous printing and publishing	26.05-26.08	275-279
52	Industrial inorganic and organic chemicals	27.01	281 (except 28195)
53	Agricultural chemicals	27.02-27.03	287
54	Miscellaneous chemical products	27.04	2861, 289
55	Plastic materials and synthetic rubber	28.01-28.02	2821-2822
56	Synthetic fibers	28.03-28.04	2823-2824
57	Drugs	29.01	283
58	Cleaning and toilet preparations	29.02-29.03	284
59	Paints and allied products	30.00	2851
60	Petroleum refining and related products	31.01-31.03	29
61	Tires and inner tubes	32.01	3011
62	Miscellaneous rubber products	32.02-32.03	3021, 3031, 3069
63	Plastic products	32.04	3079
64	Leather tanning and industrial leather	33.00	3111, 3121
65	Footwear and other leather products	34.01-34.03	3131, 314, 3151, 3161, 317, 3199
66	Glass	35.01-35.02	3211, 322, 3231
67	Cement and concrete products	36.01 & 36.10-3614	3241, 327
68	Structural clay products	36.02-36.05	325
69	Pottery and related products	36.06-36.09	326
70	Miscellaneous stone and clay products	36.15-36.22	3281, 329
71	Blast furnaces and basic steel products	37.01	331
72	Iron and steel foundries and forgings	37.02-37.04	332, 3391, 3399
73	Primary copper and copper products	38.01, 38.07, 38.10, 38 12	3331, 3351, 3357, 3362
74	Primary aluminum and aluminum products	38.04, 38.08, 38.11	3334, 28195, 3352, 3361
75	Other primary nonferrous products	38.02, 38.03, 38.05, 38 06, 38 09, 38 13, 38 14	3332, 3333, 3339, 3341, 3356, 3369, 3392
76	Metal containers	39.01-39.02	3411, 3491
77	Heating apparatus and plumbing fixtures	40.01-40.03	343
78	Fabricated structural metal	40.04-40.09	344
79	Screw machine products	41.01	345
80	Metal stampings	41.02	3461
81	Cutlery, handtools, and general hardware	42.01-42.03	342
82	Other fabricated metal products	42.04-42.11	347-349 (except 3491)
83	Engines, turbines, and generators	43.01-43.02	351
84	Farm machinery	44.00	3522
85	Construction, mining, and oilfield machinery	45.01-45.03	3531-3533
86	Material handling equipment	46.01-46.04	3534-3537
87	Metalworking machines	47.01-47.04	354
88	Special industry machinery	48.01-48.06	355
89	General industrial machinery	49.01-49.07	356
90	Machine shop products	50.00	359
91	Computers and peripheral equipment	51.01	3573-3574
92	Typewriters and other office equipment	51.02-51.04	357 (except 3573 and 3574)
93	Service industry machines	52.01-52.05	358
94	Electric transmission equipment	53.01-53.03	361
95	Electrical industrial apparatus	53.04-53.08	362
96	Household appliances	54.04-54.07	363
97	Electric lighting and wiring	55.01-55.03	364
98	Radio and TV receiving sets	56.01-56.02	365
99	Telephone and telegraph apparatus	56.03	3661
100	Radio and communication equipment	56.04	3662
101	Electronic components	57.01-57.03	367
102	Miscellaneous electrical products	58.01-58.05	369
103	Motor vehicles	59.01-59.03	371
104	Aircraft	60.01-60.04	372
105	Ship and boat building and repair	61.01-61.02	373
106	Railroad equipment	61.03-61.04	374
107	Motorcycles, bicycles, and parts	61.05	3751
108	Other transportation equipment	61.06-61.07	379
109	Scientific and controlling instruments	62.01-62.03	3811, 382
110	Medical and dental instruments	62.04-62.06	384
111	Optical and ophthalmic equipment	63.01-63.02	3831, 3851
112	Photographic equipment and supplies	63.03	3861
113	Watches, clocks, and clock-operated devices	62.07	387
114	Jewelry and silverware	64.01	391, 3961
115	Musical instruments and sporting goods	64.02-64.04	393, 394
116	Other miscellaneous manufactured products	64.05-64.12	395, 396, 399 (except 39996)
	Transportation		
117	Railroad transportation	65.01	40, 474
118	Local transit, intercity buses	65.02	41
119	Truck transportation	65.03	42, 473
120	Water transportation	65.04	44

Economic Growth Sectoring Plan—Continued

Industry sector number and title	Bureau of Economic Analysis input-output sector	Standard Industrial Classification (SIC) 1967
121 Air transportation	65.05	45
122 Pipeline transportation	65.06	46
123 Transportation services	65.07	47 (except 473 and 474)
Communications		
124 Communication, except radio and TV	66.00	48 (except 483)
125 Radio and TV broadcasting	67.00	483
Public utilities		
126 Electric utilities	68.01	491, pt. 493
127 Gas utilities	68.02	492, pt. 493
128 Water and sanitary services	68.03	494-497, pt. 493
Trade		
129 Wholesale trade	69.01	50
130 Retail trade	69.02	52-59, 7396, pt. 8099
Finance, insurance, and real estate		
131 Banking	70.01	60
132 Credit agencies and financial brokers	70.02-70.03	61, 62, 67
133 Insurance	70.04-70.05	63-64
134 Owner occupied real estate	71.01	na
135 Real estate	71.02	65 (except pt. 6561), 66
Other services		
136 Hotels and lodging places	72.01	70
137 Personal and repair services	72.02	72 (except 723, 724), 76 (except 7692, 7694 and pt 7699)
138 Barber and beauty shops	72.03	723, 724
139 Miscellaneous business services	73.01	73 (except 731, 7396), 7692, 7694, pt. 7699
140 Advertising	73.02	731
141 Miscellaneous professional services	73.03	81, 89 (except 8921)
142 Automobile repair	75.00	75
143 Motion pictures	76.01	78
144 Amusements and recreation services	76.02	79
145 Doctors' and dentists' services	77.01	801-804
146 Hospitals	77.02	8061
147 Other medical services	77.03	0722, 807, 809 (except pt. 8099)
148 Educational services	77.04	82
149 Nonprofit organizations	77.05	84, 86, 8921
Government enterprises		
150 Post office	78.01	na
151 Commodity Credit Corporation	78.03	na
152 Other Federal enterprises	78.02, 78.04	na
153 Local government passenger transit	79.01	na
154 Other State and local government	79.01, 79.03	na
Imports		
155 Directly allocated imports	80.01	na
Dummy industries		
156 Business travel, entertainment, and gifts	81.00	na
157 Office supplies	82.00	na
158 Scrap, used and secondhand	83.00	na
Special industries		
159 Government industry	84.00	na
160 Rest of the world industry	85.00	na
161 Households	86.00	na
162 Inventory valuation adjustment	87.00	na

Appendix H. Data Sources

Source documents, for the most part, are continuing publications; all issues have been examined.

Macroeconomic projections

National Income and Product Accounts, Bureau of Economic Analysis, U.S. Department of Commerce.
Survey of Current Business, Bureau of Economic Analysis.
Current Population Reports, Bureau of the Census, U.S. Department of Commerce.
Employment and Earnings, Bureau of Labor Statistics, U.S. Department of Labor.
Statistical Abstract of the United States, Bureau of the Census.
Farm Income Statistics, U.S. Department of Agriculture.
Business Conditions Digest, Bureau of Economic Analysis.
Social Security Bulletin, Annual Statistical Supplement, Social Security Administration, U.S. Department of Health, Education, and Welfare.
Statistics of Income Report, Internal Revenue Code, Internal Revenue Service, U.S. Department of the Treasury.
Aggregate Labor Force Projections, Bureau of Labor Statistics.

Final demand projections

National Income and Product Accounts, Bureau of Economic Analysis.
Input-Output Structure of the U.S. Economy, 1958, 1963, 1967, Bureau of Economic Analysis.
Survey of Current Business, Bureau of Economic Analysis.
Current Population Reports, Bureau of the Census.
Census of Manufactures, 1967 and 1972, Bureau of the Census.
Interindustry Transactions in New Structures and Equipment, 1963 and 1967, Bureau of Economic Analysis.
Capital Stocks Data Base, Bureau of Labor Statistics.
U.S. Exports by 2-, 3-, and 4-Digit SIC EA675, Bureau of the Census.
U.S. Exports by 8-Digit SIC FT610, Bureau of the Census.
U.S. Exports, Commodity Schedule FT410, Bureau of the Census.
U.S. Imports for Consumption and General Imports, IA275, Bureau of the Census.
U.S. Imports TSUSA, Commodity by Country, FT246, Bureau of the Census.
Construction Review, Industry and Trade Administration, U.S. Department of Commerce.
Census of Governments, Bureau of the Census.
Public Employment, Bureau of the Census.
U.S. Budget Appendix, 1963-78, Office of Management and Budget, Executive Office of the President.
Military Prime Contract Awards by Federal Supply Classification, OASD-Comptroller, Department of Defense.
Monthly Status of Funds, OASD-Comptroller, Department of Defense.
Shipments of Defense Oriented Industries, MA-175, Bureau of the Census.

Intermediate demand projections

Input-Output Structure of the U.S. Economy, 1958, 1963, and 1967, Bureau of Economic Analysis.
Census of Manufactures, 1963, 1967, Bureau of the Census.
Current Industrial Reports, Bureau of the Census.
Minerals Yearbook, Bureau of Mines, U.S. Department of the Interior.
Census of Business, Bureau of the Census.
Annual Survey of Manufactures, Bureau of the Census.
Statistical Abstract of the United States, Bureau of the Census.

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, U.S. Department of the Treasury.
Census of Manufactures, Bureau of the Census.
Compendium of National Health Expenditures, U.S. Department of Health, Education, and Welfare.
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, U.S. Department of the Interior.
National Income and Product Accounts, Bureau of Economic Analysis.
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, Federal Power Commission.

Statistics of Publicly-Owned Electric Utilities, 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.

Office of Productivity and Technology data base, Bureau of Labor Statistics.

Construction Reports, Bureau of the Census.

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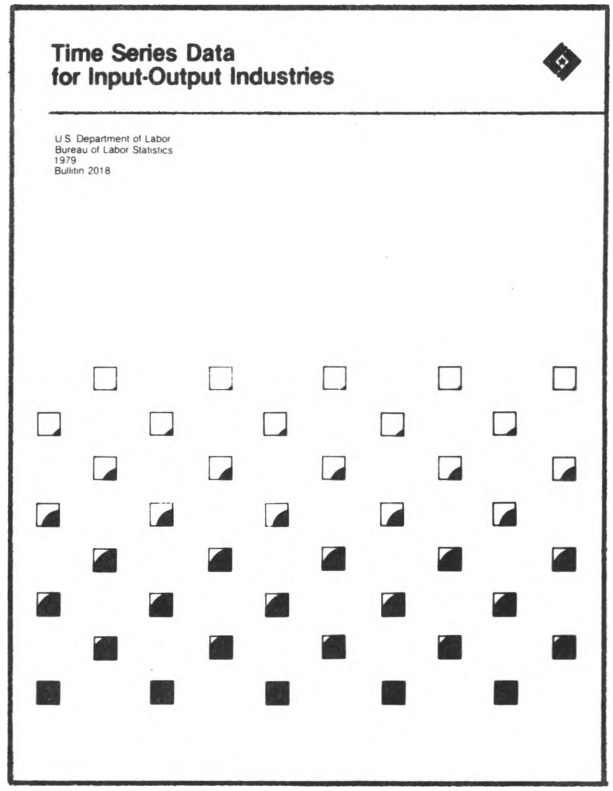
- Automobile repair
- Motion pictures



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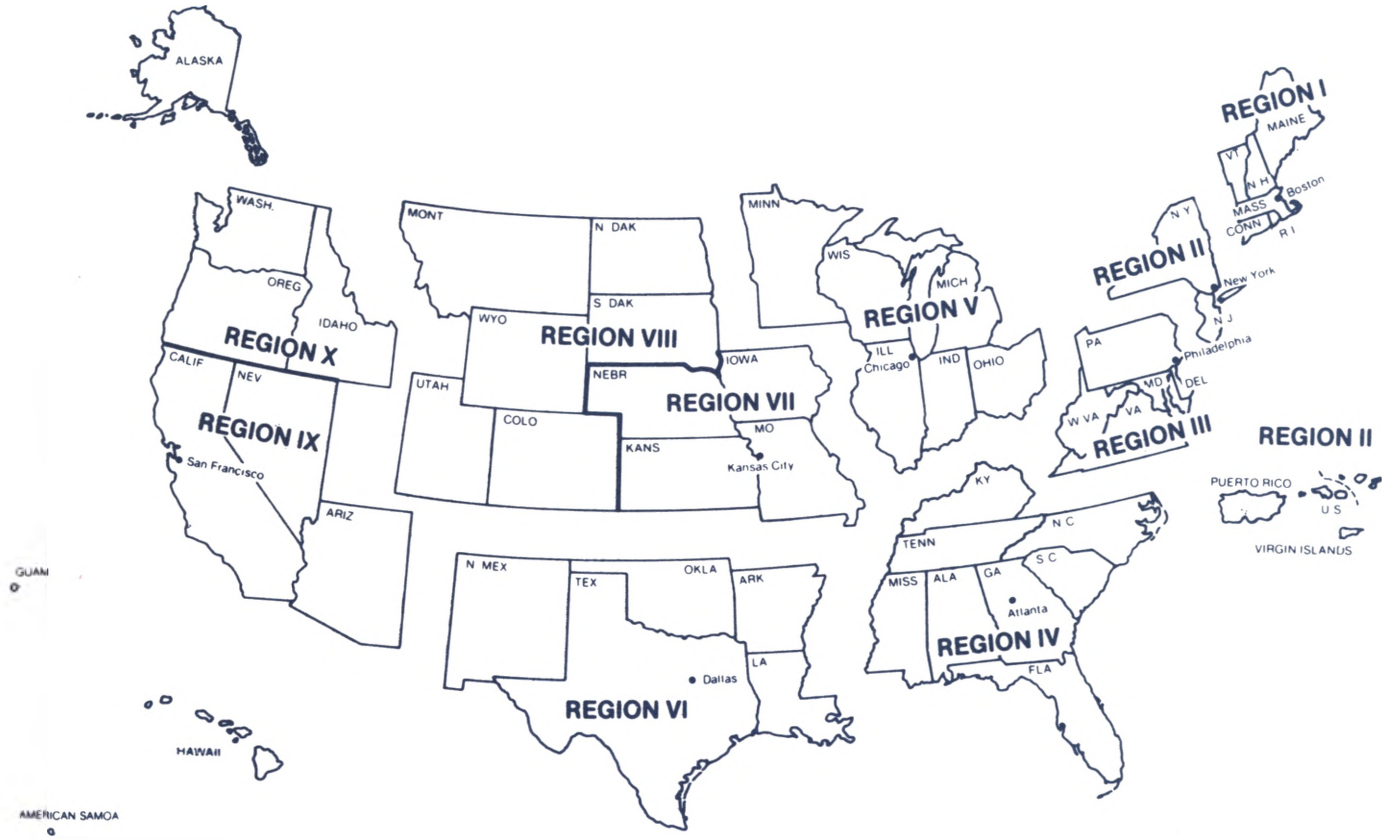

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