An Energy-Oriented Input-Output Model

EA-3625
Research Project 1366-1

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ABSTRACT

An input-output model was developed to examine the structure of relationships between energy and the general economy, with these phases:

(1) development of a base year (1972) model,
(2) projection of a year 2000 model, and
(3) projection of individual industry output.

The base year model was derived from the BEA 496-sector model by aggregating nonenergy sectors, disaggregating energy sectors and putting transactions on a commodity-by-commodity basis. The year 2000 model was obtained by scaling base technical coefficients to account for energy conservation by industry in response to higher prices and major expected changes in technology. Individual industry outputs in dollars were projected on the basis of final demand forecasts obtained by combining several recent alternative forecasts. Total output was projected as 2.5 times the 1972 base level, all energy production as 1.4 the base level, and electricity output as 1.9 its base level. Dollar projections were converted to BTU for the energy sectors by applying a mixed BTU-dollar input-output table which, in practice, accurately accounted for conversion losses in electricity generation. In a final application, energy embodied in U.S. imports were estimated as exceeding energy embodied in U.S. exports, both in 1972 and projected to the year 2000.

EPRI PERSPECTIVE

PROJECT DESCRIPTION

This report, EA-3625, describes one portion of a two-part project designed to analyze long-term trends in the pattern of U.S. household expenditures and the impact of these changing trends on energy demand. EA-3442 reports on an analysis of U.S. household expenditures for energy and nonenergy commodities. This report describes the part of the project devoted to the development of an energy-oriented input-output model of the U.S. economy for both 1972 and the year 2000. Input-output models, originally developed by Wassily Leontief, are useful economic constructs for analyzing the indirect, as well as the direct, impact on the economy of changes in final demand for one or more commodities. In this project, the objective was to determine the impact on energy demand of changes in the pattern of household expenditures. Changes in direct household expenditures on energy can be measured directly; however changes in the demand for nonenergy commodities influence total energy demand only through the energy embodied in the production of the commodities. This indirect impact on energy demand can be measured using an input-output approach combined with the estimates for nonenergy commodities obtained in EA-3442.

In this project, the 496-sector Bureau of Economic Analysis input-output model for 1972 was modified to disaggregate the energy sectors and aggregate the nonenergy sectors, resulting in a 104-sector commodity-by-commodity input-output model. Changes in the technical coefficient matrix were then projected to the year 2000. The projections were based on the results of an analysis of changes in the coefficients in response to energy price changes between 1972 and 1976, and judgmental adjustments to account for projected major changes in technology for the year 2000 matrix.

PROJECT OBJECTIVE

The objective of this portion of the project was to develop a base year and future year energy oriented input-output matrix for the U.S. economy as an input to the companion project on household energy demand.

PROJECT RESULTS

A general decline in the intensity of energy use to 75% of the base period (1972) was projected. The intensity of electricity was projected at 85% of the base. Finally, a set of projections for year 2000 final demand was applied to the year 2000 input-output model to project levels of output. Year 2000 energy consumption is projected at 94.2 quads.

Input-output models are very useful tools for analyzing relationships between various sectors of the economy and for studying, as in this case, indirect impacts of changes in household expenditure patterns on energy demand. The detailed nature of these models, which makes them so useful, also makes them more valuable for short-run rather than long-run applications. Long-run forecasts with input-output models require projecting changes in hundreds of technical coefficients in response to prices, product mix, technological change, and other factors. For that reason, the future year input-output matrices in this report and the forecasts made with them should be treated with caution. EPRI has sponsored related research (EPRI project RP1475) designed to study the nature and causes of changes in technical coefficients, although at a somewhat higher level of aggregation than the typical input-output model. An EPRI report on that project will be published later this year.

Steven D. Braithwait, Project Manager
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Rosamond Katz and Douglas McDonald served as research assistants on this project and made important contributions in finding source materials and in developing and organizing data. Other research assistants who assembled and manipulated data included Paula Boggs, James Pagano, and Donna Stauffer. Helpful technical adice on phases of the project was a companion project to an RFF study for EPRI by Thomas Lareau and Joel Darmstadter, and our interactions with them were of help in the work on this project, particularly in the applications of chapter 6. Parts of the report were typed by John Mankin, Mimi Windsor, and Maybelle Frashure. Louanne Sawyer wrote several important computer programs utilized in the project, including the program that developed the commodity-by-commodity matrix corresponding to the BEA 496 sector table. Charles Paulsen wrote the computer program that aggregated the original commodity-by-commodity matrix to conform to the sectoral classification of the RFF matrix. The project was administered by Steven Braithwait of EPRI and by Milton Russell and Kenneth Frederick of RFF.

Irving Hoch

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SUMMARY

This research aimed at the development of dependable knowledge of the underlying structure of relationships between energy and the general economy by constructing an energy-oriented input-output model of the national economy, which exhibited the structure of the economy, both as of 1972 and as projected to the year 2000. That projected structure was then employed to project year 2000 output in dollar terms for both energy and nonenergy sectors, and in BTU terms, as well, for energy sectors.

An input-output model describes the economic relationships among all the sectors of the economy by means of three basic tables. The first is a "transactions matrix" which displays crossflows of shipments in dollar terms from each sector of origin to each sector of destination. The sectoral classification spans the entire economy and is fine enough so that a large number of sectors are defined. Sectors are further classified as "final demand" or "intermediate". Expenditures by final demand sectors are the causal forces in the model, determining the levels of output of the intermediate sectors. Final demand sectors include personal consumption expenditures, government spending and foreign trade, while intermediate sectors include individual industries such as electricity production, automobile manufactures and retail trade. The second basic table in an input-output model is the "technical coefficient matrix," which exhibits the cost structure of every intermediate sector in the form of fractions that show its spending on input from each sector relative to its total costs. The technical coefficient matrix is applied to obtain the third basic table, the "inverse matrix", in which the entries for a given sector show the direct and indirect requirements generated by an increase of one dollar of final demand on that sector. For example, say the government spent one dollar more on purchases of airplanes, yielding a direct requirement of one dollar on aircraft manufacturing. Then, that sector would accordingly expand its use of inputs (aluminum, plastics, etc.) and the producers of those inputs would accordingly expand their production and their use of their specific inputs, and so on. The process converges to an ultimate set of requirements, displayed by the inverse matrix.

The most comprehensive and widely used U.S. input-output tables are those of the U.S. Bureau of Economic Analysis (BEA); its latest tables, covering the year 1972, were published in 1979. Given its authoritative nature, the 496 sector transactions table of that set was the starting point for the present study. That table was revised and extended to yield the transactions table of this study (the RFF table). Nonenergy sectors were aggregated on the basis of importance in energy use, in consumer expenditures, and in total sales. In contrast, energy sectors were disaggregated by the analysis and incorporation of data from a number of unpublished BEA data files and documents. Consequently, rather than the 5 energy sectors in the BEA table, there were 14 energy sectors in the RFF table, including separate sectors for crude oil and natural gas extraction, 7 petroleum refining product sectors, and separate sectors for the production of electricity by fossil fuels, nuclear power and hydroelectric power. Coal mining and natural gas utilities round out the list of RFF energy sectors, with a total of 104 intermediate and 13 final demand sectors for the sectoral classification as a whole. Finally, the RFF transactions table was put on a "commodity-by-commodity" basis, an accounting framework the BEA also employed as an alternative in deriving an inverse matrix, though it did not retain the underlying transactions table. Hence, that transactions table was in effect reconstructed here in obtaining the RFF table. The commodity-by-commodity table is obtained by adjusting transaction flows to eliminate the problem of industries producing some commodities other than the primary commodity indicated by their name. For example, the glass industry produces 18 different commodities but the bulk of its sales are of glass and glass products. Given the adjustment, inputs can be viewed as inputs used only in producing the primary commodity, rather than as inputs into the original industry. With the development of the 1972 RFF transactions matrix, the corresponding technical coefficient matrix and inverse matrix were obtained directly by standard mathematical operations. The construction of the three base RFF tables is seen as a major contribution of this study, since it furnishes the analyst with energy-oriented input-output tables for the economy that are not elsewhere available, and a variety of applications emerge. For example, the inverse matrix yields the following required outputs in dollars induced by a one dollar increase in final demand on each electricity sector:

	Electricity	All Energy	All Sectors
Electricity from fossil fuel	1.141	1.443	1.838
Nuclear power	1.004	1.020	1.337
Hydroelectric power	1.002	1.010	1.258

Thus, the energy-conserving nature of nuclear and hydroelectric power is made manifest.

With the 1972 tables in hand, the RFF technical coefficient matrix was then employed as a base in projecting a year 2000 technical coefficient matrix. Since a given technical coefficient is a measure of the intensity of use of an input in a given sector, changes in intensity were incorporated by multiplying the base period technical coefficient by an appropriate scale factor for two basic sets of changes. The first set accounted for changes in the intensity of energy use in response to actual price increases, typically from 1972 to 1976, and then for projected price increases expected to occur by 2000. The second set accounted for projected impacts by the year 2000 of major changes in technology now in progress. For the given projected price increases, a general decline in the intensity of energy use to 75 percent of the base period was projected and used as a benchmark in projecting the use of particular forms of energy. Intermediate sector use of coal and of fuel oil were projected as close to that benchmark, while that of electricity was projected as 85 percent and that of gasoline as 65 percent of base levels. Because of a considerable decline in its intensity of use by 1976, only modest further decreases were projected for natural gas. Projections were based on recent actual experience, on forecasts developed by others and on some predictive equations for manufacturing sectors' use of electricity and natural gas that were developed as part of this study. Projected changes in technology included economy-wide increases in the use of computers; a shift to aluminum from other metals; and general increases in plastics and decreases in competing products, including glass, wood, paper, leather and metals. There were also general increases in communications, business services, scientific instruments and drugs. The year 2000 technical coefficient matrix obtained by these changes in turn was used to obtain the corresponding inverse matrix.

The year 2000 inverse was then used with projections of year 2000 final demand to obtain projected year 2000 levels of output. The final demand projections were obtained by combining several recent alternative projections with independently derived projections, and specified a 1972 to 2000 population increase

of 24 percent and a doubling of per capita income. Some specific output projections obtained were as follows, in terms of the ratio of year 2000 to 1972 output: All electricity sectors: 1.9; Gasoline: 1.0; Computers and electronics: 6.4; Communications: 4.9; and Motor vehicles: 1.4. Energy use as a whole was projected at only 60 percent of the level that would be attained if all sectors' output grew at the same rate, for the given increase in final demand. Of the 40 percent decline in energy use, changes in use by final demand sectors account for about 24 percent and changes in use by intermediate sectors for the remaining 16 percent. Changes in technology cause a small increase in energy use of about 3 percent, which is greatly outweighed by the effect of energy conservation in intermediate sector use.

The work was concluded with several applications, focusing on the conversion of dollars to BTU for the energy sectors, and more generally, on the construction of mixed BTU-dollar input-output tables, with energy entries in BTU terms, rather than in dollars. In the case of electricity from fossil fuel, the inverse accurately accounted for conversion losses, with a total requirement per BTU of output of 2.99 BTU of input in 1972, and a projected total of 2.79 in 2000, reflecting projected increases in conversion efficiency. Finally, an international trade application examined embodied energy--energy inputs used in producing traded commodities. The results suggest that U.S. imports of embodied energy exceed corresponding exports, but that the difference projected for 2000 is below that of 1972.

In sum, this work has produced an input-output model that can be applied to other questions, a set of specific projections that can be used in considering energy-economic interactions, and a considerable amount of detailed data on both energy and the economy which is seen as a useful byproduct of the effort.

Chapter 1

INTRODUCTION AND OVERVIEW

This report describes the development and application of an energy oriented input-output model, hereafter referred to as the RFF model. The model contains the standard features of a base year transactions matrix, technical coefficient matrix and inverse matrix, and a projected technical coefficient and inverse matrix for a forecast year. The base year is 1972, and the projections are to the year 2000.

Input-output models are useful because they exhibit all of the economic operations of an economy, and account for the complex interactions that occur in the economy. They can be applied both in making provisional projections (what will happen if a single specific change occurs) and in making general projections (what will happen given a series of changes in the causative forces that drive the economy). The energy-oriented model developed here focuses on the energy sectors by developing more detailed information on those sectors than appears in standard sources, allowing the posing and answering of questions that would otherwise not be possible. In addition, a great deal of economic information has been assembled and integrated within our input-output framework, and that information should be of use to energy specialists and more generally, to economic analysts, as well as to input-output practitioners.

A brief description of input-output analysis may be of help to the nontechnical reader and is presented at this point. The description covers each of the basic matrices (or tables), in turn.

1.1 A BRIEF DESCRIPTION OF INPUT-OUTPUT ANALYSIS

The transactions matrix displays the flows of commodities among the sectors of an economy, exhibiting the array of commodity dollar amounts moving from origin sector to destination sector. Entries in a given row show the distribution of dollar sales for the sector represented by that row. Entries in a given column exhibit the dollar purchases by the sector corresponding to that column. There are two kinds of sectors: "intermediate" sectors, and "final demand" or exoge-

nous sectors. The intermediate sectors comprise the bulk of the cases, with individual sectoral categories covering such activities as crude oil extraction, food processing, aluminum manufactures, the services of hospitals, etc. The production of the intermediate sectors is determined in response to the requirements of the "final demand" sectors, the driving force in the economy. The final demand sectors correspond to the components of Gross National Product, and include Personal Consumption Expenditures, Gross Private Domestic Fixed Investment, Change in Business Inventories, Exports, Imports, and Government Spending. Strictly speaking, "final demand" refers to the bill of goods (or amounts of commodities) obtained by summing up the amounts of the commodities that flow into the individual exogenous final demand sectors, with those flows appearing as column entries in the transactions table. Final demand is satisfied by and determines the level of total output of the intermediate sectors. Total output consists of final demand plus the processing by intermediate sectors that is needed to produce the final demand requirements, and that processing is exhibited by the flows among the intermediate sectors. The exogenous row sector entries corresponding to the column entries of the final demand sectors account for value added--the payments by each sector of wages, interest, dividends, rent, and profit to the factors of production in the economy.

The intermediate sectors are thus to be viewed as endogenous, or determined within the system of relationships specified by the model. Forecasts of the levels of final demand, obtained outside the workings of the input-output model, per se, then determine the forecast levels of intermediate sector output.

The mechanics of the input-output apparatus work as follows. A base period technical coefficient matrix is derived from the transactions matrix by expressing sector inputs as fractions of all inputs (or output, since total sales equal total purchases). Operationally, each column's entries in the transactions matrix are divided by the column total to obtain the technical coefficient matrix. Then, the technical coefficient matrix is restricted to intermediate sector entries and the inverse matrix is derived from that restricted table. The inverse matrix is obtained and used in the process of solving a set of equations in which the inverse is multiplied by final demand to yield industry output. (The equations are exhibited in matrix form in chapter 2.)

The inverse matrix possesses some important characteristics. The entries in a given column show the direct and indirect requirements induced on all sectors by a one dollar increase in final demand on the sector corresponding to that column. Thus, say there are 100 sectors, and it is specified that sector [4] is to deliver an additional dollar of its commodity to final demand. To produce that additional dollar of output, sector [4] must purchase additional inputs from all other sectors, including itself; for example, if sector [4] is airplane manufactures, it must expand its use of aluminum, plastics, electronic equipment, etc. Then, the sectors furnishing those inputs must themselves expand their production to produce the initial round of inputs needed, and so a second round of expansion is set in motion to meet those requirements for inputs; this leads to a third round of expansion, and a fourth, and a fifth, and so on for an infinite set of rounds. Though the number of rounds (in the limit) is infinite, the expansion of output tapers off in each round and converges to an ultimate set of expanded outputs, which are displayed in the inverse matrix. In particular, if we read down column four of the inverse we will find an entry in row four that contains the one dollar of commodity [4] needed to satisfy the final demand increase, plus all the additional output of [4] needed to meet the processing requirements generated. The other 99 row entries in column four exhibit the additional "ultimate" output required from each of the other sectors to carry out the processing needed to meet the one dollar increase in final demand. The column sum then shows the total multiplier effect of that increase. The inverse matrix is also of use in forecasting. Say the base bill of goods is replaced by a forecast bill of goods for some future date; that projected final demand, in conjunction with the inverse matrix, will yield a corresponding set of projected outputs. Developing such a set of output projections is often the goal of input-output analysis. It is possible to make the projection process more realistic by accounting for projected changes in economic structure which change the relationships embedded in the technical coefficient matrix. Then a new inverse is obtained, corresponding to the revised technical coefficient matrix, and this in turn implies revised and presumably improved projections of output. Such a process was carried out here and is now described in some detail.

1.2 THE ORGANIZATION OF THE WORK AND ITS PRESENTATION IN THIS REPORT

The starting point for the work on the RFF model was a recasting of the U.S. Bureau of Economic Analysis (BEA) 1972 transactions table. That table, which contained 496 sectors, was seen as both the most recent and the best of currently available input-output tables. The RFF table was derived from the BEA

table in three steps: (1) aggregating the BEA nonenergy sectors, (2) disaggregating the BEA energy sectors, and (3) transforming an initial commodity-by-industry matrix into a commodity-by-commodity matrix. Corresponding technical coefficient and inverse matrices were then obtained. The work entailed is covered in chapter 2.

The base period technical coefficient matrix was then transformed into a projected year 2000 table. Changes in economic structure thus could be accounted for by scaling of ratios of input to output, which reflected projected changes in intensity of use without specifying dollar levels. The transformation was carried out in two steps, respectively covered in chapters 3 and 4. First, projected changes in intensity of energy use in response to actual and projected price increases were incorporated, with a detailed description of the process presented in chapter 3. Then, there was an accounting for major expected changes in technology by the year 2000, drawing on information from Ridker and Watson (1) and the Bureau of Labor Statistics Economic Growth Project (2) as well as a series of projections based on a variety of sources. A detailed description of the technology projections appears in chapter 4. With the incorporation of the structural changes, the base technical coefficient matrix was transformed into the year 2000 version of that matrix, and the corresponding inverse matrix was then obtained directly.

Projection of year 2000 final demand was then obtained by blending and combining projections made by the U.S. Bureau of Labor Statistics (3) and by Lareau and Darmstadter (4) (in a companion study to the present work) with independent estimates. The final demand projections, in conjunction with the year 2000 projected inverse, yielded corresponding output projections. Both the final demand and output projections are documented in chapter 5.

Finally, a number of applications are covered in chapter 6. In particular, base and projected energy outputs measured in 1972 dollars are converted to BTU through the application of mixed BTU-Dollar input-output tables. Those tables were derived from our base and projected tables (which used dollars as units) by converting energy flows from dollars to BTU. Though the BTU-Dollar tables are formally equivalent to the conventional tables in mathematical terms, they extend the coverage of the input-output models by yielding specific results not otherwise attainable. In particular, direct and indirect energy requirements in BTU terms can be read from the BTU-Dollar inverse. Other applications covered in chapter 6 are estimates and projections of energy consumption,

obtained as output plus net imports minus inventory change; an examination of the energy impacts of mandated improvements in motor vehicle fuel economy; and the estimation of energy embodied in exports and imports, covering both direct and indirect requirements generated by those foreign trade sectors.

The discussion in the text typically follows this organization: a chapter is introduced with an overview section which outlines the work of the chapter in nontechnical form; then, succeeding sections present detailed, technical and specialized information. In addition to the coverage in the text, more specialized and detailed material is presented in a set of 10 appendixes, labeled A through J, respectively. The order of the appendixes corresponds to the order of coverage of the topic of concern in text. Three of the appendixes present the RFF input-output tables. Appendix E presents base (1972) transactions, technical coefficient and inverse matrices. Appendix H presents the projected year 2000 technical coefficient and inverse matrices. Finally, Appendix J presents both the 1972 and 2000 BTU-Dollar inverse matrices. The remaining appendixes present technical information and documentation that seem likely to be primarily of interest to the specialist. Because of their specialized nature, the bulk of the appendixes are not included in this document, but are separately available (5). However both 1972 and 2000 inverse matrices, appearing in appendixes E and H, respectively, seem of more general interest, and appear at the conclusion of this document.

1.3 SOME DETAILS ON PROCEDURES, CONTRIBUTIONS AND FINDINGS

In the chapter 2 development of the base input-output tables, the RFF model was organized into 117 sectors, including 104 intermediate sectors. Nonenergy sectors were obtained by aggregating sets of sectors in the BEA 496 sector table, with level of energy use by individual sector a major criterion in the aggregation process. In contrast, the five energy commodities in the BEA table were disaggregated into 14 energy sectors, including coal mining, crude petroleum extraction, natural gas extraction, 7 separate sectors for petroleum products (including individual sectors covering gasoline, distillate fuel oil and residual fuel oil, respectively), natural gas utilities and 3 separate electricity sectors, respectively covering generation by fossil fuels, nuclear power and hydroelectric power.

The development of estimated base period flows for individual petroleum products drew on an unpublished workfile obtained from the BEA, with flows developed both for the BEA table's 496 sectors (shown in Appendix C) and the RFF

table's 117 sectors. The disaggregation of the electricity sectors was based on work carried out by Nancy Simon of the BEA (6).

The BEA transactions table is a commodity-by-industry table showing the flows of commodities into industries. The distinction arises because a given commodity typically is produced by more than one industry and a given industry typically produces more than one commodity. However, the bulk of a specific commodity output is usually produced by the industry of the same name. (The use of the same name for both commodity and industry can be a source of confusion.) The BEA presents information on the commodity-industry correspondences, and that information was used to convert the commodity-by-industry flow table into a commodity-by-commodity flow table, purporting to exhibit transactions where both origins and destinations are defined on the same "commodity" basis. In this matrix, column and row numbers correspond, and column totals equal row totals. Although the BEA developed a commodity-by-commodity matrix as part of its 1972 model, that matrix was not retained, and therefore a reconstruction of that table in effect was carried out here.

In transforming the technical coefficient matrix, chapter 3 develops projections of changes in the intensity of energy use, that is, changes in amounts spent on energy relative to total spending, by drawing on energy price forecasts and estimated demand elasticities. The price forecasts were generally consistent with those of Lareau and Darmstadter, who assumed the following annual percentage changes, in real terms: electricity: +2.4 percent; natural gas: +3.4 percent; fuel oil and coal: +2.2 percent, and gasoline: +2.4 percent. The natural gas forecast reflects the removal of price controls; however, it was assumed here that there would be some muting of quantity effects, given recent institutional constraints on the use of natural gas in response to price controls.

The energy use projections had three phases, accounting in turn for changes in fuel mix in the electric utility sectors; changes in intensity of use of electricity and utility gas; and changes in intensity of use of all other forms of energy. The work usually proceeded by estimating recent changes in intensity of use, typically for the 1972-1976 period, and then projecting anticipated changes from 1977 to 2000. For the given general level of projected price increases, a general decline in the intensity of energy use to 75 percent of the base period was projected, and this figure was used as a benchmark for the projection of individual forms of energy use. In those individual forecasts,

the intensity of use by industry was projected to fall to 85 percent of 1976 levels for electricity, to 65 percent for gasoline, to a bit above 75 percent for coal, and to a bit below 75 percent for fuel oil. Natural gas posed problems because of price controls and consequent nonprice rationing, with considerable decline in intensity of use apparent by 1976. In response, our projections usually introduced some modest further declines in intensity, though a lower limit of 50 percent of the 1972 intensity was imposed in the individual sector projections.

The sectoral distribution of electricity sales between 1972 and 2000 was projected as follows: nuclear power's share of sales was projected to increase from 2.5 percent in 1972 to 20 percent in 2000; hydropower's share to fall from 3.3 to 2 percent; and fossil fuel to decline from 94.2 to 78 percent.

Finally, in addition to the reduction in intensity of gasoline use by intermediate sectors, a general shift from gasoline to diesel fuel in trucking was imposed as an expected structural change.

The work of chapter 4 completes the transformation of the technical coefficient matrix by scaling entries to correspond to changes in technology. Of course, most economically viable changes in technology occur in response to relative price changes, and some of the changes in the RFF model involve predicted responses to real energy price increases, in particular. Changes in the technology of motor vehicle manufactures to attain improvements in fuel economy fall under that heading. Those changes include predicted increases in plastics and aluminum, decreases in iron, steel, and other metals, and shifts from labor to machinery (robots) and computers. Economy-wide increases in intensity of use of computers were projected, but our projections also accounted for differences in the rate of computerization between sectors. A general and pronounced increase in the intensity of use of plastics was projected, with corresponding declines in glass, wood, metals, paper, and leather, all of which were seen as being at a competitive disadvantage with plastics. Finally, the expectation of general scientific advance was built into the table by projecting general increases in intensity of use for communications, business services, scientific instruments, and drugs.

With the completion of the projection of the year 2000 technical coefficient matrix, the corresponding year 2000 inverse was obtained directly.

Chapter 5 develops and employs final demand projections in concert with the projected year 2000 inverse to obtain year 2000 output projections, measured in 1972 dollars. The final demand projections were obtained by combining projections made by the Bureau of Labor Statistics and by Lareau and Darmstadter (cited as L-D for short) with independently derived evidence. The latter included national defense spending projections based on Department of Defense growth factors organized in an input-output framework (7). Growth in personal consumption expenditures under the three basic sets of projections were as follows, for 2000 relative to 1972:

BLS	2.82
This Study	2.49
Lareau-Darmstadter (L-D)	2.08

The total final demand projections employed here involved a 1972 to 2000 population increase of 24 percent and approximately a doubling of per capita income. At the level of the individual sector forecasts, the BLS and L-D projections were often handled by simple averaging to obtain the projections we employed. However, the BLS projections were usually higher than the corresponding L-D values; in some cases, the former projections appeared too high, as in the case of wood products sectors; in others, the latter projections appeared too low, as in the case of consumption of drugs, computers, and communications; hence, the alternative projection was employed in those cases. Finally, in some cases, both the BLS and L-D projections appeared to overstate or understate, and then an independent estimate was employed. This was particularly notable in the case of motor vehicles, where this study employed a considerably lower projection than either the BLS or L-D value. This study also employed a lower projection for gasoline consumption than the BLS and L-D projections, based on a personal consumption expenditures reduction in intensity of use to 0.62 of the 1972 value.

Total output projections can be compared as follows, employing the ratio of year 2000 to 1972 levels:

EPRI "intermediate growth" scenario	3.34
BLS	2.68
This study	2.39
Lareau-Darmstadter (L-D)	2.11
EPRI "low growth" scenario	2.01

The EPRI projections are based on listed annual growth rates for alternative scenarios, as shown in a planning document (8). The BLS projection is exactly

midway between the EPRI "low growth" and "intermediate growth" scenarios, while the others are closer to the "low growth" case.

Some sense of individual output projections can be obtained from the following ratios of year 2000 output to 1972 base levels. For the electricity sectors, these ratios were obtained:

Electricity from:

Fossil fuel	1.6
Nuclear power	13.3
Hydropower	1.1

For energy as a group, these ratios seem instructive:

All electricity sectors	1.9
Coal mining	1.9
Petroleum products other than gasoline	1.8
Natural gas utilities	1.2
Natural gas extraction	1.2
Crude petroleum	1.1
Gasoline	1.0

Some other growth ratios of note are:

Computers and electronics	6.4
Communications	4.9
Hospitals	4.7
Aluminum	3.6
Motor vehicles	1.4
New highways and streets	0.8
Mobile homes	0.6

The projection levels in the last three cases appear related to higher energy prices.

A sequential process that disaggregated projection components allowed the estimation of the separate impacts of final demand changes, changes in intensity of energy use in production, and changes in technology. From those estimates, it was concluded that final demand changes account for about 60 percent of the projected decline in energy use, with the total decline itself implying energy use at only 60 percent of the level to be attained in a world where all sector's output grew at the same pace. Changes in technology cause an increase in energy use, though the amount of increase is relatively small (only 3 percent), and even this estimate seems somewhat overstated because some of the technological change is directed to energy saving.

Chapter 6 is devoted to applications, with its focus on the conversion of dollars to BTU for the energy sectors, and more generally, on the construction of mixed BTU-dollar input-output tables. The conversion of output to BTU included these results:

	trillion BTU		Ratio
	1972	2000	2000/1972
Electricity	5,383.1	10,086.9	1.874
Gasoline	12,331.2	12,058.3	0.978
Primary energy	62,078.0	86,276.0	1.390

Electricity output here is measured at point of consumption, that is after accounting for conversion losses, in line with BEA convention on measuring utility flows. Primary energy consists of the output of coal mining, crude oil and natural gas extraction, and nuclear power and hydropower in electricity generation, measured at the point of production. (The definition of primary energy accords with the standard treatment of energy production by the Bureau of Mines and the Department of Energy.)

The year 2000 consumption projections of this study compare to recent projections by DOE for the same year as follows:

	Year 2000 Consumption in Quadrillion BTU	
	This Study	DOE Projection Made in 1981
Primary Energy Production		
Coal	26.8	42.0
Crude oil	23.1	20.0
Natural gas	25.6	18.0
Nuclear power	7.8	10.6
Hydro & other	3.2	9.7
Net Imports: Imports minus exports		
Coal	-5.3	-5.9
Petroleum	10.9	3.0
Natural gas	2.6	2.0
Inventory Change	-0.5	0.0
Total	94.2	99.4

(A quadrillion is one thousand trillion.)

The respective totals seem reasonably close, though it should be added that DOE projections made a few years earlier were considerably higher in total, at approximately 120 quadrillion BTU. Further, considerable disagreement occurs

for component projections; we project much lower coal production, lower nuclear and hydroelectric power, higher oil and gas production, and considerably higher petroleum imports than does DOE. (It should be added that our petroleum import projection is much below the 1977 actual level.) It will be interesting, of course, to test the conflicting projections against reality, as the future unfolds.

The BTU-Dollar matrices were also employed to exhibit direct energy intensities by sector for 1972 and 2000, both in terms of dollars and BTU. Then the inverse matrices were drawn on to estimate direct and indirect requirements in BTU induced by an increase in final demand of one BTU on a given sector, with results that seemed generally reasonable. For example, conversion losses appeared accurately accounted for in the generation of electricity from fossil fuels, and more generally, the requirements patterns clearly distinguished "primary" from "secondary" energy sectors; the former induced very little additional energy output given an increase of one BTU of final demand on the sector; the latter induced substantial amounts. As a specific case in point, estimated 1972 and projected 2000 requirements generated by a one BTU increase in Electricity from Fossil Fuel were as follows:

	1972	2000
Coal Mining	1.6018	1.8255
Crude Petroleum	0.2970	0.1571
Natural Gas Extraction	0.8399	0.6417
Gasoline	0.0084	0.0054
Jet Fuel	0.0129	0.0079
Kerosene	0.0002	0.0001
Distillate Fuel Oil	0.0558	0.0365
Residual Fuel Oil	0.5406	0.3114
LPG	0.0098	0.0039
All Other Petroleum Refining	0.0260	0.0157
Electricity, Fossil Fuel	1.0118	1.0096
Electricity, Nuclear Power	0.0003	0.0018
Electricity, Hydropower	0.0003	0.0002
Natural Gas Utilities	0.7816	0.6074

These results mean that the generation of an additional BTU of electricity caused the additional production of 1.6 BTU of coal in 1972, and a projected 1.8 BTU of coal in 2000; the additional extraction of 0.30 BTU of crude petroleum in 1972, and a projected amount of 0.16 in 2000; and so on. If we consider the sum of the induced BTU requirements for coal, residual oil, natural gas utilities, distillate oil, and jet fuel, we obtain 2.99 in 1972 and 2.79 in 2000, essentially what is to be expected given the current conversion rate of 3 BTU of input of fossil fuel to one BTU of output of electricity, and some pro-

jected increases in conversion efficiency from 1972 to 2000. (The latter involves both a projected general increase in efficiency from all fuels and a shift to coal, with higher conversion efficiency than oil and gas.) In the list of derived BTU direct and indirect requirements, there did appear to be some understatement of induced energy effects attributed to petroleum products, implying a topic for future inquiry. However, though refinement appears necessary, the general pattern of results does seem encouraging.

In an application of the input-output apparatus, it was asked whether motor vehicle manufactures' substitution of aluminum and plastics for iron and steel will cause increased electricity use to significantly erode mandated gasoline savings, and it was concluded that such erosion will not occur. In a final application, it was shown that imports and exports can themselves be treated as a form of final demand and multiplied by the inverse matrix to yield direct and indirect requirements associated with each category of use, in turn yielding estimates of all energy embodied in goods traded. The evidence suggests that U.S. imports of embodied energy are more than its exports but that the difference projected for 2000 is below that for 1972. (This application may be a useful innovation, and might be used to address other "embodiment" questions.) The application also considered U.S. "world requirements" which consisted not only of direct and indirect requirements imposed by final demand on the U.S. economy but also the direct and indirect requirements imposed by imports. The import requirements on the rest of the world are a relatively small part of the total, amounting to only 6 percent of that total in 1972, and 7 percent in 2000. (And, of course, they are essentially balanced by exports.) The work here, however, yielded the additional estimates of a decline in intensity of energy use to 0.6 the base level, both for all U.S. production requirements and for U.S. requirements on the world (direct and indirect). Parallel results were noted in the discussion of chapter 5. These results may seem surprising at first glance, since a reduction in intensity to 0.6 the base value was a minimum level that held only for gasoline and a number of uses of natural gas. However, the explanation probably lies in the concurrent increase in intensity of use of the output of several nonenergy sectors, such as computers, communications and business services, which would imply compensating reductions in the intensity of use of other sectors, including energy.

The substantive results of this work have included tables accounting for various kinds of requirements, and projections of the economy to the year 2000, with a focus on energy use. Several other aspects of our results seem note-

worthy. Input-output analysis can be applied to policy questions, but care must be exercised, for results can often be ambiguous, with additional information necessary before solid judgments can be reached. On the other hand, input-output analysis can be of great benefit in developing and organizing information that describes the structure of the economy in integrated and coherent fashion. This information then lends itself to many applications. In particular, and at the risk of unseemly self-congratulation, it seems likely there will be considerable scope for further applications of the RFF model and results.

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Chapter 2

DEVELOPMENT OF THE BASE (1972) INPUT-OUTPUT TABLES

2.1 OVERVIEW

The RFF base tables comprise the standard set of input-output tables, including a transactions or flow table, a technical coefficient matrix and an inverse matrix. The latter two tables are obtained, in sequence, directly from the flow table; hence, the construction of the flow table is the crucial step in the process of base table development. The base tables present the actual interrelations of the economy for an historical year and furnish the starting point for projections of future relationships. This chapter describes the development of those tables.

The RFF base flow table was derived from the U.S. Bureau of Economic Analysis (BEA) 1972 transactions table, and its construction involved three steps: (1) aggregation of nonenergy sectors, (2) disaggregations of energy sectors, and (3) construction of a commodity-by-commodity matrix by transforming an initial commodity-by-industry matrix. The BEA developed and published a 496 sector transactions table in its "Orange Book," The Detailed Input-Output Structure of the U.S. Economy: 1972, Vol. 1 (1), with all transactions in dollar terms, measured in units of one million dollars. The table exhibits transactions among 496 intermediate (or endogenous) sectors; flows into 11 final demand (or exogenous) sectors, which appear as column entries in the table; and flows originating from 7 exogenous sectors, which appear as row entries in the table. Personal consumption expenditures (PCE) is the most important of the exogenous column sectors, and value added is the most important of the exogenous row sectors. The full enumeration of the sectors defined by the BEA for its 496 sector table, and the corresponding Standard Industrial Classifiction (SIC) codes, is presented as appendix A of this report.

For the purposes of the present study, a table of about 100 sectors was seen as more manageable and more appropriate than the original 496 sector table, and aggregation was therefore carried out for the nonenergy sectors, comprising the bulk of the sectors in the BEA table. Level of energy use by individual sector

was a major criterion employed in the aggregation process. Data on energy use by sector and specifics on the application of the energy use criterion appear below, in section 2.2, and are amplified in appendix B. (The BEA also aggregated its 496 sector tables and published the corresponding 85 sector flow table, technical coefficient matrix and inverse matrix (2).)

In contrast to the treatment of nonenergy sectors, disaggregation was carried out for the BEA energy sectors. There were five energy "commodities" in the 496 sector table: coal mining; crude petroleum and natural gas extraction; petroleum refining; electric utilities; and natural gas utilities. Coal mining and natural gas utilities were retained as they appeared in the BEA table; crude petroleum and natural gas extraction were respectively treated as individual sectors; petroleum refining was disaggregated into seven product categories; and electricity was categorized into three sectors by source of power: fossil fuel, nuclear power and hydroelectric power. Asphalt and tar products are treated as related to petroleum refining in the Standard Industrial Classification and in the BEA tables; though not defined as energy sectors, those sectors were included here under the general heading of "Energy and Related Sectors". Details on the development of the energy sectors appear in section 2.3, below, and are amplified in appendixes C and D, which respectively cover construction of the petroleum products and the electricity sectors.

The BEA transactions table that appears in the BEA "Orange Book" consists of commodity-by-industry flows, that is, the flows of commodities into industries, where rows represent commodities and columns represent industries. The distinction arises because most industries produce more than one commodity, and most commodities are produced by more than one industry. Typically, however, the bulk of a given commodity will be produced by the corresponding industry. Thus, though the commodity "glass and glass products" is produced by 28 separate industries, the bulk of the commodity output of $3,529.1 million is produced by the "glass and glass products" industry, in the amount of $3,388.9 million. Further, that industry produces 18 different commodities, but its total sales of $3,453.0 million are predominantly the $3,388.9 million of the "glass and glass products" commodity (3).

Because industry and commodity typically are so nearly coincident, the BEA designates both by the same name and identifying number. Although reasonable, the common name and number for both commodity and industry can be a source of

confusion, so caution must be exercised in working with and referring to those categories.

There are a number of advantages in the use of a commodity-by-commodity matrix, which is a table purporting to show the flow of commodities into sectors that are also defined on a commodity basis. The BEA presents data on the "make" of commodities by industry, showing industries producing each commodity, and commodities produced by each industry, with dollar amounts given in each case. The information in the "make" table, in conjunction with some important assumptions, can be applied to convert the given commodity-by-industry matrix into the more useful commodity-by-commodity matrix. That application was carried out here, and is discussed in detail in section 2.4 below.

The outcome of the outlined steps is shown in the list on the following pages in terms of the sectoral taxonomy employed in the RFF input-output model. Individual sectors are designated by numbers in square brackets and by their assigned names. The sectors are grouped under these headings: I. Energy and Related; II. Agriculture, Forestry & Fisheries; III. Mining; IV. Construction and Related; V. Manufactures; VI. Transportation, Communication and Public Utilities; VII. Trade, Banking and Finance; VIII. Services; IX. Government Enterprises; X. Exogenous Sectors.

List of RFF Input-Output Sectors

No. RFF Sector Name

I. Energy and related sectors

[1] Coal mining
[2] Crude petroleum
[3] Natural gas extraction
[4] Gasoline
[5] Jet fuel
[6] Kerosene
[7] Distillate fuel oil
[8] Residual fuel oil
[9] LPG (Liquified Petroleum Gas)
[10] All other petroleum refining
[11] Asphalt and tar products
[12] Electricity, fossil fuel
[13] Electricity, nuclear power
[14] Electricity, hydropower
[15] Natural gas utilities

II. Agriculture, forestry & fisheries

[16] Meat animals
[17] Other livestock products
[18] Grains
[19] Other crops and ag. services
[20] Forestry and fisheries

III. Mining

[21] Iron mining
[22] Nonferrous metals mining
[23] Nonmetallic minerals mining

IV. Construction and related

IV-A. New construction
[24] New residential buildings
[25] Mobile homes
[26] New nonresidential buildings
[27] New energy activity structures
[28] New highways & streets
[29] All other new construction

IV-B. Maintenance and repair (M&R) construction
[30] M & R residential buildings
[31] M & R, nonresidential buildings
[32] M & R, energy activity structs.
[33] M & R, highways & streets
[34] All other M & R

V. Manufactures

V-A. Ordnance manufactures
[35] Ordnance

V-B. Food and kindred products
[36] Meat packing
[37] Distilling
[38] All other food & kindred

V-C. Tobacco manufactures
[39] Tobacco

V-D. Textiles and apparel mfg.
[40] Textiles
[41] Apparel

V-E. Wood and paper manufacture
[42] Logging and saw mills
[43] Other lumber and wood
[44] Household furniture
[45] Other furniture
[46] Pulp and paper mills
[47] Other paper products

V-F. Printing and publishing
[48] Printing and publishing

V-G. Chemicals, plastics, drugs, paints and rubber
[49] Chemicals
[50] Plastics materials
[51] Drugs
[52] Cleaning & toilet preps.
[53] Paints
[54] Rubber & plastic prods.

V-H. Leather manufactures
[55] Leather

V-I. Glass, stone & clay mfg.
[56] Glass
[57] Cement
[58] Other stone & clay

V-J. Primary metals mfg.
[59] Iron & steel mfg.
[60] Aluminum mfg.
[61] Other primary non-ferrous metals mfg.

V-L. Machinery mfg. (non-electrical)

[63] Machinery (non-electrical)

V-M. Electrical machinery mfg.

[64] Computing, electronics and related
[65] Refrigeration & heating eqpmt.
[66] Household appliances
[67] Electric lighting
[68] Radio, TV & communic. eqpmt.
[69] All other electric mach.

V-N. Transportation equipment mfg.

[70] Motor vehicles & parts
[71] Trucks, motorcycles & related
[72] Aircraft
[73] Other transportation eqpmt.

V-O. Other manufactures

[74] Scientific instruments & related
[75] Photographic equipment & supplies
[76] Jewelry
[77] Other miscellaneous mfg.

VI. Transportation, communication & public utilities

[78] Railroads
[79] Local, suburban & interurban trans.
[80] Trucking & warehousing
[81] Water transport
[82] Air transport
[83] Pipelines & other trans.
[84] Communications
[85] Water & sanitary service

VII. Trade, banking and finance

[86] Wholesale trade
[87] Retail trade
[88] Banking
[89] Other finance & insurance
[90] Owner occupied dwellings
[91] Real estate

VIII. Services

[92] Hotels
[93] Personal services
[94] Business services
[95] Eating & drinking places
[96] Auto repair
[97] Amusements
[98] Hospitals
[99] Other medical services
[100] Educational services
[101] Non-profit orgns.
[102] Social services

IX. Government enterprises

[103] Postal service & other fed. enterprises
[104] State & local enterprises

X. Exogenous sectors

X-A. Final demand sectors (columns)

[105] Personal conumption exp.
[106] Gross private domestic fixed invest.
[107] Change in inventories
[108] Exports
[109] Imports
[110] Federal govt. purchases, defense
[111] Federal govt. purchases, non-defense (& CCC)
[112] State & local, edu.
[113] State & local, other

X-B Value added et al. (rows)

[114] Noncomparable imports
[115] Scrap, used, etc.
[116] Balancing sectors, Rest of World, etc.
[117] Value added

In tabular form, the RFF flow table can now be represented in this fashion:

	[1]	[2]	. . .	[104]	[105]	. . .	[113]
[1]	x_{11}	x_{12}	. . .	$x_{1,104}$	$x_{1,105}$	. . .	$x_{1,113}$
[2]	x_{21}	x_{22}	. . .	$x_{2,104}$	$x_{2,105}$	. . .	$x_{2,113}$
.	.	.		.	.		.
.	.	.		.	.		.
.	.	.		.	.		.
[104]	$x_{104,1}$	$x_{104,2}$	. . .	$x_{104,104}$	$x_{104,105}$	. . .	$x_{104,113}$
[114]	$x_{114,1}$	$x_{114,2}$	. . .	$x_{114,104}$	$x_{114,105}$	. . .	$x_{114,113}$
.	.	.		.	.		.
.	.	.		.	.		.
.	.	.		.	.		.
[117]	$x_{117,1}$	$x_{117,2}$	. . .	$x_{117,104}$	$x_{117,105}$	. . .	$x_{117,113}$

where x_{ij} shows amount shipped from sector [i] to sector [j], with i = 1,2,...,104,114,...,117, and j=1,...,104,105,...,113. Sectors [1] through [104] are intermediate sectors; sectors [105] through [113] are final demand sectors; and sectors [114] through [117] are exogenous row sectors.

Now let the sum down a given column, j, be written $\sum_{i=1}^{117} x_{ij} \equiv X_j$, and the sum across a given row be written $\sum_{j=1}^{113} x_{ij} \equiv X_i$. The commodity-by-commodity flow table has the feature that $X_i = X_j$ for i=j, or total costs equal total output for a given sector, which is why the same symbol can be used for both row and column sum. The equality of row and column sum is of consequence in obtaining the technical coefficient and inverse matrix, and in using projected final demand to obtain projected output.

In particular, let $x_{ij}/X_j = a_{ij}$ for the intermediate sectors, i,j = 1,..., 104, and define:

$$A = \left\{ a_{ij} \right\} = \begin{bmatrix} a_{11} & \cdots & a_{1,104} \\ \vdots & & \vdots \\ a_{104,1} & \cdots & a_{104,104} \end{bmatrix}$$

where A is the technical coefficient matrix.

Next, define the elements (or row entries) of the final demand vector as $F_i = \sum_{j=105}^{113} x_{ij}$. It is now obvious that

$$\begin{bmatrix} a_{11} & \cdots & a_{1,104} \\ \vdots & & \vdots \\ a_{104,1} & \cdots & a_{104,104} \end{bmatrix} \begin{bmatrix} X_1 \\ \vdots \\ X_{104} \end{bmatrix} + \begin{bmatrix} F_1 \\ \vdots \\ F_{104} \end{bmatrix} = \begin{bmatrix} X_1 \\ \vdots \\ X_{104} \end{bmatrix}$$

or $AX + F = X$ where F is the final demand vector and X is a vector of outputs.

We can rewrite the expression as: $F = X - AX = (I - A)X$ where I is the identity matrix. Finally, solving for X yields: $X = (I - A)^{-1}F$ where $(I - A)^{-1}$ is the "matrix of total requirements, direct and indirect" per dollar of delivery to final demand, or the inverse matrix, for short. As is standard in input-output work, all values in all matrices are in producers' prices.

If we assume the technical coefficient matrix is unchanged as of a future period, we can forecast future X by replacing F with F*, projected final demand. More generally, we can account for expected changes in A, as well, by replacing A by A*, a projected technical coefficient matrix. Then projected X, or X*, is obtained as:

$$X^* = (I - A^*)^{-1}F^*$$

In the present case, both F* and A* are projected to the year 2000, and corresponding values of output are then obtained. Those projections are developed in later sections, while the remainder of this chapter is devoted to the details of the construction of the 1972 base matrices, focusing on the flow table. Sections 2.2 and 2.3 discuss the formation of the nonenergy and the energy sectors, respectively. Section 2.4 presents details on the construction of the flow table; given the flow table, the technical coefficient and inverse matrix are obtained directly, and are described in section 2.5. (The three tables appear explicitly in appendix E.)

In the discussion of the construction of the flow table, and more generally, throughout this report, there is reference both to RFF and BEA individual sectors. A detailed cross-classification of the two sets of sectors is therefore presented, appearing as an appendix to this chapter for ease of access. By convention, RFF sector numbers are exhibited within square brackets and BEA sector numbers within parentheses. (In addition to the cross-classification in the appendix to this chapter, appendix A enumerates and cross-classifies the BEA sectors with the corresponding Standard Industrial Classification codes, as defined by the U.S. Office of Management and Budget.)

2.2 FORMATION OF NONENERGY SECTORS BY AGGREGATION

In deciding which BEA sectors to aggregate under more inclusive headings, major energy users were generally retained as individual sectors in the classification. Major energy users were defined in terms of total dollars spent on all sources of energy. In addition, some attention was given to a sector's ratio of energy use to its total consumption, but this measure received much less weight in the decision process than total dollars spent.

Spending on all sources of energy was defined as the sum of expenditures on coal, crude petroleum and natural gas extraction; petroleum refining and related; electric utilities and natural gas utilities. Under this definition, total 1972 spending on energy for the economy as a whole was approximately $110 billion, in turn approximately 3.3 percent of spending on all inputs. Specific values were:

	Spending on energy		Spending on all inputs in million dollars	Energy as fraction of all inputs
	(In million dollars)	(Percent of total)		
Intermediate sectors	72,733.3	66.1	2,102,342.9	.0346
Final demand sectors	37,244.0	33.9	1,186,171.2	.0314
	109,977.3	100.0	3,288,514.1	.0334

The final demand figure excludes imports and exports with the aim of presenting levels of domestic consumption, regardless of source of supply. (Inclusion of foreign trade yields domestic supplies of commodities.)

Table 1 exhibits a ranking of the highest energy-using sectors in the BEA sectoral classification, covering the 50 highest energy consuming sectors, in rank order. Besides the dollar amount spent on energy, Table 1 shows each sector's energy consumption as a percentage of the total economy's expenditures on energy. (Appendix B amplifies this information.)

In the aggregation decisions, several other criteria were employed in addition to importance of energy consumption, including the following:

1) There was an effort to make the RFF tables consumption-oriented as well as energy-oriented. Thus, there was some attempt to define sectors that would correspond well to consumer expenditure categories. For example, Household Furniture was not aggregated with Office Furniture.

2) There was some attempt to recognize likely key sectors in technological advance.

3) The minimum output for an individual RFF sector was set at one billion dollars. Sectors with smaller outputs were aggregated into a larger sectoral grouping.

4) There was some attempt to establish conformity with the Standard Industrial Classification (SIC) system, particularly in manufactures. Thus, where other criteria permitted, there was an attempt to aggregate within SIC 3-digit codes. This was to facilitate forecasting, because more data are generally available at a 3-digit than at a 4-digit level.

Table 1

Fifty Highest Energy Using Sectors in BEA 1972 Table, in Rank Order
(Consuming Sector is Identified by BEA Number)

RANK	CONSUMING SECTOR		ENERGY CONSUMPTION (MILLION $)	PERCENT OF ALL SECTOR ENERGY CONSUMPTION
1	910000	PERSONAL CONSUMPTION EXPENDITURES	32403.0	29.4634
2	310100	PETROLEUM REFINING AND MISC. PROD.	17529.8	15.9395
3	680200	GAS PRODUCTION AND DISTRIBUTION(UTILITIES)	11189.5	10.1744
4	680100	ELECTRIC SERVICES(UTILITIES)	7310.5	6.6473
5	690200	RETAIL TRADE	2998.3	2.7263
6	370101	BLAST FURNACES AND STEEL MILLS	1680.3	1.5279
7	980000	STATE AND LOCAL GOVT. PURCHASES, EDUCATION	1618.5	1.4717
8	690100	WHOLESALE TRADE	1556.0	1.4148
9	790200	STATE AND LOCAL ELECTRIC UTILITIES	1207.5	1.0980
10	710200	REAL ESTATE	1193.5	1.0852
11	960000	FEDERAL GOVT. PURCHASES, NATIONAL DEFENSE	1175.6	1.0689
12	990000	STATE & LOC. GOVT. PURCH.,OTHER GEN. GOVT.	1160.0	1.0548
13	270100	INDUSTRIAL INORGANIC AND ORGANIC CHEMICALS	1100.6	1.0008
14	650500	AIR TRANSPORTATION	912.8	0.8300
15	080000	CRUDE PETROLEUM AND NATURAL GAS	858.3	0.7804
16	650300	MOTOR FREIGHT TRANSPORTATION, WAREHOUSING	841.5	0.7652
17	070000	COAL MINING	841.3	0.7650
18	110400	NEW HIGHWAYS AND STREETS	791.3	0.7195
19	740000	EATING AND DRINKING PLACES	624.5	0.5678
20	730100	MISCELLANEOUS BUSINESS SERVICES	551.9	0.5018
21	650100	RAILROADS AND RELATED SERVICES	533.6	0.4852
22	770200	HOSPITALS	531.6	0.4834
23	770500	NONPROFIT ORGANIZATIONS	504.4	0.4586
24	020202	FEED GRAINS	491.3	0.4467
25	720100	HOTELS AND LODGING PLACES	461.7	0.4198
26	790300	OTHER STATE AND LOCAL GOVT. ENTERPRISES	433.0	0.3937
27	240200	PAPER MILLS, EXCEPT BUILDING PAPER	380.9	0.3463
28	770400	EDUCATIONAL SERVICES	378.5	0.3442
29	720200	PERSONAL AND REPAIR SERVICES	364.8	0.3317
30	010301	MEAT ANIMALS	364.4	0.3313
31	650400	WATER TRANSPORTATION	342.2	0.3112
32	120100	MAINTENANCE AND REPAIR, RESIDENTIAL	315.7	0.2871
33	120214	MAINT., REPAIR HIGHWAYS AND STREETS	309.6	0.2815
34	750000	AUTOMOBILE REPAIR AND SERVICES	306.4	0.2786
35	380400	PRIMARY ALUMINUM	297.3	0.2703
36	120201	MAINT., REPAIR OTHER NONFARM BUILDINGS	291.1	0.2647
37	650200	LOCAL, SUB., INTERURBAN HWY. PASS. TRANSP.	289.9	0.2636
38	700100	BANKING	289.9	0.2636
39	240300	PAPERBOARD MILLS	278.2	0.2530
40	780200	FEDERAL ELECTRIC UTILITIES	274.0	0.2491
41	991000	STATE & LOCAL GOVT. HEALTH, WELF., SANIT.	261.1	0.2374
42	360100	CEMENT, HYDRAULIC	247.4	0.2250
43	310200	PAVING MIXTURES AND BLOCKS	244.9	0.2227
44	770300	OTHER MEDICAL AND HEALTH SERVICES	242.4	0.2204
45	970000	FEDERAL GOVERNMENT PURCHASES, NONDEFENSE	238.0	0.2164
46	110101	NEW RESIDENTIAL 1-UNIT STRUCTURES, NONFARM	232.5	0.2114
47	270201	NITROGENOUS AND PHOSPHATIC FERTILIZERS	226.9	0.2063
48	320400	MISCELLANEOUS PLASTICS PRODUCTS	208.1	0.1892
49	590302	MOTOR VEHICLE PARTS AND ACCESSORIES	206.9	0.1881
50	930000	CHANGE IN BUSINESS INVENTORIES	198.4	0.1804

Some of the major individual decisions in sector aggregation are now reviewed, using the grouping of sectors listed earlier in section 2.1. The discussion here can be further focused and placed in context by referring to the appendix to this chapter.

In RFF group I, Energy, BEA sectors (31.0200) and (31.0300) were combined because both primarily produced paving and roofing materials, involving asphalt and tar products (4); in addition, the total output of each BEA sector was under one billion dollars. The remaining sectors in group I either directly correspond to BEA sectors or are obtained by disaggregation of BEA sectors, as discussed in section 2.3 below.

In RFF group II, Agriculture, Forestry and Fisheries, the classification reflects high energy use by (01.0301) Meat Animals and (02.0202) Feed Grains. An examination of the BEA flow table showed that Food Grains had an input structure relatively close to that of Feed Grains, so the two sectors were combined into one category, labeled [8] Grains. Other classifications here allow for likely differences in demand elasticities between sectors, and possible differences in technological change.

In RFF group III, Mining, high energy consumption by Iron Mining (05.0000) and by Stone and Clay Mining (09.0000) implied the sectoral breakdown employed.

Several considerations affected decisions for RFF Group IV, Construction and Related. First, residential construction was set apart as a separate category to correspond to new housing purchases in consumption analysis, though it should be noted that the BEA treats both new residential construction and residential maintenance construction under the heading of Gross Private Domestic Investment. Again, Mobile Homes (61.0602) was perceived as a competitive form of housing and moved to the Construction Group. That sector's output is also treated as purchased by Investment (92.0000) rather than by Personal Consumption (91.0000). Finally, the other construction categories are keyed to energy relationships. New Highways and Streets and Maintenance of Highways and Streets were major energy consumers (ranking 18 and 33, respectively, in Table 1 above), as was Maintenance and Repair of Nonfarm Nonresidential Buildings (rank 36). In addition, it seemed useful to establish a separate sector for new energy activity structures (RFF sector [27]), which

includes oil and gas well exploration and drilling, and a sector for maintenance and repair of energy activity structures (RFF sector [32]).

RFF Group V covers manufacturing sectors at a somewhat higher level of aggregation than occurs for nonmanufacturing. This is documented as follows. The BEA input-output table contains 367 manufacturing sectors, accounting for 74 percent of the total of 496 intermediate sectors. However, manufactures output is 749.925 billion dollars, which is only 36 percent of total intermediate sector output of 2,102.343 billion dollars. In contrast, there are 43 manufacturing sectors in the RFF aggregated table, thus comprising 41 percent of the 104 intermediate sectors, a percentage that is close to the output percentage. This suggests the aggregation yields better proportional representation than the original BEA classification system.

Some of the considerations involved in the RFF manufactures classification can be briefly noted. In the Food and Kindred Group, Sector [36] Meat Packing, was defined because of heavy energy use; and Sector [37] Distilling, was set apart both to allow for possible expansion of ethanol production, and to establish a correspondence with the alcoholic beverage category appearing in consumption studies.

Textiles [40] and Apparel [41] were treated as separate categories because the latter set of commodities primarily comprises personal consumption goods. As noted earlier, a similar distinction occurred for [44] Household Furniture versus [45] Other Furniture.
The Wood and Paper manufacturing sectoring reflects high energy use by sector [42] Logging and Sawmills, and by sector [46] Pulp and Paper Mills.

In the BEA chemicals group, sector (27.0100) Industrial Chemicals, was a major energy user. However, separating that sector from the other chemical sectors seemed cumbersome, in terms of data coverage, particularly since (27.0100) accounted for about two-thirds of chemical industry output. Hence, the group was not disaggregated.

Drugs (29.0100) was treated as a separate RFF sector both for coordination with consumption forecasts and to allow for possible important technical changes in that industry.

Sector [57] Hydraulic Cement, was treated as a separate industry because of its high energy use, and because it seemed convenient to handle that sector separately from the broader Stone and Clay Products industry group.

In contrast (37.0101) Blast Furnaces and Steel Mills was a high energy user, but it was aggregated with the other Primary Iron and Steel manufacturing sectors to form [59], for ease of handling. Similarly, high energy use occurred for (38.0400) Primary Aluminum Production, but it seemed best, given data constraints, to aggregate that sector with (38.0800) and (38.1100), the other aluminum manufacturing sectors, to form RFF sector [60]. This corresponds to assuming an "integrated" industry, so that expansion of all components occurs in the same fashion. For [59] and [60], there was this distribution of energy and output levels by components:

Sector	Component	Energy use (million $)	Output (million $)	Energy divided by Output
[59]	Blast furnaces	1680.3	25,735.3	.0653
[59]	All other iron and steel	406.2	9,644.4	.0421
[60]	Primary aluminum	297.3	2,718.5	.1094
[60]	Other aluminum	125.5	4,786.5	.0262

From these data, it would appear that the Aluminum aggregation is more likely to cause difficulty than is that for Iron and Steel, given the variation in the energy use ratio.

A Computing, Electronics and Related Sector [64] was set up with technical change very much in mind. Sector [64] contains Office, Computing and Accounting Machines; Electronic Components and Accessories; and a number of other individual sectors, based on discussion in the SIC Manual (5).

The Photographic Equipment Sector [75] and Jewelry [76] were set up to facilitate personal consumption analysis.

The detailed breakdown of the transportation sectors, and the decision to retain wholesale and retail trade as separate sectors, reflected the high energy use of all of those sectors. Similarly, Banking and Real Estate were retained as individual sectors because of their high energy use. The Service Sector classification reflected both high energy use and convenience for personal consumption analysis. High energy using sectors included [97] Hospi-

tals; [98] Other Medical Services; [99] Educational Services; and [100] Non-profit Organizations.

The Commodity Credit Corporation (78.0300) was treated as a component of Final Demand under the heading of sector [110], Federal Government Purchases, Non-defense. This has the virtue of accounting for all commodity flows.

The Final Demand sectors paralleled those utilized by the BEA. There was an aggregation of some of the exogenous row sectors into sector [116] plus retention of Noncomparable Imports as [114], Scrap as [115] and Value Added as [117]. Sector [116] included Government Industry, Rest of World Industry, Household Industry and Inventory Valuation Adjustment.

2.3 FORMATION OF ENERGY SECTORS BY DISAGGREGATION

The Energy and Related Group encompasses Sectors [1] through [15] in the RFF table. Sectors [1] Coal, and [15] Natural Gas Utilities are exactly equivalent to corresponding BEA sectors (07.0000) and (68.0200), respectively. As noted earlier, [11] Asphalt and Tar Products was obtained as the sum of BEA (31.0200) and (31.0300). The remaining sectors in the Energy and related group were obtained through some involved disaggregation processes, discussed in detail in this section.

A major resource in the disaggregation was an unpublished energy "work file", obtained from the BEA, which contained detailed information on the underlying elements of the BEA energy sectors (6). The work file was drawn on in disaggregating Crude Petroleum and Natural Gas Extraction, and Petroleum Products, respectively yielding RFF sectors [2] and [3], and [4] through [10]. Electricity was disaggregated by fuel type, with sectors [12], [13] and [14] respectively accounting for electricity produced by fossil fuel, nuclear power and hydroelectric power. The formation of each set of energy sectors is now described, in turn.

2.3.1 Crude Petroleum and Natural Gas Extraction

BEA sector (08.0000) was disaggregated into component sectors [2] Crude Petroleum and [3] Natural Gas Extraction by the following steps.

The BEA Work File showed this initial distribution of items (products and activities), in million dollars:

Crude petroleum & natural gas (production total)	16,730.3
Total imports	-2,762.7
Crude petroleum	14,469.2
Natural gas	4,028.5
Natural gas liquids	879.2
Operating oil wells	14.0
Installing machinery	53.4
Inventory change	32.7
Contract work	11.6
Miscellaneous receipts	4.4

The sum of the positive consumption items (19,493.0) plus the negative item for imports (-2,762.7) yields the listed production total of 16,730.3. In the work file, those amounts were allocated to individual sectors as shown in Table 2. Sector (99.9999) is employed to indicate initially unidentified categories. BEA flow table entries (7) implied that the $112.4 million of shipments to (99.9999) were later allocated to (31.0100), increasing its total to $14,981.2 million.

The transactions of Table 2 were now assigned to sector [2] or sector [3] as sectors of origin, based on the following decisions.

Natural gas liquids (NGL) was treated as a component of crude petroleum, following the BEA definition of row flows as showing commodity rather than industry source of shipments; NGL consists of products obtained from processing of natural gas, including ethane, LPG and gasoline (8). The operating oil wells category was also treated as a component of crude petroleum, as was the "other" inventory change of $32.7 million, which appeared to account for inventory change other than that in natural gas.

The investment in installing machinery, amounting to a $53.4 million shipment to sector (92.0000), was distributed as 80.3 percent to [2] and 19.7 percent to [3] on the basis of direct sales to (31.0100) and (68.0200), respectively.

All of the imports of $2,762.7 million were allocated to petroleum products, given one explicit work file entry of $2,617.1 million of crude petroleum imports, and the apparent assignment of all natural gas imports of $347.1 million to sector (68.0200). These figures are in rough agreement with DOE data on imports (9).

Table 2

Shipments from Sector (08.0000), Crude Petroleum and Natural Gas, as Listed in Work File

Consuming sector	Crude petrol.	Natural gas	Nat. gas liquids	Operat. oil wells	Install mach.	All other or not identified	Total
08.0000	9.1	288.3	273.3	14.0	-	11.6	596.3
27.0100	45.4	-	-	-	-	-	45.4
27.0405	-	11.7	-	-	-	-	11.7
28.0100	-	-	10.0	-	-	-	10.0
30.0000	-	-	1.7	-	-	-	1.7
31.0100	14,382.6	-	486.2	-	-	-	14,868.8
65.0600	31.6	-	-	-	-	-	31.6
68.0200	-	3,685.9	-	-	-	-	3,685.9
92.0000	-	-	-	-	53.4	-	53.4
93.0000	-	42.6	-	-	-	32.7	75.3
94.0000	0.5	-	-	-	-	-	0.5
95.0000	-	-	-	-	-	-2,762.7	-2,762.7
99.9999	-	-	108.0	-	-	4.4	112.4
Total	14,469.2	4,028.5	879.2	14.0	53.4	-2,714.0	16,730.3

Table 3 shows the resulting allocations between [2] and [3], based on these decisions.

Besides accounting for shipments from sector [2] and [3] to all other industries, it was also necessary to account for shipments to sectors [2] and [3]. Here, it was first assumed that internal shipments went from disaggregated sector to itself and not to the other disaggregated sector, clarifying the first line of Table 3.

It was next assumed that, aside from each sector's shipments to itself, both [2] and [3] had the same technical coefficients, given absence of information on how cost structures actually varied. Corresponding flows were then derived so that the assumption in fact held. Some details are presented in section 2.4, below, because the specific operations involved are an extension of the process of obtaining the commodity-by-commodity matrix.

2.3.2 Petroleum Products

BEA sector (31.0100), Petroleum Refining and Miscellaneous Products of Petroleum and Coal, was disaggregated into the following sectors in the RFF table:

[4] Gasoline, including Motor Gasoline and Aviation Gasoline
[5] Jet Fuel
[6] Kerosene
[7] Distillate Fuel Oil
[8] Residual Fuel Oil
[9] LPG (liquified petroleum gases, excluding feedstock)
[10] All Other Petroleum products

There were around 2,500 observations in the Work File which were employed to estimate commodity flows from those seven sectors. A given observation in the work file included producer sector code, consumer sector code, product code, and amount consumed, in million dollars. In some cases, notes to clarify entries also appeared. However, there were some important gaps in the data, which were only partially closed by the BEA, and considerable effort in this study was devoted to closing those gaps.

Table 4 summarizes the 2,500 observations in the work file which express the flows from (31.0100) to specific consuming sectors, in terms of individual products of petroleum refining, consumption of those products, and problems in the form of gaps in the data. RFF sectors [4] through [9] correspond to the first seven products of table 4, with Aviation Gasoline and Motor Gasoline

Table 3

Shipments from Sector (08.0000) as Allocated to Obtain Shipments from RFF Sectors [2] and [3]

BEA Sector Number	RFF Sector Number [2] Crude petrol.	[3] Nat. gas	Total
08.0000	308.0	288.3	596.3
27.0100	45.4	-	45.4
27.0405	-	11.7	11.7
28.0100	10.0	-	10.0
30.0000	1.7	-	1.7
31.0100	14,981.2	-	14,981.2
65.0600	31.6	-	31.6
68.0200	-	3,685.9	3,685.9
92.0000	42.9	10.5	53.4
93.0000	32.7	42.6	75.3
94.0000	0.5	-	0.5
95.0000	-2,762.7	-	-2,762.7
Total	12,691.3	4,039.0	16,730.3

Table 4

1972 Value of Consumption of Specific Products of the Petroleum Refining Sector (31.0100), as Derived from BEA Energy Work File

Product	Product code (item)	Consumption in Million Dollars						
				Initial Unallocated				
				Group 1		Group 2		Group 3
		Total Consumption	Initial Allocated	Unallocated	Allocated	Unallocated	Allocated	Unallocated
Aviation gasoline	2911111	318.0	199.1	-	-	(118.9)	-	-
Motor gasoline	2911131	16,629.0	16,165.3	-	-	(463.7)	-	-
Jet fuel	29112	1,626.6	1,346.4	-	-	(280.2)	-	-
Kerosene	2911311	376.7	358.2	-	-	(18.5)	-	-
Distillate fuel oil	2911411	4,823.6	4,452.7	-	-	(370.9)	-	-
Residual fuel oil	29115	2,766.0	2,564.6	-	-	(201.4)	-	-
Liquified petroleum gases, excluding feedstock (LPG)	291166	1,078.9	1,078.4	-	-	(0.5)	-	-
		27,618.8	26,164.7	-	-	(1,454.1)	-	-
Unfinished oils & lube oil base stock	29118	1,053.2	213.6	-	-	(839.6)	-	-
Asphalt	29119	698.4	698.4	-	-	(0.0)	-	-
Petrolatum	2911011	20.0	4.6	-	-	(15.4)	-	-
Petroleum cope	2911021	122.3	95.8	-	-	(26.5)	-	-
Road oil	2911031	34.2	34.2	-	-	(0.0)	-	-
Still gas	2911041	16.8	0.0	-	-	(16.8)	-	-
Special napthas	2911051	84.2	73.6	-	-	(10.6)	-	-
Petroleum waxes	2911062	110.3	108.7	-	-	(1.6)	-	-
Other finished pet. products	2911098	107.7	47.9	-	-	(59.8)	-	-
Products of pet. ref. nsk*	2911001	50.4	4.6	-	-	(45.8)	-	-
		2,297.5	1,281.4	-	-	(1,016.1)	-	-
Lubricating & similar oil	2911721	1,407.8	478.5	(929.3)	-	-	-	-
Lubricating greases	2911731	126.1	66.7	(59.4)	-	-	-	-
Lube oil, grease nsk	2911700	109.9	0.0	(109.9)	-	-	-	-
		1,643.8	545.2					
Undistrib. lube oil, grease	29117	-	-	(1,098.6)	744.9	(353.7)	-	-
Unallocated petroleum ref.	2911	-	-	-	-	(2,823.9)	2,304.3	(519.6)
Net inventory change (1)	2911xxx	-155.2	-155.2	-	-	-	-	(0.0)
Contract work (1)	2911098	69.9	69.9	-	-	-	-	(0.0)
Miscellaneous receipts (1)	2911099	74.2	74.2	-	-	-	-	(0.0)
Net inventory change (2)	2992xxx	1.6	1.6	-	-	-	-	(0.0)
Contract work (2)	2992098	6.1	5.5	-	-	-	-	(0.6)
Misc. receipts (2)	2992099	1.0	0.0	-	-	-	-	(1.0)
Bricquettes	2999015	9.9	9.9	-	-	-	-	(0.0)
Other including colcined coke	2999098	120.0	110.2	-	-	-	-	(9.8)
Products of pet., coal nec, nsk*	2999001	9.5	0.1	-	-	-	-	(9.4)
Net inventory change (3)	2999xxx	0.2	0.2	-	-	-	-	(0.0)
Contract work (3)	2999098	0.6	0.1	-	-	-	-	(0.5)
Misc. receipts (3)	2999099	0.7	0.2	-	-	-	-	(0.5)
Secondary prod. adjustment	1000	-3.0	0.0	-	-	-	-	(-3.0)
		135.5	116.7					(18.8)
Final unallocated	—	-	-	-	-	-	-	(538.4)

*nsk - not specified by kind; nec - not elsewhere classified; -: not applicable.

aggregated to form sector [4]. All categories following LPG were assumed to be components of RFF sector [10], with the exception of net inventory change. The BEA consumption totals for each petroleum product sector were accepted as given "control totals"; to attain those control totals, it was necessary that net inventory change be allocated among all of the RFF petroleum product sectors, rather than being concentrated in [10]. The consumption totals, and corresponding levels of production, were as follows, in million dollars:

	Consumption	Imports	Production
[4] Gasoline	16,947.0	10.6	16,936.4
[5] Jet Fuel	1,626.6	245.1	1,381.5
[6] Kerosene	376.7	1.3	375.4
[7] Distillate	4,823.6	412.9	4,410.7
[8] Residual	2,766.0	1,658.8	1,107.2
[9] LPG	1,078.9	79.8	999.1
[10] All Other	4,076.8	459.8	3,617.0
	31,695.6	2,868.3	28,827.3

In this enumeration, production is obtained by subtracting imports from consumption.

The BEA carried out a partial closure of the gaps in its product data, and Table 4 can be used as a vehicle to review their gap-closing procedures.

Table 4 distinguishes between cases where both product and consuming sector were identified and cases where one or both of those elements were not known initially. The identified flows are summed, by product, under the column headed "Initial Allocated". The difference between total consumption and "Initial Allocated" is accounted for within three groups. The first group contained only lubricating oils and greases, amounting to $1,098 million. Of that amount, $744.9 million was distributed by BEA analytic decision to individual consuming sectors, leaving a remaining unallocated amount of $353.7 million, which was then transferred into group 2. Since lubricating oils are a component of RFF sector [10], the allocated $744.9 million automatically became part of the flow from sector [10]. Group 2 now contained the remaining unallocated lubricating oils and greases plus the initially unallocated portions of all the preceding products enumerated in table 4; the group 2 total was then $2,823.9 million, or roughly 10 percent of total shipments. Of that amount, the BEA analysis then identified $2,304.3 million as flowing into specific individual consuming sectors, though the products involved were <u>not</u> identified, i.e., group 2 output is an aggregate of products. The remaining unallocated amount in group 2 was now transferred to group 3, which also contained unal-

located amounts from the remaining product categories, which included net inventory change, contract work and miscellaneous products and receipts. The group 3 unallocated total of $538.4 million was not further allocated in the work file, i.e., this was a remaining residual not shown as flowing into individual sectors.

The RFF efforts to close the data gaps consisted of the following procedures. As a first step, the work file's identified flows from (31.0100) to consuming sector were summed by consuming sector and compared to the corresponding total flows into the respective sectors from (31.0100), as listed in the BEA 496 sector table (10). The differences between the two sets of total flows summed to the $538.4 million left unallocated in the work file, and consequently identified the individual sectors of Group 3 and the amounts of their consumption. Obviously, this identification picked up a final set of allocation decisions made by the BEA after the work file information was compiled.

The comparison also made explicit that, in the work file, flows into new and maintenance construction had been aggregated into an overall construction category (11.0000). Thus, in the construction of the RFF table there were three major problems in allocating the flow of petroleum products from (31.0100):

(1) disaggregating the construction flows;

(2) identifying the products involved in the flows to members of group 2 ($2,304.3 million in total); and

(3) identifying the products involved in the flows to members of group 3 ($538.4 million in total).

The solutions to those problems can be summarized as follows. Detail on the construction flows was obtained from unpublished BEA data (11) and used for the construction sectors in the RFF flow table. Identification of products for the group 2 cases could often be inferred from clues furnished by the notes in the work file. For the remaining cases in group 2, and those in group 3, the estimated distribution of products was based both on outside data plus constraints imposed by a concern for internal consistency. The outside data included energy sector data in input-output form appearing in two studies by Jack Faucett Associates (the GSA 35 sector table and the NEA 99 sector table) (12), (13); Bureau of Mines data (14), (15); and 1972 energy data appearing in Hoch (16). In some cases, a good deal of judgment was necessary to complete the estimating process. Thus, some allocations were made by matching of

product to sector characteristics and some special assumptions were necessary in the case of jet fuel, for which some anomalies occurred. It is clear that in many of the judgment cases, alternative assumptions would also be defensible. However, the final set of allocations seemed generally plausible and consistent, and the consequent flow table entries seemed well suited for purposes of forecasting future levels of use.

Those flow table entries, in the form of shipments to BEA consuming sector from each of the seven petroleum product sectors, appear as a table in Appendix C, while selected entries are shown in table 5, covering flows to BEA agricultural and final demand sectors. In both cases, rows and columns are transposed for ease of presentation. The appendix table was later aggregated to conform to the RFF sectoral definitions; however, it should be of use to input-output analysts carrying out alternative aggregations of the BEA tables. Appendix C also contains details on the solutions to the allocation problems which were summarized here.

The column entries for the seven petroleum product sectors were obtained in straightforward fashion by assuming that the technical coefficients for all petroleum products are the same, which is equivalent to arguing that the refinery process yielding petroleum products (per dollar of output) is the same for all products. This seems a reasonable first approximation to reality. Operationally, this assumption was imposed after the commodity-by-commodity matrix was obtained, so further detail is given in section 2.4 below. The experience with the current model suggests that in future work it will be useful to develop individual column estimates for the petroleum sectors' technical coefficients. However, because the present study disaggregates row flows, and because final demand projections for individual petroleum products are not proportional to base levels, the disaggregated model yields results that can not be obtained with an aggregated model, and it seems reasonable to view those results as improvements.

2.3.3 Electric Utility Sectors by Fuel Type

The BEA 496 sector base table contains one electric utility row, accounting for purchases of electricity by each sector, and three electric utility columns, accounting for inputs used in the production of electricity by private ties, the Federal Government, and State and Local Government, respectively. Following BEA convention, the row entries treat electricity as a commodity under the heading of sector (68.0100), while the column entries are interpreted

Table 5

Estimated Flows of Petroleum Products from Seven RFF Sectors to Selected Consuming Sectors (Agriculture and Final Demand), 1972, in Million Dollars

BEA CODE	CONSUMING SECTOR	PRODUCTS OF PETROLEUM REFINING (PRODUCING SECTORS)							
		4 GASO-LINE	5 JET FUEL	6 KERO-SENE	7 DISTIL-LATE	8 RESI-DUAL	9 LPG	10 ALL OTHER	TOTAL
010100	DAIRY FARM PRODUCTS	31.0	0.0	0.0	0.0	0.0	4.9	0.0	35.9
010200	POULTRY AND EGGS	9.9	0.0	0.0	1.3	0.0	12.5	0.1	23.8
010301	MEAT ANIMALS	67.0	0.0	0.0	39.3	0.0	3.8	6.9	117.0
010302	MISCELLANEOUS LIVESTOCK	2.7	0.0	0.0	2.0	0.0	0.5	0.4	5.6
020100	COTTON	13.7	0.0	0.0	27.1	0.0	2.1	4.8	47.7
020201	FOOD GRAINS	48.7	0.0	0.0	33.5	0.0	3.8	5.9	91.9
020202	FEED GRAINS	234.9	0.0	0.0	130.8	0.0	51.8	22.9	440.4
020203	GRASS SEEDS	3.0	0.0	0.0	1.0	0.0	0.3	0.2	4.5
020300	TOBACCO	4.8	0.0	0.0	6.1	0.0	9.9	0.3	21.1
020401	FRUITS	17.8	0.0	0.0	50.4	0.0	0.8	4.2	73.2
020402	TREE NUTS	3.6	0.0	0.0	3.8	0.0	0.0	0.0	7.4
020501	VEGETABLES	18.6	0.0	0.0	17.3	0.0	1.1	3.0	40.0
020502	SUGAR CROPS	4.2	0.0	0.0	7.6	0.0	0.5	1.5	13.8
020503	MISCELLANEOUS CROPS	1.4	0.0	0.0	1.1	0.0	0.3	0.2	3.0
020600	OIL BEARING CROPS	52.5	0.0	0.0	44.1	0.0	3.0	7.7	107.3
020701	FOREST PRODUCTS	1.8	0.0	0.0	1.4	0.0	0.4	0.3	3.9
020702	GREENHOUSE AND NURSERY PRODUCTS	9.6	0.0	0.0	10.4	0.0	1.8	1.2	23.0
030000	FORESTRY AND FISHERY PRODUCTS	47.3	0.0	1.3	0.5	0.0	0.0	0.0	49.1
040000	AGRIC.. FORESTRY. AND FISHERY SERVICES	52.5	0.0	0.0	14.5	0.0	4.3	0.2	71.5
910000	PERSONAL CONSUMPTION EXPENDITURES	11198.4	0.0	304.7	1500.2	0.0	343.8	155.6	13502.7
920000	GROSS PRIVATE DOMESTIC FIXED INVESTMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
930000	CHANGE IN BUSINESS INVENTORIES	37.8	158.6	0.0	-80.9	-51.4	0.0	-65.3	-1.2
940000	EXPORTS	3.4	130.3	0.7	1.4	133.7	37.9	391.0	698.4
950000	IMPORTS	-10.6	-245.1	-1.3	-412.9	-1658.8	-79.8	-459.8	-2868.3
960000	FEDERAL GOVT. PURCHASES. NATIONAL DEFENSE	121.1	367.0	1.3	77.1	75.4	0.0	39.7	681.6
970000	FEDERAL GOVERNMENT PURCHASES. NONDEFENSE	23.0	13.8	0.0	55.2	0.0	0.2	5.7	97.9
980000	STATE AND LOCAL GOVT. PURCHASES. EDUCATION	142.3	0.0	0.0	1.0	175.7	0.0	4.0	323.0
991000	STATE & LOCAL GOVT. HEALTH. WELF.. SANIT.	59.8	0.0	0.0	36.4	9.9	0.0	0.0	106.1
992000	STATE AND LOCAL GOVT. PURCHASES. SAFETY	64.5	5.3	0.0	0.0	0.0	0.0	0.0	69.8
993000	STATE & LOC. GOVT. PURCH..OTHER GEN. GOVT.	158.9	0.0	0.0	83.5	0.0	0.0	0.0	242.4
ROW TOTALS		16936.3	1381.5	375.4	4410.6	1107.2	999.1	3616.9	28827.0

as purchases by the three respective industries: sectors (68.0100), (78.0200), and (79.0200). If treated in standard fashion, a conversion of the base table to a commodity-by-commodity table would yield one row and one column for electricity.

However, data developed by Nancy Simon of BEA allowed the disaggregation of inputs used in producing electricity into inputs for fossil fuel production, nuclear power production, hydroelectric power production and transmission and distribution. Simon's work is summarized in (17); results in that publication correspond to the BEA aggregate tables employing 85 sectors (18). In turn, those results draw on 496 sector tables corresponding to the BEA base tables, and presented in an unpublished document (19). Those latter tables were utilized here. Simon began with the input flows into the three electricity sectors in the 496 sector study, and those data are presented here as table 6 for their general interest. Each column of table 6 is then disaggregated into use in fossil fuel production, nuclear fuel production, hydroelectric production, transmission and distribution and other activities (accounting for nonelectricity production by the TVA). Tables showing those disaggregated flows appear in Appendix D.

The information in the disaggregated tables was then recombined by summing over all forms of ownership to yield inputs by source of power, as shown in detail in table 7 and in summary form in table 8, which shows totals for intermediate inputs, value added and all inputs, displaying those measures in a cross-classification by type of power and form of ownership.

The transmission and distribution component shown in table 7 was apportioned to the three fuel subsectors on the basis of the relative share of each fuel use in production, as shown in the total inputs entries in table 8. Those entries and corresponding shares of total were:

	Amounts in million dollars			Fraction of Total		
	Private	Federal	State & Local	Private	Federal	State & Local
Fossil fuel	15,321.1	639.8	1991.8	.94287	.89822	.92944
Nuclear fuel	475.6	0.0	31.0	.02927	.00000	.01447
Hydroelectric	452.7	72.5	120.2	.02786	.10178	.05609
Total	16,249.4	712.3	2143.0	1.00000	1.00000	1.00000

Table 6

The Use of Commodities by All Electric Utility Sectors and Their Distribution by Form of Ownership, 1972, in Million Dollars

BEA code	BEA Sector	Total use	Private utilities	Federal govt. utilities	State & local govt. utilities
20401	FRUITS	0.3	0.3	0.0	0.0
20702	GREENHOUSE AND NURSERY PRODUCTS	2.8	2.8	0.0	0.0
40000	AGRIC., FORESTRY, AND FISHERY SERVICES	92.6	82.0	0.0	10.6
70000	COAL MINING	2613.1	2308.3	170.3	134.5
100000	CHEMICAL AND FERTILIZER MINERAL MINING	2.4	0.0	2.4	0.0
120206	MAINT., REPAIR ELECTRIC UTILITY FACILITIES	1384.7	1213.2	0.0	171.5
120213	MAINT., REPAIR CONSERV. & DEVELOP. FACILS.	79.2	0.0	79.2	0.0
130500	SMALL ARMS	0.1	0.1	0.0	0.0
140101	MEAT PACKING PLANTS	0.4	0.4	0.0	0.0
140102	SAUSAGES AND OTHER PREPARED MEATS	0.3	0.3	0.0	0.0
140103	POULTRY DRESSING PLANTS	0.3	0.3	0.0	0.0
142001	CONFECTIONERY PRODUCTS	0.6	0.5	0.0	0.1
142103	WINES, BRANDY, AND BRANDY SPIRITS	0.7	0.7	0.0	0.0
142104	DISTILLED LIQUOR, EXCEPT BRANDY	2.0	1.7	0.2	0.1
150101	CIGARETTES	1.0	0.8	0.1	0.1
150102	CIGARS	0.1	0.1	0.0	0.0
170200	FELT GOODS, N.E.C.	0.7	0.0	0.0	0.7
180400	APPAREL MADE FROM PURCHASED MATERIALS	12.5	7.7	0.1	4.7
240200	PAPER MILLS, EXCEPT BUILDING PAPER	2.4	0.1	1.4	0.9
240300	PAPERBOARD MILLS	0.5	0.0	0.0	0.5
240400	ENVELOPES	5.4	4.2	0.3	0.9
240500	SANITARY PAPER PRODUCTS	2.0	1.6	0.1	0.3
240701	PAPER COATING AND GLAZING	4.0	3.7	0.1	0.2
240703	DIE-CUT PAPER AND BOARD	8.7	8.0	0.3	0.4
240704	PRESSED AND MOLDED PULP GOODS	0.2	0.0	0.0	0.2
240705	STATIONERY PRODUCTS	1.6	1.5	0.0	0.1
240706	CONVERTED PAPER PRODUCTS, N.E.C.	2.4	2.2	0.1	0.1
260200	PERIODICALS	1.4	1.1	0.1	0.2
260301	BOOK PUBLISHING	1.8	0.4	0.2	1.2
260400	MISCELLANEOUS PUBLISHING	8.6	7.8	0.4	0.4
260501	COMMERCIAL PRINTING	20.5	10.3	0.9	9.3
260601	MANIFOLD BUSINESS FORMS	33.3	31.7	0.5	1.1
260602	BLANKBOOKS AND LOOSELEAF BINDERS	6.5	6.0	0.2	0.3
260801	ENGRAVING AND PLATE PRINTING	2.0	1.9	0.0	0.1
270100	INDUSTRIAL INORGANIC AND ORGANIC CHEMICALS	24.8	23.5	1.2	0.1
270300	AGRICULTURAL CHEMICALS, N.E.C.	0.2	0.0	0.0	0.2
270402	ADHESIVES AND SEALANTS	0.4	0.4	0.0	0.0
270406	CHEMICAL PREPARATIONS, N.E.C.	92.5	84.5	3.1	4.9
290100	DRUGS	0.9	0.0	0.0	0.9
290201	SOAP AND OTHER DETERGENTS	1.7	0.0	0.1	1.6
290202	POLISHES AND SANITATION GOODS	0.9	0.0	0.2	0.7
290203	SURFACE ACTIVE AGENTS	0.9	0.0	0.0	0.9
310100	PETROLEUM REFINING AND MISC. PROD.	1424.5	1325.9	0.6	98.0
320100	TIRES AND INNER TUBES	9.9	8.8	0.0	1.1
320302	FABRICATED RUBBER PRODUCTS, N.E.C.	7.5	7.5	0.0	0.0
320400	MISCELLANEOUS PLASTICS PRODUCTS	0.1	0.1	0.0	0.0
320500	RUBBER AND PLASTICS HOSE AND BELTING	24.5	24.5	0.0	0.0
340302	LUGGAGE	0.3	0.3	0.0	0.0
340304	PERSONAL LEATHER GOODS	0.2	0.2	0.0	0.0
340305	LEATHER GOODS, N.E.C.	0.1	0.1	0.0	0.0
350100	GLASS & GLASS PRODUCTS, EXCEPT CONTAINERS	2.4	0.7	0.1	1.6
360100	CEMENT, HYDRAULIC	3.5	3.5	0.0	0.0
360900	POTTERY PRODUCTS, N.E.C.	0.1	0.1	0.0	0.0
361800	GASKETS, PACKING AND SEALING DEVICES	0.1	0.1	0.0	0.0
370101	BLAST FURNACES AND STEEL MILLS	5.0	5.0	0.0	0.0
370103	STEEL WIRE AND RELATED PRODUCTS	0.3	0.3	0.0	0.0
381000	NONFERROUS WIRE DRAWING AND INSULATING	10.2	10.2	0.0	0.0
410203	METAL STAMPINGS, N.E.C.	0.3	0.0	0.0	0.3
420201	HAND AND EDGE TOOLS, N.E.C.	2.2	2.2	0.0	0.0
420500	MISCELLANEOUS FABRICATED WIRE PRODUCTS	3.3	3.3	0.0	0.0
430100	STEAM ENGINES AND TURBINES	85.6	77.2	2.2	6.2
430200	INTERNAL COMBUSTION ENGINES, N.E.C.	17.9	17.9	0.0	0.0
490200	BALL AND ROLLER BEARINGS	8.8	8.8	0.0	0.0
490300	BLOWERS AND FANS	2.5	2.5	0.0	0.0

Table 6 (continued)

BEA code	BEA Sector	Total use	Private utilities	Federal govt. utilities	State & local govt. utilities
490700	GENERAL INDUSTRIAL MACHINERY, N.E.C.	9.3	9.3	0.0	0.0
500001	CARBURETORS, PISTONS, RINGS, VALVES	0.3	0.0	0.0	0.3
500002	MACHINERY, EXCEPT ELECTRICAL, N.E.C.	1.0	0.0	0.0	1.0
510101	ELECTRONIC COMPUTING EQUIPMENT	5.1	5.1	0.0	0.0
510400	OFFICE MACHINES, N.E.C.	0.5	0.5	0.0	0.0
530100	INSTRUMENTS TO MEASURE ELECTRICITY	2.8	2.8	0.0	0.0
530200	TRANSFORMERS	18.6	18.6	0.0	0.0
530300	SWITCHGEAR AND SWITCHBOARD APPARATUS	0.5	0.5	0.0	0.0
530700	CARBON AND GRAPHITE PRODUCTS	3.5	3.5	0.0	0.0
540400	ELECTRIC HOUSEWARES AND FANS	0.1	0.1	0.0	0.0
550100	ELECTRIC LAMPS	52.1	47.8	0.0	4.3
560100	RADIO AND TV RECEIVING SETS	0.7	0.6	0.0	0.1
570300	ELECTRONIC COMPONENTS, N.E.C.	1.0	1.0	0.0	0.0
580100	STORAGE BATTERIES	1.1	0.6	0.0	0.5
580300	X-RAY APPARATUS AND TUBES	0.7	0.0	0.0	0.7
580400	ENGINE ELECTRICAL EQUIPMENT	0.1	0.1	0.0	0.0
590302	MOTOR VEHICLE PARTS AND ACCESSORIES	9.0	5.2	0.1	3.7
610700	TRANSPORTATION EQUIPMENT, N.E.C.	2.3	2.3	0.0	0.0
620100	ENGINEERING AND SCIENTIFIC INSTRUMENTS	0.3	0.0	0.0	0.3
620200	MECHANICAL MEASURING DEVICES	1.5	1.2	0.0	0.3
620500	SURGICAL APPLIANCES AND SUPPLIES	0.7	0.0	0.0	0.7
620700	WATCHES, CLOCKS, AND PARTS	0.1	0.1	0.0	0.0
630300	PHOTOGRAPHIC EQUIPMENT AND SUPPLIES	11.6	11.0	0.3	0.3
640101	JEWELRY, PRECIOUS METAL	0.2	0.2	0.0	0.0
640104	SILVERWARE AND PLATED WARE	0.1	0.1	0.0	0.0
640400	SPORTING AND ATHLETIC GOODS, N.E.C.	0.5	0.4	0.0	0.1
640501	PENS AND MECHANICAL PENCILS	1.2	1.1	0.0	0.1
640502	LEAD PENCILS AND ART GOODS	1.8	1.6	0.1	0.1
640503	MARKING DEVICES	4.7	4.3	0.2	0.2
640504	CARBON PAPER AND INKED RIBBONS	6.1	5.7	0.2	0.2
640800	BROOMS AND BRUSHES	0.2	0.0	0.0	0.2
650100	RAILROADS AND RELATED SERVICES	240.4	157.2	45.9	37.3
650200	LOCAL, SUB., INTERURBAN HWY. PASS. TRANSP.	6.5	6.1	0.1	0.3
650300	MOTOR FREIGHT TRANSPORTATION, WAREHOUSING	190.9	141.9	19.3	29.7
650400	WATER TRANSPORTATION	65.1	52.2	6.0	6.9
650500	AIR TRANSPORTATION	18.9	12.2	0.5	6.2
650600	PIPE LINES, EXCEPT NATURAL GAS	6.4	5.6	0.3	0.5
650700	TRANSPORTATION SERVICES	0.2	0.2	0.0	0.0
660000	COMMUNICATIONS, EXCEPT RADIO AND TV	142.4	128.0	2.7	11.7
680100	ELECTRIC SERVICES(UTILITIES)	3528.3	2542.9	96.8	888.6
680200	GAS PRODUCTION AND DISTRIBUTION(UTILITIES)	1226.1	1133.4	6.3	86.4
680300	WATER SUPPLY AND SANITARY SERVICES	38.2	38.2	0.0	0.0
690100	WHOLESALE TRADE	400.2	364.3	5.8	30.1
690200	RETAIL TRADE	15.0	14.9	0.0	0.1
700100	BANKING	112.7	110.6	0.0	2.1
700200	CREDIT AGENCIES	6.3	6.3	0.0	0.0
700300	SECURITY AND COMMODITY BROKERS	199.5	178.5	0.0	21.0
700400	INSURANCE CARRIERS	56.0	51.4	0.1	4.5
710200	REAL ESTATE	362.9	349.7	8.2	5.0
720100	HOTELS AND LODGING PLACES	12.1	11.6	0.1	0.4
720200	PERSONAL AND REPAIR SERVICES	181.0	176.0	0.0	5.0
730100	MISCELLANEOUS BUSINESS SERVICES	410.0	375.5	10.7	23.8
730200	ADVERTISING	56.5	55.2	0.0	1.3
730300	MISCELLANEOUS PROFESSIONAL SERVICES	105.9	93.3	0.4	12.2
740000	EATING AND DRINKING PLACES	105.2	96.4	2.9	5.9
750000	AUTOMOBILE REPAIR AND SERVICES	91.0	90.6	0.4	0.0
760100	MOTION PICTURES	4.5	4.4	0.1	0.0
760200	AMUSEMENT AND RECREATION SERVICES	1.9	1.7	0.1	0.1
770200	HOSPITALS	0.8	0.0	0.0	0.8
770400	EDUCATIONAL SERVICES	1.9	1.2	0.2	0.5
770500	NONPROFIT ORGANIZATIONS	11.5	11.2	0.3	0.0
780100	U.S. POSTAL SERVICE	101.6	94.1	0.3	7.2
790300	OTHER STATE AND LOCAL GOVT. ENTERPRISES	5.7	5.3	0.0	0.4
800000	NONCOMPARABLE IMPORTS	7.3	6.3	0.5	0.5
810000	SCRAP, USED, AND SECONDHAND GOODS	0.2	0.2	0.0	0.0

Table 7

The Use of Commodities by All Electric Utility Sectors and Their Distribution by Type of Production, 1972, in Million Dollars

BEA Code	BEA Sector	Total use	Fossil fuel prodn.	Nuclear fuel prodn.	Hydro-electric prodn.	Transm. and Distn.	Other activities (TVA)
20401	FRUITS	0.3	0.0	0.0	0.0	0.3	0.0
20702	GREENHOUSE AND NURSERY PRODUCTS	2.8	0.4	0.1	0.2	2.1	0.0
40000	AGRIC., FORESTRY, AND FISHERY SERVICES	92.6	0.4	0.0	0.1	92.1	0.0
70000	COAL MINING	2613.1	2613.1	0.0	0.0	0.0	0.0
100000	CHEMICAL AND FERTILIZER MINERAL MINING	2.4	0.0	0.0	0.0	0.0	2.4
120206	MAINT., REPAIR ELECTRIC UTILITY FACILITIES	1384.7	592.6	20.9	18.4	752.8	0.0
120213	MAINT., REPAIR CONSERV. & DEVELOP. FACILS.	79.2	51.1	0.0	7.8	20.3	0.0
130500	SMALL ARMS	0.1	0.0	0.0	0.0	0.1	0.0
140101	MEAT PACKING PLANTS	0.4	0.0	0.0	0.0	0.4	0.0
140102	SAUSAGES AND OTHER PREPARED MEATS	0.3	0.0	0.0	0.0	0.3	0.0
140103	POULTRY DRESSING PLANTS	0.3	0.0	0.0	0.0	0.3	0.0
142001	CONFECTIONERY PRODUCTS	0.6	0.0	0.0	0.0	0.6	0.0
142103	WINES, BRANDY, AND BRANDY SPIRITS	0.7	0.0	0.0	0.0	0.7	0.0
142104	DISTILLED LIQUOR, EXCEPT BRANDY	2.0	0.0	0.0	0.0	2.0	0.0
150101	CIGARETTES	1.0	0.0	0.0	0.0	1.0	0.0
150102	CIGARS	0.1	0.0	0.0	0.0	0.1	0.0
170200	FELT GOODS, N.E.C.	0.7	0.5	0.0	0.0	0.2	0.0
180400	APPAREL MADE FROM PURCHASED MATERIALS	12.5	4.7	0.4	0.1	7.3	0.0
240200	PAPER MILLS, EXCEPT BUILDING PAPER	2.4	0.5	0.1	0.3	1.5	0.0
240300	PAPERBOARD MILLS	0.5	0.1	0.0	0.0	0.4	0.0
240400	ENVELOPES	5.4	1.5	0.2	0.2	3.5	0.0
240500	SANITARY PAPER PRODUCTS	2.0	0.6	0.0	0.0	1.4	0.0
240701	PAPER COATING AND GLAZING	4.0	1.2	0.1	0.1	2.6	0.0
240703	DIE-CUT PAPER AND BOARD	8.7	2.6	0.2	0.2	5.7	0.0
240704	PRESSED AND MOLDED PULP GOODS	0.2	0.1	0.0	0.0	0.1	0.0
240705	STATIONERY PRODUCTS	1.6	0.4	0.0	0.0	1.2	0.0
240706	CONVERTED PAPER PRODUCTS, N.E.C.	2.4	0.8	0.0	0.0	1.6	0.0
260200	PERIODICALS	1.4	0.6	0.0	0.0	0.8	0.0
260301	BOOK PUBLISHING	1.8	0.5	0.0	0.0	1.3	0.0
260400	MISCELLANEOUS PUBLISHING	8.6	6.6	0.1	0.2	1.7	0.0
260501	COMMERCIAL PRINTING	20.5	8.8	1.7	1.9	8.1	0.0
260601	MANIFOLD BUSINESS FORMS	33.3	10.6	0.4	0.4	21.9	0.0
260602	BLANKBOOKS AND LOOSELEAF BINDERS	6.5	2.1	0.1	0.0	4.3	0.0
260801	ENGRAVING AND PLATE PRINTING	2.0	0.6	0.0	0.0	1.4	0.0
270100	INDUSTRIAL INORGANIC AND ORGANIC CHEMICALS	24.8	0.4	22.9	0.0	0.3	1.2
270300	AGRICULTURAL CHEMICALS, N.E.C.	0.2	0.0	0.0	0.0	0.2	0.0
270402	ADHESIVES AND SEALANTS	0.4	0.2	0.0	0.0	0.2	0.0
270406	CHEMICAL PREPARATIONS, N.E.C.	92.5	89.7	2.5	0.0	0.3	0.0
290100	DRUGS	0.9	0.2	0.2	0.1	0.4	0.0
290201	SOAP AND OTHER DETERGENTS	1.7	0.6	0.2	0.2	0.7	0.0
290202	POLISHES AND SANITATION GOODS	0.9	0.2	0.0	0.0	0.7	0.0
290203	SURFACE ACTIVE AGENTS	0.9	0.1	0.1	0.0	0.7	0.0
310100	PETROLEUM REFINING AND MISC. PROD.	1424.5	1394.1	2.0	1.3	27.1	0.0
320100	TIRES AND INNER TUBES	9.9	4.1	0.6	0.4	4.8	0.0
320302	FABRICATED RUBBER PRODUCTS, N.E.C.	7.5	6.3	0.0	0.0	1.2	0.0
320400	MISCELLANEOUS PLASTICS PRODUCTS	0.1	0.0	0.0	0.0	0.1	0.0
320500	RUBBER AND PLASTICS HOSE AND BELTING	24.5	24.4	0.0	0.0	0.1	0.0
340302	LUGGAGE	0.3	0.0	0.0	0.0	0.3	0.0
340304	PERSONAL LEATHER GOODS	0.2	0.0	0.0	0.0	0.2	0.0
340305	LEATHER GOODS, N.E.C.	0.1	0.0	0.0	0.0	0.1	0.0
350100	GLASS & GLASS PRODUCTS, EXCEPT CONTAINERS	2.4	1.3	0.1	0.1	0.9	0.0
360100	CEMENT, HYDRAULIC	3.5	0.5	3.0	0.0	0.0	0.0
360900	POTTERY PRODUCTS, N.E.C.	0.1	0.0	0.0	0.0	0.1	0.0
361800	GASKETS, PACKING AND SEALING DEVICES	0.1	0.0	0.0	0.0	0.1	0.0
370101	BLAST FURNACES AND STEEL MILLS	5.0	2.0	3.0	0.0	0.0	0.0
370103	STEEL WIRE AND RELATED PRODUCTS	0.3	0.1	0.0	0.0	0.2	0.0
381000	NONFERROUS WIRE DRAWING AND INSULATING	10.2	0.0	0.0	0.0	10.2	0.0
410203	METAL STAMPINGS, N.E.C.	0.3	0.1	0.0	0.0	0.2	0.0
420201	HAND AND EDGE TOOLS, N.E.C.	2.2	0.0	0.0	0.0	2.2	0.0
420500	MISCELLANEOUS FABRICATED WIRE PRODUCTS	3.3	3.2	0.0	0.0	0.1	0.0
430100	STEAM ENGINES AND TURBINES	85.6	79.3	2.0	4.3	0.0	0.0
430200	INTERNAL COMBUSTION ENGINES, N.E.C.	17.9	17.9	0.0	0.0	0.0	0.0
490200	BALL AND ROLLER BEARINGS	8.8	8.8	0.0	0.0	0.0	0.0

Table 7 (continued)

BEA Code	BEA Sector	Total use	Fossil fuel prodn.	Nuclear fuel prodn.	Hydro-electric prodn.	Transm. and Distn.	Other activities (TVA)
490300	BLOWERS AND FANS	2.5	2.5	0.0	0.0	0.0	0.0
490700	GENERAL INDUSTRIAL MACHINERY, N.E.C.	9.3	6.5	1.9	0.9	0.0	0.0
500001	CARBURETORS, PISTONS, RINGS, VALVES	0.3	0.1	0.0	0.0	0.2	0.0
500002	MACHINERY, EXCEPT ELECTRICAL, N.E.C.	1.0	0.4	0.1	0.1	0.4	0.0
510101	ELECTRONIC COMPUTING EQUIPMENT	5.1	1.8	0.2	0.1	3.0	0.0
510400	OFFICE MACHINES, N.E.C.	0.5	0.2	0.0	0.0	0.3	0.0
530100	INSTRUMENTS TO MEASURE ELECTRICITY	2.8	1.0	0.0	0.0	1.8	0.0
530200	TRANSFORMERS	18.6	0.0	0.0	0.0	18.6	0.0
530300	SWITCHGEAR AND SWITCHBOARD APPARATUS	0.5	0.0	0.0	0.0	0.5	0.0
530700	CARBON AND GRAPHITE PRODUCTS	3.5	0.0	0.0	0.0	3.5	0.0
540400	ELECTRIC HOUSEWARES AND FANS	0.1	0.0	0.0	0.0	0.1	0.0
550100	ELECTRIC LAMPS	52.1	9.6	0.4	7.4	34.7	0.0
560100	RADIO AND TV RECEIVING SETS	0.7	0.0	0.0	0.0	0.7	0.0
570300	ELECTRONIC COMPONENTS, N.E.C.	1.0	0.3	0.0	0.0	0.7	0.0
580100	STORAGE BATTERIES	1.1	0.3	0.1	0.0	0.7	0.0
580300	X-RAY APPARATUS AND TUBES	0.7	0.2	0.0	0.1	0.4	0.0
580400	ENGINE ELECTRICAL EQUIPMENT	0.1	0.0	0.0	0.0	0.1	0.0
590302	MOTOR VEHICLE PARTS AND ACCESSORIES	9.0	3.7	0.6	0.2	4.5	0.0
610700	TRANSPORTATION EQUIPMENT, N.E.C.	2.3	2.3	0.0	0.0	0.0	0.0
620100	ENGINEERING AND SCIENTIFIC INSTRUMENTS	0.3	0.2	0.1	0.0	0.0	0.0
620200	MECHANICAL MEASURING DEVICES	1.5	0.9	0.3	0.2	0.1	0.0
620500	SURGICAL APPLIANCES AND SUPPLIES	0.7	0.1	0.0	0.0	0.6	0.0
620700	WATCHES, CLOCKS, AND PARTS	0.1	0.0	0.0	0.0	0.1	0.0
630300	PHOTOGRAPHIC EQUIPMENT AND SUPPLIES	11.6	3.6	0.0	0.3	7.7	0.0
640101	JEWELRY, PRECIOUS METAL	0.2	0.0	0.0	0.0	0.2	0.0
640104	SILVERWARE AND PLATED WARE	0.1	0.0	0.0	0.0	0.1	0.0
640400	SPORTING AND ATHLETIC GOODS, N.E.C.	0.5	0.0	0.0	0.0	0.5	0.0
640501	PENS AND MECHANICAL PENCILS	1.2	0.1	0.0	0.0	1.1	0.0
640502	LEAD PENCILS AND ART GOODS	1.8	0.5	0.0	0.0	1.3	0.0
640503	MARKING DEVICES	4.7	1.4	0.1	0.1	3.1	0.0
640504	CARBON PAPER AND INKED RIBBONS	6.1	1.4	0.1	0.0	4.6	0.0
640800	BROOMS AND BRUSHES	0.2	0.1	0.0	0.0	0.1	0.0
650100	RAILROADS AND RELATED SERVICES	240.4	236.5	2.0	0.0	1.6	0.3
650200	LOCAL, SUB., INTERURBAN HWY. PASS. TRANSP.	6.5	3.7	0.1	0.0	2.7	0.0
650300	MOTOR FREIGHT TRANSPORTATION, WAREHOUSING	190.9	173.9	2.0	1.0	13.5	0.5
650400	WATER TRANSPORTATION	65.1	63.3	0.4	0.0	1.1	0.3
650500	AIR TRANSPORTATION	18.9	8.7	0.5	0.3	9.4	0.0
650600	PIPE LINES, EXCEPT NATURAL GAS	6.4	6.3	0.0	0.0	0.1	0.0
650700	TRANSPORTATION SERVICES	0.2	0.1	0.0	0.0	0.1	0.0
660000	COMMUNICATIONS, EXCEPT RADIO AND TV	142.4	60.6	1.6	1.7	78.5	0.0
680100	ELECTRIC SERVICES(UTILITIES)	3528.3	3519.3	0.0	0.0	9.0	0.0
680200	GAS PRODUCTION AND DISTRIBUTION(UTILITIES)	1226.1	1226.1	0.0	0.0	0.0	0.0
680300	WATER SUPPLY AND SANITARY SERVICES	38.2	18.3	1.3	8.3	10.3	0.0
690100	WHOLESALE TRADE	400.2	364.3	2.9	1.8	31.1	0.1
690200	RETAIL TRADE	15.0	5.1	0.3	0.3	9.3	0.0
700100	BANKING	112.7	89.4	1.1	0.8	21.4	0.0
700200	CREDIT AGENCIES	6.3	4.1	0.3	0.1	1.8	0.0
700300	SECURITY AND COMMODITY BROKERS	199.5	154.0	1.8	2.3	41.4	0.0
700400	INSURANCE CARRIERS	56.0	27.5	2.3	1.5	24.7	0.0
710200	REAL ESTATE	362.9	87.3	1.2	10.1	264.3	0.0
720100	HOTELS AND LODGING PLACES	12.1	7.2	0.3	0.1	4.5	0.0
720200	PERSONAL AND REPAIR SERVICES	181.0	16.9	1.2	1.2	161.7	0.0
730100	MISCELLANEOUS BUSINESS SERVICES	410.0	252.3	5.5	6.1	146.1	0.0
730200	ADVERTISING	56.5	0.0	0.0	0.0	56.5	0.0
730300	MISCELLANEOUS PROFESSIONAL SERVICES	105.9	79.3	1.9	2.0	22.7	0.0
740000	EATING AND DRINKING PLACES	105.2	58.7	2.0	1.5	43.0	0.0
750000	AUTOMOBILE REPAIR AND SERVICES	91.0	35.3	4.1	2.0	49.6	0.0
760100	MOTION PICTURES	4.5	1.9	0.0	0.0	2.6	0.0
760200	AMUSEMENT AND RECREATION SERVICES	1.9	0.1	0.0	0.0	1.8	0.0
770200	HOSPITALS	0.8	0.1	0.0	0.0	0.7	0.0
770400	EDUCATIONAL SERVICES	1.9	1.1	0.0	0.0	0.8	0.0
770500	NONPROFIT ORGANIZATIONS	11.5	9.1	0.0	0.1	2.3	0.0
780100	U.S. POSTAL SERVICE	101.6	9.1	0.7	0.9	90.9	0.0
790300	OTHER STATE AND LOCAL GOVT. ENTERPRISES	5.7	1.3	0.6	1.1	2.7	0.0
800000	NONCOMPARABLE IMPORTS	7.3	0.3	0.0	0.0	7.0	0.0
810000	SCRAP, USED, AND SECONDHAND GOODS	0.2	0.2	0.0	0.0	0.0	0.0

Table 8

Total Intermediate Inputs, Value Added and
Total Inputs for Electric Utility Sectors

BEA Sector and Type of Input		Fossil fuel prodn.	Nuclear fuel prodn.	Hydro-electric prodn.	Transm. and Distn.	Other activities (TVA)
Private electric utilities (68.0100)						
Intermediate inputs	11,747.6	9,626.6	89.4	67.0	1,964.6	-
Value added	15,679.1	5,694.5	386.2	385.7	9,212.7	-
Total inputs	27,426.7[a/]	15,321.1	475.6	452.7	11,177.3	-
Federal govt. elec. util. (78.0200)						
Intermediate inputs	473.4	425.0	-	11.7	31.9	4.8
Value added	501.3	214.6	-	60.8	213.3	12.6
Total inputs	974.7[a/]	639.8	-	72.5	245.2	17.4
State & local govt. elec. utils. (79.0200)						
Intermediate inputs	1,656.6	1,441.0	9.5	10.2	195.9	-
Value added	1,606.9	550.8	21.5	110.2	924.6	-
Total inputs	3,263.5[a/]	1,991.8	31.0	120.2	1,120.5	-
All sectors combined						
Intermediate inputs	13,877.6	11,492.6	98.9	88.9	2,192.4	4.8
Value added	17,787.3	6,459.9	407.7	556.5	10,350.6	12.6
Total inputs	31,664.9	17,952.7	506.6	645.4	12,543.0	17.4

[a/] Total use equals corresponding total for given sector in BEA 496-order I-O table.

The apportionment was carried out for each type of ownership. Thus, in the case of private ownership, row (12.0206) had a shipment of $654.5 million to Transmission and Distribution; this was distributed as $617.1, $19.2 and $18.2 million, respectively, to fossil fuel, nuclear and hydroelectric power by applying the corresponding scale factors for private ownership.

In the construction of the commodity-by-commodity matrix, electric utility row entries for each fuel type were obtained by scaling the row entry expressing all electricity use by each fuel type's fraction of output in 1972. This involves the assumption that all industries use different types of power in exactly the same proportion. This might be rationalized by arguing that, in effect, we have a national grid, with different types of power freely substitutable in use. An alternative approach would be to attempt a more realistic allocation, under the argument that different regions differ in dependence on nuclear and hydroelectric power, and that the distribution of industries differs between regions. However, the time and effort involved in accounting for such variations seemed prohibitive, in terms of the resources available for this project.

Because hydroelectric power tends to be located in areas of low cost electricity (particularly the Pacific Northwest), a lower price for electricity from hydroelectric power should (and does) prevail, even in a national input-output table. However, the extent of the price differential will be somewhat understated by our "national grid" assumption, given a disproportionate use of hydroelectric power in the production of aluminum, which is charged a low electricity price both because it is concentrated in areas of low cost electricity and because it uses so much electricity, given declining block pricing.

2.4 THE COMMODITY-BY-COMMODITY MATRIX

2.4.1 Background

The distinction between industries and commodities arises because most industries produce "secondary" products, and more generally, because classification systems in reality are seldom "watertight". Typically, a given industry produces the bulk of its primary product, and the bulk of what it produces is its primary product. The BEA furnishes detailed information showing how much of a given commodity is produced by the several industries that produce it, and how much of each commodity a given industry produces. That information can be used

to convert the BEA commodity-by-industry matrix to a commodity-by-commodity matrix, given the acceptance of some fairly strong assumptions.

There are 496 "industry/commodity" categories in the BEA flow table; these are exclusive of final demand categories. They consist of 494 intermediate industries, plus two commodities that are not industries: Noncomparable Imports (80.0000) and Scrap, Used and Second Hand Goods (81.0000). There are five industries which have no corresponding commodity, i.e., their production is entirely of "other" commodities. These include Forest Products (2.0701), the nonprivate electric utilities (78.0200) and (79.0200), the Commodity Credit Corporation (78.0300) and Local Government Passenger Transit (79.0100). Hence, there are 494 industries and 491 commodities, yielding 496 intermediate sectors, distributed as follows (20):

	No. of cases
Both commodity and industry:	489
Commodity only	2
Industry only	5
	496

The conversion of the commodity-by-industry transactions table to a commodity-by-commodity table yields a matrix where columns correspond to rows, and column totals equal row totals. It purports to show the commodity flows used in producing each commodity, rather than the commodity flows used by each industry. The commodity-by-commodity table is consistent with the standard development and interpretation of input-output tables; thus, costs equal output for each sector. Further, because there was some concern that an inverse using the commodity-by-industry matrix might lead to forecast error, and because the commodity-by-commodity matrix was particularly well adapted to some of our applications, it was our chosen instrument.

Although the BEA developed a commodity-by-commodity transactions table, it was not retained in machine readable form (21), and therefore we constructed such a table, which was essentially equivalent to reconstructing the earlier BEA table. At its fullest development, our table somewhat extended the earlier BEA table because it incorporated the disaggregated energy sectors.

Following this introductory section, section 2.4.2 discusses the general procedures involved in forming the commodity-by-commodity table, and establishes the consistency of our approach with that used by the BEA. Section 2.4.3 expands on a technical issue in handling the scrap sector (81.0000).

Finally, section 2.4.4 amplifies the earlier discussions of how the energy sectors were incorporated into the commodity-by-commodity matrix.

2.4.2 General Procedures

The basic assumption employed in converting the commodity-by-industry table to a commodity-by-commodity table is that an industry's cost structure holds for whatever commodity it produces; then, a given set of inputs can be distributed between corresponding commodities on the basis of an industry's make of commodities. The assumption simplifies reality, of course, since it is plausible that, in fact, cost structures vary between commodities produced by a given industry. However, estimating those varying cost structures would be extremely expensive, and consequently we must make do with the simplifying assumption for the present. Procedures under that assumption can be illustrated by the following example. Say that industry (1) has this set of purchases:

Commodity	Amount
(1)	10
(2)	30
(3)	20
(4)	40

Further, say industry (1) produces a total of 100 units of output, of which 60 units are of commodity (1), 30 are of commodity (3) and 10 are of commodity (4). It is assumed that the proportions .60, .30 and .10 can be multiplied by the costs for industry (1) to find the costs attributable to producing commodity (1), (3) and (4), respectively, by industry (1). Then we would get this set of flows redistributing the inputs into industry (1) between the commodities it produces:

			Commodity		
Commodity	(1)	(2)	(3)	(4)	Total
(1)	6	0	3	1	10
(2)	18	0	9	3	30
(3)	12	0	6	2	20
(4)	24	0	12	4	40
Total	60	0	30	10	100

Similar redistributions are carried out for all industries, with final entries in each cell of the "new" table obtained by adding together all of the components allocated to the cell. Thus, say industry (2) had this set of inputs:

(1)	20
(2)	0
(3)	40
(4)	20

and it produced 20 units of (1) and 60 units of (2), so that its "make ratios" were .25 and .75 for commodity (1) and (2), respectively. Then its inputs would be distributed as:

	(1)	(2)	(3)	(4)
(1)	5	15	0	0
(2)	0	0	0	0
(3)	10	30	0	0
(4)	5	15	0	0

If industries (3) and (4) produced none of commodity (1), all inputs in the production of commodity (1) would now be accounted for, and its cost structure would be:

	(1)		
(1)	6+5	=	11
(2)	18+0	=	18
(3)	12+10	=	22
(4)	24+5	=	29
Total	60+20		80

The process can be generalized as follows. Let u_{ij} denote use of commodity i by industry j, with i = 1,...,K and j = 1,...,N. For a given sector, J, we have a column vector of inputs to that sector:

$$\begin{bmatrix} u_{1J} \\ u_{2J} \\ \vdots \\ u_{KJ} \end{bmatrix}$$

Now, let the commodities produced by sector J be denoted by a row vector:

$$[v_{J1} \quad v_{J2} \quad \cdots \quad v_{JK}],$$

where v_{J1} is commodity 1 produced by industry J, v_{J2} is commodity 2 produced by industry J, and so on to v_{JK} is commodity K produced by industry J. Let $g_J = \sum_{i=1}^{K} u_{iJ} = \sum_{i=1}^{K} v_{Ji}$, where g_J is total industry input equal to total industry output of J. Then the vector product:

$$\begin{bmatrix} u_{1J} \\ u_{2J} \\ \vdots \\ u_{KJ} \end{bmatrix} \left[(v_{J1}/g_j) \; (v_{J2}/g_j) \; \cdots \; (v_{JK}/g_j) \right]$$

yields a matrix of size KxK, which distributes industry J input to each of the K commodities.

If we now let J run from 1 through N, i.e., move through all industries, and add the resultant N matrices cell by cell, we can write the resultant matrix as this matrix product:

$$\begin{bmatrix} u_{11} & u_{12} & \cdots & u_{1N} \\ u_{21} & u_{22} & \cdots & u_{2N} \\ \vdots & & & \vdots \\ u_{K1} & u_{K2} & \cdots & u_{KN} \end{bmatrix} \quad \begin{bmatrix} (v_{11}/g_1) & \cdots & (v_{1k}/g_1) \\ (v_{21}/g_2) & \cdots & (v_{2K}/g_2) \\ \vdots & & \vdots \\ (v_{N1}/g_N) & \cdots & (v_{NK}/g_N) \end{bmatrix}$$

Essentially this matrix product appears in a section of BEA's Handbook of its input-output definitions and conventions, "The Yellow Book" (22). Two steps are necessary to establish concordance with the BEA formulation. First, it must be shown that the BEA formulation reduces to that presented above, although its initial expression is more complicated. The BEA formulation is:

$$\begin{bmatrix} (u_{11}/g_1) & \cdots & (u_{1N}/g_N) \\ \vdots & & \vdots \\ (u_{K1}/g_1) & \cdots & (u_{KN}/g_N) \end{bmatrix} \quad \begin{bmatrix} (v_{11}/q_1) & \cdots & (v_{1K}/q_K) \\ \vdots & & \vdots \\ (v_{N1}/q_1) & \cdots & (v_{NK}/q_K) \end{bmatrix} \quad \begin{bmatrix} q_1 \\ \vdots \\ q_K \end{bmatrix} = \begin{bmatrix} q_1 \\ \vdots \\ q_K \end{bmatrix}$$

where $q_i = \sum_{j=1}^{N} v_{ji} = \sum_{j=1}^{N} u_{ij}$ = commodity output for sector i. This expression reduces to:

$$\begin{bmatrix} (u_{11}/g_1) & \cdots & (u_{1N}/g_N) \\ \vdots & & \vdots \\ (u_{K1}/g_1) & \cdots & (u_{KN}/g_N) \end{bmatrix} \quad \begin{bmatrix} v_{11} & \cdots & v_{1K} \\ \vdots & & \vdots \\ v_{N1} & \cdots & v_{NK} \end{bmatrix} \quad \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix} = \begin{bmatrix} q_1 \\ \cdot \\ \cdot \\ q_K \end{bmatrix}$$

The expression now means that the product of the first two matrices is the commodity-by-commodity table. Note that the product of the two matrices is equivalent to the matrix product presented above as the generalized commodity-by-commodity table. This is because the division of column entries by g_j in the left-hand matrix can be replaced by the division of row entries by g_j in the right hand matrix.

Second, the BEA eliminates the scrap sector and balances that loss in commodity output by dividing by a commodity output total net of scrap. It is noted that "scrap is treated in such a way as to prevent its requirement as an input from generating output in the industries in which it originates" (23). In practice, this means the make entries are divided by $g_J - v_{JK}$ rather than by g_J, where v_{JK} is the scrap produced by industry J. Let M = K-1; then the matrix product becomes:

$$\begin{bmatrix} u_{1J} \\ u_{2J} \\ \vdots \\ u_{MJ} \end{bmatrix} \quad [(v_{J1}/[g_J - v_{JK}]) (v_{J2}/[g_J - v_{JK}]) \cdots (v_{JM}/[g_J - v_{JK}])]$$

That convention was followed here to maximize consistency with BEA procedures. The next section develops some aspects of the approach that should be made explicit.

2.4.3 On Handling the Scrap Sector

The scrap sector (81.0000) covers scrap, used and secondhand goods, and its level is often estimated as a balancing item or residual. As noted above, the BEA eliminated the scrap column from its flow table by scaling entries in each row so they added to the original row total after scrap was set equal to zero. This process then causes inequality between row and column totals, which the BEA handled in practice by subtracting the increment gained from each column, in turn. The negative entry is best thought of as an offset to the scrap row entry. The consequence of carrying out the adjustment for every column is that the combined scrap row (consisting of the previous scrap entry plus the negative entry) now adds to zero, although individual entries will be either positive or negative. The BEA procedures were again duplicated here, in line with the effort to establish consistency with their approach. The procedure

can be illustrated as follows. The commodity-by-commodity matrix as first developed consists of a table with both a row and a column of scrap and second-hand goods; these appear as row and column 5 in this artificial example:

	clm1	clm2	clm3	clm4	(scrap) clm5	Total
row 1	50	30	0	20	10	110
row 2	40	0	10	0	10	60
row 3	10	20	30	40	0	100
row 4	0	5	60	5	0	70
row 5 (scrap)	10	5	0	5	0	20
Total:	110	60	100	70	20	

Now the entries in column 5 are eliminated, and previous row entries are multiplied by old total/(old total - column 5 entry), so that the new row total equals the old row total. Then, the positive increment in a given cell will be balanced by a negative entry appearing in the given column and in row 5. In our example we get:

					Total
	55	33	0	22	110
	48	0	12	0	60
	10	20	30	40	100
	0	5	60	5	70
	10	5	0	5	
	-5	-3	0	-2	
Row 5	-8	0	-2	0	0
	—	—	—	—	
	-3	2	-2	3	
Total	110	60	100	70	

The row 5 entries now become (-3, 2, -2, 3), which sum to zero. The two negative entries in each column which appear below the original scrap entries, are the amounts balancing the increments respectively added to the row 1 and row 2 entries.

In practice, the row offset entries for the RFF version of the 496 sector table were entered as row (81.0001), appearing as offsets to row (81.0000), "scrap, used and second-hand goods." The sum of the (81.0001) entries exactly offset the (81.0000) entries.

2.4.4 Incorporation of Energy Sector Extensions into Transactions Table

There were three sets of disaggregated energy sectors in the RFF model: (1) crude petroleum and natural gas extraction, [2] and [3] in the RFF model, obtained from BEA (08.0000); (2) the seven petroleum products, [4] through [10], obtained from (31.0100); and the three electricity sectors, [12], [13] and [14], respectively covering generation by fossil fuel, nuclear power and hydroelectric power. Disaggregation for the first two sets involved row entries, while that for the third set involved column entries. Those disaggregations were described in detail in section 2.3, which also presented a brief summary of corresponding disaggregations of columns for sectors [2] through [10], and of rows for [12] through [14]. Those latter disaggregations were obtained mechanically by applying simple assumptions of proportionality after accounting for "internal" flows, again by simple assumptions. Since those operations were carried out as part of the process of forming the commodity-by-commodity matrix, some additional details on the operations are presented at this point.

Because the disaggregated energy sectors first appeared in the 496-order table before that table was aggregated to conform to the RFF sectoring, the convention was adopted of assigning distinct but consistent numbers to the "new" energy sectors. Thus, at the 496 sector level, (08.0002) and (08.0003) referred to crude oil and crude natural gas, respectively; (31.0004) through (31.0110) to the seven petroleum products; and (68.0101), (68.0102) and (68.0103) to the three electricity sectors by fuel type. With aggregation of the table, those sectors were assigned their RFF numbers.

In the case of crude petroleum and natural gas, commodity (08.0000) was produced almost entirely by industry (08.0000), with small additional amounts produced by Industrial Chemicals (27.0100), and Natural Gas Utilities (68.0200). Production of (08.0000) and total production, both in million dollars, and corresponding "make ratios" by industry are as follows:

Industry	Production of (08.0000)	Total Production by Industry	Make Ratio
(08.0000)	16,685.0	17,819.0	.936360
(27.0100)	12.4	16,102.1	.000770
(68.0200)	32.9	20,138.7	.001634
Total	16,730.3		

The make ratio equals the production of (08.0000) divided by total industry production. In forming the commodity-by-commodity matrix, the make ratios are multiplied by the flows into each industry and the terms collected by commodity. By assuming there were no cross shipments between (08.0002) and (08.0003), these flows emerged in the commodity-by-commodity matrix:

	Column (08.0002)	Column (08.0003)
Row (08.0002)	288.4338	0.0000
Row (08.0003)	0.0000	275.9741

It was then assumed, aside from shipments to self, that the technical coefficients for the disaggregated sectors were the same. Hence, a simple algebraic adjustment in value added was carried out to offset the differences in the proportion for shipments to self, to yield this final distribution of shipments:

	(8.0002)	(8.0003)	(8.0000)
Total inputs	12,691.300	4,039.000	16,730.300
Shipments to self	288.434	275.974	564.408
Value added	8,481.827	2,515.153	10,996.980
Intermediate shipments to other sectors	3,921.039	1,247.873	5,168.912

In the case of petroleum products, the commodity-by-commodity matrix was initially formed using the seven product rows, (31.0104) through (31.0110), and the BEA petroleum product column (31.0100). There were 14 industries that produced some of commodity (31.0100), with the bulk of production accounted for by industry (31.0100). The industries and amounts of production, in million dollars, and corresponding make ratios, are shown in the following list:

(1) Industry	(2) Make of commodity (31.0100)	(3) Total make by industry	(4) Make of commodity (81.0000)	(5) Make Ratio: (2)/[(3)-(4)]
(8.0000)	836.5	17,819.0	0	.046944
(14.2900)	5.4	1,990.4	0	.002713
(27.0100)	34.3	16,102.1	0	.002130
(27.0406)	2.0	2,052.8	0	.000974
(29.0201)	2.7	3,156.0	0	.000856
(29.0202)	6.8	1,788.6	0	.003802
(29.0203)	4.4	441.6	0	.009964
(29.0300)	0.8	3,919.4	0	.000204
(30.0000)	0.2	3,610.1	0	.000055
(31.0100)	27,911.0	29,591.0	9.9	.943542
(31.0200)	0.3	902.6	0	.000332
(31.0300)	13.2	947.0	0	.013939
(38.0400)	4.1	2,346.8	5.9	.001751
(68.0200)	5.6	20,138.7	0	.000278

After the transformation process had yielded the one commodity column, (31.0100), that column was disaggregated to the set of seven columns, (31.0104) through (31.0110), by assuming that the technical coefficients for all petroleum products are the same. In practice, this involved multiplying each row entry in column (31.0100) by a set of seven scale factors, expressing the proportions of total sales accounted for by the individual petroleum commodities. The scale factors, obtained from the row totals listed in table 5, above, were as follows:

Sector	Petroleum product	Scale factor
(31.0104)	Gasoline	.587515
(31.0105)	Jet fuel	.047924
(31.0106)	Kerosene	.013023
(31.0107)	Distillate	.153002
(31.0108)	Residual	.038408
(31.0109)	LPG	.034659
(31.0110)	All other	.125469
	Total	1.000000

Division by respective column totals then yields the same technical coefficients for all seven sectors.

In the case of electricity, the formation of the commodity-by-commodity matrix involved the shifting of almost negligible amounts of nonelectricity output produced by electric utilities and of electricity produced by nonutilities.

The former included small amounts of water supply and sanitary services produced by some utilities and the nonelectricity output of the TVA; the latter consisted only of electricity produced by the Panama Canal Company, the production and sale of electricity by mining, manufacturing and railroad industries having been reclassified and accounted for as utility production in the construction of the base commodity-by-industry table. (However, the selfuse of electricity produced by nonutilities is not included in the BEA flow table, and no attempt to account for such production was made here.)

The initial version of the commodity-by-commodity flow matrix had three electricity columns, respectively covering fossil fuel, nuclear fuel and hydroelectric power, and an aggregate electricity row. The row entries were then scaled by the share of each form of production in total production, after accounting for internal use, to yield the individual rows for each source of electricity output. The distribution of output in million dollars is shown in the following list, as are the scale factors derived from those output values:

Sector	Total use	Internal Use	Use by all other sectors: Net use	Scale factor: Net use as fraction of total net use
(68.0101) fossil fuel	29,731.2	3,533.78	26,197.42	.9327
(68.0102) nuclear fuel	849.1	0.26	848.84	.0302
(68.0102) hydroelectric	1,043.6	0.25	1,043.35	.0371
	31,623.9	3,534.29	28,089.61	1.0000

In calculating internal use, it was assumed that there were no cross-shipments between the different electricity sectors, which seems reasonable if almost all internal consumption occurs at or near the point of generation.

2.5 THE TECHNICAL COEFFICIENT AND INVERSE MATRICES

With the completion of the construction of the flow table, the derivation of the technical coefficient and inverse matrices was carried out by standard computer operations. The RFF version of the BEA 496 sector commodity-by-commodity flow table is available both on computer tape and in printout form. The aggregated form of the flow table has 117 total sectors of which 104 are endogenous (as defined in section 2.2). That table is presented in its entirety in appendix E, as are the corresponding technical coefficient and inverse matrices, respectively.

A major application of input-output analysis occurs in the use of the inverse table, which purports to show the direct plus indirect "requirements" (original effect plus multiplier effects) of an increment of final demand, as of 1972. Thus, the column totals for the table exhibit the estimated total impact of a one dollar increase in spending on each commodity, in turn, including the original dollar. Sector [36], Meat Packing, has the highest column total of all the sectors, at $3.52. This can be explained by that sector's low value added relative to total costs. Sectors [14], Electricity from Hydroelectric Power, and [90] Owner-Occupied Dwellings, have the lowest column totals, at $1.96, reflecting high value added (capital costs) relative to total costs. The sum of the entries in the energy sector rows in each column (rows 1 through 10 and 12 through 15) exhibits the total dollar impact on energy production of a one dollar expansion in consumption of a given sector's output. Thus, a one dollar expansion in demand for coal mining (Sector [1]) yields a total of $1.214 in new energy production, of which $1.000 is the original increase, $0.141 is the induced additional increase in coal production (by way of the entry of 1.141 on the main diagonal) and $0.073 is the additional increase in the production of other energy sectors.

The impacts of an expansion of one dollar in final demand on each of the energy sectors is shown in the following list in terms of induced expansion of electricity production, all energy production, and all intermediate sector production.

Sector number	Sector name	Electricity	All energy	All sectors
[1]	Coal mining	0.0302	1.2141	1.7357
[2]	Crude petroleum	0.0140	1.0612	1.5291
[3]	Natural gas extraction	0.0146	1.1131	1.6040
[4]-[10]	Petroleum products	0.0195	1.6781	2.2600
[12]	Electricity, fossil fuel	1.1411	1.4427	1.8378
[13]	Electricity, nuclear power	1.0035	1.0199	1.3369
[14]	Electricity, hydropower	1.0020	1.0106	1.2579
[15]	Natural gas utilities	0.0103	1.8713	2.1864

The results for the petroleum product sectors, [4] through [10], are identical because it was assumed that the pattern of refining costs was the same for each sector. Petroleum Products and Natural Gas Utilities have the greatest multiplier effects of all the energy sectors because of the expansion they induce in crude petroleum and natural gas extraction. The low multiplier effects for nuclear and hydroelectric power indicate those sectors are poor instruments for

generating economic expansion in times of unemployment, but excellent sources for limiting induced energy use in periods of pressure on energy supplies. Of course, both features reflect the capital-intensive nature of those sectors' production. To expand on the last point, the construction of new nuclear and hydroelectric power plants would likely require relatively large amounts of inputs, including energy, possibly involving greater direct and indirect effects than the construction of new fossil fuel plants, or of other forms of fixed capital. But those ultimate impacts would have to be traced by an examination of changes induced from increases in Gross Private Domestic Fixed Investment (GPDFI). A thorough examination presumably would entail disaggregation of the GPDFI sector into types of power plant construction and other forms of investment, as well as the treatment of GPDFI as an endogenous sector. This might well be a useful avenue of future inquiry (24).

The estimated impacts of an expansion in one dollar of final demand are shown for selected nonenergy sectors in the following list. (Information for all sectors is given in appendix E.)

Sector number	Sector name	Electricity	All energy	All sectors
[11]	Asphalt and tar products	0.0220	0.3825	2.2026
[18]	Grains	0.0081	0.0922	1.8631
[21]	Iron mining	0.0522	0.1442	1.9857
[28]	New highways and streets	0.0122	0.1259	2.0103
[46]	Pulp and paper mills	0.0354	0.1488	2.1939
[49]	Chemicals	0.0364	0.1970	2.1110
[57]	Cement	0.0657	0.2395	1.9063
[60]	Aluminum mfg.	0.0692	0.1572	2.4664
[70]	Motor vehicles & parts	0.0179	0.0580	2.4506
[78]	Railroads	0.0165	0.0772	1.6737
[82]	Air transport	0.0081	0.1324	1.7223
[87]	Retail trade	0.0231	0.0478	1.3513
[92]	Hotels	0.0445	0.0984	1.7320
[98]	Hospitals	0.0170	0.0580	1.7054

Sectors whose expansion has the greatest impact on electricity production per dollar of final demand are Aluminum Manufactures, Cement, Iron Mining and Hotels. A dollar expansion in final demand brings about an expansion of 10 cents or more in energy production for a number of sectors, including Asphalt and Tar Products, New Highways and Streets, Pulp and Paper Mills, Chemicals, and Air Transport, in addition to the four sectors noted as having pronounced impacts on electricity output.

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22. Section entitled, "Mathematical Derivation of the Total Requirements Tables for the 1972 Input-Output Study" in BEA, Definitions and Conventions of the 1972 Input-Output Study, Washington, D.C., 1980, pp. 37-39.

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APPENDIX TO CHAPTER 2
RFF AND BEA SECTORAL CROSS-CLASSIFICATIONS

This appendix cross-classifies the RFF sectors with the BEA sectors appearing in the BEA 496 sector tables. The appendix first enumerates the RFF sectors in order, listing RFF sector number and name and then the corresponding BEA sector number or numbers. The RFF sector number appears in square brackets, while the BEA sector numbers are presented within parentheses. There are 10 major groups within which the RFF sectors are classified, denoted by roman numerals. Three of those major groups are further classified into subgroups. Construction sectors are classified as new versus maintenance and repair construction. Exogenous sectors are classified as (1) final demand sectors, appearing as columns, and (2) value added and special industries, appearing as rows. Finally, manufacturing sectors are grouped within 15 categories. The BEA sectors are also organized into groups as defined by the BEA, and indicated by the first two digits of the BEA sector number. In some instances, the RFF to BEA correspondence is listed in terms of BEA group rather than sector number.

After the RFF to BEA correspondences are listed, the BEA to RFF correspondences are presented as well. Here, BEA sector number and name are listed and the corresponding RFF sector number is shown. The individual BEA sectors are grouped within both the RFF and the BEA classification systems.

SECTORAL CROSS-CLASSIFICATION:
RFF SECTORS AND CORRESPONDING
BEA SECTORS OR GROUP OF SECTORS

RFF Sector No.	RFF Sector Name	BEA Sector Numbers
	I. Energy and Related Sectors	
[1]	Coal mining	(07.0000)
[2]	Crude petroleum	(08.0002)
[3]	Natural gas extraction	(08.0003)
[4]	Gasoline	(31.0104)
[5]	Jet fuel	(31.0105)
[6]	Kerosene	(31.0106)
[7]	Distillate fuel oil	(31.0107)
[8]	Residual fuel oil	(31.0108)
[9]	LPG (Liquified Petroleum Gas)	(31.0109)
[10]	All other petroleum refining	(31.0110)
[11]	Asphalt and tar products	(31.0200), (31.0300)
[12]	Electricity, fossil fuel	(68.0101), (78.0201), (79.0201)
[13]	Electricity, nuclear power	(68.0102), (78.0202), (79.0202)
[14]	Electricity, hydropower	(68.0103), (78.0203), (79.0203)
[15]	Natural gas utilities	(68.0200)
	II. Agriculture, Forestry & Fisheries	
[16]	Meat animals	(01.0301)
[17]	Other livestock products	(01.0100), (01.0200), (01.0302)
[18]	Grains	(02.0201), (02.0202)
[19]	Other crops & ag. services	(02.0100), (02.0203) to (02.0600), (02.0702), (04.0000)
[20]	Forestry & fisheries	(02.0701)*, (03.0000)
	*appears only as industry, not as commodity	
	III. Mining	
[21]	Iron mining	(05.0000)
[22]	Nonferrous metals mining	(06.0100), (06.0200)
[23]	Nonmetallic minerals	(09.0000), (10.0000)
	IV. Construction and Related	
IVA	New Construction	
[24]	New residential buildings	(11.0101)-(11.0105), (11.0501)
[25]	Mobile homes	(61.0602)
[26]	New nonresidential buildings	(11.0106)-(11.0209), (11.0502)
[27]	New energy activity structures	(11.0303)-(11.0305), (11.0503), (11.0504)
[28]	New highways & streets	(11.0400)
[29]	All other new construction	(11.0301), (11.0302), (11.0306)-(11.0308), (11.0505)-(11.0508)
IVB	Maintenance & Repair (M&R) Construction	
[30]	M & R, residential bldgs.	(12.0100), (12.0202)
[31]	M & R, nonresidential bldgs.	(12.0201), (12.0203)
[32]	M & R, energy activity structs.	(12.0206)-(12.0208), (12.0215)
[33]	M & R, highways & streets	(12.0214)
[34]	All other M & R	(12.0204), (12.0205), (12.0209)-(12.0203), (12.0216)

V. Manufactures

VA Ordnance Manufactures		
[35]	Ordnance	Group (13): (13.0100)-(13.0700)
VB Food and Kindred Products		
[36]	Meat packing	(14.0101)
[37]	Distilling	(14.2101), (14.2103), (14.2104)
[38]	All other food & kindred	(14.0102)-(14.2003), (14.2102) (14.2200)-(14.3200)
VC Tobacco Manufactures		
[39]	Tobacco	Group (15): (15.0101)-(15.0200)
VD Textiles and Apparel Mfg.		
[40]	Textiles	Groups (16), (17) and (19)
[41]	Apparel	Group (18)
VE Wood and Paper Manufacture		
[42]	Logging and saw mills	(20.0100)-(20.0400)
[43]	Other lumber and wood	(20.0501)-(20.0903), (21.0000)
[44]	Household furniture	Group (22)
[45]	Other furniture	Group (23)
[46]	Pulp and paper mills	(24.0100), (24.0200), (24.0300)
[47]	Other paper products	(24.0400)-(24.0706), (25.0000)
VF Printing and Publishing		
[48]	Printing & publishing	Group (26)
VG Chemicals, Plastics, Drugs, Paints and Rubber		
[49]	Chemicals	Group (27)
[50]	Plastics materials	Group (28)
[51]	Drugs	(29.0100)
[52]	Cleaning & toilet preparations	(29.0201)-(29.0300)
[53]	Paints	(30.0000)
[54]	Rubber & plastic products	Group (32)
VH Leather Manufactures		
[55]	Leather	Groups (33) and (34)
VI Glass, Stone & Clay Mfg.		
[56]	Glass	Group (35)
[57]	Cement	(36.0100)
[58]	Other stone & clay	(36.0200)-(36.2200)
VJ Primary Metals Mfg.		
[59]	Iron & steel mfg.	Group (37)
[60]	Aluminum mfg.	(38.0400), (38.0800), (38.1100)
[61]	Other primary non-ferrous metals mfg.	(38.0100)-(38.0300),(38.0500)-(38.0700), (38.0900), (38.1000), (38.1200)-(38.1400)
VK Fabricated Metals Mfg.		
[62]	Fabricated metals	Groups (39), (40), (41), (42)
VL Machinery Mfg. (non-electrical)		
[63]	Machinery (non-electrical)	Groups (43) thru (50)

VM Electrical Machinery Mfg.

[64]	Computing, electronics and related	Group (51); (53.0100), (53.0500) and Group (57)
[65]	Refrigeration & heating eqpmt.	(52.0300)
[66]	Household appliances	Group (54)
[67]	Electric lighting	Group (55)
[68]	Radio, TV & communic. eqpmt.	Group (56)
[69]	All other electric mach.	(52.0100), (52.0200), (52.0400), (52.0500); (53.0200)-(53.0400); (53.0600)-(53.0800); Group (58)

VN Transportation Equipment Mfg.

[70]	Motor vehicles & parts	(59.0301) & (59.0302)
[71]	Trucks, motorcycles & related	(59.0100), (59.0200), (61.0500), (61.0601)
[72]	Aircraft	Group (60)
[73]	Other transportation eqpmt.	(61.0100)-(61.0300), (61.0700)*

*Mobile homes moved to construction group.

VO Other Manufactures

[74]	Scientific instruments & related	Group (62), (63.0100), (63.0200)
[75]	Photographic equipment & supplies	(63.0300)
[76]	Jewelry	(64.0100)-(64.0105)
[77]	Other miscellaneous mfg.	(64.0200)-(64.1200)

VI. Transportation, Communication and Public Utilities

[78]	Railroads	(65.0100)
[79]	Local, suburban & inter-urban trans.	(65.0200) [and (79.0100): industry]
[80]	Trucking & warehousing	(65.0300)
[81]	Water transport	(65.0400)
[82]	Air transport	(65.0500)
[83]	Pipelines & other trans.	(65.0600), (65.0700)
[84]	Communications	(66.0000), (67.0000)
[85]	Water & sanitary service	(68.0300)

VII. Trade, Banking and Finance

[86]	Wholesale trade	(69.0100)
[87]	Retail trade	(69.0200)
[88]	Banking	(70.0100)
[89]	Other finance & insurance	(70.0200)-(70.0500)
[90]	Owner occupied dwellings	(71.0100)
[91]	Real estate	(71.0200)

VIII. Services

[92]	Hotels	(72.0100)
[93]	Personal services	(72.0200) and (72.0300)
[94]	Business services	Group (73)
[95]	Eating & drinking places	(74.0000)
[96]	Auto repair	(75.0000)
[97]	Amusements	Group (76)
[98]	Hospitals	(77.0200)
[99]	Other medical services	(77.0100) and (77.0300)

[100]	Educational services	(77.0400)
[101]	Non-profit organizations	(77.0500)
[102]	Social services	(77.0600)-(77.0000)

IX. Government Enterprises

[103]	Postal service & other federal enterprises	(78.0100), (78.0400)
[104]	State & local enterprises	(79.0300)

X. Exogenous Sectors

XA Final Demand Sectors (columns)

[105]	Personal consumption expend.	(91.0000)
[106]	Gross private domestic fixed invest.	(92.0000)
[107]	Change in inventories	(93.0000)
[108]	Exports	(94.0000)
[109]	Imports	(95.0000)
[110]	Federal govt. purchases, defense	(96.0000)
[111]	Federal govt. purchases, non-defense (& CCC)	(97.0000) & (78.0300)
[112]	State & local, edu.	(98.0000)
[113]	State & local, other	(99.0000)

XB Value Added and Special Industries (rows)

[114]	Noncomparable imports	(80.0000)
[115]	Scrap, used, etc.	(81.0000)
[116]	Balancing sectors, Rest of World Industry, etc.	Groups (82) through (85)
[117]	Value added	Groups (88), (89) and (90) (Aggregate is listed as Group 87)

SECTORAL CROSS CLASSIFICATION
BEA SECTORS AND CORRESPONDING RFF SECTORS
(Note: N.E.C. indicates not elsewhere classified.)

BEA Sector Number	BEA Sector Name and RFF Sector Number
	I. Energy and Related
07.0000	Coal mining [1]
08.0000	Crude petroleum and natural gas [2] and [3]
31.0100	Petroleum refining and miscellaneous products of petroleum and coal [4] through [10]
31.0200	Paving mixtures and blocks [11]
31.0300	Asphalt felts and coatings [11]
68.0100	Electric services (utilities) [12], [13], [14] (part)
68.0200	Gas production and distribution (utilities) [15]
78.0200	Federal electric utilities [12] and [14] (part)
79.0200	State and local electric utilities [12], [13], [14] (part)
	II. Agriculture, Forestry and Fisheries
	1. Livestock and livestock products
1.0100	Dairy farm products [17]
1.0200	Poultry and eggs [17]
1.0301	Meat animals [16]
1.0302	Miscellaneous livestock [17]
	2. Other Agricultural Products
2.0100	Cotton [19]
2.0201	Food grains [18]
2.0202	Feed grains [18]
2.0203	Grass seeds [19]
2.0300	Tobacco [19]
2.0401	Fruits [19]
2.0402	Tree nuts [19]
2.0501	Vegetables [19]
2.0502	Sugar crops [19]
2.0503	Miscellaneous crops [19]
2.0600	Oil bearing crops [19]
2.0701	Forest products [20]
2.0702	Greenhouse and nursery products [19]
	3. Forestry and Fishery Products
3.0000	Forestry and fishery products [20]
	4. Agricultural, Forestry, and Fishery Services
4.0000	Agricultural, forestry, and fishery services [19]
	III. Mining
	5. Iron and Ferroalloy Ores Mining
5.0000	Iron and ferroalloy ores mining [21]
	6. Nonferrous Metal Ores Mining
6.0100	Copper ore mining [22]
6.0200	Nonferrous metal ores mining, except copper [22]

7. Coal Mining

7.0000	Coal mining [1]

8. Crude Petroleum and Natural Gas

8.0000	Crude petroleum and natural gas [2] and [3]

9. Stone and Clay Mining and Quarrying

9.0000	Stone and clay mining and quarrying [23]

10. Chemical and Fertilizer Mineral Mining

10.0000	Chemical and fertilizer mining [23]

IV. Construction and Related

11. New Construction

11.0101	New residential 1-unit structures, nonfarm [24]
11.0102	New residential 2-4 unit structures, nonfarm [24]
11.0103	New residential garden apartments [24]
11.0104	New residential high-rise apartments [24]
11.0105	New residential addns., alterations, nonfarm [24]
11.0106	New hotels and motels [26]
11.0107	New dormitories [26]
11.0201	New industrial buildings [26]
11.0202	New office buildings [26]
11.0203	New warehouses [26]
11.0204	New garages and service stations [26]
11.0205	New stores and restaurants [26]
11.0206	New religious buildings [26]
11.0207	New educational buildings [26]
11.0208	New hospital and institutional buildings [26]
11.0209	New other nonfarm buildings [26]
11.0301	New telephone and telegraph facilities [29]
11.0302	New railroads [29]
11.0303	New electric utility facilities [27]
11.0304	New gas utility facilities [27]
11.0305	New petroleum pipelines [27]
11.0306	New water supply facilities [29]
11.0307	New sewer system facilities [29]
11.0308	New local transit facilities [29]
11.0400	New highways and streets [28]
11.0501	New farm housing units, additions, alterations [24]
11.0502	New farm service facilities [26]
11.0503	New petroleum and natural gas well drilling [27]
11.0504	New petroleum, natural gas, mineral exploration [27]
11.0505	New military facilities [29]
11.0506	New conservation and development facilities [29]

12. Maintenance & Repair Construction

12.0100	Maintenance and repair, residential [30]
12.0201	Maintenance, repair other nonfarm buildings [31]
12.0202	Maintenance, repair farm residential buildings [30]
12.0203	Maintenance, repair farm service facilities [31]
12.0204	Maintenance, repair telephone and telegraph [34]
12.0205	Maintenance, repair railroads [34]
12.0206	Maintenance, repair electric utility facilities [32]
12.0207	Maintenance, repair gas utility facilities [32]
12.0208	Maintenance, repair petroleum pipelines [32]
12.0209	Maintenance, repair water supply facilities [34]
12.0210	Maintenance, repair sewer facilities [34]

12.0211 Maintenance, repair local transit facilities [34]
12.0212 Maintenance, repair military facilities [34]
12.0213 Maintenance, repair conservation & development facilities [34]
12.0214 Maintenance, repair highways and streets [33]
12.0215 Maintenance, repair petroleum and natural gas wells [32]
12.0216 Maintenance, repair other nonbuilding facilities [34]

V. Manufactures

13. Ordnance and Accessories

13.0100 Complete guided missiles [35]
13.0200 Ammunition, except for small arms, N.E.C. [35]
13.0300 Tanks and tank components [35]
13.0500 Small arms [35]
13.0600 Small arms ammunition [35]
13.0700 Other ordnance and accessories [35]

14. Food and Kindred Products

14.0101 Meat packing plants [36]
14.0102 Sausages and other prepared meats [38]
14.0103 Poultry dressing plants [38]
14.0104 Poultry and egg processing [38]
14.0200 Creamery butter [38]
14.0300 Cheese, natural and processed [38]
14.0400 Condensed and evaporated milk [38]
14.0500 Ice cream and frozen desserts [38]
14.0600 Fluid milk [38]
14.0700 Canned and cured sea foods [38]
14.0800 Canned specialties [38]
14.0900 Canned fruits and vegetables [38]
14.1000 Dehydrated food products [38]
14.1100 Pickles, sauces, and salad dressings [38]
14.1200 Fresh or frozen packaged fish [38]
14.1300 Frozen fruits and vegetables [38]
14.1401 Flour and other grain mill products [38]
14.1402 Cereal preparations [38]
14.1403 Blended and prepared flour [38]
14.1501 Dog, cat, and other pet food [38]
14.1502 Prepared feeds, N.E.C. [38]
14.1600 Rice milling [38]
14.1700 Wet corn milling [38]
14.1801 Bread, cake, and related products [38]
14.1802 Cookies and crackers [38]
14.1900 Sugars [38]
14.2001 Confectionery products [38]
14.2002 Chocolate and cocoa products [38]
14.2003 Chewing gum [38]
14.2101 Malt liquors [37]
14.2102 Malt [38]
14.2103 Wines, brandy, and brandy spirits [37]
14.2104 Distilled liquor, except brandy [37]
14.2200 Bottled and canned soft drinks [38]
14.2300 Flavoring extracts and sirups, N.E.C. [38]
14.2400 Cottonseed oil mills [38]
14.2500 Soybean oil mills [38]
14.2600 Vegetable oil mills, N.E.C. [38]
14.2700 Animal and marine fats and oils [38]
14.2800 Roasted coffee [38]
14.2900 Shortening and cooking oils [38]

14.3000	Manufactured ice [38]
14.3100	Macaroni and spaghetti [38]
14.3200	Food preparations, N.E.C. [38]

15. Tobacco Manufactures

15.0101	Cigarettes [39]
15.0102	Cigars [39]
15.0103	Chewing and smoking tobacco [39]
15.0200	Tobacco stemming and redrying [39]

16. Broad and Narrow Fabrics, Yarn & Thread Mills

16.0100	Broadwoven fabric mills, finishing plants [40]
16.0200	Narrow fabric mills [40]
16.0300	Yarn mills & finishing of textiles, N.E.C. [40]
16.0400	Thread mills [40]

17. Miscellaneous Textile Goods and Floor Coverings

17.0100	Floor coverings [40]
17.0200	Felt goods, N.E.C. [40]
17.0300	Lace goods [40]
17.0400	Padding and upholstery filling [40]
17.0500	Processed textile waste [40]
17.0600	Coated fabrics, not rubberized [40]
17.0700	Tire cord and fabric [40]
17.0900	Cordage and twine [40]
17.1001	Nonwoven fabrics [40]
17.1002	Textile goods, N.E.C. [40]

18. Apparel

18.0101	Women's hosiery, except socks [41]
18.0102	Hosiery, N.E.C. [41]
18.0201	Knit outerwear mills [41]
18.0202	Knit underwear mills [41]
18.0203	Knitting mills, N.E.C. [41]
18.0300	Knit fabric mills [41]
18.0400	Apparel made from purchased materials [41]

19. Miscellaneous Fabricated Textile Products

19.0100	Curtains and draperies [40]
19.0200	Housefurnishings, N.E.C. [40]
19.0301	Textile bags [40]
19.0302	Canvas products [40]
19.0303	Pleating and stitching [40]
19.0304	Automotive and apparel trimmings [40]
19.0305	Schiffi machine embroideries [40]
19.0306	Fabricated textile products, N.E.C. [40]

20. Lumber and Wood Products, Except Containers

20.0100	Logging camps and logging contractors [42]
20.0200	Sawmills and planing mills, general [42]
20.0300	Hardwood dimension and flooring mills [42]
20.0400	Special product sawmills, N.E.C. [42]
20.0501	Millwork [43]
20.0502	Wood kitchen cabinets [43]
20.0600	Veneer and plywood [43]
20.0701	Structural wood members, N.E.C. [43]
20.0702	Prefabricated wood buildings [43]
20.0800	Wood preserving [43]
20.0901	Wood pallets and skids [43]

20.0902	Particleboard [43]
20.0903	Wood products, N.E.C. [43]

21. Wood Containers

21.0000	Wood containers [43]

22. Household furniture

22.0101	Wood household furniture [44]
22.0102	Household furniture, N.E.C. [44]
22.0103	Wood TV and radio cabinets [44]
22.0200	Upholstered household furniture [44]
22.0300	Metal household furniture [44]
22.0400	Mattresses and bedsprings [44]

23. Other Furniture and Fixtures

23.0100	Wood office furniture [45]
23.0200	Metal office furniture [45]
23.0300	Public building furniture [45]
23.0400	Wood partitions and fixtures [45]
23.0500	Metal partitions and fixtures [45]
23.0600	Blinds, shades, and drapery hardware [45]
23.0700	Furniture and fixtures, N.E.C. [45]

24. Paper and Allied Products, Except Containers and Boxes

24.0100	Pulp mills [46]
24.0200	Paper mills, except building paper [46]
24.0300	Paperboard mills [46]
24.0400	Envelopes [47]
24.0500	Sanitary paper products [47]
24.0602	Building paper and board mills [47]
24.0701	Paper coating and glazing [47]
24.0702	Bags, except textile [47]
24.0703	Die-cut paper and board [47]
24.0704	Pressed and molded pulp goods [47]
24.0705	Stationery products [47]
24.0706	Converted paper products, N.E.C. [47]

25. Paperboard Containers & Boxes

25.0000	Paperboard containers and Boxes [47]

26. Printing and Publishing

26.0100	Newspapers [48]
26.0200	Periodicals [48]
26.0301	Book publishing [48]
26.0302	Book printing [48]
26.0400	Miscellaneous publishing [48]
26.0501	Commercial printing [48]
26.0502	Lithographic platemaking and services [48]
26.0601	Manifold business forms [48]
26.0602	Blankbooks and looseleaf binders [48]
26.0700	Greeting card publishing [48]
26.0801	Engraving and plate printing [48]
26.0802	Bookbinding and related work [48]
26.0803	Typesetting [48]
26.0804	Photoengraving [48]
26.0805	Electrotyping and stereotyping [48]

27. Chemicals & Selected Chemical Products

27.0100	Industrial inorganic and organic chemicals [49]
27.0201	Nitrogenous and phosphatic fertilizers [49]
27.0202	Fertilizers, mixing only [49]
27.0300	Agricultural chemicals, N.E.C. [49]
27.0401	Gum and wood chemicals [49]
27.0402	Adhesives and sealants [49]
27.0403	Explosives [49]
27.0404	Printing ink [49]
27.0405	Carbon black [49]
27.0406	Chemical preparations, N.E.C. [49]

28. Plastics & Synthetic Materials

28.0100	Plastics materials and resins [50]
28.0200	Synthetic rubber [50]
28.0300	Celluloid man-made fibers [50]
28.0400	Organic fibers, noncellulosic [50]

29. Drugs, Cleaning & Toilet Preparations

29.0100	Drugs [51]
29.0201	Soap and other detergents [52]
29.0202	Polishes and sanitation goods [52]
29.0203	Surface active agents [52]
29.0300	Toilet preparations [52]

30. Paints & Allied Products

30.0000	Paints and allied products [53]

31. Petroleum Refining & Related Industries

31.0100	Petroleum refining and misc. prod. [4]-[10]
31.0200	Paving mixtures and blocks [11]
31.0300	Asphalt felts and coatings [11]

32. Rubber & Miscellaneous Plastics Products

32.0100	Tires and inner tubes [54]
32.0200	Rubber and plastics footwear [54]
32.0301	Reclaimed rubber [54]
32.0302	Fabricated rubber products, N.E.C. [54]
32.0400	Miscellaneous plastics products [54]
32.0500	Rubber and plastics hose and belting [54]

33. Leather Tanning & Finishing

33.0001	Leather tanning and finishing [55]

34. Footwear & Other Leather Products

34.0100	Footwear cut stock [55]
34.0201	Shoes, except rubber [55]
34.0202	House slippers [55]
34.0301	Leather gloves and mittens [55]
34.0302	Luggage [55]
34.0303	Women's handbags and purses [55]
34.0304	Personal leather goods [55]
34.0305	Leather goods, N.E.C. [55]

35. Glass & Glass Products

35.0100	Glass & glass products, except containers [56]
35.0200	Glass containers [56]

36. Stone & Clay Products

36.0100	Cement, hydraulic [57]
36.0200	Brick and structural clay tile [58]
36.0300	Ceramic wall and floor tile [58]
36.0400	Clay refractories [58]
36.0500	Structural clay products, N.E.C. [58]
36.0600	Vitreous plumbing fixtures [58]
36.0701	Vitreous china food utensils [58]
36.0702	Fine earthenware food utensils [58]
36.0800	Porcelain electrical supplies [58]
36.0900	Pottery products, N.E.C. [58]
36.1000	Concrete block and brick [58]
36.1100	Concrete products, N.E.C. [58]
36.1200	Ready-mixed concrete [58]
36.1300	Lime [58]
36.1400	Gypsum products [58]
36.1500	Cut stone and stone products [58]
36.1600	Abrasive products [58]
36.1700	Asbestos products [58]
36.1800	Gaskets, packing and sealing devices [58]
36.1900	Minerals, ground or treated [58]
36.2000	Mineral wool [58]
36.2100	Nonclay refractories [58]
36.2200	Nonmetallic mineral products, N.E.C. [58]

37. Primary Iron and Steel Manufacturing

37.0101	Blast furnaces and steel mills [59]
37.0102	Electrometallurgical products [59]
37.0103	Steel wire and related products [59]
37.0104	Cold finishing of steel shapes [59]
37.0105	Steel pipe and tubes [59]
37.0200	Iron and steel foundries [59]
37.0300	Iron and steel forgings [59]
37.0401	Metal heat treating [59]
37.0402	Primary metal products, N.E.C. [59]

38. Primary Nonferrous Metals Manufacturing

38.0100	Primary copper [61]
38.0200	Primary lead [61]
38.0300	Primary zinc [61]
38.0400	Primary aluminum [60]
38.0500	Primary nonferrous metals, N.E.C. [61]
38.0600	Secondary nonferrous metals [61]
38.0700	Copper rolling and drawing [61]
38.0800	Aluminum rolling and drawing [60]
38.0900	Nonferrous rolling and drawing, N.E.C. [61]
38.1000	Nonferrous wire drawing and insulating [61]
38.1100	Aluminum castings [60]
38.1200	Brass, bronze, and copper castings [61]
38.1300	Nonferrous castings, N.E.C. [61]
38.1400	Nonferrous forgings [61]

39. Metal Containers

39.0100	Metal cans [62]
39.0200	Metal barrels, drums and pails [62]

40. Heating, Plumbing, and Fabricated Structural Metal Products

40.0100	Metal sanitary ware [62]
40.0200	Plumbing fixture fittings and trim [62]
40.0300	Heating equipment, except electric [62]
40.0400	Fabricated structural metal [62]
40.0500	Metal doors, sash, and trim [62]
40.0600	Fabricated plate work (boiler shops) [62]
40.0700	Sheet metal work [62]
40.0800	Architectural metal work [62]
40.0901	Prefabricated metal buildings [62]
40.0902	Miscellaneous metal work [62]

41. Screw Machine Products & Stampings

41.0100	Screw machine products, etc. [62]
41.0201	Automotive stampings [62]
41.0202	Crowns and closures [62]
41.0203	Metal stampings, N.E.C. [62]

42. Other Fabricated Metal Products

42.0100	Cutlery [62]
42.0201	Hand and edge tools, N.E.C. [62]
42.0202	Hand saws and saw blades [62]
42.0300	Hardware, N.E.C. [62]
42.0401	Plating and polishing [62]
42.0402	Metal coating and allied services [62]
42.0500	Miscellaneous fabricated wire products [62]
42.0700	Steel springs, except wire [62]
42.0800	Pipe, valves, and pipe fittings [62]
42.1000	Metal foil and leaf [62]
42.1100	Fabricated metal products, N.E.C. [62]

43. Engines and Turbines

43.0100	Steam engines and turbines [63]
43.0200	Internal combustion engines, N.E.C. [63]

44. Farm and Garden Machinery

44.0001	Farm machinery and equipment [63]
44.0002	Lawn and garden equipment [63]

45. Construction & Mining Machinery

45.0100	Construction machinery and equipment [63]
45.0200	Mining machinery, except oilfield [63]
45.0300	Oilfield machinery [63]

46. Materials Handling Machinery & Equipment

46.0100	Elevators and moving stairways [63]
46.0200	Conveyors and conveying equipment [63]
46.0300	Hoists, cranes, and monorails [63]
46.0400	Industrial trucks and tractors [63]

47. Metalworking Machinery and Equipment

47.0100	Machine tools, metal cutting types [63]
47.0200	Machine tools, metal forming types [63]
47.0300	Special dies and tools, machine tool acc. [63]
47.0401	Power driven hand tools [63]
47.0402	Rolling mill machinery [63]
47.0403	Metalworking machinery, N.E.C. [63]

48. Special Industry Machinery & Equipment

48.0100	Food products machinery [63]
48.0200	Textile machinery [63]
48.0300	Woodworking machinery [63]
48.0400	Paper industries machinery [63]
48.0500	Printing trades machinery [63]
48.0600	Special industry machinery,N.E.C. [63]

49. General Industrial Machinery & Equipment

49.0100	Pumps and compressors [63]
49.0200	Ball and roller bearings [63]
49.0300	Blowers and fans [63]
49.0400	Industrial patterns [63]
49.0500	Power transmission equipment [63]
49.0600	Industrial furnaces and ovens [63]
49.0700	General industrial machinery, N.E.C. [63]

50. Miscellaneous Machinery, Except Electrical

50.0001	Carburetors, pistons, rings, valves [63]
50.0002	Machinery, except electrical, N.E.C. [63]

51. Office, Computing, and Accounting Machines

51.0101	Electronic computing equipment [64]
51.0102	Calculating and accounting machines [64]
51.0200	Typewriters [64]
51.0300	Scales and balances [64]
51.0400	Office machines, N.E.C. [64]

52. Service Industry Machines

52.0100	Automatic merchandising machines [69]
52.0200	Commercial laundry equipment [69]
52.0300	Refrigeration and heating equipment [65]
52.0400	Measuring and dispensing pumps [69]
52.0500	Service industry machines, N.E.C. [69]

53. Electric Transmission & Distribution Equipment & Industrial Apparatus

53.0100	Instruments to measure electricity [64]
53.0200	Transformers [69]
53.0300	Switchgear and switchboard apparatus [69]
53.0400	Motors and generators [69]
53.0500	Industrial controls [64]
53.0600	Welding apparatus, electric [69]
53.0700	Carbon and graphite products [69]
53.0800	Electrical industrial apparatus, N.E.C. [69]

54. Household Appliances

54.0100	Household cooking equipment [66]
54.0200	Household refrigerators and freezers [66]
54.0300	Household laundry equipment [66]
54.0400	Electric housewares and fans [66]
54.0600	Sewing machines [66]
54.0700	Household appliances, N.E.C. [66]

55. Electric Lighting and Wiring Equipment

55.0100	Electric lamps [67]
55.0200	Lighting fixtures and equipment [67]
55.0300	Wiring devices [67]

56. Radio, TV, and Communication Equipment

56.0100	Radio and TV receiving sets [68]
56.0200	Phonograph records and tape [68]
56.0300	Telephone and telegraph apparatus [68]
56.0400	Radio & TV communication equipment [68]

57. Electronic Components and Accessories

57.0100	Electron tubes [64]
57.0200	Semiconductors & related devices [64]
57.0300	Electronic components, N.E.C. [64]

58. Miscellaneous Electrical Machinery, Equipment, and Supplies

58.0100	Storage batteries [69]
58.0200	Primary batteries, dry and wet [69]
58.0300	X-ray apparatus and tubes [69]
58.0400	Engine electrical equipment [69]
58.0500	Electrical equipment, N.E.C. [69]

59. Motor Vehicles and Equipment

59.0100	Truck and bus bodies [71]
59.0200	Truck trailers [71]
59.0301	Motor vehicles [70]
59.0302	Motor vehicle parts [70]

60. Aircraft and Parts

60.0100	Aircraft [72]
60.0200	Aircraft & missile engines & engine parts [72]
60.0400	Aircraft and missile equipment, N.E.C. [72]

61. Other Transportation Equipment

61.0100	Ship building and repairing [73]
61.0200	Boat building and repairing [73]
61.0300	Railroad equipment [73]
61.0500	Motorcycles, bicycles, and parts [71]
61.0601	Travel trailers and campers [71]
61.0602	Mobile homes [25]
61.0700	Transportation equipment, N.E.C. [73]

62. Professional, Scientific, and Controlling Instruments and Supplies

62.0100	Engineering and scientific instruments [74]
62.0200	Mechanical measuring devices [74]
62.0300	Automatic temperature controls [74]
62.0400	Surgical and medical instruments [74]
62.0500	Surgical appliances and supplies [74]
62.0600	Dental equipment and supplies [74]
62.0700	Watches, clocks, and parts [74]

63. Optical, Ophthalmic, and Photographic Equipment and Supplies

63.0100	Optical instruments and lenses [74]
63.0200	Ophthalmic goods [74]
63.0300	Photographic equipment and supplies [75]

64. Miscellaneous Manufacturing

64.0101	Jewelry, precious metal [76]
64.0102	Jewelers materials and lapidary work [76]
64.0104	Silverware and plated ware [76]

64.0105 Costume jewelry [76]
64.0200 Musical instruments [77]
64.0301 Games, toys, and children's vehicles [77]
64.0302 Dolls [77]
64.0400 Sporting and athletic goods, N.E.C. [77]
64.0501 Pens and mechanical pencils [77]
64.0502 Lead pencils and art goods [77]
64.0503 Marking devices [77]
64.0504 Carbon paper and inked ribbons [77]
64.0600 Artificial trees and flowers [77]
64.0701 Buttons [77]
64.0702 Needles, pins, and fasteners [77]
64.0800 Brooms and brushes
64.0900 Hard surface floor coverings [77]
64.1000 Burial caskets and vaults [77]
64.1100 Signs and advertising displays [77]
64.1200 Manufacturing industries, N.E.C. [77]

VI. Transportation, Communication, and Public Utilities

65. Transportation and Warehousing

65.0100 Railroads and related services [78]
65.0200 Local, sub., interurban hwy. pass. transp. [79]
65.0300 Motor freight transportation, warehousing [80]
65.0400 Water transportation [81]
65.0500 Air transportation [82]
65.0600 Pipe lines, except natural gas [83]
65.0700 Transportation services [83]

66. Communications, Except Radio & TV

66.0000 Communications, except radio and TV [84]

67. Radio and TV broadcasting

67.0000 Radio and TV broadcasting [84]

68. Electric, Gas, Water, and Sanitary Services

68.0100 Electric services (utilities) [12], [13], [14]
68.0200 Gas production and distribution (utilities) [15]
68.0300 Water supply and sanitary services [85]

VII. Trade, Banking and Finance

69. Wholesale and Retail Trade

69.0100 Wholesale trade [86]
69.0200 Retail trade [87]

70. Finance and Insurance

70.0100 Banking [88]
70.0200 Credit agencies [89]
70.0300 Security and commodity brokers [89]
70.0400 Insurance carriers [89]
70.0500 Insurance agents and brokers [89]

71. Real Estate and Rental

71.0100 Owner-occupied dwellings [90]
71.0200 Real estate [91]

VIII. Services

72. Hotels and Lodging, Personal and Repair Services (Except Auto)

72.0100 Hotels and lodging places [92]
72.0200 Personal and repair services, except auto repair and beauty and barber shops [93]
72.0300 Beauty and barber shops [93]

73. Business Services

73.0100 Miscellaneous business services [94]
73.0200 Advertising [94]
73.0300 Miscellaneous professional services [94]

74. Eating & Drinking Places

74.0000 Eating & drinking places [95]

75. Automobile Repair and Services

75.0000 Automobile repair and services [96]

76. Amusements

76.0100 Motion pictures [97]
76.0200 Amusement and recreation services [97]

77. Health, Educational, and Social Services and Nonprofit Organizations

77.0100 Doctors and dentists [99]
77.0200 Hospitals [98]
77.0300 Other medical and health services [99]
77.0400 Educational services [100]
77.0500 Nonprofit organizations [101]
77.0600 Job training and related services [102]
77.0700 Child day care services [102]
77.0800 Residential care [102]
77.0900 Social services, N.E.C. [102]

IX. Government Enterprises

78. Federal Government Enterprises

78.0100 U.S. postal service [103]
78.0200 Federal electric utilities [12], [14]
78.0300 Commodity credit corporation [111]
78.0400 Other federal government enterprises [103]

79. State & Local Government Enterprises

79.0100 Local government passenger transit [79]
79.0200 State & local electric utilities [12], [13], [14]
79.0300 Other state and local government enterprises [104]

X. Exogenous Sectors

XA. Final Demand Sectors (columns)

91. Personal Consumption Expenditures

91.0000 Personal consumption expenditures [105]

92. Gross Private Domestic Fixed Investment

92.0000 Gross private domestic fixed investment [106]

93. Change in Business Inventories [107]

93.0000 Change in business inventories [107]

94. Exports

94.0000 Exports [108]

95. Imports

95.0000 Imports [109]

96. Federal Government Purchases, National Defense

96.0000 Federal government purchases, national defense [110]

97. Federal Government Purchases, Nondefense

97.0000 Federal government purchases, nondefense [111]

98. State and Local Government Purchases, Education

98.0000 State and local government purchases, education [112]

99. State & Local Government Purchases, Other

99.1000 State & local govt. health, welfare, sanitation [113]
99.2000 State & local govt. purchase, safety [113]
99.3000 State & local govt. purchase, other gen. govt. [113]

XB. Value Added and Special Industries (rows)

80. Noncomparable Imports

80.0000 Noncomparable imports [114]

81. Scrap, Used, and Secondhand Goods

81.0000 Scrap, used, and secondhand goods [115]

82. Government Industry

82.0000 Government industry [116]

83. Rest of the World Industry

83.0000 Rest of the world industry [116]

84. Household Industry

84.0000 Household industry [116]

85. Inventory Valuation Adjustment

85.0000 Inventory valuation adjustment [116]

V.A. Value Added, Total

88.0000 Employee compensation [117]
89.0000 Indirect business taxes [117]
90.0000 Property-type income [117]

Chapter 3

DEVELOPMENT OF YEAR 2000 INPUT-OUTPUT TABLES: PROJECTION OF ENERGY COEFFICIENTS

3.1 OVERVIEW

The development of the projected year 2000 input-output tables primarily involved scaling key elements in the base technical coefficient matrix to account for predicted changes in use per dollar of industry output. The inverse matrix was then obtained directly. The projection of the technical coefficient matrix first accounted for changes in energy sector coefficients, and then for changes in other sector coefficients. The first set of changes is discussed in this chapter, and the second set in chapter 4. In all cases, the changes were registered in 1972 dollars. In effect, this projects relationships in physical quantities; alternatively, relationships could be projected in dollar terms. There are arguments for each approach, but the use of physical quantities helped implement a goal of the present study, which was to project year 2000 energy use in BTU. The scaling of the energy coefficients first accounted for recent changes in intensity of energy use and then for projected future changes to the year 2000, primarily in response to higher prices. Given then available data, the period of recent change was usually 1972-1976, so that projections were usually from 1976 to 2000. In contrast, most of the changes covered in chapter 4 account for and project shifts brought about by technological advances. (The distinction is hardly watertight, since some changes in energy use probably involve changes in technology, and technological advance itself is often a response to a change in relative prices. A deep probing of such relationships, however, was outside the scope of the present study.)

This introductory section is followed by three major sections. Section 3.2 covers the electric utility sectors' sales and fuel mix; section 3.3 discusses row changes in the intensity of use of electricity and natural gas; and section 3.4 considers changes in intensity of use of all other forms of energy. The term "energy intensity" is used here as a succinct synonym for the technical coefficient expressing expenditures on energy relative to sectoral output or all input. A change in energy intensity is then measured as the ratio of the

technical coefficient in a later period to that of an earlier period. The predictions of changes in energy intensities draw on price forecasts, with general agreement with the forecasts employed by Lareau and Darmstadter (1). They assume the following annual percentage price changes, in real terms: electricity: +2.0%; natural gas: +3.4%; fuel oil and coal: +2.2%, and gasoline: +2.4%. The natural gas forecast reflects the removal of price controls; however, it was assumed here that quantity impacts would be muted because natural gas has been rationed by nonprice regulation and institutional devices, given price controls. If the annual percentage price changes are projected from 1976 to 2000, the 2000 price relative to the 1976 price is 1.6 for electricity, 1.7 for fuel oil and coal, 1.8 for gasoline and 2.2 for natural gas, or roughly a doubling for energy prices, generally. Now, Mack and McDuffie list six estimates of long run price elasticity for aggregate energy use in industry, with an average value of -0.38 (2). For that average value, the elasticity relation can be expressed explicity as $Q = KP^{-0.38}$, where Q is quantity, P is price and K is a constant. For this relation, a doubling of price implies a decrease in energy use to 75 percent of base period use. This projection is supported by a parallel forecast made by Leff, Mack and Bodine and by data generated by the D.O.E. Industrial Energy Efficiency Program (3). Consequently, this projection was treated as a benchmark for the projections of individual forms of energy use. Those latter projections made use of a variety of data sources and sectoral estimates, but were basically consistent with a 25 percent reduction in intensity of energy use. Specifically, the general level of intensity of use in 2000 relative to that in 1976 was projected as .85 for electricity, a bit over .75 for coal, and a bit under .75 for nontransportation use of petroleum products. Concern over distortions imposed by price controls led to a muting of quantity reductions for natural gas. Thus, projections of use for nonmanufacturing sectors typically were around 0.6 their 1972 levels, while projections for nonmanufacturing sectors ranged from 0.5 to 0.8 their 1972 levels; for many sectors, the projected reductions had almost been attained by 1976. Other projections made in this chapter include a decline in intensity of use to 0.66 for gasoline; a considerable shift of electricity sales to nuclear power; and a shift to coal in electricity generated from fossil fuels.

3.2 ELECTRIC UTILITY SALES MIX AND FOSSIL FUEL INPUT MIX

3.2.1 Overview

In predicting changes in electricity in the technical coefficient matrix, row changes in electricity flows involve changes in (1) the relative level of con-

sumption of electricity from all sources, and (2) shifts in the mix of sales furnished by sectors [12], [13] and [14], covering electricity from fossil fuels, nuclear power and hydroelectric power, respectively. Column changes consist of changes in mix and level of inputs employed in [12], assuming that columns for [13] and [14] are invariant over time. Row changes in the use of electricity from all sources are discussed in section 3.3. However, changes in row mix and column mix are interrelated and are discussed jointly in this section. Results are summarized in the following comparisons of proportions for 1972 base year values and year 2000 projections. The sales mix proportions were:

		1972	2000
[12]	Fossil fuel	.9402	.7814
[13]	Nuclear power	.0268	.1984
[14]	Hydropower & other	.0330	.0202
		1.0000	1.0000

Similarly, the technical coefficients of fuel inputs into [12] were:

		1972	2000
[1]	Coal	.087795	.102720
[5], [7], [8]	Petroleum	.047099	.027310
[15]	Natural gas	.041196	.032957
		.176090	.162987

Details follow.

3.2.2 Details on Predictions

The initial step in predicting sales mix was the assembly of the data in tables 9 and 10. Table 9 shows actual generation of electricity attributable to specific fuels over the period 1972 through 1979, and it shows a number of predictions of electricity generation, including some made by EPRI and DOE. Table 10 converts the amounts of table 9 into percentages.

Although predictions in tables 9 and 10 show some variation between sources, a good deal of agreement seems manifest. All the predictions show considerable increases in coal and in nuclear fuel generation, and very marked decreases in oil and natural gas. The EPRI forecasts have the special feature of a "shortfall" in two of the cases. This represents generation below a research and development planning target of 5,850 billion kilowatt-hours, taken as a useful "intermediate" value for planning purposes, and corresponding to an average GNP growth rate of 4.4 percent from 1979 to 2000. A "low" growth rate case is also

Table 9

Actual and Predicted Generation of
Electricity in Billion Kilowatt-Hours, by Fuel Source

Actual

	1972	1973	1974	1975	1976	1977	1978	1979
				Billion Kilowatt-Hours				
Coal	772.9	845.7	829.8	853.0	944.6	985.5	976.6	1075.6
Oil	272.5	312.8	299.3	288.9	319.8	357.9	364.2	302.9
Nat. gas	375.7	340.4	319.9	299.8	294.6	305.4	305.4	329.5
Nuclear	54.1	83.3	113.7	172.5	191.1	250.9	276.4	255.2
Hydro	272.6	271.6	300.9	300.1	283.7	220.4	280.4	279.8
Other[a/]	1.8	2.4	2.8	3.3	3.9	4.1	3.3	4.4
Total	1749.6	1856.2	1866.4	1917.6	2037.7	2124.2	2206.3	2247.4

Predicted

						EPRI: 2000		
						Intermediate Growth		Low Growth
	NERC 1989	NCA 1990	DOE(I) 1990	DOE(I) 1995	DOE(II) 2000	Low Nuclear	High Nuclear	High Nuclear
				Billion Kilowatt-Hours				
Coal	1760	1862	1752	2300	2375	2610	2610	2610
Oil	315	263	200	80	60	313[b]	313[b]	313[b]
Nat. gas	160	200	60	0	0			
Nuclear	865	661	745	870	1025	920	1840	1510
Hydro	230	303	305	325	350	420	420	420
Other[a]	25		40	75	145	124	124	124
Total	3355	3289	3100	3650	3955	4387	5307	4966
Shortfall						1463	543	0
R&D Plan						5850	5850	4966

Sources: Actual values: Edison Electric Institute, Statistical Yearbook 1979, Tables 10, 13, 13.1, pp. 16, 17, 20, 21. Predicted values: National Electric Reliability Council, 1980 Summary of Projected Peak Demand, Generating Capability and Fossil Fuel Requirements, 1980, pp. 34, 45-58. National Coal Association, A Forecast for U.S. Coal in the 1980's, 1981, pp. 11-19. U.S. Energy Information Administration, 1980 Annual Report to Congress, Vol. 3: Forecasts, 1981, Prediction DOE(I): p. 68; Prediction DOE (II): p. 159. EPRI Policy Planning Division, Electric Power Research Institute, Overview and Strategy, 1981-1985, Research and Development Program Plan, 1980, pp. 3, 56, 57.

Note: Actual values are from Edison Electric Institute (EEI), Statistical Yearbook, 1979. Predictions are by NERC: National Electric Reliability Council, 1980; NCA: National Coal Association, 1981; DOE: Department of Energy, 1981; EPRI: Electric Power Research Institute, 1980. DOE(I) and DOE(II) refer to separate DOE forecasts. The specific documents employed are listed above.

[a]"Other" represents generation by geothermal, wood, waste and "new sources": wind, solar and biomass.

[b]In the EPRI forecast, coal liquids are included in the oil and natural gas figures.

Table 10

Actual and Predicted Generation of Electricity
by Fuel Source as a Percent of Total

	Actual (Data from EEI)			Predicted				
	1972	1978	1979	NERC 1989	NCA 1990	DOE(I) 1990	DOE(I) 1995	DOE(II) 2000
Coal	44.17	44.26	47.86	52.5	56.6	56.5	63.0	60.0
Oil	15.88	16.51	13.48	9.4	8.0	6.5	2.2	1.5
Nat. gas	21.48	13.84	14.66	4.7	6.1	1.9	0	0
Nuclear	3.09	12.53	11.35	25.8	20.1	24.0	23.8	25.9
Hydro	15.58	12.71	12.45	6.9	9.2	9.8	8.9	8.9
Other	0.10	0.15	0.20	0.7		1.3	2.1	3.7
Total	100.00	100.00	100.00	100.0	100.0	100.0	100.0	100.0

	Predicted EPRI: 2000		
	Intermediate Growth		Low Growth
	Low Nuclear	High Nuclear	High Nuclear
Coal	59.5	49.2	52.4
Oil			
Nat. gas	7.1	5.9	6.3
Nuclear	21.0	34.7	30.3
Hydro	9.6	7.9	8.5
Other	2.8	2.3	2.5
Total	100.0	100.0	100.0

Sources: Actual values: Edison Electric Institute, Statistical Yearbook 1979, Tables 10, 13, 13.1, pp. 16, 17, 20, 21. Predicted values: National Electric Reliability Council, 1980 Summary of Projected Peak Demand, Generating Capability and Fossil Fuel Requirements, 1980, pp. 34, 45-58. National Coal Association, A Forecast for U.S. Coal in the 1980's, 1981, pp. 11-19. U.S. Energy Information Administration, 1980 Annual Report to Congress, Vol. 3: Forecasts, 1981, Prediction DOE(I): p. 68; Prediction DOE (II): p. 159. EPRI Policy Planning Division, Electric Power Research Institute, Overview and Strategy, 1981-1985, Research and Development Program Plan, 1980, pp. 3, 56, 57.

Note: Actual values are from Edison Electric Institute (EEI), Statistical Yearbook, 1979. Predictions are by NERC: National Electric Reliability Council, 1980; NCA: National Coal Association, 1981; DOE: Department of Energy, 1981; EPRI: Electric Power Research Institute, 1980. DOE(I) and DOE(II) refer to separate DOE forecasts. The specific documents employed are listed above.

considered, employing a 2.5 percent GNP growth rate. The "shortfall" is seen as accommodated by some combination of reduced economic activity, substitution of more expensive energy sources and/or more extreme conservation measures (4).

The forecasts of tables 9 and 10 were drawn on as follows. The general level of generation and of coal and nuclear fuel use, as shown by DOE and EPRI, was accepted. The general pattern of a shift away from oil and natural gas was also accepted, but only in relative terms. In terms of absolute levels of inputs, however, it was hypothesized that some modest increases in oil and gas use will occur. This, in turn, reflects the hypothesis that oil and gas price controls will be removed and will not be reimposed (5). The specific projections employed here are presented in table 11. In table 11, the forecast for generation by coal is set at approximately the DOE forecast level, while those for oil and natural gas are consistent with general forecasts made in this chapter for the industrial use of those fuels. Recent experience suggests that the DOE and EPRI forecasts for oil and natural gas were overly pessimistic.

Table 11

Year 2000 Forecasts of Electricity Generation by Fuel Type, Compared to 1972 and 1979 Levels

	Billion Kwh Generated			
	1972	1979	2000	2000/1972
Coal	772.9	1,075.6	2,330	3.0
Oil	272.5	302.9	410	1.5
Natural gas	375.7	329.5	775	2.1
Fossil fuel Total	1,421.1	1,708.0	3,515	2.5
Nuclear power	54.1	255.2	1,190	22.0
Hydropower	272.6	279.8	350	1.3
Other	1.8	4.4	150	83.3
Total	1,749.6	2,247.4	5,205	3.0

The forecast for nuclear power lies between the EPRI low nuclear and high nuclear cases, though shaded somewhat toward the low nuclear case. Specifically, the forecast was set at the low value plus one-third of the difference between low and high values. Given the recent slowdown in nuclear development, the forecast may still seem optimistic. However, it is hypothesized here that speedier licensing procedures, reduction of other regulatory constraints and technological advances will somewhat improve the nuclear power picture. The projections of hydroelectric and "other" power are essentially those of DOE; however, the aggregate of the two approximately equals the aggregate of the

EPRI projections, where "other" power primarily represents geothermal energy (105 of 124 billion kwh). More generally, at several points in the analysis it seemed reasonable to treat hydroelectric and other electricity as an aggregate. The forecast generation total of 5,205 billion kwh is above the DOE forecast and approximately equal to the EPRI case of "intermediate" economic growth, though involving only a moderate "shortfall", at worst.

The forecast amounts in absolute terms must be interpretated as "provisional", for they are used here only to develop the proportionate distribution of electricity generation between [12], [13], and [14], and to forecast the year 2000 technical coefficients for fuel use in [12]. The input-output apparatus determines its own levels of use, and in chapter 5 those levels are compared to the provisional levels presented here. In that comparison, the input-output model produces absolute levels of projected electricity output that are considerably more modest than those of table 11; however, the proportionate distribution of sales between [12], [13] and [14] is quite close to that implied by table 11 (see section 5.5 below)

To develop proportionate sales by electricity sectors, base year sales by sector (from the flow table) were combined with base year and forecast kilowatt-hours generated to yield a provisional forecast of sales. (The amount generated corresponds to kilowatt-hours consumed plus line loss of about 8.5 percent of amount generated. Hence, essentially the same distribution would be obtained by using BTU at point of consumption, for the alternative measures differ only by a constant multiplier.) Table 12 shows given 1972 values and

Table 12

Predicted Year 2000 Sales by Electricity Sectors
(Provisional Forecasts)

	1972 Base Year		"Price" in	Year 2000	
	Dollar Output in Millions	Billion kwh Generated	Dollars per 1000 kwh	Billion kwh	Million Dollars
Sector	(1)	(2)	(3)	(4)	(5)
[12] Fossil fuels	29,731.2	1,421.1	20.921	3,515	73,538
[13] Nuclear power	849.1	54.1	15.695	1,190	18,677
[14] Hydropower & "Other"	1,043.6	274.4	3.803	500	1,901
Total	31,623.9	1,749.6		5,205	94,116

Sources: Column (1), 1972 flow table (Appendix E); column (2): table 9; column (3): col. (1)/col. (2); column (4): table 11; column (5): col. (4) x col. (3).

year 2000 readings on generation, from which are derived the year 2000 sales by applying the 1972 "price" (dollars per 1000 kwh).

Two sets of proportions are now derived and are exhibited in table 13. The first shows proportions for all sales and the second for all sales exclusive of sales to the electricity sectors. The difference occurs because it was assumed that each electricity sector consumes only its own electricity, and that this internal input as a fraction of all input remains invariant over time. The first set of proportions is labeled total sales, and the second set is labeled net sales, since it is net of internal use. (Section 2.4.4 above presents more information on the distinction and the data employed in calculating net sales (6)). The net sales proportions were employed in distributing sectoral use of electricity to the industry source of electricity output for the intermediate sectors. Consequently, the respective net sales proportions of table 13 hold for the row entries of [12], [13] and [14] in each column of the corresponding technical coefficient matrix (appendixes E and H). The total sales proportions were employed in distributing electricity sales output for the final demand sectors, and in retrospect, the use of net sales proportions in that case, also, would have been more precise. However, the resulting differences seem quite modest, and even the more precise proportions as input data yield some modest discrepancies in output proportions (see section 5.5).

Table 13

Electricity Sales Proportions by Sector,
1972 and Predicted 2000

Sector		Total Sales Proportions		Net Sales Proportions	
		1972	2000	1972	2000
[12]	Fossil Fuels	.9402	.7814	.9327	.7591
[13]	Nuclear Power	.0268	.1984	.0302	.2186
[14]	Hydro & Other	.0330	.0202	.0371	.0223
	Total	1.0000	1.0000	1.0000	1.0000

The fossil fuel entries in table 11 were also employed in projecting year 2000 fossil fuel technical coefficients. The share of each fossil fuel in total fuel use is as follows:

	1972	2000	2000/1972
Coal	.5438	.6629	1.219
Oil	.1918	.1166	.608
Natural gas	.2644	.2205	.834
	1.0000	1.0000	

For each fuel, the ratio of share in 2000 to share in 1972 was interpreted as a technical coefficient scale factor, and, in turn, was multplied by 0.96 to account for assumed increases in energy efficiency, yielding this final set of scale factors:

Coal	1.17
Oil	0.58
Natural gas	0.80

The respective scale factors were then multiplied by the corresponding 1972 technical coefficients to yield projected year 2000 technical coefficients, as shown in table 14.

Table 14

Technical Coefficients for Fossil Fuel Inputs in Sector [12], 1972 and Predicted 2000

Sector	1972 Technical Coefficient	Scale Factor	2000 Technical Coefficient
[1] Coal	.087795	1.17	.102720
[5] Jet fuel	.001322	0.58	.000760
[7] Distillate oil	.005597	0.58	.003246
[8] Residual oil	.040180	0.58	.023304
[15] Natural gas	.041196	0.80	.032957
Sum	.176090		.162987

Although a 0.96 scale factor was employed to account for increased energy efficiency, the sum of the year 2000 coefficients equals 0.925 of the corresponding 1972 sum. The difference between 0.96 and 0.925 can be explained as a fuel mix effect, presumably reflecting higher conversion efficiency for coal than for the other fossil fuels. The overall projected 7.5 percent reduction in input for given level of output approximately equals the percentage reduction in energy input needed to produce a given level of output in petroleum refining (see section 3.4.3, below), and is somewhat more modest than the percentage reduction projected for most industrial sectors. Aside from likely inherent difficulty in conserving energy in industries that convert energy from one form to another, environmental regulation probably imposes additional constraints that limit energy conservation in fossil fuel generation; consequently, the overall result obtained here appears reasonable.

3.3 ROW CHANGES IN USE OF ELECTRICITY AND NATURAL GAS

3.3.1 Overview

The electric utility and the natural gas row entries were multiplied by corresponding sets of scale factors to transform the base 1972 rows into estimated year 2000 rows in the technical coefficient matrix. The scale factors were obtained as follows. Actual changes in intensity from 1972 to 1976 were estimated from available data for individual sectors. Then a regression equation for electricity and a corresponding equation for natural gas were used to help develop predicted changes in energy intensity from 1976 to 2000, given increased energy prices. In the case of electricity, year 2000 technical coefficients were predicted to fall to 0.85 their 1976 levels by direct application of its regression equation. The natural gas equation, if applied mechanically, would yield projected declines in intensity to around 0.6 the 1976 levels. However, intensity reductions from 1972 to 1976 were almost as pronounced, and it was hypothesized that much of this involved gas supply reductions imposed by price controls. Hence, further reductions from 1976 to 2000 were limited, so that intensity would fall to a minimum of 0.5 the 1972 level, with a general scale factor of 0.9 used to account for the change from 1976 to 2000. A number of important assumptions were necessary in developing the regression equations, and they are critically examined in the next section, which discusses the regression analysis.

3.3.2 Regression Equations from Manufacturing Data

The treatment of electricity and natural gas utility sales poses special problems in input-output analysis because prices paid for purchases from those sectors vary between consuming sectors. For other sectors than the utilities, producer prices are employed in calculating sales, with transportation, retail trade and wholesale trade margins removed and treated as components of the transportation and trade sectors. In contrast, utility sales to consumers in effect incorporate trade and transportation margins, so that prices vary between sectors. Though this complicates analysis, it was turned to advantage here because it meant that sufficient data were available to permit the relation of changes in energy intensity to price changes by means of regression analysis.

Data applicable in regression analyses were limited to manufacturing sectors, but for those cases, prices and energy intensities could be derived for 1972 and 1976, primarily drawing on Census of Manufactures data (7). The Census

series generally furnished good coverage of electricity use, though there were occasional gaps; larger gaps occurred for natural gas use. In both cases, the gaps were closed by estimate, drawing on internal evidence in the case of electricity and on American Gas Association data (8) in the case of natural gas. Details on those estimates appear in Appendix F.

For the regression analysis, the central relationship of interest can be expressed as follows: Let P denote the price of a unit of utility use, and TC the technical coefficient for utility purchases by a given manufacturing sector, with subscripts 72 and 76 denoting 1972 and 1976, respectively, so that P_{72} and TC_{72} are the base year values. Then corresponding 1976 values were deflated by accounting for changes in the general price level to yield the respective deflated values DP_{76} and DTC_{76} for that year. Finally, DTC_{76}/TC_{72} was specified as the dependent variable and DP_{76}/P_{72} as the key independent variable in the regression equation to be fitted. To simplify notation, these variables were respectively named the technical coefficient ratio and the price ratio. In addition to the price ratio, independent variables included the square of the price ratio and dummy variables based on the size of the technical coefficient in 1972. Observations on the variables were obtained for each industry in turn, and the regression equation was then estimated by employing those observations. A detailed description of these procedures is now presented.

In practice, the measures employed were developed from manufacturing industry series respectively exhibiting use of electricity and natural gas by each industry in turn, covering both expenditures and physical quantities consumed. The industries were classified by the Standard Industrial Classification (SIC) codes at the 4-digit SIC level (the finest level of detail). This allowed exact correspondence with BEA sectors, so that after the expenditures and quantity figures were coded in SIC orders they could be, and were, sorted and recombined in BEA sectoral order. The BEA ordered information was also combined and ordered in the RFF sectoral classification (9). Prices were obtained by dividing expenditures by quantities, with 1976 prices deflated to 1972 terms by the Consumer Price Index. Technical coefficient estimates were obtained for 1972 and 1976 by dividing expenditures on each utility by total industry shipments; thus, let $(\text{electricity expenditures})_i/\text{shipments}_i = TCE_i$ and $(\text{natural gas expenditures})_i/\text{shipments}_i = TCN_i$, where i is specific industry, TCE_i is the technical coefficient for electricity use, and TCN_i is the technical coefficient for natural gas use. These technical coefficients correspond to those

defined by the BEA for their commodity-by-industry table; it was assumed here that growth relationships obtained would hold as well for the commodity-by-commodity technical coefficients. Deflated measures of the technical coefficients were obtained by the following operations. Deflated expenditures on utility energy were obtained by multiplying 1976 quantities by 1972 prices; the 1976 value of shipments was converted to the 1972 price level by deflating by the Consumer Price Index; and the technical coefficient was estimated as deflated expenditures divided by deflated shipments.

Both current and deflated technical coefficients developed for the RFF manufacturing sectors appear as tables 15 and 16, respectively covering electricity and natural gas. Corresponding price data for the RFF sectors and both technical coefficient and price data for the BEA sectors appear in Appendix F. In tables 15 and 16, the deflated ratios appearing in the last column were the individual scale factors used to convert 1972 to 1976 row entries expressing the use of utility energy by manufacturing sectors.

Regression equations were now fitted using both the RFF and BEA sectoral data. Results were similar between the two sets of cases, and the coefficient for the price ratio was statistically significant in every equation. However, the t ratios in the BEA equations were considerably higher than those in the RFF equations, no doubt reflecting the much greater number of observations in the former cases. Thus, there were 367 and 358 observations in the BEA electricity and natural gas equations, respectively, as opposed to 46 observations in the RFF equations. (There were nine fewer observations for natural gas than for electricity in the BEA equations because of elimination of cases where purchases of natural gas were listed as zero in 1972.) Consequently, the equations obtained by using the BEA data were employed in developing projections.

As indicated above, the dependent variable was the ratio of technical coefficients, consisting of deflated 1976 to base 1972 value, for each sector, in turn, while the key independent variable was the price ratio consisting of the 1976 deflated utility price for each sector relative to the 1972 price for that sector, denoted as P Ratio, for short. In addition to the price ratio, other independent variables were brought into the equation, including the square of the price ratio and some dummy variables accounting for the initial size of the technical coefficient. The latter measures were introduced to test the hypothesis that the greater the importance of utility expenditures in total inputs (and hence, the greater the technical coefficient), the greater the change in

Table 15

Technical Coefficients for Use of Electricity by
RFF Manufacturing Sectors, 1972 and 1976

RFF Manufacturing Sector Number	Name	1972 Expend. on Elect. (in million) dollars (1)	Technical Coefficients [a] 1972 base year dollars (2)	1976 current dollars (3)	1976 deflated dollars [b] (4)	Ratios of 1976 to 1972 Tech. Coeffs. current (3)/(2)	deflated (4)/(2)
4	*GASOLINE, etc. (Petroleum ref.)	195.0	0.007287	0.005650	0.003720	0.775	0.511
11	ASPHALT AND TAR PRODUCTS	16.1	0.008329	0.009890	0.008906	1.187	1.069
25	MOBILE HOMES	5.1	0.001573	0.002660	0.002250	1.692	1.431
35	ORDNANCE	43.9	0.006112	0.007362	0.004787	1.205	0.783
36	MEAT PACKING	39.3	0.001708	0.002331	0.001885	1.364	1.103
37	DISTILLING	26.0	0.003871	0.006127	0.004599	1.583	1.188
38	ALL OTHER FOOD & KINDRED	391.6	0.004589	0.005533	0.004326	1.206	0.943
39	TOBACCO	11.6	0.001959	0.003039	0.002092	1.551	1.067
40	TEXTILES	252.1	0.009902	0.015570	0.010081	1.572	1.018
41	APPAREL	132.1	0.004344	0.005897	0.005159	1.358	1.188
42	LOGGING AND SAW MILLS	75.1	0.007684	0.009773	0.008575	1.272	1.116
43	OTHER LUMBER AND WOOD	82.8	0.007657	0.010975	0.008851	1.433	1.156
44	HOUSEHOLD FURNITURE	35.3	0.004764	0.007344	0.005799	1.542	1.217
45	OTHER FURNITURE	20.2	0.005165	0.006743	0.005539	1.305	1.072
46	PULP AND PAPER MILLS	233.3	0.020740	0.026917	0.018993	1.298	0.916
47	OTHER PAPER PRODUCTS	114.3	0.006718	0.007582	0.005827	1.129	0.867
48	PRINTING AND PUBLISHING	136.7	0.004535	0.006079	0.004799	1.341	1.058
49	CHEMICALS	678.8	0.026173	0.033861	0.023318	1.294	0.891
50	PLASTICS	130.6	0.013332	0.017522	0.011832	1.314	0.887
51	DRUGS	37.0	0.004614	0.006807	0.004686	1.475	1.015
52	CLEANING & TOILET PREPARATIONS	28.1	0.002874	0.003778	0.002811	1.315	0.978
53	PAINTS	15.6	0.004082	0.004502	0.003840	1.103	0.941
54	RUBBER	223.5	0.010682	0.014604	0.010330	1.367	0.967
55	LEATHER	25.0	0.004333	0.005477	0.004495	1.264	1.037
56	GLASS	75.0	0.013249	0.021495	0.015047	1.622	1.136
57	CEMENT	91.0	0.050804	0.071280	0.045856	1.403	0.903
58	OTHER STONE & CLAY	140.2	0.009954	0.014007	0.010528	1.407	1.058
59	IRON & STEEL MFG.	674.4	0.018427	0.022756	0.016667	1.235	0.904
60	ALUMINUM MFG.	253.6	0.034566	0.043895	0.030066	1.270	0.870
61	OTHER PRIMARY NONFERROUS METALS MFG.	133.2	0.008256	0.013124	0.009458	1.590	1.146
62	FABRICATED METALS	297.8	0.006294	0.008168	0.006205	1.298	0.986
63	MACHINERY (NON-ELECTRICAL)	266.2	0.005488	0.006756	0.005395	1.231	0.983
64	COMPUTING, ELECTRONICS, AND RELATED	110.8	0.005451	0.007677	0.005171	1.408	0.948
65	REFRIGERATION & HEATING EQPMT.	28.6	0.004038	0.005588	0.004004	1.384	0.992
66	HOUSEHOLD APPLIANCES	30.8	0.004438	0.006189	0.004627	1.395	1.043
67	ELECTRIC LIGHTING	31.5	0.005574	0.007900	0.005989	1.417	1.074
68	RADIO, TV & COMMUNIC. EQPMT.	80.9	0.004333	0.005352	0.003612	1.235	0.834
69	ALL OTHER ELECTRIC MACH.	87.6	0.006474	0.008428	0.005987	1.302	0.925
70	MOTOR VEHICLES & PARTS	201.1	0.003284	0.004561	0.003097	1.389	0.943
71	TRUCKS, MOTORCYCLES & RELATED	15.2	0.003245	0.003867	0.002968	1.192	0.915
72	AIRCRAFT	93.9	0.005538	0.006482	0.004297	1.171	0.776
73	OTHER TRANSPORTATION EQPMT.	36.2	0.004872	0.006422	0.004827	1.318	0.991
74	SCIENTIFIC INSTRUMENTS & RELATED	41.4	0.004923	0.006548	0.004731	1.330	0.961
75	PHOTOGRAPHIC EQUIPMENT & SUPPLIES	15.4	0.002738	0.003663	0.002787	1.338	1.018
76	JEWELRY	8.7	0.003809	0.004341	0.003371	1.140	0.885
77	OTHER MISCELLANEOUS MFG.	54.1	0.005471	0.006969	0.005501	1.274	1.006

*Refers to Petroleum Refining, covering RFF sectors 4 through 10.

[a] "Technical Coefficient" here is defined as expenditures on electricity divided by industry shipments.

[b] Deflated dollars are obtained as follows: shipments are deflated by the Consumer Price Index to 1972 dollar equivalents; electricity expenditures equals 1976 quantities times 1972 prices.

Table 16

Technical Coefficients for Use of Natural Gas by
RFF Manufacturing Sectors, 1972 and 1976

RFF Manufacturing Sector Number	Name	1972 Expend. on Nat. Gas (in million) dollars (1)	Technical Coefficients [a] 1972 base year dollars (2)	1976 current dollars (3)	1976 deflated dollars [b] (4)	Ratios of 1976 to 1972 Tech. Coeffs. current (3)/(2)	deflated (4)/(2)
4 *	GASOLINE	368.7	0.013777	0.017016	0.004987	1.235	0.362
11	ASPHALT AND TAR PRODUCTS	15.9	0.008226	0.009826	0.005109	1.195	0.621
25	MOBILE HOMES	3.2	0.000987	0.000617	0.000293	0.625	0.297
35	ORDNANCE	16.9	0.002353	0.001912	0.001253	0.813	0.533
36	MEAT PACKING	28.0	0.001217	0.001192	0.000644	0.979	0.529
37	DISTILLING	16.1	0.002397	0.004502	0.002311	1.878	0.964
38	ALL OTHER FOOD & KINDRED	248.6	0.002913	0.003855	0.001900	1.323	0.652
39	TOBACCO	2.7	0.000456	0.000410	0.000248	0.898	0.545
40	TEXTILES	65.3	0.002565	0.002980	0.001629	1.162	0.635
41	APPAREL	28.9	0.000950	0.000839	0.000397	0.883	0.417
42	LOGGING AND SAW MILLS	14.7	0.001504	0.001485	0.000747	0.987	0.497
43	OTHER LUMBER AND WOOD	39.8	0.003681	0.004434	0.001947	1.205	0.529
44	HOUSEHOLD FURNITURE	9.4	0.001269	0.001183	0.000607	0.933	0.479
45	OTHER FURNITURE	10.8	0.002762	0.002967	0.001490	1.074	0.539
46	PULP AND PAPER MILLS	168.2	0.014953	0.019121	0.007681	1.279	0.514
47	OTHER PAPER PRODUCTS	42.3	0.002486	0.002924	0.001417	1.176	0.570
48	PRINTING AND PUBLISHING	33.2	0.001101	0.000983	0.000460	0.892	0.417
49	CHEMICALS	595.8	0.022972	0.029968	0.013387	1.305	0.583
50	PLASTICS	56.3	0.005747	0.009291	0.003244	1.617	0.564
51	DRUGS	10.5	0.001309	0.001490	0.000853	1.138	0.652
52	CLEANING & TOILET PREPARATIONS	14.8	0.001514	0.001954	0.000977	1.291	0.646
53	PAINTS	6.2	0.001622	0.001501	0.000914	0.925	0.564
54	RUBBER	67.6	0.003231	0.003044	0.001819	0.942	0.563
55	LEATHER	5.8	0.001005	0.001101	0.000296	1.095	0.294
56	GLASS	137.5	0.024289	0.035633	0.019268	1.467	0.793
57	CEMENT	78.5	0.043825	0.056571	0.024835	1.291	0.567
58	OTHER STONE & CLAY	169.2	0.012012	0.016943	0.009100	1.410	0.758
59	IRON & STEEL MFG.	475.3	0.012987	0.015131	0.007699	1.165	0.593
60	ALUMINUM MFG.	86.5	0.011790	0.011954	0.007907	1.014	0.671
61	OTHER PRIMARY NONFERROUS METALS MFG.	77.1	0.004779	0.006962	0.003687	1.457	0.771
62	FABRICATED METALS	136.2	0.002879	0.003229	0.001796	1.122	0.624
63	MACHINERY (NON-ELECTRICAL)	95.6	0.001971	0.002157	0.001083	1.094	0.549
64	COMPUTING, ELECTRONICS, AND RELATED	20.7	0.001018	0.001044	0.000505	1.025	0.496
65	REFRIGERATION & HEATING EQPMT.	11.3	0.001595	0.002170	0.001139	1.360	0.714
66	HOUSEHOLD APPLIANCES	15.3	0.002205	0.002958	0.001606	1.342	0.729
67	ELECTRIC LIGHTING	11.6	0.002053	0.002370	0.001204	1.155	0.587
68	RADIO, TV & COMMUNIC. EQPMT.	15.2	0.000814	0.000901	0.000435	1.107	0.535
69	ALL OTHER ELECTRIC MACH.	27.3	0.002018	0.002569	0.001398	1.273	0.693
70	MOTOR VEHICLES & PARTS	65.7	0.001073	0.001756	0.001015	1.637	0.946
71	TRUCKS, MOTORCYCLES & RELATED	6.9	0.001473	0.001334	0.000719	0.906	0.488
72	AIRCRAFT	18.0	0.001062	0.001248	0.000680	1.175	0.641
73	OTHER TRANSPORTATION EQPMT.	7.3	0.000983	0.001163	0.000616	1.184	0.627
74	SCIENTIFIC INSTRUMENTS & RELATED	9.7	0.001153	0.001179	0.000634	1.023	0.550
75	PHOTOGRAPHIC EQUIPMENT & SUPPLIES	4.4	0.000782	0.001018	0.000638	1.301	0.816
76	JEWELRY	1.1	0.000482	0.000768	0.000321	1.594	0.667
77	OTHER MISCELLANEOUS MFG.	18.0	0.001820	0.001667	0.000832	0.916	0.457

* Refers to Petroleum Refining, Covering RFF Sectors 4 through 10

[a] "Technical Coefficient" here is defined as expenditures on natural gas divided by industry shipments.

[b] Deflated dollars are obtained as follows: shipments are deflated by the Consumer Price Index to 1972 dollar equivalents; natural gas expenditures equals 1976 quantities times 1972 prices.

the technical coefficient in the later period relative to the base period. There was some modest confirmation of this hypothesis, but only the dummy variable covering the lowest range of values turned out to be statistically significant for both electricity and natural gas. These low range dummy variables were labeled TC01 and covered the range .000 to .004 in electricity and .000 to .001 in natural gas.

Table 17 explicitly lists the fitted regression equations. In both cases, energy intensities are predicted to fall as prices rise, though the sign of the squared term implies that the impact tends to taper off given a large enough price increase.

Table 17

Multivariate Regression Equation Estimates
Using Technical Coefficient Ratio As
Dependent Variable, BEA Sectors

Variable or Measure	Coefficients		t Ratios	
	Elect.	Nat. Gas	Elect.	Nat. Gas
Constant	2.491	2.108	11.066	8.055
P ratio	-1.722	-1.149	5.297	5.124
$(\text{P ratio})^2$	0.437	0.192	3.708	4.110
TC01	0.066	0.181	3.013	3.980
	$\bar{R}^2$			
Explained variance	0.299	0.142	-	-

Table 18 applies the equations of table 17 to predict changes in energy intensity as a function of given changes in price. In particular, a year 2000 price increase of 1.6 times the 1976 level for electricity, and a doubling of the 1976 level for natural gas implies an energy use intensity relative to the base level of about 0.85 for electricity and 0.6 for natural gas.

Note that in the case of electricity, the technical coefficient ratio decreases as the price ratio increases from 1.0 to 2.0, but then increases with futher increases in the price ratio. This counterintuitive result appears attributable to the effect of a few outlying observations on the square of the price variable, given an inspection of the underlying data. That inspection suggests that an asymptotic relation in fact holds, so that it would be reasonable to treat the equation of table 17 as holding only for price ratios of 2.0 or less,

Table 18

Predicted Technical Coefficient Ratio
for Given Price Ratio

Price Ratio	Predicted Technical Coefficient Ratio	
	Elect.	Nat. gas
1.00	1.206	1.151
1.20	1.054	1.006
1.35	0.963	0.907
1.50	0.891	0.817
1.60	0.855	0.762
2.00	0.795	0.578
2.50	0.917	0.433
3.00	1.258	0.389

with a predicted constant technical coefficient ratio of around 0.8 for all price ratios above 2.0 (10). Under that interpretation our predicted technical coefficient ratio (for the price ratio of 1.6) is unaffected.

Note also that if prices are unchanged, that is, if the price ratio is 1.0, then table 18 shows the electricity intensity as 1.2 times the base level, while natural gas is 1.15 times the base level. Several possible explanations for these results can be put forward. The increase for natural gas may in part represent the expansion in use that would occur if nonprice rationing were removed. Possible explanations that seem primarily applicable to electricity include changes in technology that cause increased use at any given price, and implicit cross elasticity effects that occur because prices of alternative energy sources have increased faster than the price of electricity.

In any event, it is worth noting explicitly that our projections in effect build in structural changes accounting for some increase in intensity of utility use, somewhat offsetting the impact of projected price increases. It is also worth stressing that projections from 1976 to 2000 were obtained by using the same scale factor for all sectors. A critical examination of the assumptions involved here seems in order and is presented at this point, with additional detail appearing in appendix F. The discussion may be particularly useful in furnishing suggestions and leads for future research.

The form of the regression equation employed can be viewed as a variant of the conventional demand curve. The use of energy intensity in effect standardizes quantity levels between industries by dividing by output; the use of ratios

relative to base period levels means that changes in quantities are related to changes in price. Though somewhat unorthodox, the approach seems generally consistent with conventional demand analysis.

The deflation of shipments by the Consumer Price Index rather than by industry specific price indexes might be questioned as a possible source of overstatement of price effects. The problem is most pronounced for data on petroleum refining, but with the elimination of the observation on that sector, the regression results were essentially unchanged. Hence, bias from this source seems likely to be quite minor.

It was noted above that cross-elasticity relationships might have affected the regression results in implicit fashion, and a good case can be made for an explicit accounting by introducing the prices of other energy sources in the regression analysis. There are some inhibitions, however. First, there would be serious complications in applying regression results where petroleum product and coal energy intensity ratios are dependent variables. This is because all product flows in input-output tables are in producer prices, save for those of the energy utilities. Hence a great deal of effort would be necessary to properly account for the trade and transportation margins which comprise the differences between consumer and producer prices. Of course, prices paid by each industry for alternative sources of energy can be used directly in the regression equations for the energy utilities. But here, it must be noted that data gaps and limitations are much more pronounced for petroleum products and coal than for the utilities, so that the costs of using those data would be relatively high. Despite these qualms, the introduction of other energy prices could well improve the analysis, and is suggested for future research.

It was also noted earlier that projections from 1976 to 2000 used the same scale factor for all sectors. This can be rationalized by arguing that observed variations between sectors need not express a long term trend, but rather involve changes with no necessary implications for the future, so that they can be viewed as random disturbances specific to the base period. In these circumstances, the only meaningful long-run pattern is that established for all sectors. An alternative approach is to argue that differences in response between sectors should be incorporated in the analysis. There was some statistical testing of these alternative hypotheses and it was concluded that the use of the same scale factor was defensible on the basis of currently available data. This is not to deny that better data, longer data series and

more intensive analysis might establish useful distinctions between sectoral responses to price changes.

Focusing on electricity consumption, statistical tests were carried out by examining differences between groups of manufacturing sectors as defined in the appendix to chapter 2. The 15 groupings there were reduced to 14 by combining the Food and Tobacco groups (VB and VC in the classification) because of the small number of observations on Tobacco. The number of observations per group ranged from 6 for Ordnance to 48 for Food and Tobacco, with 367 observations in total. The regression equation for electricity was then extended by bringing into the equation a dummy variable and an interaction term for each group. The dummy variables, per se, accounted for differences in intercepts between groups. The interaction terms, accounting for slope differences, were formed by multiplying each dummy variable, in turn, by P Ratio, the price measure. Then nonsignificant dummy variables and interaction terms were eliminated in a stepwise procedure, so that only statistically significant variables were retained. In effect, the procedure would yield a specific regression equation for an individual group if that group's consumption relation differed significantly from the overall pattern.

It turned out that of the 14 groups, only 5 had statistically significant intercept or slope differences, and 4 of those 5 had predicted consumption that fell within 10 percent of the prediction obtained using the general equation. Specifically, given a price increase of 1.6 times base price, the following scale factors adjust the general "across-the-board" prediction to account for the individual differences established by the extended regression equation:

Mfg. group	Sectors	Scale factor
B and C	Food and tobacco	0.97
D	Textiles and apparel	1.08
G	Chemicals	0.96
K	Fabricated metals	1.02
N	Transportation equipment	0.75
	All other	1.015

Intuitively, it seems clear that only minor changes in predicted output and electricity use would be generated by applying these scale factors. In fact, a sensitivity analysis was carried out using a variant of the year 2000 matrix in which the scale factors were applied, and intuition was confirmed. Additional detail appears in chapter 5.

Finally, since the fitted regression equations were derived from cross-section data spanning a wide range of quantities and prices, it seemed justifiable to treat them as long run relationships useful for long term predictions. Some recent evidence on electricity consumption in manufactures adds support to this interpretation. From 1976 to 1979, the real price for electricity used in manufacturing increased by 15 percent, while electricity use relative to manufacturing output in real terms remained roughly constant (11). Our electricity regression equation, however, implies a 7 percent increase in intensity of use given that price increase, which can be rationalized as accounting for the full impact, in the long run, of technical change and higher prices for competitive fuels. (For a small enough price increase, those positive effects should outweigh the negative effect of the price increase.) In any event, it seems unlikely that our year 2000 electricity predictions are understated.

3.3.3 Predictions of Utility Coefficients

Year 2000 predictions of row entries for the use of electricity were obtained as follows. Summarizing the work carried out for manufactures, actual changes from 1972 to 1976 were incorporated by applying the scale factors in the last column of table 15, above, and then an estimated scale factor of 0.85 was used for all sectors to move from 1976 to 2000. One exception occurred in the case of petroleum refining, for which a scale factor of 0.70 was employed, based on specific information for that sector (section 3.4.3, below).

For the use of electricity by nonmanufactures as a group, it was estimated that the average technical coefficient ratio for 1976 relative to 1972 was 1.06 (12), so that a general scale factor from 1972 to 2000 was obtained by multiplying 1.06 times 0.85 to yield 0.90, which was employed in scaling most of the nonmanufacturing sectors. In developing predictions for the 1976-2000 period, some outside forecasts were drawn on for some nonmanufacturing sectors, and for the remainder it was assumed that the 0.85 scale factor developed for manufactures would be applicable. This is a somewhat heroic assumption, but seemed the most reasonable prediction in a situation of very sparse information.

Specific nonmanufacturing scale factors were developed as follows. Gelb and Pliskin (13) present information used in forecasting consumption changes for most of the mining sectors (sectors [1], [2], [3], [21] and [22]). They predict increased energy use in iron and copper mining, a forecast consistent with other reviews of mining in the literature; however, that forecast was somewhat muted here, given the expected impact of higher prices, and the Gelb and

Pliskin prediction that electricity use per ton of ore in copper mining would fall at a projected 0.8 percent rate between 1972 and 1985 by way of expected technical changes (14). Agricultural sector forecasts were based on USDA data on energy use in agriculture (15), while the forecast for the communications sector [84] drew on a report of the DOE Industrial Efficiency Program (16) which showed a reduction of 16.1 percent in electricity per telephone for American Telegraph and Telephone between 1973 and 1978, and a reduction of 16 percent in BTU per customer line for the General Telephone and Electronics Corporation. This information was accepted as an indicator of declining electricity use per unit of output in the 1972-1976 period, and in turn implied a year 2000 scale factor of 0.71. Individual estimates were also developed for the railroads and for state and local government, given information specific to those sectors (17).

Turning to natural gas use, the Lareau-Darmstadter projected price increase of 3.4 percent per year implies somewhat more than a doubling of price from 1976 to 2000, which in turn would imply a decline in intensity to about 0.6 the base level, applying the regression results shown in table 18. But that great a decline had already occurred from 1972 to 1976 for many manufacturing sectors, as shown in table 16, above, and it seemed likely that a considerable amount of the decline had occurred because of price controls, consequent "shortages" and nonprice rationing. Further, since the situation was viewed as a temporary disequilibrium it seemed plausible that mechanical application of the price forecast would lead to understatement of intensity of use. Hence, the impact on quantity was considerably muted. In the case of manufacturing sectors, it was assumed that, at most, intensity would be halved from 1972 to 2000, so a minimum of 0.5 was imposed as the 1972 to 2000 scale factor. This was generally consistent with a 1976 to 2000 scale factor of 0.9, which was employed for that period. This, in turn, corresponds to a 2000 to 1976 price ratio of 1.35 (from table 18). For nonmanufacturing sectors, 2000 to 1972 scale factors ranging from 0.6 to 0.8 were employed. This was because of the likelihood that sectors primarily relying on natural gas for space heating would have less of a reduction in use than sectors using natural gas in industrial processes, on the presumption that heating demand would be less elastic than industrial demand. Relative to share of GNP, all commercial gas use showed only moderate decline, and gas use by services, in particular, had only a small decline between 1972 and 1976 (18). In the case of agriculture and mining, the sources drawn on for the electric utility use projections were also applied in the natural gas projections.

All of the scale factors for utility use are collected and displayed in table 19.

3.4 OTHER ENERGY SECTORS

This section discusses the projection of changes in the energy sectors other than the utilities. Sections 3.4.1 and 3.4.2 focus on changes in the use of coal and fuel oil, with manufacturing use of those forms of energy covered in 3.4.1, and nonmanufacturing in 3.4.2. Sections 3.4.3 and 3.4.4 respectively project the intensity of use of energy in petroleum refining and in transportation. Finally, section 3.4.5 projects the use of other petroleum products and of unconventional energy sources (synthetic fuels). Additional details appear in appendix G.

In the usual fashion, the projection process involved accounting for actual shifts in intensity of energy use during a base period, usually 1972 to 1976, and then forecasting from the end of the base period to the year 2000.

3.4.1 Coal and Fuel Oil Use in Manufactures

Changes in coal and fuel oil intensities from 1971 to 1976 are shown for individual manufacturing sectors in table 20. Coal declines in all cases save sector [32], and shows considerable decline for manufactures as a whole. In recent years, the intensity of coal use generally has declined in industry, covering agriculture, construction and mining, as well as manufactures; thus, the intensity of use in industry in 1978 relative to 1974 was 0.746 for coal as opposed to 1.054 for petroleum products (19).

Many have argued that a considerable shift to coal from petroleum products and natural gas will occur in future industrial use (20). In contrast, the Lareau-Darmstadter projection of a coal price increase equal to that of fuel oil suggests an equal percentage reduction in the use of both fuels. Projections here do not go quite that far, for they do assume a modest shift toward coal from 1976 to 2000, in relative terms, but they also assume a general reduction in fuel use as a response to higher prices. Table 20 also shows a considerable shift to residual oil from distillate oil, but it was assumed that much of the shift was transitory, given considerable year to year variation in those fuels' share of consumption (21).

Table 19

Forecast Scale Factors Transforming 1972
Technical Coefficients to Year 2000 Values,
for Consumption of Electricity and Natural Gas

	Sector	Electricity Use	Natural Gas Use
1	COAL MINING	1.05	0.50
2	CRUDE PETROLEUM	1.00	0.50
3	NATURAL GAS EXTRACTION	1.00	0.50
4	GASOLINE	0.70	0.60
5	JET FUEL	0.70	0.60
6	KEROSENE	0.70	0.60
7	DISTILLATE FUEL OIL	0.70	0.60
8	RESIDUAL FUEL OIL	0.70	0.60
9	LPG	0.70	0.60
10	ALL OTHER PETROLEUM REFINING	0.70	0.60
11	ASPHALT AND TAR PRODUCTS	0.90	0.55
12	ELECTRICITY, FOSSIL FUEL	1.00	0.80
13	ELECTRICITY, NUCLEAR POWER	1.00	0.80
14	ELECTRICITY, HYDROPOWER	1.00	0.80
15	NATURAL GAS UTILITIES	0.90	1.00
16	MEAT ANIMALS	0.78	0.80
17	OTHER LIVESTOCK PRODUCTS	0.78	0.80
18	GRAINS	0.79	0.75
19	OTHER CROPS AND AG. SERVICES	0.79	0.75
20	FORESTRY AND FISHERIES	0.78	0.80
21	IRON MINING	1.10	1.00
22	NONFERROUS METALS MINING	0.90	1.10
23	NONMETALLIC MINERALS	0.90	0.80
24	NEW RESIDENTIAL BUILDINGS	0.90	0.60
25	MOBILE HOMES	1.20	0.50
26	NEW NONRESIDENTIAL BUILDINGS	0.90	0.60
27	NEW ENERGY ACTIVITY STRUCTURES	0.90	0.90
28	NEW HIGHWAYS & STREETS	0.90	0.60
29	ALL OTHER NEW CONSTRUCTION	0.90	0.60
30	MAINT. & REPAIR, RESIDENTIAL	0.90	0.60
31	M & R, NONRESIDENTIAL BLDGS.	0.90	0.60
32	M & R, ENERGY ACTIVITY STRUCTS.	0.90	0.60
33	M & R, HIGHWAYS & STREETS	0.90	0.60
34	ALL OTHER M & R	0.90	0.60
35	ORDNANCE	0.67	0.50
36	MEAT PACKING	0.94	0.50
37	DISTILLING	1.00	0.86
38	ALL OTHER FOOD & KINDRED	0.80	0.59
39	TOBACCO	0.90	0.50
40	TEXTILES	0.87	0.57
41	APPAREL	1.00	0.50
42	LOGGING AND SAW MILLS	0.95	0.50
43	OTHER LUMBER AND WOOD	0.98	0.50
44	HOUSEHOLD FURNITURE	1.03	0.50
45	OTHER FURNITURE	0.91	0.50

Table 19 (continued)

	Sector	Electricity Use	Natural Gas Use
46	PULP AND PAPER MILLS	0.78	0.50
47	OTHER PAPER PRODUCTS	0.74	0.50
48	PRINTING AND PUBLISHING	0.90	0.50
49	CHEMICALS	0.76	0.52
50	PLASTICS	0.75	0.50
51	DRUGS	0.86	0.59
52	CLEANING & TOILET PREPARATIONS	0.83	0.58
53	PAINTS	0.80	0.51
54	RUBBER	0.82	0.51
55	LEATHER	0.88	0.50
56	GLASS	0.97	0.70
57	CEMENT	0.77	0.51
58	OTHER STONE & CLAY	0.90	0.68
59	IRON & STEEL MFG.	0.77	0.53
60	ALUMINUM MFG.	0.74	0.60
61	OTHER PRIMARY NONFERROUS METALS MFG.	0.97	0.69
62	FABRICATED METALS	0.84	0.56
63	MACHINERY (NON-ELECTRICAL)	0.84	0.50
64	COMPUTING, ELECTRONICS, AND RELATED	0.81	0.50
65	REFRIGERATION & HEATING EQPMT.	0.85	0.63
66	HOUSEHOLD APPLIANCES	0.89	0.66
67	ELECTRIC LIGHTING	0.91	0.53
68	RADIO, TV & COMMUNIC. EQPMT.	0.71	0.50
69	ALL OTHER ELECTRIC MACH.	0.79	0.62
70	MOTOR VEHICLES & PARTS	0.80	0.85
71	TRUCKS, MOTORCYCLES & RELATED	0.78	0.50
72	AIRCRAFT	0.66	0.58
73	OTHER TRANSPORTATION EQPMT.	0.84	0.56
74	SCIENTIFIC INSTRUMENTS & RELATED	0.82	0.50
75	PHOTOGRAPHIC EQUIPMENT & SUPPLIES	0.87	0.73
76	JEWELRY	0.75	0.60
77	OTHER MISCELLANEOUS MFG.	0.83	0.50
78	RAILROADS	0.83	0.68
79	LOCAL, SUBURBAN & INTERURBAN TRANS.	0.90	0.68
80	TRUCKING & WAREHOUSING	0.90	0.68
81	WATER TRANSPORT	0.90	0.68
82	AIR TRANSPORT	0.90	0.68
83	PIPELINES & OTHER TRANS.	0.90	0.68
84	COMMUNICATIONS	0.71	0.80
85	WATER & SANITARY SERVICE	0.90	0.80
86	WHOLESALE TRADE	0.90	0.80
87	RETAIL TRADE	0.90	0.80
88	BANKING	0.90	0.80
89	OTHER FINANCE & INSURANCE	0.90	0.80
90	OWNER OCCUPIED DWELLINGS	0.90	0.80
91	REAL ESTATE	0.90	0.80
92	HOTELS	0.90	0.50

Table 19 (continued)

	Sector	Electricity Use	Natural Gas Use
93	PERSONAL SERVICES	0.90	0.80
94	BUSINESS SERVICES	0.90	0.80
95	EATING & DRINKING PLACES	0.90	0.80
96	AUTO REPAIR	0.90	0.80
97	AMUSEMENTS	0.90	0.80
98	HOSPITALS	0.90	0.80
99	OTHER MEDICAL SERVICES	0.90	0.80
100	EDUCATIONAL SERVICES	0.90	0.80
101	NON-PROFIT ORGNS.	0.90	0.80
102	SOCIAL SERVICES	0.90	0.80
103	POSTAL SERVICE & OTHER FED. ENTERP.	0.90	0.65
104	STATE & LOCAL ENTERPRISES	1.00	0.65

Table 20

Change in Energy Intensity: Ratio of
Deflated 1976 to 1971 Value of Technical Coefficient

Code	Sector	Corresponding RFF I-O Sectors	Coal	Distillate Oil	Residual Oil
20	Food and kindred	36-38	0.628	0.960	1.434
21	Tobacco	39	[a]	1.000	1.815
22	Textile mill products	40	0.843	1.220	1.744
23	Apparel, other textiles	41	0.403	0.667	3.805
24	Lumber and wood	42,43	0.727	0.903	3.598
25	Furniture and fixtures	44,45	0.399	1.432	1.556
26	Paper and allied	46,47	0.767	0.506	1.305
27	Printing and publishing	48	[a]	1.005	1.016
28	Chemicals and allied	49-53	0.569	0.894	1.666
29	Petroleum and coal products	4-10	0.342	0.447	0.617
30	Rubber, misc. plastics	54	0.696	0.805	2.801
31	Leather	55	0.487	1.163	1.207
32	Stone, clay, glass	56-58	1.209	1.230	1.374
33	Primary metals	59-61	0.509	0.663	1.751
34	Fabricated metals	62	0.572	1.226	1.716
35	Machinery, except electric	63	0.460	0.770	1.152
36	Electric, electronic equip.	64-69	0.751	0.814	1.035
37	Transportation eqpt.	70-73	0.746	0.876	1.500
38	Instruments	74,75	[a]	0.939	1.210
39	Miscellaneous manuf.	76,77	0.611	0.729	1.354
	All manufactures		0.710[b]	0.823	1.502

Sources: 1971 data obtained from U.S. Bureau of the Census, Census of Manufactures, 1972, Special Report Series: Fuels and Electric Energy Consumed, MC72 (SR)-6, 1973; 1976 data obtained from U.S. Bureau of the Census, Annual Survey of Manufactures, 1975-1976, 1979.

[a] Not listed because of disclosure rules.

[b] Excluding both shipments and coal expenditures of nondisclosure cases.

Given the benchmark projection of a 25 percent reduction in energy use by industry from 1976 to 2000, as noted in the introduction to this chapter, it was assumed that there would be an equivalent reduction in the manufacturing use of coal and fuel oil. The projection problem then became one of allocating the reduction by fuel and by sector. The fuel part of the problem was solved by starting with the minimum percentages observed for the distribution of manufacturing expenditures on distillate oil, residual oil and coal over the two years, 1971 and 1976, and then scaling the sum of those minimums to yield 75 percent. Then, a small relative shift to coal was built in. Data and results were as follows:

	Actual Percent		Projected Percent
	1971	1976	2000
Distillate oil	27.5	22.6	20.0
Residual oil	32.5	48.8	28.0
Coal	40.0	28.6	27.0
Total	100.0	100.0	75.0

To distribute the reductions by sector, the following procedure was used. From table 20, for each fuel the technical coefficient ratio for each sector was divided by that for all manufactures to yield a relative sectoral effect. This effect was then muted by averaging it with 1.00, in an attempt to compensate for the likely transitory nature of many of the changes from 1971 to 1976 by reducing forecast variability. Note that the muting is equivalent to averaging the individual industry effect with that for all manufactures, and then forming a scale factor by dividing by the all manufactures value. The scale factor was then multiplied by the ratio of projected to actual 1971 value, using the percentages given above, to yield a final value presented in table 21. To illustrate, consider Chemicals and Allied use of distillate. In table 20, code 28 corresponds to the sectors of interest. The distillate value for that code is 0.894, which is divided by 0.823, the all manufactures value for distillates, to yield 1.086. Then the sum (1.086 + 1.00) is divided by 2, to yield 1.043. This is multiplied by the general distillate oil factor of .727, that factor being obtained by forming the ratio 20.0/27.5. The result is 0.76, the entry appearing for sectors [49] through [53] in the Distillate Oil column of table 21, and treated as the change in intensity from 1972 to 2000. Some final adjustments were made for some of the entries appearing in table 21, including adjustments for some special cases (22) plus some further muting of the results for residual oil to avoid likely distortion from transitory changes. In particular, high estimates for sectors [41], [42] and [43] were replaced by a

Table 21

Year 2000 Scale Factors for Coal and Fuel Oil for Manufacturing Sectors

	RFF Manufacturing Sector	Scale Factors		
		Coal	Dist. Oil	Resid. Oil
4	GASOLINE	0.65	0.70	0.65
5	JET FUEL	0.65	0.70	0.65
6	KEROSENE	0.65	0.70	0.65
7	DISTILLATE FUEL OIL	0.65	0.70	0.65
8	RESIDUAL FUEL OIL	0.65	0.70	0.65
9	LPG	0.65	0.70	0.65
10	ALL OTHER PETROLEUM REFINING	0.65	0.70	0.65
11	ASPHALT AND TAR PRODUCTS	0.68	0.73	0.89
25	MOBILE HOMES	0.68	0.73	0.89
35	ORDNANCE	0.68	0.73	0.89
36	MEAT PACKING	0.63	0.79	0.87
37	DISTILLING	0.63	0.79	0.87
38	ALL OTHER FOOD & KINDRED	0.63	0.79	0.87
39	TOBACCO	0.68	0.80	0.98
40	TEXTILES	0.75	0.91	0.96
41	APPAREL	0.51	0.66	1.33
42	LOGGING AND SAW MILLS	0.71	0.77	1.33
43	OTHER LUMBER AND WOOD	0.71	0.77	1.33
44	HOUSEHOLD FURNITURE	0.51	0.98	0.89
45	OTHER FURNITURE	0.51	0.98	0.89
46	PULP AND PAPER MILLS	0.71	0.58	0.83
47	OTHER PAPER PRODUCTS	0.71	0.58	0.83
48	PRINTING AND PUBLISHING	0.68	0.80	0.75
49	CHEMICALS	0.61	0.76	0.93
50	PLASTICS	0.61	0.76	0.93
51	DRUGS	0.61	0.76	0.93
52	CLEANING & TOILET PREPARATIONS	0.61	0.76	0.93
53	PAINTS	0.61	0.76	0.93
54	RUBBER	0.68	0.72	1.25
55	LEATHER	0.57	0.88	0.80
56	GLASS	0.80	0.91	0.85
57	CEMENT	1.00	0.91	0.85
58	OTHER STONE & CLAY	0.80	0.91	0.85
59	IRON & STEEL MFG.	0.57	0.66	0.96
60	ALUMINUM MFG.	0.57	0.66	0.96
61	OTHER PRIMARY NONFERROUS METALS MFG.	0.57	0.66	0.96
62	FABRICATED METALS	0.61	0.88	1.00
63	MACHINERY (NON-ELECTRICAL)	0.57	0.71	0.78
64	COMPUTING, ELECTRONICS, AND RELATED	0.70	0.73	0.75
65	REFRIGERATION & HEATING EQPMT.	0.70	0.73	0.75
66	HOUSEHOLD APPLIANCES	0.70	0.73	0.75
67	ELECTRIC LIGHTING	0.70	0 73	0.75
68	RADIO, TV & COMMUNIC. EQPMT.	0.70	0.73	0.75
69	ALL OTHER ELECTRIC MACH.	0.70	0.73	0.75
70	MOTOR VEHICLES & PARTS	0.70	0.75	0.89
71	TRUCKS, MOTORCYCLES & RELATED	0.70	0.75	0.89
72	AIRCRAFT	0.70	0.75	0.89
73	OTHER TRANSPORTATION EQPMT.	0.70	0.75	0.89
74	SCIENTIFIC INSTRUMENTS & RELATED	0.70	0.78	0.80
75	PHOTOGRAPHIC EQUIPMENT & SUPPLIES	0.70	0.78	0.80
76	JEWELRY	0.64	0.68	0.85
77	OTHER MISCELLANEOUS MFG.	0.64	0.68	0.85

reduced projection of 1.33. To balance this change, small increases were made in the projections for the other sectors, so the overall residual oil projection basically would be unaffected.

3.4.2 Coal and Fuel Oil Use for Nonmanufactures

Projections for nonmanufactures usually employed the general forecast of a 25 percent reduction in energy use from 1976 to 2000, with a modest relative shift to coal. Some scattered information was available on 1972 to 1976 shifts, and on long run projections for specific sectors. Projections of agricultural intensities were based on a USDA report (23), and that of construction on data in Leary and Mack (24). Projections by Gelb and Pliskin (25) were drawn on for the mining sectors, but modifications were imposed to correct for likely overstatement. The projected reduction in energy intensity for hotels was somewhat more pronounced than that for other sectors, based on an estimate of a 7 percent annual reduction in energy use over a 3 year period (26). For other sectors, the change in intensity from 1972 to 1976 was based on changes in consumption in the "residential-commercial sector" (27), while the 1976 to 2000 projection employed the general forecast of a 25 percent reduction in intensity. Results appear as table 22.

3.4.3 Energy Use in Petroleum Refining

Hamel and Brown (28) present a detailed analysis of Petroleum Refining's potential for energy savings, projected from 1980 to 2000. They conclude that (1) conservation measures should save 19.7 percent of refinery energy consumption; and (2) while 1.16 barrels of crude oil were required per barrel of output in 1980, by the year 2000 this should drop to 1.075 barrels of input per barrel of output. The Bureau of Labor Statistics (29) notes that Petroleum Refining had reduced its energy use by 10 percent in 1976 relative to 1972, and that it was expected that energy use would be reduced another 15 percent by 1985. Combining the two forecasts suggests a reduction in energy use per unit of output from 1972 to 2000 of around 35 to 40 percent. Those figures, and the data of section 3.3, yielded the following scale factors for Petroleum Refining: Electricity: .70; Natural Gas: .60; Coal: .65; Distillate Oil: .70; Residual Oil: .65; and all Other Petroleum Products: .65.

The projected reduction in crude input relative to refined output yields a scale factor of 0.93 for the period 1980 to 2000 and a conservative estimate of 0.92 for the entire 1972 to 2000 period. Hence, technical coefficients showing

Table 22

Year 2000 Scale Factors for Coal and Fuel Oil for Nonmanufacturing Sectors

	RFF NonManufacturing Sector	Scale Factors		
		Coal	Dist. Oil	Resid. Oil
1	COAL MINING	1.06	1.06	1.06
2	CRUDE PETROLEUM	0.63	0.63	0.63
3	NATURAL GAS EXTRACTION	0.63	0.63	0 63
12	ELECTRICITY, FOSSIL FUEL	1.17	0.58	0.58
13	ELECTRICITY, NUCLEAR POWER	0.00	0.00	0.00
14	ELECTRICITY, HYDROPOWER	0.00	0.00	0.00
15	NATURAL GAS UTILITIES	0.60	0.62	0.62
16	MEAT ANIMALS	0.00	0.88	0.00
17	OTHER LIVESTOCK PRODUCTS	0.00	0.88	0.00
18	GRAINS	0.00	0.88	0.00
19	OTHER CROPS AND AG. SERVICES	0.79	0.88	0.00
20	FORESTRY AND FISHERIES	0.00	0.88	0.00
21	IRON MINING	0.93	0.93	0.93
22	NONFERROUS METALS MINING	1.07	1.07	1.07
23	NONMETALLIC MINERALS	0.85	0.85	0.85
24	NEW RESIDENTIAL BUILDINGS	0.00	0.63	0.61
26	NEW NONRESIDENTIAL BUILDINGS	0.00	0.63	0.61
27	NEW ENERGY ACTIVITY STRUCTURES	0.00	0.70	0.00
28	NEW HIGHWAYS & STREETS	0.00	0.63	0.61
29	ALL OTHER NEW CONSTRUCTION	0.00	0.63	0.00
30	MAINT. & REPAIR, RESIDENTIAL	0.00	0.63	0.00
31	M & R, NONRESIDENTIAL BLDGS.	0.00	0.63	0.61
32	M & R, ENERGY ACTIVITY STRUCTS.	0.00	0.63	0.00
33	M & R, HIGHWAYS & STREETS	0.00	0.63	0.61
34	ALL OTHER M & R	0.00	0.63	0.61
84	COMMUNICATIONS	0.00	0.00	0.00
85	WATER & SANITARY SERVICE	0.60	0.62	0.62
86	WHOLESALE TRADE	0.00	0.62	0.00
87	RETAIL TRADE	0.60	0.62	0.62
88	BANKING	0.00	0.62	0.62
89	OTHER FINANCE & INSURANCE	0.00	0.62	0.62
90	OWNER OCCUPIED DWELLINGS	0.00	0.00	0.00
91	REAL ESTATE	0.60	0.62	0.62
92	HOTELS	0.55	0.57	0.57
93	PERSONAL SERVICES	0.60	0.62	0.62
94	BUSINESS SERVICES	0.60	0.62	0.62
95	EATING & DRINKING PLACES	0.00	0.62	0.62
96	AUTO REPAIR	0.60	0.62	0.62
97	AMUSEMENTS	0.60	0.62	0.62
98	HOSPITALS	0.60	0.62	0.62
99	OTHER MEDICAL SERVICES	0.00	0.00	0.00
100	EDUCATIONAL SERVICES	0.60	0.62	0.62
101	NON-PROFIT ORGNS.	0.00	0.62	0.62
102	SOCIAL SERVICES	0.00	0.62	0.62
103	POSTAL SERVICE & OTHER FED. ENTERP.	0.60	0.62	0.62
104	STATE & LOCAL ENTERPRISES	0.60	0.62	0.62

flows from sectors [2] and [3] into [4] through [10] were multiplied by the 0.92 scale factor.

Sector [2], Crude Oil, has sales to other sectors than Petroleum Refining, including substantial sales to [49], Chemicals. It was expected that some productivity gains also would hold for these sales, and a scale factor of 0.95 was therefore employed for all other entries in row [2], setting productivity gains at about half those in Petroleum Refining.

It was also assumed that no other changes were necessary in the Crude Natural Gas row, with all entries other than the flow into [3] being scaled by 1.00.

3.4.4 Energy Use in Transportation

The projection of energy use in transportation followed the usual pattern of developing estimates of change in energy intensity between 1972 and 1976, and then of accounting for additional expected changes from 1976 to 2000 on the basis of several specialized studies. Additional details appear in appendix G.

The estimates of recent changes in energy intensities were derived from data in Kulp and associates (30), and included these values:

	1976/1972	1977/1972
Railroads		
Freight	.958	.944
Passenger	.786	.830
Local, Suburb & Interurban		
Rail Transit	1.165	1.062
Commuter Rail	.743	.810
Motor Buses	1.133	1.149
Intercity Buses	.962	.933
Trucking	.988	.977
Waterborne	.904	.846
Air Transport		
Airline Passenger	.848	.825
Air Cargo	.763	NA
General Aviation	.984	1.010

(NA = Not Available)

There is a general pattern of reduction in energy intensity, with the minor exceptions of rail transit, motor buses and general aviation. Explanations may include an aging and less efficient stock of vehicles in the first two cases, and larger private planes in the last.

Year 2000 projections drew on transportation projections by the data analysis Branch of ERDA (31), Knorr and Millar (32), and the National Transportation

Policy Study Commission (33). In particular, data in Knorr and Millar yield the following projections of changes in energy intensities from 1975 to 2000 (34):

	2000/1975 Intensity
Automobiles in Fleets	0.600
Personal Automobiles	0.610
Personal Trucks	0.639
Commercial Trucks	0.659 - 0.977

Both Knorr and Millar and the Transportation Commission projected a considerable shift from gasoline to diesel fuel in truck use of fuel. This shift was accounted for in our projections as follows. Data in the Commission report (35) were employed to estimate the truck fuel intensity change from 1975 to 2000 as 0.740, which seems reasonably consistent with the Knorr and Millar estimates. In conjunction with data in the BEA input-output flow table, these dollar estimates of 1972 truck use of fuels were then derived:

	Trucking Sector [80]	Internal Use by Intermediate Sectors (Million Dollars)	Total
Diesel	521	340	861
Gasoline	282	820	1102
Total	803	1160	1963

Internal use by intermediate sectors refers to truck fuel expenditures not involved in shipments to other sectors.

To simplify matters, it was now assumed that the shift to diesel would be accomplished by gasoline being fully replaced by diesel in the trucking sector, while internal use proportions remained unchanged. This yielded year 2000 proportions for diesel and gasoline that seemed reasonably close to those projected by the Transportation Commission. The relevant comparisons are:

Truck Fuels	Proportions of Use		
	Study Commission		Simplifying Assumption
	1975	2000	2000
Diesel	.44	.66	.58
Gasoline	.56	.34	.42

Projected changes in intermediate sector use of gasoline were derived given the projected intensity scale factors of 0.60 for fleet automobiles, and 0.74 for

intermediate sector trucking, and an initial distribution of intermediate sector gasoline use as 60 percent by automobiles and 40 percent by trucks (36). These values imply an overall intensity scale factor of 0.66 (by way of .60 times .60 plus .40 times. 74).

Similar calculations were employed to derive a PCE (Personal Consumption Expenditures) scale factor of 0.616 for gasoline use per vehicle mile of travel, reflecting a shift to personal truck use by consumers. These data were employed (37):

	Distribution of Vehicles		Change in Energy Intensity
	1975	2000	2000/1975
Passenger Cars	.88	.79	.61
Passenger Trucks	.12	.21	.64

Then .79 times .61 plus .21 times .64 equals .616.

The evidence developed in this section was integrated with additional information (38) to yield table 23, which lists energy scale factors for fuel categories and corresponding sectors, by time period. The 1972-2000 factor was obtained as the product of the 1972-1976 factor and the 1976-2000 factor. The 1976-2000 factors drew on the projections cited above, but modified them by assuming at least some long run price elasticity. There is generally good correspondence between fuel category and sector; however, most transportation sectors employ minor amounts of fuel other than the major category noted in table 23, and the scale factor for the major category was also applied to the minor categories. The 1976-2000 intensity factor for diesel fuel in [80].

Trucking accounts both for improved fuel economy and for the shift to diesel fuel from gasoline.

3.4.5 Other Energy Sector Changes and Unconventional Sources of Energy

Given relatively low levels of use and sparse information, scale factors for sectors [6] Kerosene [9] LPG and [10] All Other Petroleum Products were derived by drawing on evidence and projections used for other sectors. Where information had been developed across inputs, as in the case of mining and petroleum refining, those scale factors were applied here also. For other sectors, it was assumed that technical coefficients were unchanged from 1972 to 1976, while

Table 23

Projected Energy Intensity Scale Factors in Transportation

Row Sector: Major Fuel Category[a]	Column Sector(s)	1972-76	1976-2000	1972-2000
[4] Gasoline	[80] Trucking	0.99	0	0
	[1]-[79], [81]-[104], All Other Intermediate Sectors	1.00	0.66	0.66
[5] Jet Fuel	[82] Air Transport	0.84	0.65	0.55
	[12] Electric Utilities, Fossil Fuel	-	-	0.575[b]
	All Other Intermediate	1.00	2.75[c]	2.75
[7] Distillate Oil (Diesel)	[78] Rail	0.96	0.76	0.73
	[79] Local, Suburban, Interurban	0.99	0.85	0.84
	[80] Trucking	0.98	1.14[d]	1.12
	[83] Pipelines	-	-	0.95[b]
[8] Residual Oil	[81] Water	0.90	0.85	0.77
[15] Natural Gas	[83] Pipelines	-	-	0.68[b]

[a] Most transportation sectors employ minor amounts of other fuels, and the scale factor for the major category was also applied to the minor categories.

[b] Previously derived estimate.

[c] Accounts for increased business use of jet planes and jet fuel.

[d] Obtained as product of (0.74) and (1.54); first term accounts for improved fuel economy, and second for projected shift from gasoline to diesel fuel, obtained as ratio of 1977 trucking sector use of (gasoline plus diesel) to (diesel), or 803/521.

from 1972 to 2000 they would be scaled by 0.75 for [6] and [9], and by 0.85 for [10]. The use of the 0.75 scale factor assumes that price elasticity is the same as that of the other petroleum products, while the 0.85 scale factor assumes that price elasticity is somewhat lower than that of the other products. There was one exception to the use of 0.85 for sector [10]. Sector [10] includes Asphalt Production, and sectors [28] and [33], Highway and Street Construction and Maintenance, are heavy users of asphalt, as produced directly by [10] and indirectly by way of purchases from [11] Asphalt and Tar Products. Projections for the construction sectors included an estimate of .862 for asphalt intensity in 1976 relative to 1972, and that figure was also applied to the cases noted here.

Given the projected shift to coal from oil and gas in fossil fuel electricity, and a relative increase in shipments of western coal, corresponding changes were projected for technical coefficients in both column [1] Coal and column [12] Electricity from Fossil Fuels. In the case of coal, the shift from eastern to western coal was assumed to imply increases in machinery (greater stripmining) and in transportation (longer distances shipped for inputs), with the expectation that these would in large part be balanced by decreases in Coal's shipments to itself, which are primarily financial transactions involving services rendered by one coal company to another (39). With presumed larger scale operations in western coal production, some decline in such transactions seemed reasonable. Hence, the adjusted coefficients were:

		Before	After
[1]	Coal (internal)	.120515	.102855
[63]	Machinery	.053600	.070000
[78]	Railroads	.003032	.003632
[80]	Trucking	.003528	.004228

In the case of electricity from fossil fuels, the expected shifts were handled by employing the following scale factors in column [12] of the technical coefficient matrix:

[78]	Railroads	1.25
[80]	Trucking	0.75
[83]	Pipelines	0.50

In accounting for likely substitutions of synthetic fuels for oil and gas, several projections by the National Coal Association and the Department of Energy were utilized (40). Relatively modest amounts are involved by the year 2000, as indicated by the "consensus" projections employed here:

		Fraction of Supply Obtained from Given Sector	
		Oil	Natural Gas
[1]	Coal	.018	.014
[20]	Wood	.007	-
[37]	Distilling	.005	-
	Total	.030	.014

The Distilling entry accounts for alcohol used in gasohol, while the Coal entries cover coal liquefaction and gasification, respectively. The DOE projections show considerable inputs expected from biomass, particularly from wood; however, a large portion of this involves internal use of wood residues by the Pulp and Paper sector. The BEA accounting conventions involve ignoring self-generated energy used internally, though an offset reduction in other energy inputs would appear justified. Hence, an additional downscaling of energy inputs by a factor of 0.9 was also imposed on sectors [42], [43], [46] and [47], covering Logging, Lumber and Pulp and Paper. The remaining use of wood accounts for alcohol produced from wood rather than grain, which was picked up directly in the technical coefficient matrix. The major adjustments then involved the following changes in technical coefficients:

		Sectors [4]-[10]
[2]	Crude oil	-.014726
[1]	Coal	+.008836
[20]	Wood	+.003436
[37]	Distilling	+.002454

		Sector [15]
[3]	Crude gas	-.002467
[1]	Coal	+.002467

Thus, there was a reduction in the input of crude oil into petroleum refining, which was balanced by inputs of synthetic oil from coal, wood and ethanol production. Similarly, a reduction in inputs of crude natural gas into the gas utilities was balanced by an increase in inputs of synthetic gas derived from coal.

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3. Harvey S. Leff, Richard S. Mack and J. Frank Bodine, "Potential for Future Conservation of Energy in Industry," Appendix C of R.B. Williamson and C.L. Cooper, U.S. Residential and Manufacturing Energy Use in the Year 2000, Institute for Energy Analysis, Oak Ridge Associated Universities, 1980; and U.S. Department of Energy, Industrial Energy Efficiency Program, Annual Report, 1979.

4. EPRI Policy Planning Division, Electric Power Research Institute, Overview and Strategy, 1981-1985, Research and Development Program Plan, 1980, p. 52.

5. In U.S. Energy Information Administration, 1980 Annual Report to Congress, Vol. 3, p. 69, it is noted that the Power Plant and Industrial Fuel Use Act (FUA) and other regulations aimed at phasing out natural gas use by utilities; however, the law allows permanent exemptions, depending on the supply and price of natural gas. It was consequently hypothesized here that the law will not be binding in the year 2000.

6. The explicit calculations are as follows:

	(1) Million Dollars	(2) Scale Factors	(3) Million Dollars
[12] Fossil fuel	73,538.4	.881142	64,800
[13] Nuclear power	18,677.1	.999694	18,670
[14] Hydropower and "other"	1,901.5	.999760	1,900

Where column (1) entries are those of col. (5) in table 12; column (2) entries are obtained by dividing net use by total use, for the electricity sector data shown in section 2.4.4; and column (3) entries equal col. (1) times col. (2). The division of the column (3) entries by their sum (85,370) yields the net sales proportions shown in table 13.

7. U.S. Bureau of the Census, 1972 Census of Manufactures, Washington, D.C., General Summary Tables, Table 3, "General Statistics for Establishments by Industry Group and Industry: 1972 and 1967," 1973, p. 6-25. U.S. Bureau of the Census, 1972 Census of Manufacturers, Special Report Series, Fuels and Electric Energy Consumed MC72(SR)-6, Washington, D.C., Table 7, "Fuels and Electric Energy Used for Heat and Power, by Industry Group: 1971," 1973, pp. SR6-86 to SR6-88. U.S. Bureau of the Census, Annual Survey of Manufactures, 1974, Fuels and Electric Energy Consumed, M74(A5)-4.2, Washington, D.C., Table 7, "Fuels and Electric Energy Used for Heat and Power, by Industry Group and Industry: 1973 and 1972," 1976, pp. 166-173. U.S. Bureau of the Census, Annual Survey of Manufactures 1975-1976, Washington, D.C. 1979, Part 1, Table 4, "General Statistics for Industry Groups and Industries: 1976 and 1975," pp.1-6 to 1-23; Part 4, Table 3, "Quantity and Cost of

Purchased Fuels and Electric Energy Used for Heat and Power, by Industry Group and Industry: 1976 and 1975," pp. 4-3 to 4-21. U.S. Bureau of the Census, 1977 Census of Manufactures, Fuels and Electric Energy Consumed, Part 1. Industry Groups and Industries (Revised), Washington, D.C. 1981, Table 3, "Quantity and Cost of Purchased Fuels and Electric Energy Used for Heat and Power by Industry Group and Industry: 1977 and 1976," pp. 4-14 to 4-31.

8. American Gas Association, 1972 Gas Facts, Arlington, Va., 1972, Tables 71 and 86.

9. The sorting and ordering were carried out employing computer programs written by Louanne Sawyer of Resources for the Future.

10. The strong association between the price ratio and the technical coefficient ratio, and the likely asymptotic form of the relationship, is documented by the following class averages, where the classes are defined in terms of price ratio intervals. Note that the values for outlying observations, particularly the one observation for the price ratio above 2.0, can explain why the fitted regression equation shows an increasing technical coefficient ratio for the price ratio above 2.0. There are 367 observations in total. (The data below also appear as Appendix Table F9.)

	Class Averages		
Price Ratio Range	Price Ratio	Technical Coefficient Ratio	Number of Observations
<1.0	0.897	1.314	11
1.0-<1.1	1.050	1.169	20
1.1-<1.2	1.161	1.109	48
1.2-<1.3	1.251	1.021	84
1.3-<1.4	1.343	1.005	85
1.4-<1.5	1.438	0.928	68
1.5-<1.6	1.540	0.868	35
1.6-<1.7	1.643	0.811	8
1.7-<2.0	1.758	0.801	7
≥ 2.0	2.376	0.982	1

11. Developed from data in "National Income and Product Accounts, 1976-79," Survey of Current Business, Special Supplement, July 1981, p. 49, p. 72 and Edison Electric Institute, Statistical Yearbook, 1979, p. 29, p. 51. The "Large Light and Power" category in the latter source was treated as corresponding to manufactures; electricity use by Large Light and Power was measured in kilowatt-hours; manufacturing output was measured in deflated 1972 dollars. The price deflators for manufacturing output were used in deflating electricity prices; these corresponded well to the Consumer Price Index (CPI) except for 1979, when the CPI increased more than the manufacturing price index. If the CPI were used in deflation, the real electricity price rise from 1976 to 1979 would be around 10 percent rather than the 15 percent figure used in the calculations.

12. Derived from data in Edison Electric Institute, Statistical Yearbook, 1979, and Survey of Current Business, July 1979, p. 52.

13. Bernard A. Gelb and Jeffrey Pliskin, Energy Use in Mining: Patterns and Prospects, New York: Ballinger, 1979, pp. 45, 46, 80, 81, 140, and 141.

14. Peter J. Kakela, "Iron Ore: Energy, Labor and Capital Changes with Technology," Science, December 15, 1978, Vol. 202, No. 4373, pp. 1151-1157; Oak Ridge Associated Universities, Industrial Energy Use Data Book, N.Y.: Garland STPM Press, 1981, pp. 8-10 and 8-18; and Gelb and Pliskin, Energy Use in Mining, 1979, p. 81.

15. U.S. Department of Agriculture, ESCS, Energy and U.S. Agriculture, 1974 and 1978, Stat. Bull. No. 632, 1980.

16. U.S. Department of Energy, Industrial Energy Efficiency Program, Annual Report, 1979, pp. 26, 27.

17. Edison Electric Yearbook, 1979, and Survey of Current Business, July 1979.

18. Derived from data in American Gas Association Gas Facts, 1972 and 1979 editions, and Survey of Current Business, July, 1979.

19. Derived from data in Monthly Energy Review, April, 1981, p. 25 and Survey of Current Business, July 1978, p. 52, and July 1979, p. 52.

20. Appendix G documents a number of examples.

21. Based on data in Monthly Energy Review, June 1981, p. 40 and p. 42.

22. In table 21 there are three sets of special cases: (1) Sectors [11], [25] and [35] were not estimated individually because of lack of data, so their scale factors were set at the all manufactures average. (2) The scale factor for coal in Stone, Clay and Glass was set at a higher level for [57] Cement than for [56] Glass and [58] Other Stone and Clay, since it appeared that the shift to coal was specific to cement, based on U.S. Department of Energy, Industrial Energy Efficiency Program, Annual Report, 1979, p. 29. (3) Scale factors for petroleum refining were estimated by incorporating some additional evidence, noted in section 3.4.3.

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Chapter 4

DEVELOPMENT OF YEAR 2000 INPUT-OUTPUT TABLES: PROJECTED CHANGES IN TECHNOLOGY

4.1 OVERVIEW

This chapter discusses the changes made in the base technical coefficient matrix to account for projected major changes in economic structure beyond those occurring as a direct response to higher energy prices, which were covered in chapter 3. These changes are subsumed under the heading of changes in technology, though some involve an indirect response to energy price changes as well. Of course, much technological change occurs in response to relative price changes in sectoral inputs or outputs, but a deep probing of the underlying economics of technological change is outside the scope of this study. We proceed here by incorporating major discerned trends into our tables.

Changes in automobile and truck manufactures input mix are considered first, and those changes can be viewed both as changes in technology and as responses to higher energy prices (covering both mandated and voluntary improvements in fuel economy). The chapter then covers important changes expected for computers and electronics, plastics versus competing products, all other intermediate sectors, and value added.

Changes in input intensity for automobiles and trucks include changes in materials, involving increases in plastics and aluminum, and decreases in iron, steel, and other metals; and shifts from labor to machinery (robots) and computers. Motor Vehicle Manufactures and Business Services are projected to lead all sectors in percentage increases in intensity of use of computers and electronics, but that use is projected to burgeon generally, with increases for every sector. A general and pronounced increase in intensity of use of plastics is also projected, with corresponding declines in competing commodities: glass, wood, metals, paper, and leather. The expectation of considerable scientific advance is accounted for by projecting general increases in intensity of use for Communications, Business Services, Scientific Instruments, and

Drugs. Finally, an examination of trends in value added yields some projected changes in input intensity in Meat Packing and Drugs.

The incorporation into the base table of the changes documented in this and the preceding chapter completes the construction of the year 2000 technical coefficient matrix. Both that matrix and the corresponding inverse matrix appear in Appendix H.

A number of sources were drawn upon for this chapter, but two studies were of particular help: (1) The Bureau of Labor Statistics Economic Growth Project and (2) The Ridker and Watson study. The BLS projected an aggregate version of the BEA technical coefficient matrix to the year 1990, and an unpublished printed copy and a computer tape of the matrix, as well as descriptive materials, were obtained from the BLS (1). Correspondence was established between the BLS and RFF sectors and the ratios of projected 1990 to 1972 coefficients were obtained and drawn on for comparison and application. A similar set of correspondences, comparisons and applications were made by utilizing the input-output table developed for the Ridker and Watson study (2) and by drawing on an unpublished report by Shapanka (3), which was part of the Ridker and Watson effort.

4.2 AUTOMOBILE AND TRUCK MANUFACTURES, SECTORS [70] AND [71]

4.2.1 Overview.

Some major projected changes in technical coefficients for automobile and truck manufactures are accounted for by the set of scale factors shown in table 24. The scale factors exhibit changes in input intensity, and were based on a review of a considerable literature, which is documented in the next section.

4.2.2 Detail on Projections of Automobile and Truck Manufacturer Input Intensity.

The changes in input intensity shown in Table 24 are, in a sense, consensus figures based on the reconciliation of data and projections in a number of sources, which will be reviewed at this point.

Considerable changes in automobile inputs per car had occurred from the 1972 base period by the late 1970s as indicated by table 25.

Table 24

Projected Changes in Technical Coefficients
for Automobile and Truck Manufactures

Input Furnishing Sector	Change in Input Intensity: Year 2000 Relative to 1972 Technical Coefficient	
	[70] Automobiles	[71] Trucks
[50] Plastics (raw materials)	2.20	1.50
[54] Rubber and finished plastics	1.60	1.25
[56] Glass	0.80	0.95
[59] Iron and steel	0.50	0.80
[60] Aluminum	1.90	1.35
[61] Other non-ferrous metals	0.70	0.88

Table 25

Materials Used in a Chevrolet Impala (pounds)

Material	1974	1977	Percent change
Steel	2,708	2,221	-18
Iron castings	690	620	-10
Plastics	138	200	+43
Glass	107	115	+ 7
Aluminum	59	69	+17
Nontire rubber	37	35	- 5
Copper	27	25	- 7
Zinc	24	20	-17
Other	548	405	-26
Total	4,338	3,710	-14

Source: U.S. Office of Technology Assessment, Changes in the Future Use and Characteristics of the Automobile Transport System, Vol. II, Technical Report, 1979, Table 137, p. 314.

The changes per car can be interpreted as changes per constant dollar of output; they reflect substitutions carried out to reduce weight and fuel consumption. The changes are generally seen as part of a long-term trend extending into the 1990s. Thus, Chandler (4) presents these projections of pounds of material per "typical" car over time:

	1978	1985	1990
Steel	2,110	1,575	1,335
Iron Castings	575	325	175
Plastics	175	250	300
Aluminum	115	150	195

Similar projections by General Motors and the Department of Transportation respectively appear as tables 26 and 27 (5).

Table 26

Materials Usage Per Car as Projected by General Motors

Material	General Motors Major Materials Usage (per Typical Car) 1980 Pounds	1980 % Total Car[a]	1985 Pounds	1985 % Total Car[b]
Iron	500	15	250-300	10-12
Steel	1920	58	1450	56
Aluminum	120	4	145-200	6-8
Glass	92	3	80	3
Plastics	203	6	220-300	8-12
Rubber	88	3	90	3

Source: General Motors Corporation, Public Interest Report, 1981, p. 5.

[a]Based on 3,300-pound car

[b]Based on 2,600-pound car

Although all projections show a shift from iron and steel to aluminum and plastics, there are disagreements over the relative strengths of the shifts. Thus, the DOT projection in table 27 shows a greater shift to aluminum than to plastics; Chandler (6) and Patterson (7) show a relatively equal shift; while Kaiser (8) and the BLS Economic Growth Project show a greater shift to plastics than to aluminum. The projections made here (in table 24) are also based on the hypothesis of a somewhat greater shift to plastics than to aluminum. However, finished plastics are aggregated with rubber in sector [54], and rubber's technical coefficient, per se, may well decline, since the inclusion of spare tires in new cars is diminishing. The problem of aggregating plastics and rubber was met by setting the crude plastics intensity scale factor above that of aluminum, and the finished plastics and rubber scale factor below aluminum (table 4).

The somewhat greater shift to plastics than to aluminum was based on recent experience, where the automobile shift to aluminum was less than anticipated, in part because of considerable price increases for aluminum (9). Further, Burke

Table 27

Materials Usage in New Cars 1975-1985
(absolute figures are dry weight - lbs.)

Model year	1975		1976		1977		1978		1979		1980		1985	
	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.
Material mix														
High strength steel	2.7	106	3.3	129	3.6	138	3.8	131	4.6	154	5.4	165	12.5	300
Plain carbon steel	58.3	2,315	57.6	2,247	56.7	2,173	56.2	1,932	55.1	1,833	54.2	1,669	44.0	1,056
Iron	15.8	626	15.4	599	15.2	581	14.9	513	14.7	490	14.9	458	9.0	216
Aluminum	2.2	86	2.4	92	2.8	107	3.3	114	3.9	129	4.0	124	6.5	156
Copper	0.9	37	0.9	36	0.8	32	0.8	28	0.8	28	0.8	25	1.0	24
Lead	0.7	29	0.7	28	0.7	28	0.7	24	0.7	24	0.7	22	1.0	24
Zinc	1.3	53	1.2	48	1.0	40	0.9	31	0.8	27	0.6	19	0.5	12
Glass	2.4	94	2.4	92	2.4	91	2.5	86	2.5	84	2.6	80	3.0	72
Rubber	4.0	160	4.2	165	4.2	162	4.2	144	4.3	143	4.0	124	4.5	180
Other plastics	4.2	168	4.4	173	4.9	186	5.2	179	5.8	191	6.0	184	10.5	252
Other	7.5	297	7.5	290	7.7	295	7.5	258	6.8	227	6.8	212	7.5	180
Total weight	100	3,970	100	3,900	100	3,830	100	3,440	100	3,330	100	3,080	100	2,400

Source: U.S. Department of Transportation, Report to the President from the Secretary of Transportation, The U.S. Automobile Industry, 1981, Table 3.2, p. 28.

notes: "it's indicative of Detroit's enthusiasm for plastics that manufacturers raise the point repeatedly...that plastics require less energy to make than any of the metals." (10) This makes explicit that automotive fuel savings based on increased use of aluminum can involve some tradeoffs, given aluminum's heavy consumption of electricity.

Changes in truck manufactures, sector [71] parallel those in [70] but with reduced magnitude. Data in Knorr and Millar (11) suggest that fuel savings in truck manufactures will lag behind those for automobiles, so that by 2000, fuel economy improvements in the former will be about 40 percent those in the latter sector. This estimate was used to scale the changes for [70] to obtain those for [71]; thus, a 60 percent change times 0.4 yielded roughly a 25 percent change.

In addition to the changes projected in table 24, it is expected that motor vehicle manufactures will greatly increase the intensity of use of inputs from industry [64] Computing, Electronic and Related, and from [63] Machinery. These increases reflect an increased use of computers, both within plants and as part of vehicle equipment, and an increased use of robots on assembly lines, as noted by McCallahan (12), for example. A recent decline in value added in [70] Motor Vehicles is noted later in this chapter. That decline can be explained, in part, by declining profits. However, some of the decline plausibly can be viewed as a long-term shift from labor to computers and machinery. Thus, in 1981 The Economist (13) reported the response of U.S. automobile manufactures to declining profits as follows:

> Detroit's response is two-fold. First, it is trying to cut the man-hours needed to make a car; GM thinks it can halve the time. Last year, it had only 425 robots in its factories. Now it has around 1,200 helping to paint and weld its cars. Nearly 4,000 more are on order. Second, American carmakers are trying to cut their non-wage benefits [particularly pensions].

Consequently, these adjustments were made in the sector [70] technical coefficient column entries, involving a 50 percent increase in the Machinery coefficient and a 15-fold increase in Computers and Electronics:

	1972 Value	2000 Value
[63] Machinery	.025798	.038698
[64] Computers and Electronics	.001504	.022560

4.3 COMPUTERS AND ELECTRONICS

4.3.1 Overview

The large increase in inputs of [64] Computers and Electronics shown for sector [70] is merely the most pronounced of a general increase which comprises a major trend in the U.S. economy. Considerable increases in intensity of use of sector [64] have occurred since 1972, and even greater increases should occur by 2000. In projecting those increases, the following evidence and procedures were employed. Despite the inherent uncertainties, there was an accounting for differential growth rate between sectors by drawing on a considerable literature for specific sector use, and by applying an inferred S-shaped growth pattern in the introduction and use of computers. This contrasts with the approach of the BLS Economic Growth Project, which involved scaling all entries in row [64] by an overall scale factor of 1.80 to account for growth from 1972 to 1990. Here, sectors with no inputs from sector [64] in 1972 were projected to have at least a minimum nonzero technical coefficient of .000010 by 2000; sectors with heavy use of computers in 1972 were projected to have relatively modest percentage increases by 2000; and "in-between" sectors were generally projected to have pronounced growth. A 15-fold increase in intensity of use was projected for [95] Business Services, as well as for [70] Motor Vehicles. A 10-fold increase was projected for a number of sectors, including [48] Printing and Publishing, [50] Plastics, [97] Amusements and [98] Hospitals. Some limitations on growth were imposed because of "software" constraints and because of evidence of real price increases after many years of real price declines.

4.3.2 Detail on Projection of Computers and Electronics Input Intensity

It appears obvious that computerization will continue at a rapid pace, given recent experience and opportunities in general office functions, shipment and inventory control, scheduling, design and simulation. There seems little hyperbole in the OECD evaluation (14) that "The electronics complex during the next quarter of a century will be the pole around which industrial societies will be organized." Projection of use on a sectoral basis is inherently difficult, because as Vadasz has noted (15): "We can't even imagine today ... at least half of the applications (for powerful) chips that will exist in five years." The year 2000 scale factors for use intensity of row [64] entries were derived by assessing the probable applications for computers and electronics in each sector and by making allowances for the time horizon of each application. Four "waves" of sector [64] products were identified: (1) electronic components, (2) large mainframe computers, (3) office and consumer products, and (4)

factory automation. Past and projected experience with these products suggests an S-Shaped curve for the "market penetration" of computers and electronic components, a pattern drawn on in the projection process for individual sectors.

Electronic components became a thriving industry in the 1950s and 1960s and is viewed as a "mature" industry from the 1970s onward, so that spurts of growth from major innovations seem unlikely.

The mainframe computer revolution began in the 1960s with the IBM 360 series (and competitors' counterparts) and continued strongly into the 1970s with the IBM 370 series. Almost all large corporations now maintain large computer centers to control their operations, and the use of such facilities is likely to spread to smaller scale enterprises. International Data Corporation (16) estimates that sales increased more than four times between 1970 and 1980, and projects a tripling of sales between 1980 and 1985. A new generation of supercomputers is currently under development.

Office automation owes its existence to the semiconductor chip. The memory and computing power of a vintage 1960 mainframe computer can now be placed on a silicon chip smaller than the tip of a finger. The semiconductor has been the source of minicomputers, microcomputers, and word processors. Accounting, letter writing, communications, and scheduling are all becoming computerized. There are many similiar applications in the communications, trade and transportation sectors. As mass production of these products occurs, the office of the 1980-1990 period will become highly automated. Semiconductor chips are being integrated into consumer electronic products, as well, with the trend now apparent in calculators, TVs, stereos, video recorders and games, and many household applicances. Business Week (17) forecasts a rise in the value of semiconductors as a percent of all electronic equipment from 1 percent in 1970 to 7 percent in 1990.

Large-scale factory automation due to semiconductor technology should occur around 1985-1990. Factory automation includes the use of minicomputers for process control and industrial robots for repetitive jobs. Much of the gain here will come at the expense of assembly line workers although some jobs will open up in the computer field. The day of the factory without workers has already arrived for a few specialized applications.

Although marked increases in intensity of use have been projected, there are likely constraints on the growth in use of computers and electronics. In the past, equipment price increases have been offset by performance improvement, so that constant dollar shipments have roughly equalled current dollar values (18). However, "uncharacteristic" price rises have occurred since mid-1979 (19) and this may well augur a long-term trend. Again, there appear to be constraints on growth because of increasing "software" costs, expressed in higher real rates for computer programmers, and because of increasing operator and repair costs (20). Finally, part of the gains of computers and semiconductors will come at the expense of electronic components which now compose a large part of sector [64] output.

Within this general framework, projections of intensity of use were made for particular sectors by examining their characteristics and drawing on a considerable literature which analyzed and projected use in particular applications (21). A number of sectors had no input from sector [64] in 1972; in most of those cases, a year 2000 technical coefficient of .00001 was assigned, a value generally below all other projected cases. In the case of mining sectors in this group, a value of .000028 was assigned, equal to the 1972 entry for sector [23] Nonmetallic Minerals. Specific sectors and assigned values were:

RFF Sector	Year 2000 Technical Coefficient
[1] Coal mining	0.000028
[16] Meat animals	0.000010
[17] Other livestock products	0.000010
[18] Grains	0.000010
[20] Forestry and fisheries	0.000010
[21] Iron mining	0.000028
[22] Nonferrous metals mining	0.000028
[27] New energy activity structures	0.000010
[28] New highways & streets	0.000010
[29] All other new construction	0.000010
[30] Maint. & repair, residential	0.000010
[32] M & R, energy activity structs.	0.000010
[33] M & R, highways & streets	0.000010
[34] All other M & R	0.000010
[36] Meat packing	0.000010
[37] Distilling	0.000010
[38] All other food & kindred	0.000010
[39] Tobacco	0.000010
[42] Logging & saw mills	0.000010
[53] Paints	0.000010
[57] Cement	0.000010
[96] Auto repair	0.000010
[102] Social services	0.000010

Sectors with nonzero input of [64] in 1972 are enumerated in table 28, as are their base year technical coefficients for that input and their projected increases in intensity of use from 1972 to 2000. The product of the scale factors and their corresponding technical coefficients appear as row entries for sector [64] in the year 2000 matrix presented in appendix H.

Some specifics in table 28 may be noted. The highest scale factors are shown for [70] Motor Vehicles, and [94] Business Services, reflecting computerization on assumbly lines and within vehicles, in the first instance, and the growth of "software" services in the second. The scale factor for [24] New Residential Buildings includes an accounting for computerized environmental control systems. Computerized editing and printing, computerized medical diagnostic devices, and the advent of electronic mail respectively account for the high scale factors for [48] Printing and Publishing; [98] Hospitals; and [103] Postal Service. Relatively low scale factors are used for [64] itself, and for [68] Radio, TV, and Communication Equipment, given their high base values, and their substitution of semiconductors for electronic components.

4.4 PLASTICS VERSUS COMPETING PRODUCTS

A general and pronounced increase in plastics use is expected (22). Correspondingly, some relative decreases can be expected in competing inputs, including glass, wood, paper, iron, and steel products.

In its technical coefficient matrix, the BLS Economic Growth Project forecast the 1990 use of plastics as increasing by a scale factor of at least 1.07, with many uses scaled by 1.10 to 1.15 and automobile use by 2.5. In similar fashion, here all row entries for [50] Plastics and Materials, were scaled by 1.20, and those for [54] Rubber and Plastic Products, by 1.15, in projecting to the year 2000. In addition, some individual scale factors accounted for specific shifts from competing products to plastics.

4.4.1 Plastics Versus Glass

Data on the shift from glass to plastic bottles for specific industry groups are summarized in table 29. Similar information is presented by Shapanka (23). On the basis of those data, row entry changes were made in the technical coefficients for glass and for plastics, as shown in table 30. That table also exhibits the original entry for glass. It was assumed that most of the original entry represented expenditures for bottles.

Table 28

Scale Factors Projecting Increased Intensity of Use, 1972-2000, and Base Technical Coefficients for Inputs of [64], Computers and Electronics

	RFF Sector	Scale Factor	Technical Coefficient, 1972
2	CRUDE PETROLEUM	2.0	0.000280
3	NATURAL GAS EXTRACTION	2.0	0.000280
4	GASOLINE	2.5	0.000008
5	JET FUEL	2.5	0.000008
6	KEROSENE	2.0	0.000008
7	DISTILLATE FUEL OIL	2.0	0.000008
8	RESIDUAL FUEL OIL	2.0	0.000008
9	LPG	2.0	0.000008
10	ALL OTHER PETROLEUM REFINING	2.0	0.000008
11	ASPHALT AND TAR PRODUCTS	4.0	0.000001
12	ELECTRICITY, FOSSIL FUEL	2.0	0.000295
13	ELECTRICITY, NUCLEAR POWER	2.0	0.000435
14	ELECTRICITY, HYDROPOWER	2.0	0.000250
15	NATURAL GAS UTILITIES	2.0	0.000107
19	OTHER CROPS AND AG. SERVICES	3.0	0.000005
23	NONMETALLIC MINERALS	2.0	0.000028
24	NEW RESIDENTIAL BUILDINGS	6.0	0.000002
25	MOBILE HOMES	2.0	0.001823
26	NEW NONRESIDENTIAL BUILDINGS	5.0	0.000003
31	M & R, NONRESIDENTIAL BLDGS.	2.0	0.000008
35	ORDNANCE	2.0	0.019692
40	TEXTILES	2.0	0.000337
41	APPAREL	4.0	0.000004
43	OTHER LUMBER AND WOOD	5.0	0.000003
44	HOUSEHOLD FURNITURE	2.5	0.000692
45	OTHER FURNITURE	2.5	0.000158
46	PULP AND PAPER MILLS	2.0	0.000014
47	OTHER PAPER PRODUCTS	2.0	0.000081
48	PRINTING AND PUBLISHING	10.0	0.000025
49	CHEMICALS	4.0	0.000093
50	PLASTICS	10.0	0.000007
51	DRUGS	10.0	0.000110
52	CLEANING & TOILET PREPARATIONS	4.0	0.000049
54	RUBBER	2.5	0.000250
55	LEATHER	3.0	0.000005
56	GLASS	10.0	0.000081
58	OTHER STONE & CLAY	2.0	0.000076
59	IRON & STEEL MFG.	4.0	0.001938
60	ALUMINUM MFG.	4.0	0.000551
61	OTHER PRIMARY NONFERROUS METALS MFG.	4.0	0.001122
62	FABRICATED METALS	4.0	0.001393
63	MACHINERY (NON-ELECTRICAL)	10.0	0.005806
64	COMPUTING, ELECTRONICS, AND RELATED	1.5	0.193659
65	REFRIGERATION & HEATING EQPMT.	4.0	0.033308
66	HOUSEHOLD APPLIANCES	4.0	0.003635
67	ELECTRIC LIGHTING	4.0	0.007860
68	RADIO, TV & COMMUNIC. EQPMT.	1.5	0.175639
69	ALL OTHER ELECTRIC MACH.	4.0	0.023499
70	MOTOR VEHICLES & PARTS	15.0	0.001504
71	TRUCKS, MOTORCYCLES & RELATED	10.0	0.000132
72	AIRCRAFT	3.0	0.030223
73	OTHER TRANSPORTATION EQPMT.	3.0	0.003682
74	SCIENTIFIC INSTRUMENTS & RELATED	4.0	0.034572
75	PHOTOGRAPHIC EQUIPMENT & SUPPLIES	3.0	0.023421
76	JEWELRY	2.0	0.000928
77	OTHER MISCELLANEOUS MFG.	3.0	0.006155
78	RAILROADS	5.0	0.000060
79	LOCAL, SUBURBAN & INTERURBAN TRANS.	4.0	0.001833
80	TRUCKING & WAREHOUSING	4.0	0.000039
81	WATER TRANSPORT	7.0	0.000001
82	AIR TRANSPORT	2.0	0.002687
83	PIPELINES & OTHER TRANS.	2.0	0.000662
84	COMMUNICATIONS	5.0	0.001471
85	WATER & SANITARY SERVICE	5.0	0.000042
86	WHOLESALE TRADE	5.0	0.000130
87	RETAIL TRADE	5.0	0.000053
88	BANKING	5.0	0.001097
89	OTHER FINANCE & INSURANCE	5.0	0.000323
91	REAL ESTATE	3.0	0.000007
92	HOTELS	5.0	0.000012
93	PERSONAL SERVICES	3.0	0.019340
94	BUSINESS SERVICES	15.0	0.004240
95	EATING & DRINKING PLACES	10.0	0.000001
97	AMUSEMENTS	10.0	0.000038
98	HOSPITALS	10.0	0.000009
99	OTHER MEDICAL SERVICES	3.0	0.000106
100	EDUCATIONAL SERVICES	5.0	0.002475
101	NON-PROFIT ORGNS.	5.0	0.000020
103	POSTAL SERVICE & OTHER FED. ENTERP.	10.0	0.000262
104	STATE & LOCAL ENTERPRISES	5.0	0.000012

Table 29

Percent of Bottles That Were Glass Versus
Those That Were Plastic, by Major Industry Group

	Glass		Plastic	
	1975	1979	1975	1979
Food and kindred	94.7	89.8	5.3	10.2
Chemicals, household & industrial	15.8	13.3	84.2	86.7
Medicine and health	66.6	51.8	33.4	48.2
Toiletries & cosmetics	47.2	43.3	52.8	56.7
All	83.8	78.2	16.2	21.8

Source: U.S. Bureau of Industrial Economics, 1981 Industrial Outlook, 1981, p. 83.

Table 30

Projected Changes in Technical Coefficients
Reflecting Change in Composition of Bottles

	[38] Food & kindred	[49] Chemicals	[51] Drugs	[52] Cleaning & Toilet preparations
[54] Rubber & plastic products	+.003000	+.000500	.013000	+.008000
[56] Glass	-.003000	-.000500	-.013000	-.008000
Original entry for glass	.013110	.000600	.016875	.014807

Apart from the specific entries accounting for use of bottles, it seems plausible that plastics will replace glass in other uses. However, the use of insulating glass in structures has increased as an energy conservation measure, and specialized glass use is increasing for "high technology" applications such as fiber optics, lasers, and high strength reinforcing fibers (24). Optical glassware seems likely to substitute for copper in a number of electrical applications (25). These projected changes were handled as follows. Glass use was scaled by 0.95 in most industries to account for some substitution of plastics. However, in the construction of buildings, sectors [24], [26], [30], and [31], glass was scaled by 1.10 to account for increased use of glass in insula-

tion. Thus, Harris (26) argues, "more double and triple glazing means more flat glass per structure." In the plastics sectors, [50] and [54], and in Communications [84], glass use was scaled by 1.20 to account for the use of glass in high technology applications. The use of copper by sector [84] was correspondingly reduced, as discussed below.

4.4.2 Plastics Versus Wood and Metals

Ridker and Watson (27) projected a shift to plastics from wood in the construction of furniture. There is also an associated shift to aluminum from iron and steel. The year 2000 scale factors they employ are as follows for shipments into column [44], Household Furniture:

[42]	Logging and Saw Mills	0.62
[43]	Other Lumber and Wood	0.64
[54]	Plastics	1.08
[59]	Iron and Steel	0.81
[60]	Aluminum	1.37

Ridker and Watson also project a shift to plastics from metals in Household Appliances, sector [66], with these scale factors for row shipments into column [66]:

[50]	Plastics	3.30
[59]	Iron & Steel	0.60
[60]	Aluminum	0.90
[61]	Other Metals	1.00
[62]	Fabricated Metals	0.98

They also project the following scale factors for [72], Aircraft Manufactures:

[54]	Rubber & Plastic Products	1.30
[59]	Iron & Steel	0.90
[60]	Aluminum	0.90
[61]	Other Metals	1.10
[68]	Communications	1.30

More generally, there is reason to expect some relative reductions in use by most sectors of both wood and iron and steel inputs, presumably reflecting long-term upward price trends for wood products, and increased costs for steel production. For example, a Forest Service report (28) predicts a decline in all timber products per square foot of single family housing, continuing a trend that held from 1962 to 1976, when lumber use per square foot dropped from

8.5 board feet to 6.8 board feet. (Lumber use accounts for a large share of all timber use.) Projections to the year 2000 include a decline in lumber use per square foot to 0.88 the 1976 level, and a less pronounced decline for all timber products to 0.95 the 1976 level.

Both the Bureau of Labor Statistics (29) and the Bureau of Industrial Economics (30) project relative declines in steel use, noting the substitution of plastics and aluminum for steel in other industries than automobile manufacture, including construction and machinery. The BLS Economic Growth Project employed a general scale factor of .94 for row [59], Iron & Steel, in projecting to 1990, although a number of entries were below this value.

On the basis of this information, the following projections were made:

1) The Ridker-Watson forecasts for furniture use were accepted in modified form, with these scale factors for inputs into both [44] Household Furniture, and [45] Other Furniture:

[42]	Logging and Saw Mills	0.7
[43]	Other Lumber and Wood	0.7
[54]	Rubber and Plastic Products	1.2
[59]	Iron and Steel	0.8
[60]	Aluminum	1.3

(The 1.2 value for [54] superseded the general value of 1.1 employed for all other uses of plastics.)

2) Similarly, the Ridker-Watson forecasts for household appliances and aircraft manufactures were accepted without modification.

3) The basic wood sectors, [42] and [43] were scaled by 0.9 for all uses other than [44] and [45].

4) Iron and Steel was scaled by 0.85 in all other uses, unless otherwise specified.

4.4.3 Plastics Versus Paper

Plastics have been substituting for paper packaging, particularly in Food and Kindred (31). Shipments of [47] Other Paper Products into [38] All Other Food and Kindred had a technical coefficient of .035399 in 1972. It was assumed

that by the year 2000 approximately one-third of that amount would be transferred to plastics, so these changes were made:

[47]: -.012
[54]: +.012

4.4.4 Plastics Versus Leather and Natural Textiles

Shapanka argues (32) that the use of plastics as a substitute for leather has grown rapidly. That substitution is accounted for by scaling all leather entries by 0.95. However, further displacement of natural textiles by plastics is not projected, based on recent experience in textiles and apparel, with some movement in the apparel industry back to natural fibers, particularly to new "easy care" cotton (33).

4.5 OTHER CHANGES IN TECHNOLOGY

Some additional projections of technological change include specific forecasts for metals, some impacts of scientific advances, and some projections of changes in value added, with consequent balancing effects in Meat Packing and Drugs.

4.5.1 Some Specific Forecasts for Metals

The Bureau of Industrial Economics (34) shows that between 1972 and 1979 there was considerable replacement of steel cans by aluminum cans, with aluminum's share of the total increasing from 17 percent in 1972 to 39 percent in 1979. In line with that observation, Ridker and Watson project these scale factors for shipments into [62] Fabricated Metals:

[59]	Iron and Steel	0.78
[60]	Aluminum	1.27
[61]	Other Metals	0.72

Those scale factors were accepted and employed here.

More generally, Rohatgi and Weiss (35) develop forecasts that imply that aluminum may replace as much as 35 percent of the use of copper between 1980 and 1990. Shapanka predicts that aluminum will replace half of copper use by 2015 (36). Further, optical glass wire should replace a considerable amount of copper in [84] Communications.

In 1971, copper accounted for roughly 45 percent of the output of sector [61] Other Primary Metals, and its output of 6.9 billion dollars was approximately equal to the 7.5 billion dollar output of sector [60] Aluminum (37). If it is assumed that aluminum will displace 25 percent of copper by 2000, this implies roughly an 11 percent decrease in sector [61] and a 22 percent increase in aluminum. Hence, for sectors not specified explicitly, 1.22 and 0.89 were used as scale factors for [60] and [61], respectively. In the case of [84] Communications, [61] was reduced an additional 25 percent and glass was increased accordingly. The changes were:

	Column [84]
row [56]:	+.000150
row [61]:	-.000150

4.5.2 Further Accounting for Scientific Advances

The process of scientific advance is seen as implying considerable increase in the use of Professional and Business Services, Communications, Scientific Instruments and Drugs. The BLS Economic Growth Project used row scalars of 1.19 for Professional Services, 1.14 for Business Services, 1.19 for Communications and 1.17 for Non-profit Organizations, in their projections to 1990. They reduced the use of Post Office Services by scaling by 0.85. These were accepted as useful benchmarks and led to the employment of the following row scalars in forming the year 2000 technical coefficient matrix from the 1972 matrix:

[51]	Drugs	1.25
[68]	Radio, TV, and Communications Equipment	1.25
[74]	Scientific Instruments	1.25
[75]	Photographic Equipment & Supplies	1.10
[84]	Communications	1.50
[94]	Business Services	1.25
[101]	Non-Profit Organizations	1.10
[103]	Postal Services	0.85

These scale factors were not employed for a sector's sales to itself, i.e., a scale factor of 1.000 was used for main diagonal entries.

The projected increase in communications reflects the interaction, and in effect, the partial integration of communications and computers. That increase should in itself imply an induced response in [68] Radio, TV and Communications

Equipment, through the workings of the input-output mechanism, but it also seemed appropriate to build in a direct effect by the scale factor shown.

4.5.3 Changes in Value Added and Some Consequences for International Inputs

Changes in value added (payments to factors of production, including wages, interests, rent and profit) relative to the value of shipments were investigated for most manufacturing sectors by drawing on data presented by the Bureau of Industrial Economics (38). The inferred 1975-1980 ratios of value added to value of shipments are shown as table 31. On the basis of that table, long-term changes in value added as a fraction of output were projected, with results exhibited in table 32.

The changes shown in table 32, plus some outside information implying change in industry structure, were used to make some final projections of changes in technical coefficients, covering sectors [36] Meat Packing, [51] Drugs, and [70] Automobile Manufactures. It was inferred that at least part of the decrease in value added was balanced by increases in expenditures on other sectors. The automobile manufactures results were incorporated into the projection process for sector [70] and were reported in section 4.2, above. Changes for the other sectors were as follows.

In sector [36] Meat Packing, there has been a marked trend to increasing scale of operations, as commercial feedlots displace smaller farmer-feeder lots. Although the number of feedlots has decreased, the average number of cattle marketed annually has increased. For commercial lots, the number of cattle marketed per lot doubled from 1962 to 1979. The increased scale of operations has brought a widespread use of "boxed" beef, where carcasses are broken into cuts, wrapped in vacuum packaging and shipped directly to retailers (39).

Consequent adjustments in technical coefficients were:

	Sector	Before	Increase	After
[16]	Meat Animals	.728684	.025000	.753684
[54]	Rubber and Plastics	.006529	.006529	.013058
[62]	Fabricated Metals	.002146	.002146	.004292
[63]	Machinery	.000762	.000762	.001524

It was assumed that most of the adjustment involved an increase in the meat animals coefficient, accounting for greater throughput per lot; and that inputs

Table 31

Estimated Changes in Value Added Relative to Value of Shipments, 1975-1980

		Value Added/Value Shipments					
	RFF Sector	1975	1976	1977	1978	1979	1980
35	ORDNANCE	0.6801	0.7078	0.6723	0.6925	0.6806	0.6666
36	MEAT PACKING	0.1337	0.1343	0.1285	0.1159	0.0959	0.0914
37	DISTILLING	0.4031	0.4174	0.4133	0.4145	0.4160	0.4177
38	ALL OTHER FOOD & KINDRED	0.3213	0.3284	0.3293	0.3300	0.3308	0.3259
40	TEXTILES	0.3877	0.3983	0.3895	0.4003	0.3889	0.3846
41	APPAREL	0.4693	0.4851	0.4887	0.4878	0.4887	0.4896
42	LOGGING AND SAW MILLS	0.4000	0.4293	0.4098	0.4228	0.4299	0.4444
43	OTHER LUMBER AND WOOD	0.3600	0.3944	0.4014	0.3950	0.3841	0.3694
44	HOUSEHOLD FURNITURE	0.4892	0.5016	0.5015	0.5062	0.4954	0.5014
46	PULP AND PAPER MILLS	0.4413	0.4373	0.4351	0.4268	0.4305[a/]	0.4487[a/]
47	OTHER PAPER PRODUCTS	0.4059	0.4034	0.3949	0.3915	0.0000[a/]	0.0000[a/]
48	PRINTING AND PUBLISHING	0.6364	0.6354	0.6414	0.6321	0.6299	0.6296
49	CHEMICALS	0.4628	0.4487	0.4314	0.4411	0.4341	0.4210
50	PLASTICS	0.3934	0.3830	0.3830	0.3741	0.3799	0.3770
51	DRUGS	0.7149	0.7171	0.6976	0.6666	0.6369	0.6039
52	CLEANING & TOILET PREPARATIONS	0.5658	0.5865	0.5876	0.5775	0.5840	0.5798
53	PAINTS	0.4128	0.4320	0.4255	0.4300	0.4301	0.4300
54	RUBBER	0.4963	0.4753	0.4786	0.4781	0.4753	0.4832
55	LEATHER	0.5071	0.5001	0.4886	0.4899	0.4440	0.4641
56	GLASS	0.6220	0.6098	0.5854	0.5900	0.5900	0.5900
57	CEMENT	0.5711	0.5611	0.5496	0.5437	0.5404	0.5342
58	OTHER STONE & CLAY	0.4787	0.4770	0.4677	0.4665	0.4652	0.4632
59	IRON & STEEL MFG.	0.3826	0.3711	0.3600	0.3710	0.3855	0.3562
60	ALUMINUM MFG.	0.4340	0.4069	0.4097	0.4031	0.4200	0.4200
61	OTHER PRIMARY NONFERROUS METALS MFG.	0.1509	0.2197	0.2317	0.2426	0.1995	0.1939
62	FABRICATED METALS	0.4801	0.4774	0.4795	0.4710	0.4757	0.4738
63	MACHINERY (NON-ELECTRICAL)	0.5263	0.5245	0.5408	0.5447	0.5394	0.5508
64	COMPUTING, ELECTRONICS, AND RELATED	0.5724	0.5989	0.5962	0.5928	0.5890	0.5642
65	REFRIGERATION & HEATING EQPMT.	0.4432	0.4780	0.4636	0.4751	0.4750	0.4750
66	HOUSEHOLD APPLIANCES	0.4535	0.4862	0.4913	0.4895	0.4914	0.4914
67	ELECTRIC LIGHTING	0.4790	0.5012	0.4926	0.4899	0.5057	0.4900
68	RADIO, TV & COMMUNIC. EQPMT.	0.5932	0.6091	0.6214	0.6287	0.6337	0.6305
69	ALL OTHER ELECTRIC MACH.	0.5075	0.5188	0.5282	0.5221	0.5199	0.5202
70	MOTOR VEHICLES & PARTS	0.2303	0.2526	0.2441	0.2413	0.2289	0.2063
71	TRUCKS, MOTORCYCLES & RELATED	0.3925	0.3877	0.3895	0.3900	0.3900	0.3886
72	AIRCRAFT	0.5714	0.5708	0.5847	0.6034	0.5801	0.5700
73	OTHER TRANSPORTATION EQPMT.	0.5206	0.5576	0.5889	0.5570	0.5570	0.5570
74	SCIENTIFIC INSTRUMENTS & RELATED	0.6282	0.6437	0.6524	0.6512	0.6523	0.6553
76	JEWELRY	0.5004	0.4974	0.5087	0.4826	0.4795	0.4729
77	OTHER MISCELLANEOUS MFG.	0.4578	0.5013	0.4963	0.4957	0.4864	0.4843

Source: Data in U.S. Bureau of Industrial Economics, 1981 U.S. Industrial Outlook, 1981.

[a/] Data not available.

Table 32

Estimated Long Run Changes in Value Added as a Fraction of Output

	RFF Sector	Change in Fraction Value Added
35	ORDNANCE	0.00
36	MEAT PACKING	-0.04
37	DISTILLING	0.01
38	ALL OTHER FOOD & KINDRED	0.00
39	TOBACCO	0.00
40	TEXTILES	0.00
41	APPAREL	0.02
42	LOGGING AND SAW MILLS	0.01
43	OTHER LUMBER AND WOOD	0.00
44	HOUSEHOLD FURNITURE	0.01
45	OTHER FURNITURE	0.00
46	PULP AND PAPER MILLS	0.00
47	OTHER PAPER PRODUCTS	0.00
48	PRINTING AND PUBLISHING	0.00
49	CHEMICALS	-0.04
50	PLASTICS	-0.01
51	DRUGS	-0.10
52	CLEANING & TOILET PREPARATIONS	0.01
53	PAINTS	0.01
54	RUBBER	0.00
55	LEATHER	-0.05
56	GLASS	-0.02
57	CEMENT	-0.04
58	OTHER STONE & CLAY	-0.01
59	IRON & STEEL MFG.	0.00
60	ALUMINUM MFG.	0.00
61	OTHER PRIMARY NONFERROUS METALS MFG.	0.03
62	FABRICATED METALS	0.00
63	MACHINERY (NON-ELECTRICAL)	0.01
64	COMPUTING, ELECTRONICS, AND RELATED	0.00
65	REFRIGERATION & HEATING EQPMT.	0.02
66	HOUSEHOLD APPLIANCES	0.03
67	ELECTRIC LIGHTING	0.01
68	RADIO, TV & COMMUNIC. EQPMT.	0.02
69	ALL OTHER ELECTRIC MACH.	0.01
70	MOTOR VEHICLES & PARTS	-0.05
71	TRUCKS, MOTORCYCLES & RELATED	0.00
72	AIRCRAFT	0.00
73	OTHER TRANSPORTATION EQPMT.	0.02
74	SCIENTIFIC INSTRUMENTS & RELATED	0.02
75	PHOTOGRAPHIC EQUIPMENT & SUPPLIES	0.00
76	JEWELRY	-0.03
77	OTHER MISCELLANEOUS MFG.	0.02

of sectors [54], [62], and [63] doubled to account for the boxed beef operation. (The "Before" coefficients are those of the 1972 table as modified by changes noted to this point.)

In the case of sector [51] Drugs, there have been predictions of revolutionary advances in the production of biochemical substances, based on use of recombinant DNA techniques, advanced enzymology and cell-culturing to accomplish specific ends. One expert has predicted that the output of biotechnology processes will increase from $25 million in 1980 to $25 billion by 1990 (40).

Again, the National Research Council predicts that in pharmaceuticals an explosion of knowledge should bring a new era of drug discovery and development, with better instrumentation and increased use of computers. A trend to automated storage and retrieval of drug information is noted (41).

Consequently, the following coefficient changes were assigned as a means of projecting increased biochemical research and development and a greater share of that activity in drug production.

	Technical Coefficients		
	Before	Increase	After
[17] Other Livestock Products	.000203	.000197	.000400
[18] Grains	.001377	.000623	.002000
[19] Other Crops	.000567	.000443	.001000
[49] Chemicals	.046488	.015767	.062255
[64] Computing, Electronics & Related	.000110	.000990	.001100
[74] Scientific Instruments	.002050	.003076	.005126
[94] Business Services	.158650	.059662	.218312

The sector [64] value in the "After" case corresponds to the scale factor shown in table 28, with the discussion here the source of that scale factor. The values for [74] and [94] consist of augmented effects of the scale factors shown in section 4.5.2, above.

4.6 YEAR 2000 TECHNICAL COEFFICIENT AND INVERSE MATRICES

The work of this chapter completes the construction of the year 2000 technical coefficient matrix, in turn applied to yield the year 2000 inverse (or interdependence coefficient) matrix. Those matrices are presented explicitly in appendix H.

As noted earlier, a feature of the inverse matrix is its presentation of direct and indirect requirements on each sector that are generated by a dollar of final demand on a given sector. The sum down the corresponding column of the inverse matrix exhibits the total of those requirements and can be interpreted as the multiplier effect of the expansion of one dollar in final demand on the given sector. Table 33 presents those multiplier effects for each sector, first drawing on the 1972 matrix and then the year 2000 matrix. Relatively small changes occur in all cases, as expressed by the ratios of the 2000 to 1972 values shown in the last column of table 33. The greatest changes occur for [94], Business Services, with a ratio of 1.30; [68] Radio, TV and Communication Equipment, at 1.19; and [51] Drugs, at 1.17. The ratios are usually correlated with the column sums in the year 2000 technical coefficient matrix, obtained when the value added component is set at its 1972 value. Most column sums remain close to the total of 1.000 which necessarily held in the 1972 matrix. Exceptions occur for the petroleum product sectors, which sum to .935, and for sectors particularly affected by projected changes in technology, which usually have sums above unity. Thus, [94] Business Services, has a sum of 1.203, and [64] Computers and Electronics, has a sum of 1.106.

The change in the sum of intermediate sector coefficients represents changed amounts of physical inputs flowing into each sector, as measured by fixed 1972 prices. Various interpretations can be placed on these changes, depending on what is expected to occur when inputs are measured in year 2000 prices, and it is specified that technical coefficients again sum to unity. One interpretation is that the sum of the intermediate sector coefficients remains unchanged in 2000 prices, and consequently the adjustment occurs through changes in value added. Thus, profits may rise in petroleum refining, or less labor may be employed when considerable computerization occurs. Alternatively, it can be hypothesized that the value added share remains unchanged, implying that price changes have returned the intermediate sector sum to its 1972 total in value terms. An extreme example of this case would occur where all changes occur in response to price changes, and all price elasticities have unitary value. Hence, the full implications of table 33 hinge on specifying additional evidence or assumptions. However, the table does suggest that the economic structure projected for the year 2000 is not radically different from that of 1972. In turn, that suggests that further refinement of projected changes in technical coefficients would yield only modest impacts on direct and indirect requirements.

Table 33

Sums of Column Entries in 1972 and 2000 Inverse Matrices, Exhibiting Total Direct and Indirect Requirements

	1972 Sum	2000 Sum	Ratio 2000/1972
1 COAL MINING	1.73574	1.78400	1.02780
2 CRUDE PETROLEUM	1.52911	1.55604	1.01761
3 NATURAL GAS EXTRACTION	1.60395	1.63220	1.01761
4 GASOLINE	2.26001	2.17193	0.96103
5 JET FUEL	2.26001	2.17193	0.96103
6 KEROSENE	2.26001	2.17193	0.96103
7 DISTILLATE FUEL OIL	2.26001	2.17193	0.96103
8 RESIDUAL FUEL OIL	2.26001	2.17193	0.96103
9 LPG	2.26001	2.17193	0.96103
10 ALL OTHER PETROLEUM REFINING	2.26001	2.17193	0.96103
11 ASPHALT AND TAR PRODUCTS	2.20265	2.14966	0.97595
12 ELECTRICITY, FOSSIL FUEL	1.83775	1.83405	0.99799
13 ELECTRICITY, NUCLEAR POWER	1.33693	1.36118	1.01814
14 ELECTRICITY, HYDROPOWER	1.25785	1.28117	1.01854
15 NATURAL GAS UTILITIES	2.18643	2.21603	1.01354
16 MEAT ANIMALS	2.93338	2.96547	1.01094
17 OTHER LIVESTOCK PRODUCTS	2.46621	2.50885	1.01729
18 GRAINS	1.86311	1.87746	1.00770
19 OTHER CROPS AND AG. SERVICES	1.80291	1.83078	1.01546
20 FORESTRY AND FISHERIES	1.69130	1.71836	1.01600
21 IRON MINING	1.98572	2.02511	1.01984
22 NONFERROUS METALS MINING	1.75918	1.78692	1.01576
23 NONMETALLIC MINERALS	1.75166	1.77428	1.01291
24 NEW RESIDENTIAL BUILDINGS	2.11387	2.14632	1.01535
25 MOBILE HOMES	2.54527	2.59491	1.01950
26 NEW NONRESIDENTIAL BUILDINGS	2.16541	2.25560	1.04165
27 NEW ENERGY ACTIVITY STRUCTURES	2.18372	2.19243	1.00399
28 NEW HIGHWAYS & STREETS	2.01026	1.99368	0.99175
29 ALL OTHER NEW CONSTRUCTION	2.08560	2.09919	1.00652
30 MAINT. & REPAIR, RESIDENTIAL	1.89983	1.93830	1.02024
31 M & R, NONRESIDENTIAL BLDGS.	1.86285	1.89579	1.01768
32 M & R, ENERGY ACTIVITY STRUCTS.	1.67228	1.68529	1.00778
33 M & R, HIGHWAYS & STREETS	1.69395	1.66067	0.98035
34 ALL OTHER M & R	1.67275	1.70179	1.01736
35 ORDNANCE	1.87259	1.99318	1.06440
36 MEAT PACKING	3.52421	3.66131	1.03890
37 DISTILLING	1.77085	1.82424	1.03015
38 ALL OTHER FOOD & KINDRED	2.59119	2.69569	1.04033
39 TOBACCO	1.96764	2.04430	1.03896
40 TEXTILES	2.55674	2.68667	1.05082
41 APPAREL	2.56132	2.65386	1.03613
42 LOGGING AND SAW MILLS	2.22771	2.16147	0.97027
43 OTHER LUMBER AND WOOD	2.26396	2.18805	0.96647
44 HOUSEHOLD FURNITURE	2.23834	2.21472	0.98945
45 OTHER FURNITURE	2.12306	2.10352	0.99080
46 PULP AND PAPER MILLS	2.19386	2.14810	0.97914
47 OTHER PAPER PRODUCTS	2.25994	2.28812	1.01247
48 PRINTING AND PUBLISHING	1.99512	2.06487	1.03496
49 CHEMICALS	2.11099	2.12506	1.00667
50 PLASTICS	2.20839	2.26395	1.02516
51 DRUGS	1.93805	2.26508	1.16875
52 CLEANING & TOILET PREPARATIONS	2.23751	2.46973	1.10378
53 PAINTS	2.30393	2.39072	1.03767
54 RUBBER	2.05521	2.18713	1.06419
55 LEATHER	2.40681	2.47475	1.02823
56 GLASS	1.88161	1.91567	1.01811
57 CEMENT	1.90634	1.87287	0.98244
58 OTHER STONE & CLAY	1.97611	1.99523	1.00967

Table 33 (continued)

		1972 Sum	2000 Sum	Ratio 2000/1972
59	IRON & STEEL MFG.	2.14169	2.07882	0.97064
60	ALUMINUM MFG.	2.46637	2.76786	1.12224
61	OTHER PRIMARY NONFERROUS METALS MFG.	2.63273	2.57228	0.97704
62	FABRICATED METALS	2.17157	2.13141	0.98150
63	MACHINERY (NON-ELECTRICAL)	1.99484	2.13081	1.06816
64	COMPUTING, ELECTRONICS, AND RELATED	2.02069	2.36136	1.16859
65	REFRIGERATION & HEATING EQPMT.	2.17896	2.48825	1.14195
66	HOUSEHOLD APPLIANCES	2.16925	2.25478	1.03943
67	ELECTRIC LIGHTING	2.01283	2.11233	1.04943
68	RADIO, TV & COMMUNIC. EQPMT.	2.05703	2.44837	1.19024
69	ALL OTHER ELECTRIC MACH.	2.07181	2.27032	1.09581
70	MOTOR VEHICLES & PARTS	2.45057	2.56275	1.04578
71	TRUCKS, MOTORCYCLES & RELATED	2.37683	2.49881	1.05132
72	AIRCRAFT	2.07609	2.39012	1.15126
73	OTHER TRANSPORTATION EQPMT.	2.16656	2.21233	1.02112
74	SCIENTIFIC INSTRUMENTS & RELATED	1.92908	2.16099	1.12022
75	PHOTOGRAPHIC EQUIPMENT & SUPPLIES	1.74311	1.93176	1.10823
76	JEWELRY	2.14040	2.11523	0.98824
77	OTHER MISCELLANEOUS MFG.	2.20536	2.34573	1.06365
78	RAILROADS	1.67367	1.69032	1.00995
79	LOCAL, SUBURBAN & INTERURBAN TRANS.	1.69478	1.74425	1.02919
80	TRUCKING & WAREHOUSING	1.62208	1.66822	1.02844
81	WATER TRANSPORT	2.16901	2.22346	1.02510
82	AIR TRANSPORT	1.72227	1.75385	1.01834
83	PIPELINES & OTHER TRANS.	1.50314	1.55467	1.03428
84	COMMUNICATIONS	1.27769	1.35289	1.05885
85	WATER & SANITARY SERVICE	1.69959	1.73415	1.02033
86	WHOLESALE TRADE	1.43353	1.51334	1.05568
87	RETAIL TRADE	1.35125	1.40718	1.04139
88	BANKING	1.46584	1.58634	1.08220
89	OTHER FINANCE & INSURANCE	1.89104	2.02201	1.06926
90	OWNER OCCUPIED DWELLINGS	1.25532	1.27195	1.01325
91	REAL ESTATE	1.37029	1.39297	1.01655
92	HOTELS	1.73201	1.79442	1.03603
93	PERSONAL SERVICES	1.79149	1.98100	1.10578
94	BUSINESS SERVICES	1.60711	2.09285	1.30224
95	EATING & DRINKING PLACES	2.24630	2.31941	1.03255
96	AUTO REPAIR	2.09517	2.17480	1.03801
97	AMUSEMENTS	1.79787	1.88624	1.04915
98	HOSPITALS	1.70536	1.80210	1.05673
99	OTHER MEDICAL SERVICES	1.44508	1.51936	1.05140
100	EDUCATIONAL SERVICES	1.54332	1.61702	1.04775
101	NON-PROFIT ORGNS.	1.62125	1.69336	1.04447
102	SOCIAL SERVICES	1.75104	1.79710	1.02631
103	POSTAL SERVICE & OTHER FED. ENTERP.	1.31662	1.34910	1.02467
104	STATE & LOCAL ENTERPRISES	1.86745	1.89650	1.01556

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Chapter 5

FINAL DEMAND AND OUTPUT PROJECTIONS

5.1 OVERVIEW

The independent projection of final demand for a one-hundred sector input-output table is itself a major undertaking, and was beyond the scope of the present effort. However, this effort benefited from the availability of two recent studies that made such projections, and it drew heavily on them. The first set of projections was made by Lareau and Darmstadter (1) in the companion study to the present enterprise; consequently, their projections were organized using our study's sectors, with the common forecast date of 2000. Their projections, which were limited to Personal Consumption Expenditures, were extended to develop projections for the other final demand sectors. The extended set was labeled the L-D projections. A second set of projections was obtained from a BLS study in 1979 which developed data for input-output applications (2). The BLS sectoring was such that good correspondence to our sectors could be established, and on the basis of that correspondence, a set of scale factors was derived for their forecast period of 1973 to 1990. The scale factors were then extended to cover the period 1972 to 2000, and applied to base levels of final demand to yield year 2000 projections.

The L-D and BLS projections were integrated with some independently derived evidence to yield a final set of projections. The independently derived evidence included Department of Defense projections organized in an input-output framework.

The final demand projections employed here involved a 1972 to 2000 population increase of 24 percent and approximately a doubling of both per capita income and GNP. Total output, of course, increased accordingly. The following ratios of 2000 to 1972 outputs for individual sectors are noteworthy:

Sector	2000/1972
[13] Electricity, nuclear	13.3
[64] Computers and electronics	6.4
[84] Communications	4.9
[98] Hospitals	4.7
[60] Aluminum	3.6
[50] Plastics	3.2
[12] Electricity, Fossil Fuel	1.6
[70] Motor Vehicles	1.4
[14] Electricity, Hydropower	1.1
[4] Gasoline	1.0

A sequential process that disaggregated projection components allowed the estimation of the separate impacts of final demand changes, changes in intensity of energy use in production, and changes in technology. From those projections, it was inferred that final demand changes account for about 60 percent of the projected decline in energy use, with the total decline itself implying energy use at only 60 percent of the level to be attained in a world where all sectors' output grew at the same pace. Changes in technology cause an increase in energy use, though the amount of increase is relatively small (only 3 percent), and even this estimate is somewhat overstated because some of the technological change is directed to energy saving.

5.2 THE BLS PROJECTIONS

5.2.1 Major Patterns

A sense of the major patterns inherent in the BLS projections can be obtained from table 34, which exhibits BLS 1973 base period and 1990 projections for major categories of Gross National Product (GNP), in turn corresponding to the final demand sectors of its input-output array. Table 34 also shows the ratio of the 1990 to 1973 values, the annual growth rate corresponding to that ratio, and the ratio of 2000 to 1972 values that would hold if the annual growth rate held for that twenty-eight year period.

The GNP projection involves a 3.2 percent average annual growth rate. This contrasts with the EPRI forecasts (3) noted in section 3.2.2 above of a GNP annual growth rate of 4.4 percent for an "intermediate growth" case, and of 2.5 percent for a "low growth" case.

Table 34

BLS Projections of Components of GNP
and Corresponding Growth Rates

Major Category of Expenditures	Expenditures in Billions of 1972 Dollars 1973	1990	Ratio: 1990/1973	Ratio: 2000/1972	Annual Growth Rate in Percent
GNP: Gross National Product	1234.7	2112.8	1.7112	2.4225	3.210
PCE: Personal Consumption Expenditures	767.6	1428.7	1.8613	2.7823	3.722
GPDFI: Gross Private Domestic Fixed Investment	190.6	308.3	1.6175	2.2079	2.869
CBI: Change in Business Inventory	16.5	22.7	1.3758	1.6913	1.894
EXP: Exports	87.4	173.1	1.9805	3.0818	4.102
IMP: Imports	-79.9	-146.5	1.8335	2.7142	3.630
FED: Federal Government	96.6	117.8	1.2195	1.3866	1.174
SLG: State & Local Government	155.9	208.7	1.3387	1.6168	1.731

Source: U.S. Bureau of Labor Statistics, Employment Projections for the 1980's, Bulletin 2030, 1979, p. 16.

The BLS projected annual growth rate in Personal Consumption Expenditures (PCE) is considerably above its GNP growth rate, and also above PCE annual growth rates derived from alternative projections by Data Resources (DRI), Predicasts, and Lareau-Darmstadter (4). The PCE comparisons and corresponding comparisons of real growth in PCE from 1972 to 2000 are as follows:

	Period covered	PCE annual growth rate in percent	Corresponding change: 2000/1972
BLS (1979 projection)	1973-1990	3.72	2.783
Data Resources, Inc. (DRI)	1981-1995	2.96	2.263
Predicast	1978-1990	2.60	2.052
Lareau-Darmstadter	1972-2000	2.65	2.080

The BLS higher growth rate for PCE than for GNP in large part is accounted for by much lower growth rates projected for federal government spending than occurs in other forecasts; for example, the DRI forecast of annual growth in federal government spending is 2.67 percent, in contrast to the 1.17 percent rate forecast by the BLS (table 34).

In applying the BLS projections here, the 1973-1990 average rates were employed in making projections from 1972 to 2000, which seemed reasonable on the basis of available evidence (5).

5.2.2 Specific BLS Scale Factors

The BLS 1979 projections utilized an input-output framework to exhibit projected expenditures for each of a set of final demand sectors. For each sector, a table gave actual spending in 1963, 1967 and 1973, and projected spending for 1980, 1985 and 1990, on purchases from each of 162 sectors, in millions of 1972 dollars. Though not stated explicitly, the framework was based on the BEA 1967 input-output system, updated to 1972 by the BLS, with sectors obtained as aggregates of the BEA sectors (6). This implied an almost exact correspondence between the BLS final demand sectors and those of the RFF model, and in the one divergence, a simple adjustment made the correspondence exact. In particular, the BLS presented data on Gross Private Domestic Investment, corresponding to the sum of RFF sectors [106] and [107], but it also presented data corresponding to [107], so [106] was obtained by subtraction. In sum, data were available for each of the RFF final demand sectors, which were:

[105]	PCE:	Personal Consumption Expenditures
[106]	GPDFI:	Gross Private Domestic Fixed Investment
[107]	CBI:	Change in Business Inventories
[108]	EXP:	Exports
[109]	IMP:	Imports
[110]	FEDD:	Federal Government, Defense Spending
[111]	FEDN:	Federal Government, Nondefense Spending
[112]	SLGE:	State and Local Government, Education
[113]	SLGO:	State and Local Government, All Other Expenditures

Correspondences were also established between the 152 intermediate BLS sectors and the 104 intermediate sectors of the RFF model. In many cases, the correspondence was one-to-one, as in Meat Packing, Aircraft Manufacturers, most of

the transportation sectors and Hospitals. In most other cases, the BLS sectors could be aggregated to obtain RFF sectors. In a few cases, the RFF classification was finer, and here, the BLS aggregate result was taken as applicable to all of the component sectors.

Once correspondence had been established, projected changes in spending between 1973 and 1990 could be extended to yield projected changes in spending between 1972 and 2000. This was accomplished as follows. Let $X_{1990}/X_{1973} = (1 + r)^{17}$, where X is a given sector's sales to a specific final demand sector, as measured by the BLS; r is the annual growth rate; and subscript denotes a year. Then $X_{1972}(1 + r)^{28} = X_{2000}$, where X_{1972} is the given sector sales to the specific final demand sector, as measured by the BEA and as registered in the RFF model, and $(1 + r)^{28}$ equals the scale factor used to transform the 1972 final demand entry into its corresponding year 2000 value.

Though the basic procedure employed is mechanical, the exercise of judgment was necessary in cases where a purely mechanical process would lead to flawed results. In particular, if the 1972 value substantially differed in magnitude from the 1973 value, an adjustment was made in the 1973 entry so the year 2000 prediction would be consistent with the pattern exhibited in the BLS projections. Such adjustments were made in many of the entries for sector [107], Changes in Business Inventories, and in some of the other entries, as well.

The BLS scale factors of the form $(1 + r)^{28}$ are presented for each final demand sector, in turn, in tables 35 and 36, respectively covering nongovernment and government components of final demand. In the case of expenditures on electricity, the entries show the increase expected for all electricity consumed; later the electricity totals were scaled by the factors developed in section 3.2.2 to yield year 2000 purchases from [12], [13] and [14], the fossil fuel, nuclear power and hydropower sectors. In both tables 35 and 36 it is the convention to assign a scale factor of 1.0 to cases of zero expenditures for both 1972 and 2000.

The highest scale factors for PCE included:

[84]	Communications	6.55
[64]	Computers and Electronics	5.24
[98]	Hospitals	5.03
[63]	Machinery	4.92
[72]	Aircraft	4.85
[68]	Radio, T.V., Commun. Equip.	4.75

Table 35

BLS Scale Factors Used to Transform 1972 to 2000 Final Demand, Nongovernment Sectors

Intermediate Sector	Final Demand Sector				
	[105] PCE	[106] GPDFI	[107] GBI	[108] Exports	[109] Imports
1 COAL MINING	1.28103	1.00000	2.0038	2.19913	3.13194
2 CRUDE PETROLEUM	1.00000	3.07219	0.4112	1.31573	4.91930
3 NATURAL GAS EXTRACTION	1.00000	3.13194	0.4112	1.31673	4.91930
4 GASOLINE	1.80977	1.00000	0.4576	1.72286	1.81794
5 JET FUEL	1.80977	1.00000	0.4576	1.72286	1.81794
6 KEROSENE	1.80977	1.00000	0.4576	1.72286	1.81794
7 DISTILLATE FUEL OIL	1.80977	1.00000	0.4576	1.72286	1.81794
8 RESIDUAL FUEL OIL	1.80977	1.00000	0.4576	1.72286	1.81794
9 LPG	1.80977	1.00000	0.4576	1.72286	1.81794
10 ALL OTHER PETROLEUM REFINING	1.80977	1.00000	0.4576	1.72286	1.81794
11 ASPHALT AND TAR PRODUCTS	1.00000	1.00000	0.4576	1.72286	1.81794
12 ELECTRICITY, FOSSIL FUEL	3.50278	1.00000	1.0000	5.33853	1.81521
13 ELECTRICITY, NUCLEAR POWER	3.50278	1.00000	1.0000	5.33853	1.81521
14 ELECTRICITY, HYDROPOWER	3.50278	1.00000	1.0000	5.33853	1.81521
15 NATURAL GAS UTILITIES	1.41389	1.00000	1.0000	4.09010	0.84286
16 MEAT ANIMALS	0.79438	1.00000	0.3099	3.59245	1.14092
17 OTHER LIVESTOCK PRODUCTS	1.07292	1.00000	0.3229	3.51713	1.13494
18 GRAINS	1.02017	1.00000	0.8823	3.95577	0.60472
19 OTHER CROPS AND AG. SERVICES	1.78140	1.00000	0.4171	1.69030	1.37917
20 FORESTRY AND FISHERIES	1.46775	1.00000	7.6677	1.21160	1.06447
21 IRON MINING	1.00000	1.00000	3.6643	1.67575	1.14575
22 NONFERROUS METALS MINING	1.00000	2.60971	1.6824	2.60971	1.26724
23 NONMETALLIC MINERALS	2.46007	1.00000	14.9520	3.39488	1.87166
24 NEW RESIDENTIAL BUILDINGS	1.00000	1.63513	1.0000	1.00000	1.00000
25 MOBILE HOMES	1.00000	1.64920	0.4311	4.07379	1.00000
26 NEW NONRESIDENTIAL BUILDINGS	1.00000	1.60729	1.0000	4.07379	1.00000
27 NEW ENERGY ACTIVITY STRUCTURES	1.00000	2.13099	1.0000	1.00000	1.00000
28 NEW HIGHWAYS & STREETS	1.00000	1.00000	1.0000	1.00000	1.00000
29 ALL OTHER NEW CONSTRUCTION	1.00000	1.82449	1.0000	1.00000	1.00000
30 MAINT. & REPAIR, RESIDENTIAL	1.00000	1.00000	1.0000	1.00000	1.00000
31 M & R, NONRESIDENTIAL BLDGS.	1.00000	1.00000	1.0000	4.07379	1.00000
32 M & R, ENERGY ACTIVITY STRUCTS.	1.00000	1.00000	1.0000	1.00000	1.00000
33 M & R, HIGHWAYS & STREETS	1.00000	1.00000	1.0000	1.00000	1.00000
34 ALL OTHER M & R	1.00000	1.00000	1.0000	1.00000	1.00000
35 ORDNANCE	4.67384	4.55349	2.1298	5.94972	1.06811
36 MEAT PACKING	1.75256	1.00000	2.4718	1.30671	2.04157
37 DISTILLING	2.26181	1.00000	0.6323	4.46588	1.36711
38 ALL OTHER FOOD & KINDRED	1.98690	1.00000	0.8164	2.22015	1.20686
39 TOBACCO	1.36779	1.00000	0.7017	1.60979	0.51282
40 TEXTILES	3.90026	3.18370	1.2658	3.86146	1.12352
41 APPAREL	3.06654	1.00000	1.3222	4.40343	2.62142
42 LOGGING AND SAW MILLS	1.25355	1.00000	0.2776	2.84140	1.32151
43 OTHER LUMBER AND WOOD	3.93045	0.69244	0.7188	4.79942	1.23676
44 HOUSEHOLD FURNITURE	3.13059	2.49715	0.4720	3.98981	3.07219
45 OTHER FURNITURE	3.77442	2.35135	1.4809	2.63299	3.07219
46 PULP AND PAPER MILLS	2.71598	1.00000	0.5024	2.42863	1.32467
47 OTHER PAPER PRODUCTS	2.71598	1.00000	0.5024	3.30458	1.16285
48 PRINTING AND PUBLISHING	2.00493	1.00000	2.8811	1.99861	3.65237
49 CHEMICALS	2.38463	1.00000	0.9573	3.25279	3.47205
50 PLASTICS	2.65582	1.00000	2.1687	3.34672	4.75059
51 DRUGS	3.39281	1.00000	1.8945	4.80616	4.65676
52 CLEANING & TOILET PREPARATIONS	3.00405	1.00000	2.2941	2.97462	2.78586
53 PAINTS	2.84744	1.00000	0.4679	2.78525	1.00000
54 RUBBER	2.21826	0.65218	0.4633	3.86512	5.56488
55 LEATHER	1.78452	1.00000	0.1627	2.97515	5.16873

Table 35 (continued)

Intermediate Sector	Final Demand Sector				
	[105] PCE	[106] GPDFI	[107] CBI	[108] Exports	[109] Imports
56 GLASS	2.93190	1.00000	0.4441	4.7528	1.89704
57 CEMENT	3.57330	1.00000	4.0562	2.8343	1.57902
58 OTHER STONE & CLAY	2.49235	1.00000	0.1833	2.6738	1.81095
59 IRON & STEEL MFG.	2.10527	1.00000	0.4881	3.0548	2.51925
60 ALUMINUM MFG.	2.55927	1.00000	0.8413	2.4211	1.45430
61 OTHER PRIMARY NONFERROUS METALS MFG.	3.80247	2.17578	1.6583	1.5696	1.10007
62 FABRICATED METALS	3.44445	3.44481	0.8124	2.9803	3.44936
63 MACHINERY (NON-ELECTRICAL)	4.91576	2.87443	1.5292	3.1406	2.89660
64 COMPUTING, ELECTRONICS, AND RELATED	5.24355	4.23896	1.0541	16.1992	4.77106
65 REFRIGERATION & HEATING EQPMT.	3.76727	2.06984	0.4495	7.3897	5.25293
66 HOUSEHOLD APPLIANCES	3.76727	2.06984	0.4724	7.3897	5.25293
67 ELECTRIC LIGHTING	3.55069	4.77654	0.3433	3.0105	5.31282
68 RADIO, TV & COMMUNIC. EQPMT.	4.74841	2.98308	1.5335	3.7286	4.71399
69 ALL OTHER ELECTRIC MACH.	3.09084	1.89561	0.2898	5.4120	5.74022
70 MOTOR VEHICLES & PARTS	3.24302	1.53270	0.9422	3.2523	2.55194
71 TRUCKS, MOTORCYCLES & RELATED	3.31199	1.54242	0.8965	3.2526	2.53563
72 AIRCRAFT	4.85356	1.92768	1.1136	4.0736	3.42089
73 OTHER TRANSPORTATION EQPMT.	4.13630	2.92516	1.8974	3.0586	4.75392
74 SCIENTIFIC INSTRUMENTS & RELATED	3.27967	3.98786	0.5775	3.0009	4.34858
75 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	4.26951	4.34821	40.6313	6.4348	4.85388
76 JEWELRY	3.41610	1.00000	0.6373	3.0525	1.87159
77 OTHER MISCELLANEOUS MFG.	4.03289	2.64621	0.9061	3.6274	2.93546
78 RAILROADS	2.27887	2.58285	0.9539	3.1319	0.89916
79 LOCAL, SUBURBAN & INTERURBAN TRANS.	1.54377	1.00000	1.0000	3.1319	1.00000
80 TRUCKING & WAREHOUSING	2.18006	2.71333	1.2434	3.1424	1.00000
81 WATER TRANSPORT	2.39256	3.33281	1.2141	1.7335	3.34977
82 AIR TRANSPORT	4.20433	2.82153	1.6061	5.6432	2.37663
83 PIPELINES & OTHER TRANS.	1.81526	1.00000	4.1566	2.7894	1.00000
84 COMMUNICATIONS	6.54799	2.88954	1.0000	2.9717	1.00000
85 WATER & SANITARY SERVICE	2.78833	1.00000	1.0000	2.7721	1.00000
86 WHOLESALE TRADE	2.42496	2.71862	1.2427	2.9513	2.26349
87 RETAIL TRADE	2.69428	2.51473	1.0000	3.1591	1.00000
88 BANKING	3.95055	1.00000	1.0000	2.9619	1.00000
89 OTHER FINANCE & INSURANCE	2.78348	1.00000	1.0000	2.9859	4.53166
90 OWNER OCCUPIED DWELLINGS	3.24252	1.00000	1.0000	1.0000	1.00000
91 REAL ESTATE	2.97478	2.82331	1.0000	2.7093	1.00000
92 HOTELS	3.30261	1.00000	1.0000	2.5135	1.00000
93 PERSONAL SERVICES	1.23070	2.71862	1.0000	1.0000	1.00000
94 BUSINESS SERVICES	2.56833	1.00000	1.0000	3.2963	2.55365
95 EATING & DRINKING PLACES	2.69428	2.51473	1.0000	3.1591	1.00000
96 AUTO REPAIR	3.25719	1.00000	1.0000	1.0000	1.00000
97 AMUSEMENTS	2.45448	1.00000	1.2304	1.6342	2.13161
98 HOSPITALS	5.02581	1.00000	1.0000	1.0000	1.00000
99 OTHER MEDICAL SERVICES	3.51004	1.00000	1.0000	1.0000	1.00000
100 EDUCATIONAL SERVICES	1.70075	1.00000	1.0000	1.0000	1.00000
101 NON-PROFIT ORGNS.	1.93916	1.00000	1.0000	1.0000	1.94999
102 SOCIAL SERVICES	1.93916	1.00000	1.0000	1.0000	1.00000
103 POSTAL SERVICE & OTHER FED. ENTERP.	1.33247	1.00000	1.0000	0.7095	1.00000
104 STATE & LOCAL ENTERPRISES	2.32509	1.00000	1.0000	1.0000	1.00000

Table 36

BLS Scale Factors Used to Transform 1972 to 2000 Final Demand, Government Sectors

Intermediate Sector	Final Demand Sector			
	[110] FEDD	[111] FEDN	[112] SLGE	[113] SLGO
1 COAL MINING	2.04827	1.3917	0.31929	1.37683
2 CRUDE PETROLEUM	1.00000	1.0000	1.00000	1.00000
3 NATURAL GAS EXTRACTION	1.00000	1.0000	1.00000	1.00000
4 GASOLINE	1.55732	1.0945	0.33398	0.96173
5 JET FUEL	1.55732	1.0945	0.33398	0.96173
6 KEROSENE	1.55732	1.0945	0.33398	0.96173
7 DISTILLATE FUEL OIL	1.55732	1.0945	0.33398	0.96173
8 RESIDUAL FUEL OIL	1.55732	1.0945	0.33398	0.96173
9 LPG	1.55732	1.0945	0.33398	0.96173
10 ALL OTHER PETROLEUM REFINING	1.55732	1.0945	0.33398	0.96173
11 ASPHALT AND TAR PRODUCTS	1.00000	1.0000	1.00000	1.00000
12 ELECTRICITY, FOSSIL FUEL	1.84859	4.2852	0.82347	1.75357
13 ELECTRICITY, NUCLEAR POWER	1.84859	4.2852	0.82347	1.75357
14 ELECTRICITY, HYDROPOWER	1.84859	4.2852	0.82347	1.75357
15 NATURAL GAS UTILITIES	1.58258	1.0000	1.30183	1.94027
16 MEAT ANIMALS	0.82366	1.0000	1.00000	1.00000
17 OTHER LIVESTOCK PRODUCTS	1.08976	1.0000	0.51282	2.29323
18 GRAINS	1.00000	0.0005	0.24779	1.00000
19 OTHER CROPS AND AG. SERVICES	0.84803	0.3718	0.84661	1.46729
20 FORESTRY AND FISHERIES	1.35026	1.4680	1.00000	2.39642
21 IRON MINING	1.00000	1.0000	1.00000	1.00000
22 NONFERROUS METALS MINING	1.00000	20.5478	1.00000	1.00000
23 NONMETALLIC MINERALS	1.00000	1.0000	1.00000	2.34687
24 NEW RESIDENTIAL BUILDINGS	1.17294	1.0000	0.35372	1.18293
25 MOBILE HOMES	1.17294	1.2890	0.35372	1.00000
26 NEW NONRESIDENTIAL BUILDINGS	2.55439	1.3054	0.47735	1.03736
27 NEW ENERGY ACTIVITY STRUCTURES	1.00000	1.0000	1.00000	1.51632
28 NEW HIGHWAYS & STREETS	1.00000	0.4031	1.00000	0.81485
29 ALL OTHER NEW CONSTRUCTION	3.22486	0.2240	1.00000	1.35153
30 MAINT. & REPAIR, RESIDENTIAL	1.57147	3.2903	1.35315	1.52438
31 M & R, NONRESIDENTIAL BLDGS.	1.00000	3.2903	1.35315	1.52438
32 M & R, ENERGY ACTIVITY STRUCTS.	1.57147	3.2903	1.35315	1.52438
33 M & R, HIGHWAYS & STREETS	1.00000	3.2903	1.35315	1.52438
34 ALL OTHER M & R	1.57147	3.2903	1.35315	1.52438
35 ORDNANCE	1.14852	0.8988	1.00000	1.44416
36 MEAT PACKING	1.13778	1.0000	0.51887	2.30437
37 DISTILLING	1.00000	1.0000	1.00000	2.25485
38 ALL OTHER FOOD & KINDRED	0.98471	0.1330	0.61340	2.74201
39 TOBACCO	1.00000	1.0000	1.00000	3.13194
40 TEXTILES	1.27311	1.4442	0.64913	1.91443
41 APPAREL	1.01388	1.3140	0.69244	2.46270
42 LOGGING AND SAW MILLS	1.44416	1.0000	0.51282	1.00000
43 OTHER LUMBER AND WOOD	3.13194	1.2890	0.51282	3.13194
44 HOUSEHOLD FURNITURE	1.07963	1.2544	0.63635	3.90239
45 OTHER FURNITURE	1.52430	1.3624	0.91296	2.89744
46 PULP AND PAPER MILLS	1.44416	1.0000	0.69818	2.12842
47 OTHER PAPER PRODUCTS	1.38518	1.1570	0.69818	2.12842
48 PRINTING AND PUBLISHING	2.24545	1.6984	1.20314	3.09834
49 CHEMICALS	5.69635	1.1544	0.48586	1.99081
50 PLASTICS	4.24930	1.7091	0.51282	1.75572
51 DRUGS	2.56451	1.5465	1.19511	5.60154
52 CLEANING & TOILET PREPARATIONS	0.95916	1.6786	0.76177	2.85946
53 PAINTS	1.00000	11.8389	0.51282	1.94999
54 RUBBER	6.54117	1.2890	0.75501	2.39642
55 LEATHER	1.56501	1.5128	1.00000	3.13194

Table 36 (continued)

Intermediate Sector	Final Demand Sector [110] FEDD	[111] FEDN	[112] SLGE	[113] SLGO
56 GLASS	3.22580	1.76469	0.71245	3.23578
57 CEMENT	1.00000	1.00000	1.00000	1.00000
58 OTHER STONE & CLAY	0.81371	2.16869	0.67750	2.81611
59 IRON & STEEL MFG.	1.69378	2.51361	1.00000	2.51351
60 ALUMINUM MFG.	2.14482	1.51275	1.00000	1.00000
61 OTHER PRIMARY NONFERROUS METALS MFG.	1.00000	1.08094	1.00000	1.00000
62 FABRICATED METALS	1.45806	1.27162	0.94509	8.13885
63 MACHINERY (NON-ELECTRICAL)	1.63378	1.34381	0.64199	3.21897
64 COMPUTING, ELECTRONICS, AND RELATED	3.73657	1.50513	0.70219	3.40626
65 REFRIGERATION & HEATING EQPMT.	1.16997	1.35026	0.64557	4.25045
66 HOUSEHOLD APPLIANCES	1.16997	1.35026	0.64557	4.25045
67 ELECTRIC LIGHTING	1.74053	1.18950	0.55953	2.56750
68 RADIO, TV & COMMUNIC. EQPMT.	1.32548	1.51426	1.62484	1.68241
69 ALL OTHER ELECTRIC MACH.	2.47295	3.24014	0.62261	5.84753
70 MOTOR VEHICLES & PARTS	1.77399	0.90588	0.75212	2.57170
71 TRUCKS, MOTORCYCLES & RELATED	1.76722	0.90588	0.75212	2.56035
72 AIRCRAFT	1.71077	1.56039	1.00000	1.60613
73 OTHER TRANSPORTATION EQPMT.	1.64654	1.27927	0.75212	1.18421
74 SCIENTIFIC INSTRUMENTS & RELATED	2.16959	1.84812	0.70219	3.61305
75 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	1.13305	1.69731	0.70205	3.36414
76 JEWELRY	1.00000	0.05228	0.46913	3.13194
77 OTHER MISCELLANEOUS MFG.	1.75728	1.43312	0.75225	2.34687
78 RAILROADS	0.76291	1.39528	0.66592	2.31952
79 LOCAL, SUBURBAN & INTERURBAN TRANS.	1.33603	1.21409	1.16433	2.57956
80 TRUCKING & WAREHOUSING	0.96702	1.42062	0.79970	1.81998
81 WATER TRANSPORT	1.03271	1.35026	0.67219	3.13194
82 AIR TRANSPORT	1.51451	1.11910	0.70769	2.38633
83 PIPELINES & OTHER TRANS.	1.14400	1.35026	0.74060	1.94999
84 COMMUNICATIONS	2.61861	1.87721	0.94870	4.30860
85 WATER & SANITARY SERVICE	2.09587	1.31673	0.63667	3.79724
86 WHOLESALE TRADE	1.87050	1.43710	0.73903	2.53122
87 RETAIL TRADE	2.02188	2.10527	1.06715	2.71998
88 BANKING	1.00000	1.13788	1.00000	2.82792
89 OTHER FINANCE & INSURANCE	2.05820	2.51361	1.09124	2.24374
90 OWNER OCCUPIED DWELLINGS	1.00000	1.00000	1.00000	1.00000
91 REAL ESTATE	2.91992	0.98425	1.82193	2.83395
92 HOTELS	1.13015	1.36982	1.14266	2.51361
93 PERSONAL SERVICES	4.77403	0.00720	0.54334	2.40195
94 BUSINESS SERVICES	2.02837	1.68311	1.22894	3.73885
95 EATING & DRINKING PLACES	2.02188	2.10527	1.06715	2.71998
96 AUTO REPAIR	1.75572	1.83247	0.77577	2.59377
97 AMUSEMENTS	1.49026	5.88534	0.73542	2.20314
98 HOSPITALS	2.72690	1.08618	0.51282	2.68172
99 OTHER MEDICAL SERVICES	2.01154	1.63933	1.86985	2.33272
100 EDUCATIONAL SERVICES	3.00891	0.63521	1.32852	1.83358
101 NON-PROFIT ORGNS.	2.17784	1.76691	0.79002	2.07549
102 SOCIAL SERVICES	2.17784	1.76691	0.79002	2.07549
103 POSTAL SERVICE & OTHER FED. ENTERP.	1.39842	1.73281	0.70247	2.30714
104 STATE & LOCAL ENTERPRISES	1.24599	2.42968	0.75038	1.94999

All seem reasonable, given current trends in consumption.

A number of extreme values occur in tables 35 and 36, and can be explained by special circumstances for those cases. For example, in Change in Business Inventories, the large scale factor for [23] Nonmetallic Minerals exhibits a long term growth pattern projected by the BLS, while the very large factor for [74] Photographic Equipment reflects a very small 1972 entry, there being no particular trend between 1973 and the 2000 projection. The large scale factor for Exports of [64] Computers and Electronics of course exhibits a long term trend. In the Federal Government, Nondefense column, the very low values for sector [19] Other Crops and Agricultural Services, and Sector [38] All Other Food and Kindred, appear to reflect a projected phasing out of the purchase of "surplus" agricultural production and dairy products. Finally, the low value for [29] Other New Construction probably reflects a projected decline in spending on the space program (7).

5.3 FINAL DEMAND PROJECTIONS

5.3.1 Overview

The scale factors shown in Tables 35 and 36 were multiplied by the corresponding 1972 final demand entries (Appendix E) to yield the BLS-based final demand projections. The Lareau-Darmstadter year 2000 projections were limited to PCE; however, scale factors derived from those PCE results were utilized to project other final demand entries, yielding an alternative set of final demand projections. Specifically, the ratio of individual sector PCE in 2000 to its PCE in 1972 was used as an individual sector scale factor for the nongovernment final demand columns, and the ratio of total PCE in 2000 to total PCE in 1972 (2.08) was used as a general scale factor for the government entries. This second set of projections derived from the Lareau-Darmstadter data was labeled the L-D projections. Then the final demand estimates employed here were developed by blending the BLS and L-D projections. (Alternative results using BLS and L-D final demand were also obtained for comparative purposes.) The blending was seen as a means of improving the projection process by reducing risk and by relying on the better projections in cases of conflict. The following list summarizes how the blending was carried out for the individual components of final demand:

[105]	PCE	Combined BLS, L-D and independent estimates
[106]	GPDFI	Combined BLS and L-D, with adjustment for mobile homes
[107]	CBI	BLS used
[108]	EXP	Average of BLS and L-D, plus some independent estimates
[109]	IMP	Average of BLS and L-D, plus some independent estimates
[110]	FEDD	Independent estimates developed from Department of Defense data
[111]	FEDN	BLS entries multiplied by adjustment factor
[112]	SLGE	BLS used
[113]	SLGO	BLS used

Table 37 exhibits the final demand estimates employed here; the following subsections of section 5.3 describe the sources of those estimates in some detail.

5.3.2 Personal Consumption Expenditures

Table 38 presents detailed information on personal consumption expenditures by sector, including 1972 base levels, year 2000 projections respectively listed in the BLS and L-D alternatives, the year 2000 projections utilized here and a decision code indicating their source. The decision code categories are as follows:

0: Entry was zero in both 1972 and 2000
1: BLS and L-D averaged
2: L-D used
3: BLS used
4: Independent estimate used

In addition to the intermediate sector projections, the BLS and L-D studies also projected PCE expenditures on exogenous sector output, as follows:

	Sector	Projected Spending on Sector in millions of dollars L-D	BLS
[114]	Noncomparable imports	13,474.7	17,809.6
[115]	Scrap, used, etc.	4,968.9	7,818.2
[116]	Balancing sectors	3,391.0	-21,534.5
	Total	21,834.6	4,093.3

Table 37

Year 2000 Final Demand Projections Employed
In This Study

Sector	[105] PCE	[106] GPDFI	[107] GBI	[108] EXP	[109] IMP	[110] FEDD	[111] FEDN	[112] SLCE	[113] SLGO
1	64.33	0.00	162.71	1983.20	-0.36	93.16	17.92	3.32	16.38
2	0.00	110.53	13.45	0.00	-5800.00	0.00	287.50	0.00	0.00
3	0.00	27.37	17.52	0.00	0.00	0.00	0.00	0.00	0.00
4	8967.60	0.00	17.30	0.00	-10.60	232.90	28.95	47.53	272.36
5	0.00	0.00	72.57	247.81	-245.10	1805.33	17.37	0.00	5.10
6	262.00	0.00	0.00	0.00	-1.30	5.57	0.00	0.00	0.00
7	1290.20	0.00	-37.02	0.00	-206.50	332.00	69.48	0.33	115.31
8	0.00	0.00	-23.52	254.27	-663.50	332.00	0.00	58.68	9.52
9	295.70	0.00	0.00	42.39	-39.90	0.00	0.25	0.00	0.00
10	124.61	0.00	-29.88	514.35	-275.80	145.68	7.17	1.34	0.00
11	0.00	0.00	19.72	26.44	-10.20	0.00	0.00	0.00	0.00
12	16218.45	0.00	0.00	105.25	-93.64	1131.30	397.40	559.80	1282.26
13	4117.91	0.00	0.00	26.73	-23.77	287.28	100.90	142.14	325.54
14	419.26	0.00	0.00	2.72	-2.42	29.32	10.28	14.47	33.19
15	5965.00	0.00	0.00	277.13	-780.98	306.77	29.55	540.39	370.79
16	0.00	0.00	140.94	197.71	-375.49	0.00	0.00	0.00	0.00
17	2253.51	0.00	-4.97	105.39	-34.63	0.00	4.60	21.33	68.11
18	182.70	0.00	1159.94	10390.50	-38.35	0.00	-0.41	1.44	5.80
19	7640.00	0.00	307.91	3823.76	-880.80	40.83	-40.10	105.40	148.19
20	1293.14	0.00	62.00	146.19	-1523.82	0.00	-898.28	3.00	10.06
21	0.00	0.00	28.22	192.15	-998.94	0.00	0.00	0.00	0.00
22	0.00	465.77	45.43	75.05	-692.88	0.00	11.82	0.00	0.00
23	17.73	0.00	93.00	468.42	-551.53	0.00	0.46	0.00	0.94
24	0.00	102435.20	0.00	0.00	0.00	428.14	0.00	0.00	865.91
25	0.00	1906.27	43.59	44.93	0.00	0.00	0.30	2.51	0.00
26	0.00	50635.60	0.00	30.77	0.00	944.98	956.30	2755.27	3786.83
27	0.00	24436.38	0.00	0.00	0.00	0.00	0.00	0.00	1648.24
28	0.00	0.00	0.00	0.00	0.00	0.00	138.60	0.00	8254.38
29	0.00	9549.80	0.00	0.00	0.00	2864.45	489.99	0.00	6608.99
30	0.00	0.00	0.00	0.00	0.00	556.56	0.00	0.00	0.00
31	0.00	0.00	0.00	17.85	0.00	0.00	2477.64	3001.69	1309.13
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	199.41	0.00	6114.12
34	0.00	0.00	0.00	0.00	0.00	2146.99	1477.58	0.00	379.57
35	1183.75	207.48	137.59	1386.04	-147.25	15478.03	1382.21	0.00	23.54
36	19293.84	0.00	506.73	675.98	-1877.48	0.00	18.74	180.05	436.91
37	15942.93	0.00	153.33	80.11	-1385.42	0.00	0.00	0.00	-26.38
38	91826.30	0.00	652.29	4328.85	-3842.25	0.00	51.47	697.74	1552.80
39	9252.63	0.00	152.47	1376.07	-78.01	0.00	0.00	0.00	-2.51
40	14846.85	1608.07	807.32	2066.61	-2624.88	81.28	56.30	15.25	164.83
41	66346.59	0.00	980.54	939.77	-7169.09	212.86	74.50	2.56	192.83
42	2.31	0.00	75.89	2113.43	-1232.00	0.56	0.80	4.31	0.00
43	737.71	9.33	259.07	523.14	-1167.62	24.87	25.20	8.41	5.64
44	11098.65	1322.37	167.86	97.63	-540.60	17.63	71.26	16.99	52.68
45	499.80	5128.33	115.66	62.93	-319.79	3.90	127.22	260.10	398.69
46	88.05	0.00	29.09	1873.17	-2963.61	12.62	43.47	72.89	136.86
47	6086.32	0.00	91.74	473.64	-144.24	92.98	104.98	109.68	476.13
48	11873.16	0.00	758.58	767.59	-684.58	204.88	435.94	1459.29	1920.35
49	1407.28	307.76	205.91	6896.51	-4239.69	857.94	321.92	61.17	486.95
50	0.00	0.00	158.10	2073.31	-1106.69	119.89	0.39	0.26	0.35
51	14166.34	0.00	400.87	1906.83	-932.25	81.66	131.60	76.25	4605.02
52	18214.09	0.00	387.24	426.83	-113.02	27.47	42.28	63.00	262.21
53	306.03	0.00	54.27	169.24	-2.68	1.48	20.42	21.64	8.19
54	9951.33	66.21	248.77	1371.21	-4578.42	191.89	96.36	34.88	389.90
55	8785.21	0.00	40.92	308.50	-4876.99	15.77	5.74	0.00	27.25
56	1372.08	0.00	69.46	690.77	-644.72	15.96	34.50	30.85	253.36

Table 37 (continued)

Sector	[105] PCE	[106] GFDFI	[107] CBI	[108] EXP	[109] IMP	[110] FEDD	[111] FEDN	[112] SLGE	[113] SLGO
57	0.00	0.00	149.27	8.36	-149.83	0.00	0.00	0.00	0.00
58	1385.33	0.00	50.23	582.69	-1051.71	9.65	8.48	4.54	31.82
59	9.68	2.10	238.67	2052.19	-11757.03	142.34	10.70	1.80	12.07
60	45.47	0.00	-24.74	526.30	-996.76	19.11	0.17	0.30	0.00
61	23.36	139.61	498.98	1078.49	-3294.01	33.22	127.66	0.00	0.00
62	4781.86	5292.17	977.31	3989.54	-3516.25	459.68	211.02	115.11	-32.56
63	1360.77	45614.23	1838.67	13535.98	-5786.10	797.63	498.54	121.27	1025.24
64	2780.65	21866.27	126.07	27364.30	-32721.74	1970.87	1114.00	128.29	501.71
65	1449.88	2252.37	118.17	2049.55	-235.71	41.76	5.12	37.83	31.03
66	13599.89	2136.62	179.64	1034.62	-1876.77	10.95	4.97	12.27	78.63
67	2593.59	280.51	61.35	600.00	-633.82	40.09	23.94	19.53	17.97
68	23321.80	13160.17	637.78	2641.86	-8685.34	9613.48	1568.48	207.65	111.21
69	3216.01	8091.09	80.48	3905.02	-3028.08	569.18	431.49	65.19	1040.86
70	38647.90	25142.01	741.87	5073.54	-18633.52	250.53	152.51	162.98	2360.30
71	3720.19	5333.67	184.13	212.02	-4296.28	51.78	43.02	0.00	45.58
72	441.82	8278.44	225.72	12565.25	-2135.08	25873.92	1120.09	0.00	6.91
73	5807.91	9844.39	500.14	1425.15	-1516.47	6246.11	295.26	6.99	145.30
74	3755.78	8052.01	121.21	2356.93	-2365.23	1546.82	556.63	37.36	773.19
75	3883.94	6159.88	73.14	2705.24	-1500.59	704.47	144.44	84.53	698.40
76	6899.91	0.00	119.49	651.12	-1290.65	1.67	-1.47	7.37	10.02
77	15207.97	1926.64	297.11	1384.03	-3241.39	104.30	100.53	254.41	293.36
78	4840.87	853.79	236.77	2710.96	-72.18	629.86	202.82	38.29	193.45
79	4953.08	0.00	0.00	1.79	0.00	30.06	13.26	650.98	324.26
80	12866.45	1527.58	295.56	2136.26	0.00	2120.82	680.77	167.78	754.02
81	2034.52	69.81	38.12	3032.94	-364.54	1174.91	125.00	10.02	113.06
82	17518.47	189.10	14.62	4017.79	-1991.81	702.05	233.58	67.80	488.48
83	720.01	0.00	11.64	533.08	0.00	178.34	2.64	2.15	15.21
84	84329.62	6262.22	0.00	969.50	0.00	1268.08	533.00	285.37	3745.46
85	6663.74	0.00	0.00	26.08	0.00	107.82	3.79	86.08	-389.98
86	78849.35	14659.52	1240.99	9269.51	5942.49	2756.44	601.40	551.09	1971.56
87	243647.70	8215.56	1.70	309.38	0.00	0.00	-3.87	-188.46	635.39
88	48883.74	0.00	0.00	22.45	0.00	0.00	981.03	0.00	4810.85
89	74210.12	0.00	0.00	684.34	-584.53	12.99	-129.50	225.01	883.81
90	230694.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
91	85464.21	11509.27	0.00	5168.21	0.00	868.33	319.53	563.52	3429.64
92	12889.06	0.00	0.00	9.39	0.00	1106.62	230.47	-331.26	952.16
93	19287.75	520.61	0.00	0.61	0.00	70.34	31.09	105.41	793.84
94	18712.79	0.00	0.00	2438.46	-28.09	3975.71	2047.07	1825.22	10327.83
95	101024.52	0.00	0.00	0.00	0.00	645.82	213.54	-2163.87	685.98
96	27612.92	0.00	0.00	0.00	0.00	195.60	51.00	52.36	800.18
97	19639.85	0.00	-201.78	813.22	-26.09	371.53	-77.83	-293.80	-102.89
98	99232.56	0.00	0.00	0.00	0.00	295.45	130.28	-3.59	6251.37
99	93274.27	0.00	0.00	0.00	0.00	171.29	322.56	0.00	10910.81
100	17400.58	0.00	0.00	0.28	0.00	555.26	934.29	-44.64	46.94
101	23617.59	0.00	0.00	76.31	-57.63	0.00	-1.22	0.00	0.00
102	4202.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
103	3643.16	0.00	0.00	191.32	0.00	285.42	430.63	32.17	1169.03
104	4312.57	0.00	0.00	0.00	0.00	17.26	11.18	16.96	35.10
	1825853.71	405596.11	17374.92	167735.23	-159816.53	95152.49	23132.07	13295.97	98992.92

Table 38

Personal Consumption Expenditures by Sector,
1972 And Year 2000 Projections

Sector	Actual 1972	Projected Year 2000			
		L-D	BLS	This Study	Projected Source[a]
1 COAL MINING	125.1	64.3	160	64.3	2
2 CRUDE PETROLEUM	0.0	0.0	0	0.0	0
3 NATURAL GAS EXTRACTION	0.0	0.0	0	0.0	0
4 GASOLINE	11198.4	10169.9	20266	8967.6	4
5 JET FUEL	0.0	0.0	0	0.0	0
6 KEROSENE	304.7	156.7	551	262.0	4
7 DISTILLATE FUEL OIL	1500.2	771.4	2715	1290.2	4
8 RESIDUAL FUEL OIL	0.0	0.0	0	0.0	0
9 LPG	343.8	176.8	622	295.7	4
10 ALL OTHER PETROLEUM REFINING	155.6	141.3	282	124.6	4
11 ASPHALT AND TAR PRODUCTS	0.0	0.0	0	0.0	0
12 ELECTRICITY, FOSSIL FUEL	11397.3	17078.3	33447	16218.4	4
13 ELECTRICITY, NUCLEAR POWER	369.1	4336.2	8492	4117.9	4
14 ELECTRICITY, HYDROPOWER	453.8	441.5	865	419.3	4
15 NATURAL GAS UTILITIES	6555.0	6278.5	9268	5965.0	4
16 MEAT ANIMALS	0.0	0.0	0	0.0	0
17 OTHER LIVESTOCK PRODUCTS	1454.3	2253.5	1560	2253.5	2
18 GRAINS	163.1	237.7	166	182.7	4
19 OTHER CROPS AND AG. SERVICES	4542.3	7188.1	8092	7640.0	1
20 FORESTRY AND FISHERIES	848.3	1341.2	1245	1293.1	1
21 IRON MINING	0.0	0.0	0	0.0	0
22 NONFERROUS METALS MINING	0.0	0.0	0	0.0	0
23 NONMETALLIC MINERALS	7.7	16.5	19	17.7	1
24 NEW RESIDENTIAL BUILDINGS	0.0	0.0	0	0.0	0
25 MOBILE HOMES	0.0	0.0	0	0.0	0
26 NEW NONRESIDENTIAL BUILDINGS	0.0	0.0	0	0.0	0
27 NEW ENERGY ACTIVITY STRUCTURES	0.0	0.0	0	0.0	0
28 NEW HIGHWAYS & STREETS	0.0	0.0	0	0.0	0
29 ALL OTHER NEW CONSTRUCTION	0.0	0.0	0	0.0	0
30 MAINT. & REPAIR, RESIDENTIAL	0.0	0.0	0	0.0	0
31 M & R, NONRESIDENTIAL BLDGS.	0.0	0.0	0	0.0	0
32 M & R, ENERGY ACTIVITY STRUCTS.	0.0	0.0	0	0.0	0
33 M & R, HIGHWAYS & STREETS	0.0	0.0	0	0.0	0
34 ALL OTHER M & R	0.0	0.0	0	0.0	0
35 ORDNANCE	457.0	1183.7	2136	1183.7	2
36 MEAT PACKING	11976.5	17598.1	20990	19293.8	1
37 DISTILLING	8104.7	13554.6	18331	15942.9	1
38 ALL OTHER FOOD & KINDRED	53194.9	77959.5	105693	91826.3	1
39 TOBACCO	6086.8	10179.8	8325	9252.6	1
40 TEXTILES	4927.3	10475.9	19218	14846.9	1
41 APPAREL	22563.1	63502.5	69191	66346.6	1
42 LOGGING AND SAW MILLS	4.5	2.3	6	2.3	2
43 OTHER LUMBER AND WOOD	379.5	737.7	1492	737.7	2
44 HOUSEHOLD FURNITURE	5706.4	11098.6	17864	11098.6	2
45 OTHER FURNITURE	257.1	499.8	970	499.8	2
46 PULP AND PAPER MILLS	36.2	77.8	98	88.0	1
47 OTHER PAPER PRODUCTS	2458.6	5495.1	6678	6086.3	1
48 PRINTING AND PUBLISHING	5729.9	12258.3	11488	11873.2	1
49 CHEMICALS	548.3	1507.1	1307	1407.3	1
50 PLASTICS	0.0	0.0	0	0.0	0
51 DRUGS	4175.4	9487.2	14166	14166.3	3
52 CLEANING & TOILET PREPARATIONS	7068.7	15193.5	21235	18214.1	1
53 PAINTS	122.5	263.2	349	306.0	1
54 RUBBER	4362.5	10225.5	9677	9951.3	1
55 LEATHER	4923.0	13901.1	8785	8785.2	3
56 GLASS	562.8	1094.1	1650	1372.1	1

Table 38 (continued)

Sector	Actual 1972	Projected Year 2000 L-D	BLS	This Study	Projection Source
57 CEMENT	0	0	0	0	0
58 OTHER STONE & CLAY	620	1224	1547	1385	1
59 IRON & STEEL MFG.	5	0	10	10	3
60 ALUMINUM MFG.	20	39	52	45	1
61 OTHER PRIMARY NONFERROUS METALS MFG.	8	17	30	23	1
62 FABRICATED METALS	1737	3579	5985	4782	1
63 MACHINERY (NON-ELECTRICAL)	434	588	2133	1361	1
64 COMPUTING, ELECTRONICS, AND RELATED	530	1108	2781	2781	3
65 REFRIGERATION & HEATING EQPMT.	486	1067	1832	1450	1
66 HOUSEHOLD APPLIANCES	4572	9974	17226	13600	1
67 ELECTRIC LIGHTING	926	1898	3289	2594	1
68 RADIO, TV & COMMUNIC. EQPMT.	4911	10738	23322	23322	3
69 ALL OTHER ELECTRIC MACH.	1209	2695	3737	3216	1
70 MOTOR VEHICLES & PARTS	28380	54792	92036	38648	4
71 TRUCKS, MOTORCYCLES & RELATED	2504	8218	8295	3720	4
72 AIRCRAFT	106	442	513	442	2
73 OTHER TRANSPORTATION EQPMT.	1409	5787	5829	5808	1
74 SCIENTIFIC INSTRUMENTS & RELATED	1317	3191	4321	3756	1
75 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	1072	3192	4576	3884	1
76 JEWELRY	2255	6098	7702	6900	1
77 OTHER MISCELLANEOUS MFG.	4738	11307	19109	15208	1
78 RAILROADS	2486	4017	5665	4841	1
79 LOCAL, SUBURBAN & INTERURBAN TRANS.	4158	3487	6419	4953	1
80 TRUCKING & WAREHOUSING	6675	11181	14552	12866	1
81 WATER TRANSPORT	1028	1610	2459	2035	1
82 AIR TRANSPORT	5806	10627	24410	17518	4
83 PIPELINES & OTHER TRANS.	485	559	881	720	1
84 COMMUNICATIONS	12879	25857	84330	84330	3
85 WATER & SANITARY SERVICE	2801	5516	7811	6664	1
86 WHOLESALE TRADE	38163	65155	92543	78849	1
87 RETAIL TRADE	102158	212053	275242	243648	1
88 BANKING	12374	31933	48884	48884	3
89 OTHER FINANCE & INSURANCE	26661	68425	74210	74210	3
90 OWNER OCCUPIED DWELLINGS	76688	212727	248662	230694	1
91 REAL ESTATE	31977	75803	95125	85464	1
92 HOTELS	4699	10258	15520	12889	1
93 PERSONAL SERVICES	15672	31836	19288	19288	3
94 BUSINESS SERVICES	7374	18486	18940	18713	1
95 EATING & DRINKING PLACES	37496	67383	101025	101025	3
96 AUTO REPAIR	13780	27613	44883	27613	2
97 AMUSEMENTS	8669	18002	21278	19640	1
98 HOSPITALS	19745	44863	99233	99233	3
99 OTHER MEDICAL SERVICES	26574	60255	93274	93274	3
100 EDUCATIONAL SERVICES	10078	17661	17140	17401	1
101 NON-PROFIT ORGNS.	12370	23249	23987	23618	1
102 SOCIAL SERVICES	2277	3990	4415	4203	1
103 POSTAL SERVICE & OTHER FED. ENTERP.	2168	4397	2889	3643	1
104 STATE & LOCAL ENTERPRISES	1987	4004	4621	4313	1
	727534.40	1513847.43	2079411.47	1825853.71	

a/ Decision Codes
0: Zero Entry
1: Average of BLS and L-D
2: L-D Used
3: BLS Used
4: Independent Estimates Used

Assigning the average of these figures to the projections employed here, and adding the totals to the intermediate sector totals shown in table 38, the following grand totals and fractions of 1972 grand totals are obtained:

Source	Grand Totals in Billions of 1972 Dollars	Relative to 1972
1972 Actual	738.072	1.000
L-D Projected	1,536.681	2.082
BLS Projected	2,083.505	2.823
This Study Projected	1,838.800	2.491

The blending of the BLS and L-D projections was carried out as follows. For many of the sectors, the alternative projections seemed reasonably close, and for several the two were nearly identical (compare sectors [71], [73], [94], [100] and [101] in table 38). But there were many major differences as well, so the choice between projections was of some consequence. When the choice did not seem obvious, the two projections were averaged, in effect treating them as equally likely. The L-D projections were chosen in the case of [1] Coal Mining; [35] Ordnance; [42] through [45] the wood product sectors; and [96] Auto Repair, because the BLS projections appeared overstated given other evidence, e.g., chapter 4 noted several constraints on the expansion of wood products. The L-D projection was also accepted for [17], Other Livestock, on the basis of the development of independent projections of food consumption, noted below. On the other hand, for a number of sectors, the BLS projections were selected because they seemed more consistent with expectations of considerable growth, given the discussion in chapter 4. These included [51] Drugs; [64] Computers and Electronics; [68] Radio, TV and Communication Equipment; and [84] Communications. Computerization was also seen as affecting [88] Banking and [89] Other Finance and Insurance, again leading to the choice of the BLS projection in those cases. The effects of demographic and institutional changes were the sources of other choices of BLS projections; with an aging population and increased medical coverage, the higher of the alternative forecasts for [98] Hospitals, and [99] Other Medical Services were chosen. Similarly, with increased labor force participation by women, the higher forecast for [95] Eating and Drinking Places seemed the more reasonable of the alternatives, assuming a reduction in meals consumed at home.

A number of independent estimates were incorporated in our PCE projections, and are described at this point.

A number of projections explicitly accounted for US population growth; here, year 2000 population as a fraction of 1972 population was set at 1.238, drawing on a Census projection of 259.869 million persons in 2000, relative to the 1972 population of 209.896 million (8). For this level of population growth, the PCE projection of the present study (2.49 times the 1972 level) implies a doubling of per capita income from 1972 to 2000.

Independent projections were used for the energy sectors. In the case of petroleum products, two basic projections were drawn upon. The first was based on the PCE scale factor of .616 for gasoline use per vehicle mile of travel in 2000 relative to 1972, developed in section 3.4.4, above. That factor was multiplied by the population growth factor (1.238) and then further scaled by 1.05 to account for projected growth in the stock of automobiles per capita. The product of those components gave an overall scale factor of 0.8. That factor was also employed in projecting PCE for sector [10] All Other Petroleum Refining, because a large portion of that consumption consists of motor vehicle oil use, assumed to move in tandem with gasoline use. The second projection utilized for petroleum products was an extension of the trend in per capita use of distillate heating oils from 1972 to 1978 (9), assumed applicable to residential use of distillate oil, kerosene and LPG. At the end of that base period, total BTU use was .981 and per capita BTU use was .925 of the corresponding beginning of period figure. On an annual basis, the per capita growth factor is .9871, so the projected use per capita is .695 in 2000 relative to 1972. Multiplying by the population growth factor of 1.238 gave a total use scale factor of .86.

A similar procedure was employed in projecting natural gas, drawing on data on residential use of that fuel in BTU terms (10). Per capita use in 1978 was 0.936 that in 1972; this corresponds to an annual growth factor of .989, and a projected use per capita of .735 in 2000 relative to 1972. Multiplying by the population growth effect yields a year 2000 scale factor of 0.91.

A more involved procedure was used in projecting electricity use. The change in residential use from 1972 to 1978 was incorporated, and then use from 1978 to 2000 was projected by applying a regression equation explaining residential use per capita, given price and income changes. Per capita use of electricity in 1978 was 1.25 times the 1972 level (11), and population was 1.06 times the 1972 level, yielding a total growth effect of 1.325. In the predictive equation explaining residential use of electricity, the estimated price elasticity

was -.918, and the income elasticity was .345 (12). Given a projected price rise of two percent annually from 1978 to 2000, an increase in per capita income consistent with a doubling from 1972 to 2000, and an accounting for the demand cross-elasticities of other fuels, the year 2000 per capita consumption was projected as 1.0457 times the 1978 level. (Details on the regression equation are presented in appendix I.) The year 2000 population projection was 1.1675 the 1978 level. Finally, an additional scale factor of 1.05 was utilized to account for new products and new uses of electricity. These effects in combination yielded a scale factor of 1.2819 for 1978 to 2000 growth in electricity use, which in turn implied a scale factor of 1.6985 for 1972 to 2000 growth.

The disparate procedures involved in the projection of residential energy use deserve some explanation. An extension of current trends was used in the case of natural gas and petroleum products because there were qualms about relying on regression equations for projections, in those cases. Alternative equations for those fuels vary markedly in price and income elasticities (13), and projections using individual equations often show great sensitivity to relative price variations, leading to considerable instability in projections (14). Electricity regression results, in contrast, exhibited much more stability, and hence were relied on for the electricity projections. However, the effects of alternative projection procedures for residential energy use were examined in some detail, and are discussed at the conclusion of this chapter (in section 5.5) as part of a general consideration of the sensitivity of our results.

In all of the final demand projections, the distribution between electricity from fossil fuels, nuclear power and hydroelectric power was set at .7814, .1984 and .0202, respectively, applying the total sales proportions established in table 13, above. Net sales proportions of .7591, .2186 and .0223, respectively, were employed for the intermediate sectors, and in retrospect, it would have been more consistent to use the net sales proportions for final demand, as well. However, the differences introduced seem quite minor, and do not particularly affect the pattern or magnitude of the results. Some detailed comparisons of the effects of using the alternative sets of proportions are also discussed at the conclusion of this chapter.

The projections of food consumption employed here drew on outside evidence and projections made by several agricultural experts (15), as well as on the BLS and L-D projections. That outside evidence implied that the BLS projection of

[17] Other Livestock, was understated, while the L-D projection was accurate, so the latter was used. In contrast, both BLS and L-D appeared off the mark in the projection of [18] Grain; here, it was forecast that per capita consumption of grains in 2000 would be 0.9 the 1972 level. For the remaining food sectors, the outside evidence implied that reasonable results would be obtained by averaging the BLS and L-D projections.

The projection of consumption of [70] Motor Vehicles, was developed independently because it seemed clear that both the BLS and L-D projections were overstated. The pattern of automobile sales since 1972 is exhibited in this list (16):

Year	Billions of 1972 Dollars	Dollars Per Capita
1972	32.1	152.9
1973	34.6	163.3
1974	26.1	122.0
1975	26.0	120.4
1976	31.1	142.6
1977	34.5	156.6
1978	34.9	156.8
1979	33.1	147.0

From these data it seems clear that sales have been sensitive to energy price increases, and, as is well-known, that sales have been relatively flat. However, a mild upward trend can be read from the figures; if a three year moving average of the per capita figures is formed, the ratio of end of period to beginning of period values is 1.05.

Recent and projected shifts to smaller cars suggest a reduction in real value (in 1972 dollars) per car. On the other hand, projected shifts in the population age distribution imply that from 1972 to 2000 the population aged 16 and over will increase by about eight percent more than the population as a whole (17), implying increased rates of car ownership. Further, projected increases in per capita income and greater labor force participation by women also suggest higher car ownership per capita. On the basis of all of these considerations it was decided to project a 10 percent increase in real per capita purchases of new cars for 2000 relative to 1972. In turn, this implied an estimated increase of about five percent per capita in the stock of cars, obtained by assuming the average increase in cars over the period was about half the end of period increase.

5.3.3 Other Nongovernment Expenditures

The projections of spending by [106] Gross Private Domestic Fixed Investment (GPDFI) were generally obtained by applying the same decision rule employed for the corresponding intermediate sector purchase by PCE. For example, when the BLS estimate had been used for PCE, the BLS estimate was used for GPDFI. The exceptions were cases of independent estimates for PCE; here the average of the BLS and L-D estimates were employed. A final exception occurred in the case of [25] Mobile Homes. Here, a projection of half the level of per capita spending in 1972 was employed, so the total scale factor became 0.62 (by way of 0.5 times 1.238). That projection was based on the following trend in units shipped (18):

Year	Units Shipped In Thousands
1972	576
1973	567
1974	329
1975	213
1976	246
1977	217
1978	276
1979	277
1980	205
1981	250

It seems plausible that increased energy prices have been an important factor in the observed reduction in shipments.

It can be hypothesized that GPDFI by sector is some function of current output. In future work based on such a relationship, GPDFI might then be estimated by an iterative process, treating an initial set of projected output as a first step in the iteration and then modifying the GPDFI forecast on the basis of the specified functional relation and those outputs. Iteration would proceed until modification of the GPDFI forecasts were no longer necessary.

The projections of spending for [107] Change in Business Inventories, employed the BLS figures rather than those derived from Lareau and Darmstadter because the former were considerably lower in magnitude (a total of $17.4 billion versus $35.6 billion). The lower value seemed more likely, given advances in inventory control by way of computerization.

The projections of levels of [108] Exports and [109] Imports, were obtained by averaging the BLS and L-D projections, with several notable exceptions. First, the BLS projections of grain exports from sector [18] seemed considerably understated, on the basis of recent projections by experts on the topic (19). The BLS shows grain exports falling from $4.6 billion in 1973 to $4.3 billion in 1990, suggesting a further decline to around $4.0 billion in 2000. In contrast, a year 2000 projection of $10.4 billion was employed here, amounting to 2.25 times the 1973 level, which reflected a consensus estimate derived from the work of agricultural experts. Second, imports of crude oil were projected as having passed their peak, while imports of petroleum products were treated as on a downward trend; the evidence of recent experience and the year 2000 projections are as follows, setting 1972 import levels at 1.00 (20):

Year	Crude Oil	Distillate Oil	Petroleum Products Other than Distillate (primarily residual oil)
1972	1.00	1.00	1.00
1976	2.39	0.81	0.84
1978	2.86	0.95	0.84
1980	2.36	0.76	0.66
2000	2.10	0.50	0.40

Making use of those projections, year 2000 petroleum imports were set at the following levels:

	Fraction of 1972 Level	Millions of 1972 Dollars
[2] Crude Oil	2.1	5,800.0
[4] Gasoline	1.0	10.6
[5] Jet Fuel	1.0	245.1
[6] Kerosene	1.0	1.3
[7] Distillate Oil	0.5	412.9
[8] Residual Oil	0.4	1,658.8
[9] LPG	0.5	79.8
[10] All Other Petroleum Products	0.6	459.8

Gasoline and kerosene amounts involved were quite small, while jet fuel imports were expected to be sustained because of defense purchases, so spending on those sectors was not reduced. Finally, there were adjustments accounting for imports as an increasing share of domestic consumption in [59] Iron & Steel, and in [70] Motor Vehicles, on the basis of outside evidence (21). The adjustments yielded these values for imports as a fraction of domestic consumption:

	1972	2000
[59] Iron & Steel	.09	.21
[70] Motor Vehicles	.12	.18

In these calculations, domestic consumption equals output plus imports minus exports. An upward trend for the share of imports in [64], Computers and Electronics, was also built into our projections.

5.3.4 Federal Government Defense Expenditures

The projection of national defense expenditures had two major phases: projection of the total level of spending and accounting for the distribution of spending by sector.

The total level was estimated by taking the Reagan administration projection of defense spending in 1986, applying a three percent annual growth rate from 1987 to 2000, and then deflating the total to 1972 dollars. The Reagan administration has implemented and projected defense budget increases of 12.4 percent, 14.6 percent, and 7.3 percent for 1981 through 1983, respectively, and 7.0 percent annually for 1984 through 1986 (22). The resulting obligational authority was 292.0 billion dollars in 1982 prices. The use of a three percent annual rate after 1986 is an attempt to project expenditures on the basis of longer-term relationships. The last Carter administration budget contained increases of five percent a year for fiscal years 1984 through 1986, while a 1981 report by Secretary of Defense Harold Brown projected long run real increases in the three percent range (23). Historically, real defense expenditures declined by 12 percent from 1972 to 1975, and then rose by 3.5 percent from 1975 to 1979 (24). The projection of total spending employed here is considerably above the corresponding BLS projection (25), reflecting Reagan administration increases over previous budgets.

The distribution of defense spending by sector was based on Department of Defense documents, including a report containing tabular material organized to correspond to the BEA 496 sector table (26). That report projected the mix of defense spending by intermediate sector in the form of fractions of total, over the years 1981 through 1986. No trends were discernable over the years covered, so the 1986 figures were generally accepted as the best indicators of the year 2000 mix. For that year, entries were aggregated to convert from the BEA to the RFF sectoral classification, following the aggregation procedures outlined in Chapter 2. There were two exceptions to this general process. First,

Department of Defense food expenditures were set at zero to conform with BEA conventions. Second, the disaggregation of petroleum products was derived from information in the 1981 report by Secretary of Defense Brown (27). The following intensities of use were estimated:

Sector	Fraction of all Defense Expenditures 1972	2000	Percent of Petroleum Product Total 1972	2000
All Petroleum Products	.009272	.015691	100.0	100.0
[4] Gasoline	.001647	.001569	17.8	10.0
[5] Jet Fuel	.004892	.009728	53.8	62.0
[6] Kerosene	.000018	.000030	0.2	0.2
[7] Distillate Oil	.001049	.001789	11.3	11.4
[8] Residual Oil	.001026	.001789	11.1	11.4
[9] LPG	.000000	.000000	0.0	0.0
[10] All Other Petroleum Products	.000540	.000785	5.8	5.0

5.3.5 Other Government Expenditures

Sector [111] Federal Government Nondefense Expenditures, were as follows in recent years (28):

Year	Federal Nondefense Spending In Billions of 1972 Dollars	Per Capita in 1972 Dollars
1972	28.6	136.3
1973	27.1	127.9
1974	29.3	137.0
1975	30.9	143.1
1976	31.8	145.8
1977	35.3	160.2
1978	34.4	154.5
1979	34.6	153.7

The 1979 per capita level was 1.13 that of 1972; it was assumed here that the 2000 per capita value would increase by a like amount, relative to the 1979 level. Then, accounting for increased population yields a ratio of 2000 to 1972 nondefense spending around 1.6. This is somewhat below the ratio of 1.8 obtained using the BLS projections, explainable by changes in nondefense spending brought about under the Reagan administration.

The BLS projections for the state and local government sectors, [112] and [113], were accepted without modification. This was because the projections accounted for the effects of changing population composition, with a projected decline in educational expenditures relative to 1972, and because the overall

growth rates involved squared well with the projections of Data Resources, Incorporated.

5.4 YEAR 2000 OUTPUT PROJECTIONS IN DOLLAR TERMS

The matrix multiplication of final demand and the year 2000 Inverse Matrix yields a major result of this study, which is the set of projected year 2000 outputs, in 1972 dollars. Table 39 exhibits those outputs by sector, the corresponding 1972 outputs, and the ratio of year 2000 to 1972 levels.

The total intermediate sector output is 4,692.7 billion dollars in 2000, equal to 2.39 times the 1972 output of 1,964.3 billion dollars (all in 1972 prices). On a per capita basis, the increase in output is 93 percent.

Sectors exhibiting greatest growth in output from 1972 to 2000, in descending order, are as follows:

Sector		Output Ratio 2000/1972
[13]	Electricity - Nuclear Power	13.283
[64]	Computing, Electronics & Related	6.406
[84]	Communications	4.855
[98]	Hospitals	4.730
[51]	Drugs	3.818
[60]	Aluminum	3.575
[72]	Aircraft	3.558

Sector		Output Ratio 2000/1972
[75]	Photographic Equipment	3.557
[73]	Other Transportation Equipment	3.423
[94]	Business Services	3.397
[68]	Radio, T.V., & Communic. Equipment	3.317
[99]	Other Medical Services	3.306
[88]	Banking	3.199
[50]	Plastics	3.199

These results reflect the major increases projected by way of final demand increases, technological change, and the greatly increased share of nuclear power in generation of electricity.

Table 39

Output By Sector, Actual 1972
Compared to Projected Year 2000

Sector	Output in Millions of 1972 Dollars		Ratio
	1972	2000	2000/1972
1 COAL MINING	5439.20	10067.89	1.8510
2 CRUDE PETROLEUM	12691.30	13378.42	1.0541
3 NATURAL GAS EXTRACTION	4039.00	4652.00	1.1518
4 GASOLINE	16936.40	16561.48	0.9779
5 JET FUEL	1381.50	3814.58	2.7612
6 KEROSENE	375.40	367.86	0.9799
7 DISTILLATE FUEL OIL	4410.70	6635.01	1.5043
8 RESIDUAL FUEL OIL	1107.20	3240.59	2.9268
9 LPG	999.10	1048.67	1.0496
10 ALL OTHER PETROLEUM REFINING	3617.00	5678.86	1.5700
11 ASPHALT AND TAR PRODUCTS	1836.90	3038.71	1.6543
12 ELECTRICITY, FOSSIL FUEL	29731.25	46258.86	1.5559
13 ELECTRICITY, NUCLEAR POWER	849.05	11278.03	13.2831
14 ELECTRICITY, HYDROPOWER	1043.60	1126.49	1.0794
15 NATURAL GAS UTILITIES	20825.20	24250.52	1.1645
16 MEAT ANIMALS	30233.30	58096.88	1.9216
17 OTHER LIVESTOCK PRODUCTS	10470.80	19857.80	1.8965
18 GRAINS	17398.40	39324.21	2.2602
19 OTHER CROPS AND AG. SERVICES	20921.00	39557.60	1.8908
20 FORESTRY AND FISHERIES	2245.30	5098.44	2.2707
21 IRON MINING	1295.00	1749.66	1.3511
22 NONFERROUS METALS MINING	2208.00	5026.03	2.2763
23 NONMETALLIC MINERALS	3403.00	6169.56	1.8130
24 NEW RESIDENTIAL BUILDINGS	56008.00	103729.24	1.8520
25 MOBILE HOMES	3209.10	2001.64	0.6237
26 NEW NONRESIDENTIAL BUILDINGS	37709.00	59109.75	1.5675
27 NEW ENERGY ACTIVITY STRUCTURES	12690.80	26084.62	2.0554
28 NEW HIGHWAYS & STREETS	10429.00	8392.99	0.8048
29 ALL OTHER NEW CONSTRUCTION	12743.70	19513.23	1.5312
30 MAINT. & REPAIR, RESIDENTIAL	10500.10	29442.74	2.8040
31 M & R, NONRESIDENTIAL BLDGS.	12116.60	27134.88	2.2395
32 M & R, ENERGY ACTIVITY STRUCTS.	2558.40	4022.09	1.5721
33 M & R, HIGHWAYS & STREETS	4185.30	6583.29	1.5730
34 ALL OTHER M & R	7056.70	18582.41	2.6333
35 ORDNANCE	6938.20	20634.53	2.9740
36 MEAT PACKING	21257.70	40039.65	1.8835
37 DISTILLING	11481.90	25649.71	2.2339
38 ALL OTHER FOOD & KINDRED	87882.40	166684.62	1.8967
39 TOBACCO	9231.40	14166.34	1.5346
40 TEXTILES	29071.00	77285.38	2.6585
41 APPAREL	30164.90	87053.35	2.8859
42 LOGGING AND SAW MILLS	11613.60	21410.42	1.8436
43 OTHER LUMBER AND WOOD	10491.20	17665.95	1.6839
44 HOUSEHOLD FURNITURE	7249.20	13847.10	1.9102
45 OTHER FURNITURE	3807.50	7415.06	1.9475
46 PULP AND PAPER MILLS	11089.40	29044.73	2.6191
47 OTHER PAPER PRODUCTS	16289.59	37470.82	2.3003
48 PRINTING AND PUBLISHING	16694.49	38663.22	2.3159
49 CHEMICALS	25868.90	62237.31	2.4059
50 PLASTICS	9467.50	30284.26	3.1988
51 DRUGS	7729.00	29509.03	3.8180
52 CLEANING & TOILET PREPARATIONS	9554.70	24027.86	2.5148
53 PAINTS	3562.50	7683.22	2.1567
54 RUBBER	21036.90	55968.07	2.6605
55 LEATHER	5583.19	6617.07	1.1852
56 GLASS	5642.20	11832.43	2.0971
57 CEMENT	1801.50	3167.99	1.75853
58 OTHER STONE & CLAY	13572.69	24058.97	1.77260

Table 39 (continued)

Sector	Output in Millions of 1972 Dollars		Ratio
	1972	2000	2000/1972
59 IRON & STEEL MFG.	35379.70	46822.59	1.32343
60 ALUMINUM MFG.	7505.00	26829.40	3.57487
61 OTHER PRIMARY NONFERROUS METALS MFG.	15847.80	31976.51	2.01773
62 FABRICATED METALS	47552.20	94429.48	1.98581
63 MACHINERY (NON-ELECTRICAL)	47519.19	103028.58	2.16815
64 COMPUTING, ELECTRONICS, AND RELATED	19462.80	124677.93	6.40596
65 REFRIGERATION & HEATING EQPMT.	6480.70	13904.60	2.14554
66 HOUSEHOLD APPLIANCES	6727.10	17126.18	2.54585
67 ELECTRIC LIGHTING	5479.50	11707.48	2.13660
68 RADIO, TV & COMMUNIC. EQPMT.	17557.30	58231.63	3.31666
69 ALL OTHER ELECTRIC MACH.	13442.69	29815.74	2.21799
70 MOTOR VEHICLES & PARTS	62945.30	89385.23	1.42005
71 TRUCKS, MOTORCYCLES & RELATED	3939.90	6004.63	1.52406
72 AIRCRAFT	16569.40	58958.49	3.55828
73 OTHER TRANSPORTATION EQPMT.	7644.70	26170.69	3.42338
74 SCIENTIFIC INSTRUMENTS & RELATED	8212.10	24005.33	2.92317
75 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	5366.00	19089.16	3.55743
76 JEWELRY	2491.80	7496.64	3.00853
77 OTHER MISCELLANEOUS MFG.	8847.09	24242.68	2.74019
78 RAILROADS	15046.30	30682.15	2.03918
79 LOCAL, SUBURBAN & INTERURBAN TRANS.	7270.60	12287.56	1.69003
80 TRUCKING & WAREHOUSING	30370.60	63157.44	2.07956
81 WATER TRANSPORT	7455.00	13996.47	1.87746
82 AIR TRANSPORT	13646.40	38214.98	2.80037
83 PIPELINES & OTHER TRANS.	2828.80	5232.03	1.84956
84 COMMUNICATIONS	30668.90	148908.07	4.85534
85 WATER & SANITARY SERVICE	5933.60	14029.38	2.36440
86 WHOLESALE TRADE	103883.10	223157.33	2.14816
87 RETAIL TRADE	114352.40	270008.10	2.36119
88 BANKING	25484.60	81533.91	3.19934
89 OTHER FINANCE & INSURANCE	51984.40	140027.49	2.69364
90 OWNER OCCUPIED DWELLINGS	76687.80	230694.25	3.00823
91 REAL ESTATE	98231.40	251125.05	2.55646
92 HOTELS	8350.40	23315.16	2.79210
93 PERSONAL SERVICES	21940.30	35163.35	1.60268
94 BUSINESS SERVICES	88180.40	299553.98	3.39706
95 EATING & DRINKING PLACES	48721.40	133805.11	2.74633
96 AUTO REPAIR	24551.40	52321.50	2.13110
97 AMUSEMENTS	12719.20	31515.60	2.47780
98 HOSPITALS	22391.30	105908.81	4.72991
99 OTHER MEDICAL SERVICES	32913.80	108804.24	3.30573
100 EDUCATIONAL SERVICES	12201.50	19987.56	1.63812
101 NON-PROFIT ORGNS.	14890.90	30763.66	2.06594
102 SOCIAL SERVICES	2502.00	4815.71	1.92474
103 POSTAL SERVICE & OTHER FED. ENTERP.	9568.30	20391.23	2.13112
104 STATE & LOCAL ENTERPRISES	2798.60	6132.58	2.19130
	1964289.53	4692727.79	

Sectors exhibiting least growth in output, including declines, are exhibited as follows, in ascending order:

		Output: 2000/1972
[25]	Mobile Homes	0.624
[28]	New Highways & Streets	0.805
[4]	Gasoline	0.978
[6]	Kerosene	0.980
[9]	LPG	1.050
[2]	Crude Petroleum	1.054
[14]	Electricity-Hydro	1.079
[3]	Natural Gas Extraction	1.152
[15]	Natural Gas Utilities	1.165
[55]	Leather Manufacturing	1.185
[59]	Iron & Steel Manufacturing	1.323
[21]	Iron Mining	1.351
[70]	Motor Vehicles	1.420

Energy sectors and energy-affected sectors (Mobile Homes and Motor Vehicles) of course appear in this list, as do New Highways and Streets (reflecting reductions in spending by State and Local Government), Iron & Steel Manufactures and Iron Mining (reflecting shifts in international trade and technological change).

The projected growth in electricity sales leads that of the major energy groupings although (not surprisingly) coal growth is quite close; thus, we find:

		Output in Millions of 1972 Dollars		2000/1972
		1972	2000	
[12]-[14]	All Elec. Sectors	31,623.9	58,663.4	1.855
[1]	Coal Mining	5,439.2	10,067.9	1.851
[4]-[10]	Petroleum Products	28,827.3	37,347.1	1.295
[4]	Gasoline	16,936.4	16,561.5	0.978
[5]-[10]	All Other Pet. Prod.	11,890.9	20,785.6	1.748
[14]	Natural Gas Util.	20,825.2	24,250.5	1.165
[3]	Natural Gas Extr.	4,039.0	4,652.0	1.152
[2]	Crude Petroleum	12,691.3	13,378.4	1.054
	All Energy Sectors	103,445.9	148,359.3	1.434

Gasoline output is projected as declining by about two percent in 2000 relative to 1972. This is not too surprising, since the relative reduction in intensity of use was greatest for gasoline of all the petroleum products, and in addition, there was some projected shift from gasoline to diesel fuel. That shift, in turn, is a major factor explaining the projected increase in distillate fuel output. There are even greater increases projected for jet fuel and residual

oil. The former reflects a five-fold projected increase in military use of jet fuel, and considerable increases projected for private plane use of jet fuel and airline travel. The latter primarily reflects the projected marked decline in residual fuel imports, but also is affected by the expansion of electricity output and some shift to residual oil by manufacturers.

Differences in growth among the energy sectors are less pronounced for consumption than they are for output, reflecting the effects of exports and imports, again noting that consumption is obtained by subtracting exports and adding imports to sector output. The ratios of 2000 to 1972 consumption levels are as follows for the first 15 sectors, including Asphalt and Tar as well as the energy sectors:

Sector		Consumption 2000/1972
[1]	Coal Mining	1.635
[2]	Crude Petroleum	1.241
[3]	Natural Gas Extraction	1.152
[4]	Gasoline	0.978
[5]	Jet Fuel	2.548
[6]	Kerosene	0.982
[7]	Distillate Fuel Oil	1.419
[8]	Residual Fuel Oil	1.387
Sector		Consumption 2000/1972
[9]	LPG	1.005
[10]	All Other Petroleum Refinery	1.476
[11]	Asphalt and Tar Products	1.654
[12]	Electricity, Fossil Fuel	1.554
[13]	Electricity, Nuclear Fuel	13.266
[14]	Electricity, Hydro Power	1.078
[15]	Natural Gas Utilities	1.175
	All Energy Sectors (excludes [11]	1.455

5.5 OUTPUT COMPARISONS AND SENSITIVITY ANALYSIS

This section presents five sets of comparisons that furnish insights into the sensitivity of our results to changes in components, and to the respective importance of those components.

The first set of comparisons appears in table 40, which presents the respective outputs obtained by using the L-D and BLS projections of final demand; the table also repeats the output projections of this study and the actual 1972 output levels. The alternative projections can be of help in suggesting the likely variability attached to our individual sector projections. Setting this

Table 40

Comparisons of Outputs Obtained Employing
Alternative Year 2000 Final Demand Projections

Sector	Output in Millions of 1972 Dollars			
	Actual 1972	Year 2000 Projections		
		This Study	L-D	BLS
1 COAL MINING	5439.20	10067.89	7792.66	12197.25
2 CRUDE PETROLEUM	12691.30	13378.42	10323.76	11043.84
3 NATURAL GAS EXTRACTION	4039.00	4652.00	4611.55	6283.28
4 GASOLINE	16936.40	16561.48	17868.21	28609.20
5 JET FUEL	1381.50	3814.58	2735.20	2736.74
6 KEROSENE	375.40	367.86	256.97	667.79
7 DISTILLATE FUEL OIL	4410.70	6635.01	5649.16	7926.41
8 RESIDUAL FUEL OIL	1107.20	3240.59	2618.58	1421.53
9 LPG	999.10	1048.67	822.74	1456.58
10 ALL OTHER PETROLEUM REFINING	3617.00	5678.86	5326.69	6216.70
11 ASPHALT AND TAR PRODUCTS	1836.90	3038.71	3564.55	3076.58
12 ELECTRICITY, FOSSIL FUEL	29731.25	46258.86	44432.21	68524.06
13 ELECTRICITY, NUCLEAR POWER	849.05	11278.03	10745.09	16395.43
14 ELECTRICITY, HYDROPOWER	1043.60	1126.49	1075.20	1643.20
15 NATURAL GAS UTILITIES	20825.20	24250.52	23678.65	32866.12
16 MEAT ANIMALS	30233.30	58096.88	50679.34	62469.97
17 OTHER LIVESTOCK PRODUCTS	10470.80	19857.80	16682.70	21191.97
18 GRAINS	17398.40	39324.21	27662.14	40964.26
19 OTHER CROPS AND AG. SERVICES	20921.00	39557.60	35992.76	42764.39
20 FORESTRY AND FISHERIES	2245.30	5098.44	4028.63	5947.86
21 IRON MINING	1295.00	1749.66	1567.28	2736.85
22 NONFERROUS METALS MINING	2208.00	5026.03	4297.47	6422.65
23 NONMETALLIC MINERALS	3403.00	6169.56	6993.66	6835.04
24 NEW RESIDENTIAL BUILDINGS	56008.00	103729.24	116541.45	91183.29
25 MOBILE HOMES	3209.10	2001.64	6677.51	5195.20
26 NEW NONRESIDENTIAL BUILDINGS	37709.00	59109.75	78464.89	52442.95
27 NEW ENERGY ACTIVITY STRUCTURES	12690.80	26084.62	26407.02	26375.81
28 NEW HIGHWAYS & STREETS	10429.00	8392.99	21700.66	8374.91
29 ALL OTHER NEW CONSTRUCTION	12743.70	19513.23	26517.09	19378.40
30 MAINT. & REPAIR, RESIDENTIAL	10500.10	29442.74	26332.82	31688.40
31 M & R, NONRESIDENTIAL BLDGS.	12116.60	27134.88	24758.60	29065.21
32 M & R, ENERGY ACTIVITY STRUCTS.	2558.40	4022.09	3747.27	5465.76
33 M & R, HIGHWAYS & STREETS	4185.30	6583.29	8694.03	6593.82
34 ALL OTHER M & R	7056.70	18582.41	14420.62	19172.23
35 ORDNANCE	6938.20	20634.53	14914.95	11400.99
36 MEAT PACKING	21257.70	40039.65	34614.03	42477.56
37 DISTILLING	11481.90	25649.71	20268.38	28629.84
38 ALL OTHER FOOD & KINDRED	87882.40	166684.62	137990.11	187465.66
39 TOBACCO	9231.40	14166.34	15542.29	13045.68
40 TEXTILES	29071.00	77285.38	69108.78	93124.94
41 APPAREL	30164.90	87053.35	83453.21	91791.80
42 LOGGING AND SAW MILLS	11613.60	21410.42	21124.56	22433.86
43 OTHER LUMBER AND WOOD	10491.20	17665.95	19473.06	18744.76
44 HOUSEHOLD FURNITURE	7249.20	13847.10	14362.97	20906.96
45 OTHER FURNITURE	3807.50	7415.06	7574.37	8535.04
46 PULP AND PAPER MILLS	11089.40	29044.73	25629.25	32986.56
47 OTHER PAPER PRODUCTS	16289.59	37470.82	33723.20	42083.95
48 PRINTING AND PUBLISHING	16694.49	38663.22	36873.11	39711.45
49 CHEMICALS	25868.90	62237.31	58396.41	74482.29
50 PLASTICS	9467.50	30284.26	28390.47	35775.26
51 DRUGS	7729.00	29509.03	18251.82	30139.46
52 CLEANING & TOILET PREPARATIONS	9554.70	24027.86	20507.31	27576.71
53 PAINTS	3562.50	7683.22	7799.49	8609.56
54 RUBBER	21036.90	55968.07	55956.56	66013.70
55 LEATHER	5583.19	6617.07	15208.48	5045.04
56 GLASS	5642.20	11832.43	10230.28	14883.63
57 CEMENT	1801.50	3167.99	3744.74	3223.68
58 OTHER STONE & CLAY	13572.69	24058.97	27982.37	24726.32

Table 40 (continued)

Sector	Output in Millions of 1972 Dollars			
	Actual 1972	Year 2000 Projections		
		This Study	L-D	BLS
59 IRON & STEEL MFG.	35379.70	46822.59	50134.84	61108.39
60 ALUMINUM MFG.	7505.00	26829.40	26826.16	35095.69
61 OTHER PRIMARY NONFERROUS METALS MFG.	15847.80	31976.51	28396.07	38518.71
62 FABRICATED METALS	47552.20	94429.48	97362.06	111870.49
63 MACHINERY (NON-ELECTRICAL)	47519.19	103028.58	79359.70	133005.66
64 COMPUTING, ELECTRONICS, AND RELATED	19462.80	124677.93	78338.95	197179.71
65 REFRIGERATION & HEATING EQPMT.	6480.70	13904.60	13791.31	16863.08
66 HOUSEHOLD APPLIANCES	6727.10	17126.18	14787.84	20759.63
67 ELECTRIC LIGHTING	5479.50	11707.48	11503.18	13460.56
68 RADIO, TV & COMMUNIC. EQPMT.	17557.30	58231.63	41095.47	50912.72
69 ALL OTHER ELECTRIC MACH.	13442.69	29815.74	28741.04	34105.03
70 MOTOR VEHICLES & PARTS	62945.30	89385.23	116441.23	170225.27
71 TRUCKS, MOTORCYCLES & RELATED	3939.90	6004.63	12576.50	9430.00
72 AIRCRAFT	16569.40	58958.49	46492.95	37734.00
73 OTHER TRANSPORTATION EQPMT.	7644.70	26170.69	25398.14	20209.22
74 SCIENTIFIC INSTRUMENTS & RELATED	8212.10	24005.33	19651.33	25966.60
75 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	5366.00	19089.16	14988.87	21455.65
76 JEWELRY	2491.80	7496.64	6640.85	8720.89
77 OTHER MISCELLANEOUS MFG.	8847.09	24242.68	20811.48	28948.49
78 RAILROADS	15046.30	30682.15	28146.43	35675.05
79 LOCAL, SUBURBAN & INTERURBAN TRANS.	7270.60	12287.56	10491.45	14582.77
80 TRUCKING & WAREHOUSING	30370.60	63157.44	58059.62	69406.31
81 WATER TRANSPORT	7455.00	13996.47	12927.70	14570.73
82 AIR TRANSPORT	13646.40	38214.98	28002.95	49677.29
83 PIPELINES & OTHER TRANS.	2828.80	5232.03	4238.61	6325.13
84 COMMUNICATIONS	30668.90	148908.07	79254.91	154587.95
85 WATER & SANITARY SERVICE	5933.60	14029.38	12010.20	16018.00
86 WHOLESALE TRADE	103883.10	223157.33	194300.45	258545.59
87 RETAIL TRADE	114352.40	270008.10	237608.19	302519.56
88 BANKING	25484.60	81533.91	60345.11	84188.23
89 OTHER FINANCE & INSURANCE	51984.40	140027.49	126787.68	144388.08
90 OWNER OCCUPIED DWELLINGS	76687.80	230694.25	212726.87	248661.63
91 REAL ESTATE	98231.40	251125.05	217240.07	276084.78
92 HOTELS	8350.40	23315.16	18888.45	26347.84
93 PERSONAL SERVICES	21940.30	35163.35	45295.89	36664.55
94 BUSINESS SERVICES	88180.40	299553.98	264598.79	325464.93
95 EATING & DRINKING PLACES	48721.40	133805.11	92711.37	136765.39
96 AUTO REPAIR	24551.40	52321.50	49930.39	72749.43
97 AMUSEMENTS	12719.20	31515.60	27718.79	33775.28
98 HOSPITALS	22391.30	105908.81	50369.37	106188.42
99 OTHER MEDICAL SERVICES	32913.80	108804.24	73556.22	108888.15
100 EDUCATIONAL SERVICES	12201.50	19987.56	22090.99	20351.12
101 NON-PROFIT ORGNS.	14890.90	30763.66	29414.80	31836.96
102 SOCIAL SERVICES	2502.00	4815.71	4482.95	5075.72
103 POSTAL SERVICE & OTHER FED. ENTERP.	9568.30	20391.23	19087.15	20667.91
104 STATE & LOCAL ENTERPRISES	2798.60	6132.58	5636.98	6657.63
	1964289.53	4692727.79	4144047.71	5271382.57

study's year 2000 output levels at an index of 1.00, the following ratios are obtained for selected sectors:

	This Study	L-D	BLS
Electricity	1.00	0.96	1.48
Petroleum Products	1.00	0.94	1.31
All Energy	1.00	0.93	1.33
Aluminum Mfg.	1.00	1.00	1.31
Computing & Electronics	1.00	0.63	1.58
Motor Vehicles	1.00	1.30	1.90
Aircraft	1.00	0.79	0.64
Medical Services	1.00	0.58	1.00
All Output	1.00	0.88	1.12

For all output, this study's results are about 10 percent above those using the L-D projections and about 10 percent below the BLS projections. At the level of total output, then, the three cases seem relatively close. Energy outputs here parallel the L-D cases, running about 5 percent above them, but are well below the BLS cases. There are a number of pronounced differences at the level of the individual sector. For example, our Motor Vehicle output projections are below both the corresponding L-D and BLS figures, and our aircraft output projections are above both the alternative projections. The former reflects recent auto industry experience, and the latter the considerable increase in defense spending that is built into our final demand projections.

It is also of interest to compare total output and PCE levels for the three sets of projections:

	Relative to 1972 Level		Relative to This Study Year 2000 Projection	
	PCE	Output	PCE	Output
L-D	2.082	2.110	0.84	0.88
This study	2.491	2.389	1.00	1.00
BLS	2.823	2.684	1.13	1.12

We find greater divergence in PCE than in output. Likely explanations include (1) greater similarity in non-PCE components of final demand than in PCE, and (2) differences in projected growth among sectors having different multiplier effects; in particular, the L-D projections may involve relatively greater growth for high multiplier sectors than occurs in the other cases.

The second set of comparisons completes a sensitivity analysis begun in chapter 3. In that chapter, there was an extension of the predictive equation for manufactures' use of electricity in which groups of manufacturing sectors varied in their response to price increases. Only modest differences in response emerged, in the form of scale factors that would adjust the general response that had been used for all sectors. Recapitulating, those scale factors were:

Sectors	Scale Factor
Food and Tobacco	0.97
Textiles and Apparel	1.08
Chemicals	0.96
Fabricated Metals	1.02
Transportation Equipment	0.75

At this point, the scale factors were applied to form a revised technical coefficient matrix and a corresponding inverse. The multiplication of that inverse by final demand yielded outputs for all sectors that were essentially the same as the original outputs. Revised output as a fraction of original output was .9985 for the electricity sectors, .9990 for Energy Activity Structures, and .9992 for Coal. All other revised outputs were between .9999 and 1.0 times the original values, while total output was .99997 the original total. It is clear that the differences in response have essentially no impact on output.

A third set of comparisons turns on the projections of residential energy use in developing the PCE forecasts. In that work, an extension of recent trends was employed for petroleum product and natural gas use, while a regression equation was employed for electricity use. It was felt that these procedures gave the most reliable results in their respective cases. However, since concern may arise about the use of diverse projection procedures for the energy sectors, two alternative sets of final demand were developed and applied. In the first, an extension of trends was used to project electricity as well as the other forms of energy. In the second, regression equations were used to project natural gas and petroleum products, as well as electricity. We summarize methods and results for those alternative projections here, with additional detail presented in appendix I.

Projecting by using a continuation of trends in the residential use of electricity implies a growth factor of 3.51, rather than 1.70, for PCE in 2000 relative to 1972. This is based on a per capita residential electricity use in 1978 that was 1.25 that of 1972 (29). Assuming that the annual growth rate

from 1972 to 1978 will hold to 2000, and accounting for population growth, yields the 3.51 scale factor, which was applied as follows. Electricity use in PCE was scaled by 2.065 (the ratio of 3.51 to 1.70), all other energy use was left unchanged, and remaining intermediate sector PCE was scaled by .9876 so that total consumption was left unchanged. The revised final demand was then used to obtain revised output projections, shown in table 41. Not surprisingly, there is a considerable impact on electricity use, which is about 40 percent higher in the revised than in the original results. There is also a noticable impact on inputs for electricity production, as Coal increases by 22 percent, Residual Fuel Oil by 14 percent and Energy Activity Structures by 28 percent. All other sectors show relatively small changes, suggesting limited sensitivity to changes in electricity PCE.

Several hypotheses can be advanced to explain the difference between the original and the alternative residential electricity projections. Price increases in electricity tend to lag behind those for other forms of energy, and further, there are usually delays in a full response to price increases, in any event. It is plausible that the trends projection accounts for these lags less fully than does the regression projection. Again, some of the recent increases in residential electricity use probably involve both the shift of population from frostbelt to sunbelt, with higher airconditioning use per capita, and a general increase in airconditioning that has occurred everywhere. But recent evidence at least allows the speculation that airconditioning use may approach saturation levels in the not too distant future (30), so that trends in use are unlikely to follow an accelerating growth pattern, again building a rationale for the use of the regression equation projection. Obviously, these considerations pose important questions for future research.

In using regression equations exclusively to obtain residential energy use projections, results for several equations were averaged to reduce variability and, hopefully, to increase reliability. Some increases in use, relative to original levels, emerged both for petroleum products and natural gas, with the former scaled by 1.2674 and the latter by 1.0989 their initial levels. Electricity use was kept unchanged, and remaining intermediate sector PCE amounts were scaled by 0.9994 to keep total consumption unchanged. Corresponding output changes that emerged were limited. For petroleum products, kerosene increased by 19 percent, LPG by 8 percent and Distillate Fuel Oil by only 5 percent; Crude Petroleum output, in turn, increased by 1.7 percent. Natural Gas Utility output increased by 3.8 percent, and Natural Gas Extraction cor-

Table 41

Comparisons of Original Output Projections to
Revised Projections Using Trends for Electricity Final Demand Forecasts

	Output in Millions of 1972 Dollars		
	Original	Revised	Ratio of Revised to Original
1 COAL MINING	10068	12300	1.22173
2 CRUDE PETROLEUM	13378	13599	1.01651
3 NATURAL GAS EXTRACTION	4652	4826	1.03738
4 GASOLINE	16561	16536	0.99845
5 JET FUEL	3815	3818	1.00088
6 KEROSENE	368	368	0.99907
7 DISTILLATE FUEL OIL	6635	6692	1.00854
8 RESIDUAL FUEL OIL	3241	3686	1.13734
9 LPG	1049	1052	1.00342
10 ALL OTHER PETROLEUM REFINING	5679	5700	1.00365
11 ASPHALT AND TAR PRODUCTS	3039	3035	0.99873
12 ELECTRICITY, FOSSIL FUEL	46259	65730	1.42091
13 ELECTRICITY, NUCLEAR POWER	11278	15631	1.38599
14 ELECTRICITY, HYDROPOWER	1126	1570	1.39361
15 NATURAL GAS UTILITIES	24251	25182	1.03842
16 MEAT ANIMALS	58097	57430	0.98853
17 OTHER LIVESTOCK PRODUCTS	19858	19636	0.98881
18 GRAINS	39324	39013	0.99208
19 OTHER CROPS AND AG. SERVICES	39558	39250	0.99223
20 FORESTRY AND FISHERIES	5098	5047	0.98992
21 IRON MINING	1750	1748	0.99913
22 NONFERROUS METALS MINING	5026	5014	0.99762
23 NONMETALLIC MINERALS	6170	6164	0.99918
24 NEW RESIDENTIAL BUILDINGS	103729	103729	1.00000
25 MOBILE HOMES	2002	2002	1.00000
26 NEW NONRESIDENTIAL BUILDINGS	59110	59110	1.00000
27 NEW ENERGY ACTIVITY STRUCTURES	26085	26085	1.00000
28 NEW HIGHWAYS & STREETS	8393	8393	1.00000
29 ALL OTHER NEW CONSTRUCTION	19513	19513	1.00000
30 MAINT. & REPAIR, RESIDENTIAL	29443	29154	0.99019
31 M & R, NONRESIDENTIAL BLDGS.	27135	27018	0.99569
32 M & R, ENERGY ACTIVITY STRUCTS.	4022	5137	1.27717
33 M & R, HIGHWAYS & STREETS	6583	6582	0.99973
34 ALL OTHER M & R	18582	18564	0.99899
35 ORDNANCE	20635	20619	0.99924
36 MEAT PACKING	40040	39573	0.98836
37 DISTILLING	25650	25349	0.98828
38 ALL OTHER FOOD & KINDRED	166685	164780	0.98858
39 TOBACCO	14166	14019	0.98957
40 TEXTILES	77285	76473	0.98949
41 APPAREL	87053	85937	0.98717
42 LOGGING AND SAW MILLS	21410	21358	0.99754
43 OTHER LUMBER AND WOOD	17666	17625	0.99770
44 HOUSEHOLD FURNITURE	13847	13702	0.98949
45 OTHER FURNITURE	7415	7406	0.99879
46 PULP AND PAPER MILLS	29045	28858	0.99357
47 OTHER PAPER PRODUCTS	37471	37180	0.99224
48 PRINTING AND PUBLISHING	38663	38432	0.99402
49 CHEMICALS	62237	62142	0.99847
50 PLASTICS	30284	30046	0.99215
51 DRUGS	29509	29238	0.99083
52 CLEANING & TOILET PREPARATIONS	24028	23767	0.98916
53 PAINTS	7683	7650	0.99574
54 RUBBER	55968	55572	0.99292
55 LEATHER	6617	6474	0.97831
56 GLASS	11832	11741	0.99225
57 CEMENT	3168	3191	1.00725
58 OTHER STONE & CLAY	24059	24062	1.00014

Table 41 (continued)

		Output in Millions of 1972 Dollars		Ratio of Revised to Original
		Original	Revised	
59	IRON & STEEL MFG.	46823	46788	0.99927
60	ALUMINUM MFG.	26829	26728	0.99624
61	OTHER PRIMARY NONFERROUS METALS MFG.	31977	31907	0.99783
62	FABRICATED METALS	94429	94137	0.99690
63	MACHINERY (NON-ELECTRICAL)	103029	103198	1.00164
64	COMPUTING, ELECTRONICS, AND RELATED	124678	124288	0.99687
65	REFRIGERATION & HEATING EQPMT.	13905	13853	0.99626
66	HOUSEHOLD APPLIANCES	17126	16946	0.98946
67	ELECTRIC LIGHTING	11707	11715	1.00060
68	RADIO, TV & COMMUNIC. EQPMT.	58232	57867	0.99373
69	ALL OTHER ELECTRIC MACH.	29816	29755	0.99796
70	MOTOR VEHICLES & PARTS	89385	88650	0.99178
71	TRUCKS, MOTORCYCLES & RELATED	6005	5955	0.99170
72	AIRCRAFT	58958	58938	0.99965
73	OTHER TRANSPORTATION EQPMT.	26171	26092	0.99700
74	SCIENTIFIC INSTRUMENTS & RELATED	24005	23909	0.99598
75	PHOTOGRAPHIC EQUIPMENT & SUPPLIES	19089	19009	0.99582
76	JEWELRY	7497	7400	0.98715
77	OTHER MISCELLANEOUS MFG.	24243	24006	0.99024
78	RAILROADS	30682	30749	1.00217
79	LOCAL, SUBURBAN & INTERURBAN TRANS.	12288	12198	0.99267
80	TRUCKING & WAREHOUSING	63157	62889	0.99574
81	WATER TRANSPORT	13996	14005	1.00062
82	AIR TRANSPORT	38215	37927	0.99247
83	PIPELINES & OTHER TRANS.	5232	5232	0.99990
84	COMMUNICATIONS	148908	147704	0.99191
85	WATER & SANITARY SERVICE	14029	13929	0.99284
86	WHOLESALE TRADE	223157	221873	0.99425
87	RETAIL TRADE	270008	266960	0.98871
88	BANKING	81534	80830	0.99137
89	OTHER FINANCE & INSURANCE	140027	138791	0.99117
90	OWNER OCCUPIED DWELLINGS	230694	227842	0.98764
91	REAL ESTATE	251125	249438	0.99328
92	HOTELS	23315	23122	0.99173
93	PERSONAL SERVICES	35163	34964	0.99433
94	BUSINESS SERVICES	299554	298369	0.99605
95	EATING & DRINKING PLACES	133805	132445	0.98984
96	AUTO REPAIR	52321	51937	0.99264
97	AMUSEMENTS	31516	31191	0.98971
98	HOSPITALS	105909	104683	0.98842
99	OTHER MEDICAL SERVICES	108804	107607	0.98899
100	EDUCATIONAL SERVICES	19988	19766	0.98891
101	NON-PROFIT ORGNS.	30764	30435	0.98931
102	SOCIAL SERVICES	4816	4759	0.98815
103	POSTAL SERVICE & OTHER FED. ENTERP.	20391	20303	0.99568
104	STATE & LOCAL ENTERPRISES	6133	6075	0.99068
		4692728	4690670	

respondingly increased by 3.7 percent. All other changes were trivial, with ratios of revised to original outputs typically around 0.9995. A few sectors showed very small increases; thus, revised Pipeline Transportation Output was 1.003 times, and revised Water Transportation Output 1.0002 times, their respective original levels. We can conclude that output changes are relatively insensitive to the input changes in this case.

The projection of electricity sector shares of production is the source of the fourth set of output comparisons. Table 12, above, presented projections of electricity sales by sector that were consistent with a number of recent forecasts (including those of DOE and EPRI). In dollar terms, table 12 projections compare to those obtained here (table 39) as follows:

Electricity Sector	Year 2000 Output in Billion Dollars		Table 39 Entry as Fraction of Table 12 Entry
	Table 12	Table 39	
[12] Fossil fuels	73.5	46.3	0.63
[13] Nuclear power	18.7	11.3	0.60
[14] Hydroelectric power	1.9	1.1	0.58
Total	94.1	58.7	0.62

Obviously, the input-output results are considerably below those of other forecasts. Perhaps part of the difference involves factors touched on above, in considering the trends versus the regression forecast of electricity use. And the input-output results may express a greater sensitivity to price increases than occurs in the other forecasts. In contrast to the comparison of absolute values, the percentages in the distribution of electricity sector output are quite close to the original projections, here comparing the results in table 39 to those in table 13:

	Total Sales Proportions		Table 39 Entry as Fraction of Table 13 Entry
	Table 13	Table 39	
[12] Fossil fuels	78.14	78.86	1.009
[13] Nuclear power	19.84	19.22	0.969
[14] Hydroelectric power	2.02	1.92	0.950
	100.00	100.00	

The differences between table 13 and table 39 can be explained by the use of net sales proportions for intermediate sector entries while total sales proportions were used for final demand entries (see section 3.2, above). However,

the consequences seem quite modest, on the basis of the entries in the last column of the comparisons.

Further, even with the use of net sales proportions for final demand in an alternative generation of output, some small discrepancies also occur for the output proportions in the alternative case:

		Total Sales Proportions		Alternative Entry as Fraction of
		Table 13	Alternative	Table 13 Entry
[12]	Fossil fuels	78.14	77.87	0.997
[13]	Nuclear power	19.84	20.12	1.014
[14]	Hydroelectric power	2.02	2.01	0.995
		100.00	100.00	

Hence, the "discrepancies" under the alternative are only a bit less, in absolute terms, than those under the allocation actually employed. (The discrepancies probably involve inevitable round-off errors that occur in input-output analysis.) Finally, a comparison of outputs under the alternative with those shown in table 39 reveal differences essentially limited to the electricity sector, and even those are modest. Thus, some selected output comparisons are as follows:

		Output in Million Dollars		Alternative Relative to
		Table 39	Alternative	Table 39
[1]	Coal	10,067.9	9,994.8	0.993
[2]	Crude petrol.	13,378.4	13,370.5	0.999
[3]	Natural gas - extract.	4,652.0	4,645.9	0.999
[4]	Gasoline	16,561.5	16,562.0	1.000
[12]	Elect., fossil fuels	46,258.9	45,622.6	0.986
[13]	Elect., nuclear	11,278.0	11,784.5	1.045
[14]	Elect., hydro	1,126.5	1,179.2	1.047
[15]	Natural gas ut.	24,250.4	24,218.0	0.999
[16]	Meat animals	58,096.9	58,096.8	1.000
[64]	Computing	124,677.9	124,676.0	1.000
[95]	Eating & drinking places	133,805.1	133,804.0	1.000

Once again, we can conclude that output changes are relatively insensitive to input changes.

The fifth and final set of output comparisons involves a set of step-wise projections, bringing in each of the underlying components used in our projections, in turn, with results shown in table 42. The first column of table

Table 42

Output Projections Obtained in Sequential Process

Sector	Output in Millions of 1972 Dollars (1) 1972 Actual	(2) All Sectors Grow at Same Rate	(3) 2000 Final Demand On 1972 Inverse	(4) 2000 Final Demand On Energy only Inverse	(5) On Full 2000 Inverse
1 COAL MINING	5439.20	12359.58	11272.20	10347.08	10067.89
2 CRUDE PETROLEUM	12691.30	28838.63	20048.04	12666.81	13378.42
3 NATURAL GAS EXTRACTION	4039.00	9177.88	6099.39	4560.67	4652.00
4 GASOLINE	16936.40	38484.84	20259.45	16195.28	16561.48
5 JET FUEL	1381.50	3139.20	4402.37	3656.04	3814.58
6 KEROSENE	375.40	853.02	411.30	369.41	367.86
7 DISTILLATE FUEL OIL	4410.70	10022.50	7949.63	6506.88	6635.01
8 RESIDUAL FUEL OIL	1107.20	2515.91	5023.94	3128.76	3240.59
9 LPG	999.10	2270.27	1535.96	1024.16	1048.67
10 ALL OTHER PETROLEUM REFINING	3617.00	8218.96	7141.28	5381.96	5678.86
11 ASPHALT AND TAR PRODUCTS	1836.90	4174.01	3194.08	3004.54	3038.71
12 ELECTRICITY, FOSSIL FUEL	29731.25	67558.76	55115.63	45016.70	46258.86
13 ELECTRICITY, NUCLEAR POWER	849.05	1929.32	5917.20	10958.10	11278.03
14 ELECTRICITY, HYDROPOWER	1043.60	2371.39	1661.01	1094.42	1126.49
15 NATURAL GAS UTILITIES	20825.20	47321.41	31547.66	23784.20	24250.52
16 MEAT ANIMALS	30233.30	68699.58	56089.34	56063.64	58096.88
17 OTHER LIVESTOCK PRODUCTS	10470.80	23792.96	19708.85	19702.18	19857.80
18 GRAINS	17398.40	39534.65	38668.45	38658.65	39324.21
19 OTHER CROPS AND AG. SERVICES	20921.00	47539.09	39170.33	39138.55	39557.60
20 FORESTRY AND FISHERIES	2245.30	5102.03	5442.39	5559.64	5098.44
21 IRON MINING	1295.00	2942.65	2567.02	2551.45	1749.66
22 NONFERROUS METALS MINING	2208.00	5017.27	5145.40	5127.40	5026.03
23 NONMETALLIC MINERALS	3403.00	7732.69	6054.93	6026.71	6169.56
24 NEW RESIDENTIAL BUILDINGS	56008.00	127267.82	103729.24	103729.24	103729.24
25 MOBILE HOMES	3209.10	7292.09	2001.65	2001.65	2001.64
26 NEW NONRESIDENTIAL BUILDINGS	37709.00	85686.73	59109.75	59109.75	59109.75
27 NEW ENERGY ACTIVITY STRUCTURES	12690.80	28837.50	26084.62	26084.62	26084.62
28 NEW HIGHWAYS & STREETS	10429.00	23697.97	8392.99	8392.99	8392.99
29 ALL OTHER NEW CONSTRUCTION	12743.70	28957.70	19513.23	19513.23	19513.23
30 MAINT. & REPAIR, RESIDENTIAL	10500.10	23859.53	29088.96	28989.92	29442.74
31 M & R, NONRESIDENTIAL BLDGS.	12116.60	27532.73	26465.15	26191.49	27134.88
32 M & R, ENERGY ACTIVITY STRUCTS.	2558.40	5813.49	4630.76	3905.17	4022.09
33 M & R, HIGHWAYS & STREETS	4185.30	9510.32	6581.45	6577.85	6583.29
34 ALL OTHER M & R	7056.70	16035.05	17800.48	17692.93	18582.41
35 ORDNANCE	6938.20	15765.77	20605.48	20604.90	20634.53
36 MEAT PACKING	21257.70	48304.19	39739.97	39720.85	40039.65
37 DISTILLING	11481.90	26090.49	25278.23	25353.38	25649.71
38 ALL OTHER FOOD & KINDRED	87882.40	199696.49	165594.69	165537.25	166684.62
39 TOBACCO	9231.40	20976.64	14124.12	14121.74	14166.34
40 TEXTILES	29071.00	66058.47	75938.41	75909.94	77285.38
41 APPAREL	30164.90	68544.15	86856.16	86845.19	87053.35
42 LOGGING AND SAW MILLS	11613.60	26389.76	24806.65	24766.93	21410.42
43 OTHER LUMBER AND WOOD	10491.20	23839.31	19852.42	19832.37	17665.95
44 HOUSEHOLD FURNITURE	7249.20	16472.47	13725.29	13724.95	13847.10
45 OTHER FURNITURE	3807.50	8651.84	7419.05	7417.89	7415.06
46 PULP AND PAPER MILLS	11089.40	25198.61	25446.85	25378.33	29044.73
47 OTHER PAPER PRODUCTS	16289.59	37015.09	35884.06	35796.91	37470.82
48 PRINTING AND PUBLISHING	16694.49	37935.14	36323.97	36270.92	38663.22
49 CHEMICALS	25868.90	58782.28	56412.28	56036.31	62237.31
50 PLASTICS	9467.50	21513.15	22289.73	22260.73	30284.26
51 DRUGS	7729.00	17562.72	27564.00	27564.43	29509.03
52 CLEANING & TOILET PREPARATIONS	9554.70	21711.29	23805.28	23765.74	24027.86
53 PAINTS	3562.50	8095.12	7474.89	7447.76	7683.22
54 RUBBER	21036.90	47802.46	42515.70	42425.62	55968.07
55 LEATHER	5583.19	12686.77	6716.66	6714.33	6617.07
56 GLASS	5642.20	12820.86	12079.71	12070.66	11832.43
57 CEMENT	1801.50	4093.58	3127.32	3130.51	3167.99
58 OTHER STONE & CLAY	13572.69	30841.44	23801.82	23719.46	24058.97

Table 42 (continued)

Sector	(1) 1972 Actual	(2) All Sectors Grow at Same Rate	(3) 2000 Final Demand On 1972 Inverse	(4) 2000 Final Demand On Energy only Inverse	(5) 2000 Final Demand On Full 2000 Inverse
	Output in Millions of 1972 Dollars				
9 IRON & STEEL MFG.	35379.70	80393.82	64100.40	63819.70	46822.59
0 ALUMINUM MFG.	7505.00	17053.72	16076.66	16038.40	26829.40
1 OTHER PRIMARY NONFERROUS METALS MFG.	15847.80	36011.19	35184.61	35076.12	31976.51
2 FABRICATED METALS	47552.20	108053.57	90808.56	90514.50	94429.48
3 MACHINERY (NON-ELECTRICAL)	47519.19	107978.58	100161.74	99792.76	103028.58
4 COMPUTING, ELECTRONICS, AND RELATED	19462.80	44225.60	50559.09	50533.18	124677.93
5 REFRIGERATION & HEATING EQPMT.	6480.70	14726.19	13788.24	13768.19	13904.60
6 HOUSEHOLD APPLIANCES	6727.10	15286.08	17092.89	17089.67	17126.18
7 ELECTRIC LIGHTING	5479.50	12451.15	11193.55	11142.85	11707.48
8 RADIO, TV & COMMUNIC. EQPMT.	17557.30	39895.72	54030.51	54020.73	58231.63
9 ALL OTHER ELECTRIC MACH.	13442.69	30546.03	28771.92	28672.17	29815.74
0 MOTOR VEHICLES & PARTS	62945.30	143031.55	88819.94	88782.45	89385.23
1 TRUCKS, MOTORCYCLES & RELATED	3939.90	8952.69	5925.07	5923.80	6004.63
2 AIRCRAFT	16569.40	37650.89	58856.35	58849.15	58958.49
3 OTHER TRANSPORTATION EQPMT.	7644.70	17371.17	26150.47	26142.15	26170.69
4 SCIENTIFIC INSTRUMENTS & RELATED	8212.10	18660.47	22947.03	22928.65	24005.33
5 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	5366.00	12193.24	17841.34	17828.19	19089.16
6 JEWELRY	2491.80	5662.14	7456.03	7454.96	7496.64
7 OTHER MISCELLANEOUS MFG.	8847.09	20103.38	23730.65	23712.04	24242.68
8 RAILROADS	15046.30	34189.93	30313.10	30235.75	30682.15
9 LOCAL, SUBURBAN & INTERURBAN TRANS.	7270.60	16521.09	11505.04	11481.56	12287.56
0 TRUCKING & WAREHOUSING	30370.60	69011.57	61789.95	61485.67	63157.44
1 WATER TRANSPORT	7455.00	16940.11	14067.67	13899.24	13996.47
2 AIR TRANSPORT	13646.40	31008.92	36348.40	36250.10	38214.98
3 PIPELINES & OTHER TRANS.	2828.80	6427.92	5460.77	5092.99	5232.03
4 COMMUNICATIONS	30668.90	69689.40	128803.65	128641.45	148908.07
5 WATER & SANITARY SERVICE	5933.60	13483.01	13704.47	13642.08	14029.38
6 WHOLESALE TRADE	103883.10	236055.13	218542.91	218094.58	223157.33
7 RETAIL TRADE	114352.40	259844.67	269654.24	269600.34	270008.10
8 BANKING	25484.60	57909.04	80151.04	79954.76	81533.91
9 OTHER FINANCE & INSURANCE	51984.40	118124.93	138370.67	138102.03	140027.49
0 OWNER OCCUPIED DWELLINGS	76687.80	174258.84	230694.25	230694.25	230694.25
1 REAL ESTATE	98231.40	223212.68	243779.33	241724.63	251125.05
2 HOTELS	8350.40	18974.74	21966.00	21935.95	23315.16
3 PERSONAL SERVICES	21940.30	49855.27	34264.18	34195.08	35163.35
4 BUSINESS SERVICES	88180.40	200373.65	206906.98	205928.85	299553.98
5 EATING & DRINKING PLACES	48721.40	110710.37	131004.26	130835.72	133805.11
6 AUTO REPAIR	24551.40	55788.51	50748.56	50663.25	52321.50
7 AMUSEMENTS	12719.20	28902.03	29836.36	29811.73	31515.60
8 HOSPITALS	22391.30	50880.09	105908.95	105908.72	105908.81
9 OTHER MEDICAL SERVICES	32913.80	74790.52	108792.40	108791.38	108804.24
0 EDUCATIONAL SERVICES	12201.50	27725.65	19925.11	19921.07	19987.56
1 NON-PROFIT ORGNS.	14890.90	33836.82	29615.05	29588.84	30763.66
2 SOCIAL SERVICES	2502.00	5685.33	4787.75	4787.05	4815.71
3 POSTAL SERVICE & OTHER FED. ENTERP.	9568.30	21742.19	21772.42	21693.10	20391.23
4 STATE & LOCAL ENTERPRISES	2798.60	6359.30	6068.55	6056.35	6132.58
	1964289.53	4463484.51	4463483.98	4420235.35	4692727.79

42 exhibits the 1972 outputs by sector, and then column (2) is obtained by multiplying all of the 1972 entries by the same scale factor, so that a year 2000 level is attained in total, and each output's share in that total is unchanged. The scale factor for the column (2) multiplications was obtained by dividing the year 2000 grand total of column (3) by the 1972 total. Column (3) is obtained by multiplying the year 2000 final demand by the 1972 inverse. Columns (4) and (5) also are obtained by employing year 2000 final demand. In the case of column (4), the inverse matrix is constructed using only the changes in energy coefficients that were developed here, as described in chapter 3. Finally, column (5) is obtained using the inverse expressing the full set of changes, including changes in technology; and, of course, column (5) is our final result, as shown earlier in tables 39 and 40.

Column (2) can be viewed as a base case where all sectors' outputs expand in the same proportion, accounting only for total growth in income and output without change in output mix. We can then view the movement from column (2) to (3) as exhibiting only the effects of final demand shifts in proportions, since total final demand is the same as in the preceding column, and no changes in industry structure have as yet been introduced. The movement from (3) to (4) then adds changes ascribable to changes in industry structure in response to higher energy prices; while movement from (4) to (5) accounts for projected changes in technology. Treating levels of energy output in (2) as equivalent to 100 percent, the following list shows relative levels of output for the cases outlined, obtained by dividing the output in each column by the output of column (2), and multiplying by 100:

Form of energy	Base case: Energy output in column (2) set at 100 percent	Energy output in column as percent of energy output in column (2)		
		Col. (3)	Col. (4)	Col. (5)
All Energy	100.0	75.9	61.6	63.1
Coal, Crude Petro. and Nat. Gas. Extr.	100.0	74.3	54.7	55.8
Petroleum Products	100.0	71.3	55.4	57.0
Electricity	100.0	87.2	79.4	81.6
Nat. Gas Utilities	100.0	66.7	50.3	51.2

Changes limited to shifts in Final Demand proportions reduce energy use to about three-fourths the level in the base case. This, in turn, accounts for about 65 percent of the total decline in energy use (obtained by forming (100-75.9)/(100-63.1) = .653).

Energy output as a whole declines by 33.7 billion dollars in the movement from (3) to (4), while total output drops by 43.2 billion dollars in that case. The difference of 9.5 billion dollars can be viewed as a multiplier effect of the reduction in spending on energy. The reduction in total output between (3) and (4) is about one percent. In contrast, the shift from (4) to (5) increases total output by six percent, relative to (4) as base. In the process, energy use increases by 3.7 billion dollars, roughly 2.5 percent of the amount in (4). Of course, the higher levels of output in (5) should reflect increases in productivity that are a consequence of technological advance. This should increase incomes, so that use of the same final demand for (4) and (5) can be questioned. Of more importance, some of the changes in technology are themselves aimed at reducing energy use, so the increase in (5) necessarily involves some overstatement, insofar as the corresponding energy savings appear in (4). In sum, it is probably reasonable to infer that technological advance should bring some increases in energy use, on net, but that the increases will be relatively small compared to the decreases brought about by the responses to higher energy prices.

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5. The PCE growth rate in the BLS study varied as follows:

Period	PCE Annual Growth Rate, in %
1973-1977	2.8
1977-1980	4.1
1980-1985	4.1
1985-1990	3.8

The 1977-1980 projected rate agreed with the actual rate, based on data in The Survey of Current Business, special supplement, July, 1981, p. 22. The pattern above shows a decline in growth rate after 1985. The use of an average rate of 3.72 percent implies a bit more of a decline for the period 1990-2000, which seems consistent with the pattern shown.

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Chapter 6

APPLICATIONS

6.1 OVERVIEW

This concluding chapter is devoted to applications, focusing on the conversion of dollars to BTU for the energy sectors, and specifically, on the construction of mixed BTU-dollar input-output tables. Section 6.2 develops overall (entire sector) scale factors that convert dollars to BTU, and concludes with estimates of output in BTU terms that are obtained by applying those scale factors. Section 6.3 develops and applies mixed BTU-dollar matrices. In a model using such matrices, energy transactions are measured in BTU, rather than in dollars, but with mathematical operations carried out in analogous fashion to those performed in the conventional input-output model, with all transactions in dollars. The model utilizes many of the scale factors developed in section 6.2; however, in the case of electricity and natural gas utilities, more detailed estimates covering individual sectors are developed and utilized. This recognizes the complication that utility prices vary between sectors in input-output accounting. Beyond recognizing that complication, the application of the mixed model is inherently much more complicated than the simple scaling employed in section 6.2. But in addition to yielding alternative and presumably more accurate estimates of output in BTU terms, the mixed model also yields much information not otherwise available, including inverse matrices exhibiting direct and indirect energy requirements in BTU terms, both for 1972 and 2000. Those inverse matrices appear in Appendix J.

Besides the development of output measures in BTU terms, chapter 6 contains three other applications, respectively appearing in sections 6.4, 6.5 and 6.6. Section 6.4 presents estimates of consumption for 1972 and 2000, both in dollars and in BTU, and compares this study's year 2000 projections to those appearing in other sources. Consumption is obtained by adding imports and subtracting exports and net inventory change from domestic output. Section 6.5 examines the energy impact of mandated increases in fuel economy, investigating whether the substitution of materials in motor vehicle manufactures, particularly of aluminum for iron and steel, will cause increased electricity use to significantly erode gasoline savings, and the answer is that it will not.

(Even if petroleum conservation is a specific goal of policy, the substitutability of different forms of energy makes energy conservation, generally, an extension of that policy goal).

Section 6.6 develops estimates of the energy embodied in imports, exports and production for the domestic market. It is shown that imports and exports can themselves be treated as a form of final demand which is then multiplied by the inverse matrix to yield direct and indirect requirements associated with each category of use, yielding estimates of all energy embodied in goods traded. The evidence suggests that the U.S. imports more embodied energy than it exports but that the differences projected for 2000 is below that for 1972.

The chapter concludes with a brief survey of key topics for future research and the optimistic appraisal that there will be merit in a number of additional applications of our model.

The remainder of this overview section summarizes results for output and consumption in BTU terms, as obtained from the application of the mixed unit input-output model. Those results, in terms of levels of "primary energy" are compared to corresponding measures in other sources. Energy output in BTU is conventionally defined as corresponding to that of the "primary energy" sectors, including coal mining, crude oil, natural gas extraction, nuclear power and hydroelectric power. The conversion of dollars of output to BTU, limited to the primary energy sectors, is summarized for this study in table 43 showing both base year estimates and year 2000 projections. The 1972 values are compared to energy outputs for 1972 as listed by the Bureau of Mines and the Energy Information Administration (EIA). This study relied on the Bureau of Mines data for its conversion factors although it combined natural gas liquids with crude oil in its applications. Hence, the 1972 totals for the two cases (62 quads) are the same. In contrast, small differences occur between some entries for those cases and the corresponding entries in the EIA list; aside from round-off differences, they primarily involve differences in estimates of natural gas liquids, including lease condensates (1). The projected year 2000 primary energy total output is 86.5 quads, a 39 percent increase relative to the 1972 base.

Table 43

Comparisons of Listed Production Of Energy
(Primary Energy), 1972 and 2000, in Quadrillion BTU

	1972 Estimates			2000 Projections
	This Study	Bureau of Mines	Energy Info. Admin.	This Study
Coal	14.500	14.500	14.49	26.838
Crude Oil	19.344	19.344	20.04[a]	20.391
Natural Gas Liquids	2.584	-	2.60[b]	2.724
Natural Gas, Dry	22.208	-	22.21	25.578
Natural Gas, Wet	-	24.792[c]	-	-
Nuclear Power	0.576	0.576	0.58	7.818
Hydropower	2.866	2.866	2.86	3.174
Geothermal, Wood & Waste	-	-	0.03	-
Total	62.078	62.078	62.81	86.523

Sources: Bureau of Mines, Minerals Yearbook, 1973, 1975, Table 16, p. 37; Energy Information Administration, 1980 Annual Report to Congress, Volume Two: Data, 1981, Table 2, p. 5; This study: Table 61, below, and data in Minerals Yearbook, 1973.

[a] Includes Lease Condensate.

[b] Natural Gas Plant Liquids only, excluding Lease Condensate.

[c] Equals Natural Gas Liquids plus Natural Gas, Dry.

[d] Includes Geothermal Power in 2000 projection.

An alternative mode of listing output in BTU terms is the conversion of dollars to BTU for all of the energy sectors, including not only primary energy, but what might be characterized as secondary and tertiary forms, as well (petroleum products and the electric and natural gas utilities). Electricity output here is measured at point of consumption, rather than at point of production, so conversion losses reduce electricity BTU to approximately a third of its level in production. Results under this approach are shown in table 44.

This measurement approach is likely to be viewed with disfavor by many energy analysts, not only because it is unconventional, but because it involves obvious double or even triple counting; thus, crude petroleum that is refined to residual oil and used to generate electricity can be counted three times. Yet, if this "problem" is made explicit, the total as well as the individual values may have utility as indicators of the state of the energy economy in physical terms. To expand on this, consider the following. The concept of

Table 44

Estimated Energy Sector Outputs in Trillion BTU,
1972 Versus 2000

	Output in trillion BTU		
	1972	2000	2000/1972
[1] Coal Mining	14,499.5	26,838.4	1.851
[2] Crude Petroleum	21,927.9	23,115.1	1.054
[3] Natural Gas Extraction	22,207.5	25,578.2	1.152
[4] Gasoline	12,331.2	12,058.3	0.978
[5] Jet Fuel	1,976.7	5,458.0	2.761
[6] Kerosene	486.2	476.5	0.980
[7] Distillate Fuel Oil	5,680.1	8,544.5	1.504
[8] Residual Fuel Oil	2,447.7	7,164.1	2.927
[9] LPG	1,592.3	1,671.3	1.050
[10] All Other Petroleum Refining	4,233.4	6,646.5	1.570
[12]-[14] Electricity at point of consumption	5,383.1	10,288.0	1.911
[15] Natural gas utilities	20,182.3	23,565.9	1.168
Total	112,947.9	151,404.8	1.340

"primary energy" appears to involve the notion of an initial form of energy in its raw or natural resource state. Yet, primary energy production itself involves other energy forms as input, ranging from fuel for power equipment used in strip-mining coal to considerable amounts of oil and gas respectively used in crude oil and gas production. In general, within an input-output framework, all sectors are viewed as interdependent, so the primary-secondary distinction becomes a matter of degree, rather than an absolute difference. Payments for the natural resources involved in primary production logically should appear in an input-output table as components of value added; intermediate sector inputs of energy typically will be minor for the primary energy sectors and important in the case of the secondary energy sectors. This relationship was derived explicitly here by use of the mixed BTU-Dollar matrices. Inverse matrices from that application were drawn on to estimate direct and indirect requirements in BTU induced by an increase in final demand of one BTU on a given sector. Results seemed generally encouraging in terms of tracing impacts. Thus, conversion losses appeared accurately accounted for in the generation of electricity from fossil fuels, and more generally, the requirements patterns clearly distinguished primary from secondary energy producers.

In addition to output comparisons, it is of some interest to note some consumption comparisons, summarized in table 45. The entries in that table are based on the convention of measuring consumption as primary energy production plus

Table 45

Comparisons of Actual and Projected
Energy Consumption by Source,
in Quadrillion BTU (Quads)

Source of Consumption	1972	1977	Year 2000 Projection: DOE Forecast Made in 1980	DOE Forecast Made in 1981	This Study	This Study Relative to DOE 1981
Domestic production of primary energy						
Coal	14.5	15.9	40.7	42.0	26.8	0.64
Crude petroleum	21.9	19.8	21.9	20.0	23.1	1.16
Natural gas	22.2	19.6	16.7	18.0	25.6	1.42
Nuclear power	0.6	2.7	11.1	10.6	7.8	0.74
Hydroelectric power & other	2.9	2.4	10.6	9.7[a]	3.2	0.33
Net imports (imports minus exports)						
Coal	-1.3	-1.4	-3.7	-5.9	-5.3	0.90
Petroleum (crude oil & pet. prods.)	9.0	18.2	4.6	3.0	10.9	3.63
Natural gas	1.2	1.0	0.6	2.0	2.6	1.30
Inventory change	-0.5	-2.2	0.0	0.0	-0.5	--
Total	70.5	76.0	102.5	99.4	94.2	0.95

--not applicable

Sources: 1972, this report, table 60, below; the 1972 data essentially agree with U.S. Energy Information Administration, Energy Supply and Demand in the Midterm: 1985, 1990 and 1995, DOE/EIA-Q102/52, April 1979, p. 15. That document and its citation was also the source for the 1977 entries. Year 2000 projections: DOE forecast made in 1980 from U.S. Energy Information Administration, 1980 Annual Report to Congress, Vol. Three: Forecasts, table 4.3, middle series, p. 124; DOE forecast made in 1981 from U.S. Department of Energy, Office of Policy, Planning and Analysis, Energy Projections to the Year 2000, DOE/PE-0029, 1981, table 1-3, p. 1-9; this study projection: table 61, below.

net imports (the net of imports over exports) and net inventory change (with an increase in inventories subtracted from output). Values appear in units of quadrillion BTU or quads (a quadrillion is 1,000 trillion). Table 45 shows that a number of projections made in the late 1970's, including those of DOE, forecast U.S. energy consumption for the year 2000 as around 120 quads. By the early 1980's, however, DOE had reduced its year 2000 projection to about 100 quads. This contrasts with our projection of 94 quads, though recent experience will likely cause additional downward adjustments in DOE projections. The relatively close totals mask important differences between component projections. Our coal and hydroelectric and other power projections are considerably below those of DOE; our nuclear power projection is somewhat below and our crude petroleum output and natural gas import projections are somewhat above the corresponding DOE values; and our natural gas output and net petroleum import projections are well above the DOE values. Only in coal exports is there good agreement between the respective projections, and even this is limited to the latest DOE projection shown (1981).

The next three sections develop details on data, methods and results that are the source of tables 43, 44 and 45. These are followed by sections devoted to the two remaining applications and suggestions for future research.

6.2 OVERALL BTU-TO-DOLLAR SCALE FACTORS

This section documents the development of overall BTU-to-dollar scale factors, that is, the ratios of total BTU to total dollars, across all sectors. Those scale factors can be applied directly to output in dollars to yield estimates of output in BTU, and that process is carried out at the conclusion of this section. In addition, the scale factors for nonutility energy sectors, covering sectors [1] through [10], werre also employed in developing the mixed unit input-output model, discussed in section 6.3, below.

As a first step in developing the overall scale factors a number of physical units (barrels, kilowatt-hours, and so on) were converted to BTU; scale factors for some of the more important conversions are listed in table 46. In some cases, the scale factors vary over time. Table 47 summarizes the BTU to dollar scale factors developed here, in terms of million BTU per dollar of output at point of consumption. The derivation of the entries in table 47 is now reported in detail.

Table 46

Physical Unit Scale Factors

Energy Source	Units	Year	Amount
Coal: Anthracite	Million BTU per short-ton	1972	25.400
Coal: Bituminous & lignite		1972	24.050
		1980	22.590
Crude Petroleum	Million BTU per barrel	-	5.598
Natural Gas (Dry)	Thousand BTU per cubic foot	1972	1.027
		1980	1.021
Electricity	Thousand BTU per kilowatt-hour, point of consumption	-	3.412
Electricity from hydroelectric power	Thousand BTU per kwh, point of production	1972	10.379
		1980	10.455
Electricity from nuclear power	Thousand BTU per kwh, point of production	1972	10.792
		1980	10.769

Sources: Bureau of Mines, Mineral Yearbook: 1973, 1975, and Energy Information Administration, 1980 Annual Report to Congress, Volume Two: Data.

Table 47

BTU to Dollar Scale Factors by Sector, 1972

Sector	Dollar Sales (in millions)	Trillion BTU	Million BTU per dollar
[1] Coal	5,439.20	14,499.5	2.66574
[2] Crude Petroleum	12,691.31	21,927.9	1.72779
[3] Natural Gas Extraction	4,039.96	22,207.5	5.49832
[4] Gasoline	16,936.35	12,331.2	0.72809
[5] Jet Fuel	1,381.48	1,976.7	1.43082
[6] Kerosene	375.40	486.2	1.29521
[7] Distillate Oil	4,410.72	5,680.1	1.28779
[8] Residual Oil	1,107.18	2,447.7	2.21075
[9] LPG	999.13	1,592.3	1.59371
[10] All Other Pet. Products	3,617.02	4,233.4	1.17040
[11] Asphalt and Tar	1,836.84	0.0	0.00000
[12]-[14] Electricity Cons.[a]	31,623.87	5,383.2	0.17022
[15] Natural Gas Utilities	20,825.17	20,182.3	0.96913

[a]Dollar sales for individual sectors (in millions) were [12]: 29,731.23, [13]: 849.04, and [14]: 1,043.6. Electricity use at point of consumption is scaled using 3,412 BTU per kilowatt-hour.

6.2.1 Sector [1], Coal

The Bureau of Mines lists the following figures on coal production in 1972 (2):

	Thousand Short Tons	Trillion BTU	Value, Million Dollars
Anthracite	7,106	180.5	85.252
Bituminous & Lignite	595,386	14,319.0	4,561.983
	602,492	14,499.5	4,647.234

Total coal shipments in the RFF (and BEA) flow table are 5,439.20 million dollars, with most of the discrepancy between this total and the Bureau of Mines total accounted for by intraindustry shipments of 655.51 million dollars (from [1] to [1]). Only a small amount of the intraindustry total--approximately 31 million dollars--was employed for heat and power at the mines (3). The remainder is explained by financial transactions covering intraindustry services (4).

Given that situation, it was decided that the most direct and economic procedure was to impose a correspondence between BEA sales and Bureau of Mines BTU, and to derive the BTU dollar scale factor by division. Thus, 14,499.5 trillion BTU divided by 5,439.2 million dollars yields 2.66574 million BTU per dollar as our scale factor.

6.2.2 Sectors [2] and [3], Crude Petroleum and Natural Gas Extraction

Chapter 2 noted the decision to treat natural gas liquids as a component of crude petroleum production, treating the "dry" natural gas remaining after extraction of the liquids as the output of the Natural Gas sector.

Bureau of Mines data (5) yielded the following estimated values:

	Physical Unit	Physical Amount	Trillion BTU	Million Dollars
[2] Crude Oil	million bbl.	3,455.400	19,343.6	11,706.51
[2] Natural Gas Liquids	million cu. ft.	907.993	2,584.3	4,180.46
[3] Dry Natural Gas	million cu. ft.	21,623.705	22,207.5	
Total			44,135.4	15,886.97

The 15,886.97 million dollar figure corresponds to a sector [2] and [3] dollar total of 16,730.27 million dollars in the RFF and BEA tables. Paralleling the

procedures for coal, direct correspondence was employed to estimate scale factors, as follows:

	Trillion BTU	Million dollars of output	Million BTU per dollar
[2] Crude Petroleum	21,927.9	12,691.31	1.72779
[3] Natural Gas Extraction	22,207.5	4,038.96	5.49832

6.2.3 Sectors [4] Through [10], Petroleum Products

The establishment of scale factors for petroleum products was handled most conveniently by relating BTU consumption from Bureau of Mines data (6) to dollar domestic consumption data in the RFF table. The latter were obtained by subtracting exports and adding imports (positive values) to domestic production. Table 48 presents the data on consumption in BTU terms, while table 49 establishes the correspondence between dollars and BTU. Table 49 also lists consumption of the products of sector [11], for the record; though sector [11] is classified with Petroleum Refining and allied industries, it was treated as a major user of energy products, rather than as a producer of those products. This decision was based on evidence developed from the Bureau of Mines treatment of asphalt and road oil for 1972, which made it clear that the major refined petroleum products, including asphalt and road oil, are all produced at refineries. Hence, sector [10] should account for all of asphalt production treated as an energy product, and correspondingly, establishments in sector [11] would not be producers of asphalt, treated as an energy product.

6.2.4 Average Scale Factors for Utilities

The Bureau of Mines (7) lists 1,577,714 million kilowatt-hours of electricity energy sales to ultimate consumers in 1972. Multiplying by the conversion factor of 3,412 BTU per kilowatt-hour yields 5,383.16 trillion BTU of electricity consumption at the point of use. The division of this figure by dollar sales of 31,623.87 million dollars yields .17022 million BTU per dollar, for all sources of electricity, measured at the point of consumption. In practice, in applications involving measurement at the point of consumption, no distinction was made between prices and scale factors for electricity from fossil fuels, nuclear power and hydropower. A given consumer pays a specific price for electricity used without distinguishing between the sources of that electricity, even though costs of generation may vary considerably between sources. Given the BEA convention on measuring utility use in terms of consumer rather than producer prices, it seemed reasonable, in a number of applications, to extend that practice to the three specific electricity sectors.

Table 48

Consumption of Petroleum Products by Sector, 1972
in Barrels and BTU

Product	(1) Million Bbl.	(2) Million BTU/Bbl.	(3) Trillion BTU
[4] Gasoline			
Motor	2,333,778	5.250	12,251.2
Aviation	16,925	5.045	85.3
	2,350,703		12,336.5
[5] Jet Fuel			
Naptha	88,495	5.355	473.9
Kerosene	293,995	5.670	1,667.0
	382,490		2,140.9
[6] Kerosene	85,852	5.670	487.0
[7] Distillate	1,066,110	5.825	6,210.0
[8] Residual	925,647	6.287	5,819.3
[9] LPG			
For fuel and power	273,200	4.011	1,095.8
For petrochemical feedstocks	140,449	4.011	563.3
	413,649		1,659.1
[10] All other			
Ethane	106,201	3.082	327.3
Special Napthas	31,866	5.248	167.4
Lubricants	52,813	6.015	317.7
Wax	5,409	6.015	32.5
Petroluem Coke	88,276	6.024	532.9
Asphalt	163,788	6.636	1,086.7
Road Oil	7,538	6.636	50.0
Still Gas	185,700	6.000	1,114.2
Naptha	58,100	5.248	304.9
Miscellaneous	66,200	5.745	380.3
	765,891		4,313.9
Grand Total	5,990,342		32,965.7

Source: Derived from data appearing in U.S. Bureau of Mines, Mineral Yearbook, 1973, pp. 43, 968-972. The listed values for BTU per Bbl. are generally consistent with standard conversion factors, e.g., see U.S. Energy Information Administration, 1980 Annual Report to Congress, Vol. Two: Data, p. 227. Minor discrepancies generally appear to involve round-off error. However, the EIA lists (million BTU)/Bbl. as 6.065 for lubricants and 5.537 for wax.

Table 49

Correspondence Between Consumption in
Dollars and BTU, Petroleum Products, 1972

Sector Product	Consumption Million $	Consumption Trillion BTU	Dollars per Million BTU	Million BTU per Dollar
[4] Gasoline	$16,943.55	12,336.5	1.37345	0.72809
[5] Jet fuel	1,496.28	2,140.9	0.69890	1.43082
[6] Kerosene	376.00	487.0	0.77207	1.29521
[7] Distillate oil	4,822.22	6,210.0	0.77652	1.28779
[8] Residual oil	2,632.28	5,819.3	0.45234	2.21075
[9] LPG	1,041.03	1,659.1	0.62747	1.59371
[10] All other pet. prod.	3,685.82	4,313.9	0.85441	1.17040
[11] Asphalt tar	1,827.84	-	-	-

However, in some applications, measurement at point of production is necessary. This occurs, in particular, when estimates of "primary" energy production are wanted, with primary energy production defined to include hydropower and nuclear power. In that case, primary electricity scale factors can be derived as follows. In 1972, quantities of electricity from hydropower and nuclear power (8), at point of production were:

Nuclear power	576 trillion BTU
Hydroelectric power	2,866 trillion BTU

In that year, the heat rate for hydroelectric power was 10,379 BTU per kilowatt-hour produced, and that for nuclear power was 10,792 BTU per kilowatt-hour (9). The mechanical establishment of correspondence of respective BTU and sales of [13] and [14] yields:

	Trillion BTU	Million Dollars	Million BTU per Dollar	Dollars per Million BTU
[13]	576.00	849.04	.67841	1.47403
[14]	2886.00	1,043.60	2.76543	0.36161

The large difference in scale factors here implicitly exhibits important cost and price differentials. Within a given region, and for a given utility, the cost of electricity generated from hydropower is typically below that for electricity generated from fossil fuels and nuclear power. However, the pricing of electricity typically involves an averaging of those costs. Further, regions heavily dependent on hydropower pay considerably lower prices for electricity

than does the rest of the country. Thus, the 1972 price for the industrial use of electricity in the State of Washington was 0.941 dollars per million BTU, in contrast to a national average of 3.201 dollars per million BTU (10).

This latter difference should and does appear in the values employed for primary production analysis, but will not appear in the analysis of output measured at the point of consumption. In the former case, we employed the scale factors established for nuclear power and hydroelectric power at the point of production. In the latter case, we operated under our assumption that electricity at the point of consumption in effect is distributed on a national grid, and consumers pay the national sector price for electricity regardless of its source, in terms of [12], [13] or [14]. In place of the national grid assumption, future work could be directed to a precise matchup of sector and electricity source, using information on the regional distribution of industry and source of electricity. But this would be a formidable undertaking and it is dubious whether the gains in precision would be worth the effort, given the small share of hydropower in electricity supply, in dollar terms.

Turning to the natural gas utility, sector [15], we begin with a domestic sales total of 20,825.17 million dollars for that sector. The corresponding total BTU content of sales is estimated as follows. Sector [3], Natural Gas Extraction, has 3,669.06 million dollars of sales to [15]. Given the sector [3] BTU conversion factor of 5.49832 million BTU per dollar, the BTU flow from [3] to [15] in turn is 20,173.66 trillion BTU. There is also a flow into [15] from [2], Crude Petroleum, of 5.14 million dollars, which is interpreted here as a very minor addition to natural gas supplies. Given a BTU scale factor for [2] of 1.728 million BTU per dollar implies an additional 8.64 trillion BTU of natural gas supplies, yielding a total of 20,182.30 million BTU. (Note that net imports enter into domestic consumption, but are disregarded because the comparison employed is that of domestic sales and the input of domestic supplies.) Then the scale factor is obtained from 20,182.30 divided by 20,825.17, yielding 0.96913 million BTU per dollar.

6.2.5 Year 2000 Output in BTU by Direct Scaling

Given the scale factors developed here, as summarized in table 47 above, projections of year 2000 output in BTU were obtained directly by multiplying sector scale factors by respective dollar outputs, from table 40. Results appear in table 50. That table also exhibits corresponding estimates of primary energy, with electricity BTU from nuclear and hydroelectric power estimated at

point of production, rather than point of consumption, i.e., in terms of fossil fuel equivalent before conversion losses. Note the correspondence of the entries in table 50 to those obtained using the mixed BTU-Dollar matrices, as presented in table 44 and 45, above. The correspondence is exact for the non-utilities, and close for the utilities.

6.3 MIXED BTU-DOLLAR INPUT-OUTPUT MATRICES

Projection of output in BTU terms by mixed BTU-dollar matrices was the preferred alternative to projection by direct scaling. In practice, of course, as shown by a comparison of tables 44 and 50, the two sets of results were quite close. However, the more involved input-output technique yields additional payoff in the form of a variety of estimated multiplier effects and seems clearly preferable on those grounds.

Section 6.3.1 presents the theoretical underpinning for the mixed unit input-output approach. Then sections 6.3.2 and 6.3.3 present empirical material, with the former concerned with scale factors used in the matrices, and the latter with the results of their application. The overall scale factors developed for sectors [1] through [10] in section 6.2, above, were also employed for the mixed unit matrices. However, in the case of the utilities, sectors [12] through [15], individual sector scale factors were applied; their development is discussed in section 6.3.2. Besides presenting output projections, section 6.3.3 applies the BTU-dollar matrices to develop information on direct and indirect requirements of energy, in total, and per dollar of induced output in each inverse matrix. This includes information on primary energy required to meet both direct and indirect requirements of final demand on each sector. Finally, it can be argued that individual sector scale factors ought to be developed for the use of energy from sectors [1] through [10], even though the output of those sectors is measured in producer prices. That argument is appraised in section 6.3.4.

6.3.1 Mixed BTU-Dollar Input-Output Matrices: Theoretical Underpinning

The input-output projection procedure can be extended to handle mixed unit flows of inputs, and, in particular, mixed BTU and dollar flows. In the process, the conversion of output in dollars to output in BTU is obtained as a matter of course. In addition, information on BTU multiplier and feedback effects can be derived.

Table 50

Projected Year 2000 Output in BTU
Obtained by Direct Scaling

Sector	(1) Dollar Sales (in millions)	(2) Million BTU per dollar	(3) Output in Trillion BTU
Output at point of consumption			
[1] Coal	10,067.89	2.66574	26,838.4
[2] Crude petroleum	13,378.42	1.72779	23,115.1
[3] Natural gas extraction	4,652.00	5.49832	25,578.2
[4] Gasoline	16,561.48	0.72809	12,058.2
[5] Jet fuel	3,814.58	1.43082	5,458.0
[6] Kerosene	367.86	1.29521	476.5
[7] Distillate oil	6,635.01	1.28779	8,544.5
[8] Residual oil	3,240.59	2.21075	7,164.1
[9] LPG	1,048.67	1.59371	1,671.3
[10] All other pet. products	5,678.86	1.17040	6,646.5
[12]-[14] Electricity, at point of consumption	58,663.38	0.17022	9.985.7
[15] Natural gas utilities	24,250.52	0.96913	23,501.9
Total	148,359.26		151,038.2
Primary energy: output at point of production			
[1] Coal	10,067.89	2.66574	26,838.4
[2] Crude petroleum	13,378.42	1.72779	23,115.1
[3] Natural gas extraction	4,652.00	5.49832	25,578.2
[13] Electricity, nuclear power	11,278.03	0.67841	7,651.1
[14] Electricity, hydro & other	1,126.49	2.76543	3,115.2
	40,502.83		86,298.0

Sources: Dollar sales from table 40, BTU scale factors from table 47 and from section 6.2.4 in text, output in trillion BTU from (1) times (2).

The techniques employed are straightforward, but not obvious. The methodology employed here parallels that of Griffin (11), who clarified and built upon the work of Reardon (12), Herendeen (13), and Herendeen and Bullard (14).

In our application here, the following theoretical underpinning was employed. Consider the simplified case of three sectors, in which the first two are energy producing sectors. The BTU to dollar scale factor for Sector (1) is invariant, while that for (2) varies over consuming sectors. Initially, we are given the following set of equations that present the input-output transactions table in dollar terms:

$$\begin{bmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + \begin{bmatrix} f_1 \\ f_2 \\ f_3 \end{bmatrix} = \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$

where X_1, X_2 and X_3 are outputs in dollars; the x_{ij} are the flows from sector (i) to (j) with i, j = 1, 2, 3; and the f_i are final demands, with i = 1, 2, 3. Now we convert the dollar flows for sectors (1) and (2) into BTU flows, as follows:

$$\begin{bmatrix} x_{11}\left(\frac{B_1}{X_1}\right) & x_{12}\left(\frac{B_1}{X_1}\right) & x_{13}\left(\frac{B_1}{X_1}\right) \\ x_{21}\left(\frac{B_{21}}{x_{21}}\right) & x_{22}\left(\frac{B_{22}}{x_{22}}\right) & x_{23}\left(\frac{B_{23}}{x_{23}}\right) \\ x_{31} & x_{32} & x_{33} \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + \begin{bmatrix} f_1\left(\frac{B_1}{X_1}\right) \\ f_2\left(\frac{B_{24}}{f_2}\right) \\ f_3 \end{bmatrix} = \begin{bmatrix} B_1 \\ B_2 \\ X_3 \end{bmatrix}$$

where B_1 and B_2 are total outputs of (1) and (2) in BTU terms, (B_1/X_1) is the BTU to dollar scale factor for (1), and (B_{2j}/X_{2j}) is the individual sector BTU to dollar scale factor for (2), with B_{24}/f_2 the BTU to dollar scale factor for final demand.

The expression can be rewritten as:

$$\begin{bmatrix} B_{11} & B_{12} & B_{13} \\ B_{21} & B_{22} & B_{23} \\ x_{31} & x_{32} & x_{33} \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + \begin{bmatrix} f_1^* \\ f_2^* \\ f_3 \end{bmatrix} = \begin{bmatrix} B_1 \\ B_2 \\ X_3 \end{bmatrix}$$

where the variables are exactly the same as in the previous equation, but have been renamed for ease of exposition. For example, $B_{11} = x_{11}\ (B_1/X_1)$ and $f_2^* = f_2\ (B_{24}/f_2)$. But now we have a standard format for input-output manipulation. Thus, we can transform the equations to read:

$$\begin{bmatrix} \frac{B_{11}}{B_1} & \frac{B_{12}}{B_2} & \frac{B_{13}}{X_3} \\ \frac{B_{21}}{B_1} & \frac{B_{22}}{B_2} & \frac{B_{23}}{X_3} \\ \frac{x_{31}}{B_1} & \frac{x_{32}}{B_2} & \frac{x_{33}}{X_3} \end{bmatrix} \begin{bmatrix} B_1 \\ B_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} f_1^* \\ f_2^* \\ f_3 \end{bmatrix} = \begin{bmatrix} B_1 \\ B_2 \\ X_3 \end{bmatrix}$$

The system can be written in brief form as: $A^* X^* + f^* = X^*$, where X^* is a mixed BTU-dollar output vector. The solution now parallels that in the usual case:

$$(I - A^*)^{-1} f^* = X^*$$

Hence, for changed f^*, a corresponding X^* will be obtained.

The units for some of the elements in A^* and $(I - A^*)^{-1}$ will be "mixed," in the form of BTU per dollar, or dollar per BTU; but the multiplication of the inverse by final demand will yield outputs in the proper units--either BTU or dollars. Although only three sectors were employed here, the special case discussed clearly implies the general situation of any number of sectors, for each of the three types of sector can be viewed as representing a set of sectors with the same characteristics. In practice, here, sector (1) corresponds to the energy sectors [1] through [10], sector (2) to the utilities, [12] through [15], and sector (3) to the remaining nonenergy sectors. The construction of the scale factors for the utilities (corresponding to B_{2j}/x_{2j}, above) is now discussed.

6.3.2 Individual Sector Scale Factors for Utilities

Because utility prices vary between consuming sectors in input-output accounting, the development of individual sector BTU-dollar scale factors was seen as improving accuracy. Those scale factors were then employed in forming the mixed BTU-dollar matrices. Individual sector scale factors were readily available for manufacturing sectors by drawing on the data developed in chapter 3. In contrast, scale factors for other sectors had to be estimated by drawing on a variety of sources; although this posed difficulty, the results obtained

appear reasonably useful. Electricity and natural gas price data were converted to BTU per dollar by applying the standard conversion factors noted above in section 6.2.4: 3,412 BTU per kilowatt-hour of electricity at the point of consumption and 1,027 BTU per cubic foot of natural gas in 1972 (15).

Given individual sector prices of electricity in dollars per thousand kilowatt-hours, and prices of natural gas in dollars per 100,000 cubic feet, million BTU per dollar is obtained by the following equations:

$$MBTU/E = 3.412/P_{72E} \text{ (point of consumption)}$$
$$MBTU/N = 102.7/P_{72N}$$

where MBTU is BTU in millions, E is dollars of electricity, and N is dollars of natural gas; P_{72E} is price of electricity in 1972 and P_{72N} is price of natural gas in 1972.

Table 51 lists the BTU scale factors derived by applying those equations to the manufacturing price data, and also shows the corresponding use of electricity and natural gas in trillion BTU.

Several sources were drawn on in developing price estimates and then BTU scale factors for nonmanufacturing sectors. There were gaps in available data, so heroic assumptions were sometimes necessary, but results obtained appear defensible. Table 52 exhibits price estimates for the nonmanufacturing sectors and the corresponding BTU to dollar scale factors, essentially the inverse of prices. The Census of Mineral Industries (16) furnished direct information on both electricity and natural gas prices for eight sectors, and data in publications by Jack Faucett Associates (17), yielded price data in another seven cases, though generally the information appeared for only one utility. Edison Electric Institute and American Gas Association data (18) helped establish estimates for a number of sectors. In the case of the former, street and highway lighting has a high price, and this was a major factor in establishing a high electricity price for sector [113] State and Local Government, Non-Education Expenditures. In the case of the latter, detailed information appeared on purchases by industry for "large-volume users," in terms of both revenues and cubic feet, allowing the calculation of prices. In turn, this implied a set of prices for "small-volume users," obtained by subtracting "large volume" totals from corresponding grand totals.

Table 51

BTU Scale Factors for Electricity and Natural Gas in the RFF Manufacturing Sectors, and the Use of Electricity and Natural Gas in Trillion BTU

	RFF Sector	Million BTU per Dollar		Trillion BTU	
		Electricity	Natural Gas	Electricity	Natural Gas
4	GASOLINE	0.41814	3.60731	81.537	1330.014
11	ASPHALT AND TAR PRODUCTS	0.19632	2.00939	3.161	31.949
25	MOBILE HOMES	0.19723	2.02285	1.006	6.473
35	ORDNANCE	0.31389	1.72634	13.780	29.175
36	MEAT PACKING	0.26866	2.11143	10.558	59.120
37	DISTILLING	0.27921	1.93993	7.260	31.233
38	ALL OTHER FOOD & KINDRED	0.25406	1.98877	99.489	494.408
39	TOBACCO	0.28410	1.66451	3.296	4.494
40	TEXTILES	0.34120	1.79860	86.017	117.449
41	APPAREL	0.22747	1.91963	30.048	55.477
42	LOGGING AND SAW MILLS	0.28410	2.11840	21.336	31.140
43	OTHER LUMBER AND WOOD	0.28481	2.17309	23.582	86.489
44	HOUSEHOLD FURNITURE	0.23662	1.83295	8.353	17.230
45	OTHER FURNITURE	0.20933	1.78920	4.228	19.323
46	PULP AND PAPER MILLS	0.40379	2.67031	94.204	449.146
47	OTHER PAPER PRODUCTS	0.27406	1.99534	31.325	84.403
48	PRINTING AND PUBLISHING	0.22869	1.88752	31.261	62.666
49	CHEMICALS	0.45615	2.98894	309.634	1780.811
50	PLASTICS	0.38380	2.62929	50.125	148.029
51	DRUGS	0.26635	1.72373	9.855	18.099
52	CLEANING & TOILET PREPARATIONS	0.23306	1.90080	6.549	28.132
53	PAINTS	0.20071	1.54622	3.131	9.587
54	RUBBER	0.27944	1.68113	62.456	113.644
55	LEATHER	0.21732	1.86727	5.433	10.830
56	GLASS	0.32526	1.82545	24.395	251.000
57	CEMENT	0.35542	2.81370	32.343	220.875
58	OTHER STONE & CLAY	0.25520	1.94177	35.779	328.547
59	IRON & STEEL MFG.	0.31769	2.05812	214.251	978.223
60	ALUMINUM MFG.	0.74825	2.11404	189.755	182.864
61	OTHER PRIMARY NONFERROUS METALS MFG.	0.33550	2.18232	44.688	168.257
62	FABRICATED METALS	0.23944	1.60619	71.305	218.764
63	MACHINERY (NON-ELECTRICAL)	0.23860	1.86422	63.516	178.220
64	COMPUTING, ELECTRONICS, AND RELATED	0.28964	1.83951	32.092	38.078
65	REFRIGERATION & HEATING EQPMT.	0.28989	1.83229	8.291	20.705
66	HOUSEHOLD APPLIANCES	0.27876	1.80460	8.586	27.610
67	ELECTRIC LIGHTING	0.24582	1.70683	7.743	19.799
68	RADIO, TV & COMMUNIC. EQPMT.	0.27296	1.97995	22.082	30.095
69	ALL OTHER ELECTRIC MACH.	0.29288	1.76339	25.656	48.141
70	MOTOR VEHICLES & PARTS	0.28129	1.56507	56.567	102.825
71	TRUCKS, MOTORCYCLES & RELATED	0.22098	1.67318	3.359	11.545
72	AIRCRAFT	0.29388	1.79357	27.596	32.284
73	OTHER TRANSPORTATION EQPMT.	0.24887	1.63874	9.009	11.963
74	SCIENTIFIC INSTRUMENTS & RELATED	0.22946	1.59398	9.499	15.462
75	PHOTOGRAPHIC EQUIPMENT & SUPPLIES	0.24371	1.50985	3.753	6.643
76	JEWELRY	0.20310	1.67019	1.767	1.837
77	OTHER MISCELLANEOUS MFG.	0.22884	1.71912	12.380	30.944

Table 52

Estimated Electricity and Natural Gas Prices to Nonmanufacturing Sectors, and Corresponding Scale Factors

	RFF Sector	Estimated Prices: Elect. $ per 1,000 kwh.	Estimated Prices: Nat. Gas $ per 100,000 cu. ft.	Scale Factors, Million BTU per Dollar: Elec-tricity	Scale Factors, Million BTU per Dollar: Natural Gas	Source of Estimate [a]: Elec.	Source of Estimate [a]: NG
1	COAL MINING	12.84	70.00	0.26573	1.46714	5.	5.
2	CRUDE PETROLEUM	11.38	25.31	0.29982	4.05768	5.	5.
3	NATURAL GAS EXTRACTION	11.38	25.31	0.29982	4.05768	5.	5.
12	ELECTRICITY, FOSSIL FUEL	7.37	33.89	0.00498[b]	3.03039	2.	1.
13	ELECTRICITY, NUCLEAR POWER	7.37	33.89	0.00498[b]	3.03039	2.	1.
14	ELECTRICITY, HYDROPOWER	7.37	33.89	0.00498[b]	3.03039	2.	1.
15	NATURAL GAS UTILITIES	15.00	20.87	0.22747	0.00391[b]	0.	1.
16	MEAT ANIMALS	22.30	47.52	0.15300	2.16120	4.	1.
17	OTHER LIVESTOCK PRODUCTS	22.30	47.52	0.15300	2.16120	4.	1.
18	GRAINS	22.30	47.52	0.15300	2.16120	4.	1.
19	OTHER CROPS AND AG. SERVICES	22.30	47.52	0.15300	2.16120	4.	1.
20	FORESTRY AND FISHERIES	22.30	47.52	0.15300	2.16120	4.	1.
21	IRON MINING	10.58	48.46	0.32250	2.11927	5.	5.
22	NONFERROUS METALS MINING	9.54	47.79	0.35765	2.14899	5.	5.
23	NONMETALLIC MINERALS	13.43	33.50	0.25406	3.06567	5.	5.
24	NEW RESIDENTIAL BUILDINGS	22.90	105.00	0.14900	0.97810	0.	0.
26	NEW NONRESIDENTIAL BUILDINGS	22.90	100.00	0.14900	1.02700	0.	0.
27	NEW ENERGY ACTIVITY STRUCTURES	21.30	33.33	0.16019	3.08131	5.	5.
28	NEW HIGHWAYS & STREETS	13.74	49.33	0.24833	2.08190	2.	1.
29	ALL OTHER NEW CONSTRUCTION	22.90	100.00	0.14900	1.02700	0.	0.
30	MAINT. & REPAIR, RESIDENTIAL	22.90	105.00	0.14900	0.97810	0.	0.
31	M & R, NONRESIDENTIAL BLDGS.	22.90	100.00	0.14900	1.02700	0.	0.
32	M & R, ENERGY ACTIVITY STRUCTS.	21.30	33.33	0.16019	3.08131	5.	5.
33	M & R, HIGHWAYS & STREETS	13.74	49.33	0.24833	2.08190	2.	1.
34	ALL OTHER M & R	22.90	100.00	0.14900	1.02700	0.	0.
78	RAILROADS	19.21	48.26	0.17762	2.12806	2.	1.
79	LOCAL, SUBURBAN & INTERURBAN TRANS.	22.20	75.00	0.15369	1.36933	0.	0.
80	TRUCKING & WAREHOUSING	22.20	75.00	0.15369	1.36933	0.	0.
81	WATER TRANSPORT	22.20	75.00	0.15369	1.36933	0.	0.
82	AIR TRANSPORT	20.00	48.26	0.17060	2.12806	0.	1.
83	PIPELINES & OTHER TRANS.	11.38	23.26	0.29982	4.41531	4.	6.
84	COMMUNICATIONS	13.21	83.43	0.25829	1.23097	3.	4.
85	WATER & SANITARY SERVICE	13.74	48.33	0.24833	2.12497	2.	1.
86	WHOLESALE TRADE	21.00	90.00	0.16248	1.14111	0.	0.
87	RETAIL TRADE	22.90	100.00	0.14900	1.02700	0.	0.
88	BANKING	21.00	90.00	0.16248	1.14111	0.	0.
89	OTHER FINANCE & INSURANCE	21.00	90.00	0.16248	1.14111	0.	0.
90	OWNER OCCUPIED DWELLINGS	0.00	0.00	0.00000	0.00000	0.	0.
91	REAL ESTATE	21.00	90.00	0.16248	1.14111	0.	0.
92	HOTELS	18.00	58.33	0.18956	1.76067	0.	1.
93	PERSONAL SERVICES	22.90	105.00	0.14900	0.97810	0.	0.
94	BUSINESS SERVICES	21.00	90.00	0.16248	1.14111	0.	0.
95	EATING & DRINKING PLACES	22.90	105.00	0.14900	0.97810	0.	0.
96	AUTO REPAIR	22.90	105.00	0.14900	0.97810	0.	0.
97	AMUSEMENTS	21.00	90.00	0.16248	1.14111	0.	0.
98	HOSPITALS	18.00	68.90	0.18956	1.49057	0.	1.
99	OTHER MEDICAL SERVICES	22.90	105.00	0.14900	0.97810	0.	0.
100	EDUCATIONAL SERVICES	21.00	90.00	0.16248	1.14111	0.	0.
101	NON-PROFIT ORGNS.	21.00	90.00	0.16248	1.14111	0.	0.
102	SOCIAL SERVICES	21.00	90.00	0.16248	1.14111	0.	0.
103	POSTAL SERVICE & OTHER FED. ENTERP.	13.74	49.33	0.24833	2.08190	2.	1.
104	STATE & LOCAL ENTERPRISES	13.74	49.33	0.24833	2.08190	2.	1.
105	PERSONAL CONSUMPTION EXPEND.	22.94	121.78	0.14874	0.84332	2.	1.
106	GROSS PRIVATE DOMESTIC FIXED INVEST.	0.00	0.00	0.00000	0.00000	0.	0.
107	CHANGE IN INVENTORIES	0.00	0.00	0.00000	0.00000	0.	0.
108	EXPORTS	8.84	19.75	0.38597	5.20000	0.	6.
109	IMPORTS	8.84	19.75	0.38597	5.20000	0.	6.
110	FEDERAL GOVT. PURCHASES, DEFENSE	13.74	49.33	0.24833	2.08190	2.	1.
111	FEDERAL GOVT. PURCHASES, NON-DEFENSE (& CCC)	13.74	49.33	0.24833	2.08190	2.	1.
112	STATE & LOCAL, EDU.	13.74	49.33	0.24833	2.08190	2.	1.
113	STATE & LOCAL, OTHER	31.00	49.33	0.11006	2.08190	2.	1.

Sources: American Gas Association, 1972 Gas Facts, Arlington Va.; Edison Electric Institute, Statistical Yearbook of the Electric Utility Industry for 1972, New York, 1973; Jack Faucett Associates, Inc., National Energy Accounts: Energy Flows in the United States, 1947 Through 1974, Chevy Chase, Maryland, 1978; Jack Faucett Associates, Inc., National Energy Accounts: Energy Flows in the United States, 1947 Through 1977; U.S. Bureau of the Census, 1972 Census of Mineral Industries, Fuels and Energy Consumed, MIC72(1)-5, 1975; and U.S. Bureau of Mines, Minerals Yearbook, 1972, 1974.

[a] Sources of Estimates:

- 0: Obtained by interpolation or extrapolation from other information in table.
- 1: American Gas Association
- 2: Edison Electric Institute
- 3: Jack Faucett Assoc. 1978
- 4: Jack Faucett Assoc. 1980
- 5: Census of Mineral Industries
- 6: Bureau of Mines

[b] Estimated on basis of estimated BTU divided by dollars of intraindustry sales.

On the basis of the information developed to this point, a general pattern of prices was inferred, and was used to estimate prices of remaining sectors by interpolation or extrapolation. Table 52 includes two columns of codes which designate the sources drawn on in deriving each estimate. Where estimates were derived by interpolation or extrapolation, a code value of zero is employed; zero is also used for three cases where there is no input of electricity or natural gas (sectors [90], [105] and [106]).

The internal use of both electricity and natural gas was handled in special fashion because here there were very large dollar flows in the BEA table and relatively small actual usages of energy (19). In these cases, the scale factors were obtained by dividing estimated BTU usage by total dollars of intraindustry sales. Bureau of Mines data (20) were drawn on to obtain prices for pipeline use of natural gas.

In the case of the electricity sectors, the special treatment of internal sales was part of a process of establishing consistency with control totals. Although the scale factors in tables 51 and 52 were obtained from many and diverse sources, their initial application yielded results quite close to control totals, so only limited final adjustments were necessary. Those adjustments were derived by an iterative process employing successive versions of the mixed input-output matrices.

6.3.3 Empirical Results for Mixed BTU-Dollar Input-Output Matrices

Mixed BTU-Dollar matrices were constructed for both 1972 and 2000, and some key results derived from them are presented in this section. (The BTU-Dollar inverse matrices are presented explicitly in appendix J.) Because the units are mixed, the entries in each inverse matrix have this form:

	Energy Sectors	Nonenergy Sectors
Energy Sectors	BTU/BTU	Million BTU/Dollar
Nonenergy Sectors	Dollar/Million BTU	Dollar/Dollar

Multiplication of the inverse by corresponding final demand accounts for the mixed units, with the canceling of the denominator units. Output levels for both years, with electricity measured at point of consumption, were presented in table 44, above, while table 45 exhibited corresponding primary electricity

measures, with electricity measured at the point of production. In the final scaling process carried out so electricity outputs would equal control totals, the following figures were reached for electricity output at point of consumption, as of 1972:

	(1) Total Output,	(2) Internal Use	(3) Net (1)-(2)
	Trillion BTU		
[12] Fossil fuels	5,021.77	17.26	5,004.51
[13] Nuclear power	162.09	0.00[a]	162.09
[14] Hydropower	199.24	0.00[a]	199.24
	5,383.10		

	(4) Total Output	(5) Internal Use	(6) Net (4)-(5)	(7) Net Scale Factor (3)/(6)
	Million Dollars			
[12] Fossil fuels	29,731.23	3,524.79	26,206.44	.19096
[13] Nuclear power	849.04	0.26	848.78	.19096
[14] Hydropower	1,043.60	0.25	1,043.35	.19096
	31,623.87			

[a]Small non-zero value

The total sales figure of 5,383.10 trillion BTU and consequently the ratio of BTU to dollar output equal the respective control figures shown in table 47, above. In addition, the net scale factor (BTU for noninternal use relative to sales) is the same for all three sectors. In deriving estimates of primary electricity, the data in section 6.2.4 was applied as follows:

	1972 Output in Trillion BTU		
	Point of production (1)	Point of consumption (2)	Ratio (1)/(2)
[13] Nuclear power	576.0	162.09	3.5536
[14] Hydropower	2,886.0	199.24	14.4850

(The large difference in scale factors between [13] and [14] was explained in section 6.2.4, above.) The ratios were then applied to scale year 2000 outputs, as follows:

		Point of consumption Trillion BTU	Scale Factor	Point of production Trillion BTU
[13]	Nuclear power	2,200.23	3.5536	7,819
[14]	Hydropower	219.13	14.4850	3,174

In addition to output in BTU, a variety of other measures were obtained. Thus, Table 53 presents energy indicators obtained from the BTU-Dollar matrices in the form of direct energy intensities, and compares them to corresponding indicators in the conventional dollar input-output tables. First for 1972 and then for 2000, the table shows dollars spent on energy relative to dollars spent on all intermediate inputs and then compares that figure to million BTU spent on energy relative to dollars spent on all intermediate inputs. (Note that value added is omitted.) Of course, considerable reductions in intensity occur in 2000 relative to 1972.

Tables 54 and 55 present submatrices of the BTU-Dollar inverse matrix covering the energy sectors only, with table 54 exhibiting the 1972 case and table 55 the 2000 case. The tables exhibit the direct and indirect requirements in BTU generated by an increase in final demand of one BTU on a given sector. The electricity sectors here have their BTU to dollar scale factors set at the point of consumption. In the tables, the induced requirements for electricity seem reasonable and useful. Thus, in 1972, an increase of one BTU on [12], Electricity from Fossil Fuels, generates a little over one BTU of [12], 1.6 BTU of coal, about .3 BTU of crude oil, and about .8 BTU of crude natural gas, in addition to requirements on natural gas utilities and residual oil. No doubt those latter requirements (on "secondary" energy) in turn imply requirements on the underlying "primary" energy sources. In the year 2000, the one BTU of final demand on [12] again generates a bit over one BTU on [12], an increase to 1.8 BTU of coal, and decreases to .15 BTU of crude oil and about .6 BTU of crude natural gas. Not surprisingly, residual oil and natural gas utility requirements decline also. It appears the inverse performs well in accounting for conversion losses in generating electricity plus some additional multiplier effects. In contrast, one BTU in additional final demand on [13] Nuclear Power and [14] Hydropower, yields very little in the way of additional energy requirements. This is hardly surprising, of course, yet nevertheless seems of interest. Similar patterns occur for [1] Coal; [2] Crude Petroleum; and [3] Natural Gas Extraction. This is to be expected for primary energy producing sectors; in fact, it can be taken as a definition of primary producers in an input-output framework, for in that framework, all sectors are interdependent,

Table 53

Direct Energy Intensities (Energy Per Unit of All Intermediate Input), in Dollars and Million BTU 1972 and 2000

	Sector	1972 Dollars Per Dollar	1972 Million BTU Per Dollar	2000 Dollars Per Dollar	2000 Million BTU Per Dollar
1	COAL MINING	0.378045	0.84092	0.331411	0.71506
2	CRUDE PETROLEUM	0.115228	0.17571	0.106025	0.15177
3	NATURAL GAS EXTRACTION	0.222283	1.04710	0.213172	1.01781
4	GASOLINE	0.760723	1.30491	0.720762	1.24695
5	JET FUEL	0.760724	1.30491	0.720762	1.24695
6	KEROSENE	0.760726	1.30491	0.720764	1.24695
7	DISTILLATE FUEL OIL	0.760724	1.30491	0.720762	1.24695
8	RESIDUAL FUEL OIL	0.760724	1.30491	0.720762	1.24695
9	LPG	0.760724	1.30491	0.720762	1.24695
10	ALL OTHER PETROLEUM REFINING	0.760724	1.30491	0.720762	1.24695
11	ASPHALT AND TAR PRODUCTS	0.345340	0.41607	0.300596	0.35644
12	ELECTRICITY, FOSSIL FUEL	0.648492	1.00568	0.627668	0.96035
13	ELECTRICITY, NUCLEAR POWER	0.019217	0.01404	0.013429	0.00964
14	ELECTRICITY, HYDROPOWER	0.014624	0.01038	0.010240	0.00706
15	NATURAL GAS UTILITIES	0.881767	1.59856	0.876526	1.57870
16	MEAT ANIMALS	0.014442	0.00597	0.011113	0.00464
17	OTHER LIVESTOCK PRODUCTS	0.019208	0.01013	0.014391	0.00745
18	GRAINS	0.071782	0.08149	0.053945	0.06291
19	OTHER CROPS AND AG. SERVICES	0.053901	0.05751	0.041445	0.04526
20	FORESTRY AND FISHERIES	0.069429	0.05392	0.046756	0.03678
21	IRON MINING	0.126933	0.13635	0.129949	0.13385
22	NONFERROUS METALS MINING	0.106467	0.08252	0.100515	0.08331
23	NONMETALLIC MINERALS	0.172564	0.20781	0.147073	0.17232
24	NEW RESIDENTIAL BUILDINGS	0.003159	0.00264	0.002553	0.00209
25	MOBILE HOMES	0.004850	0.00443	0.004271	0.00279
26	NEW NONRESIDENTIAL BUILDINGS	0.005819	0.00604	0.004729	0.00488
27	NEW ENERGY ACTIVITY STRUCTURES	0.025245	0.02402	0.018918	0.01738
28	NEW HIGHWAYS & STREETS	0.082749	0.07835	0.055853	0.05258
29	ALL OTHER NEW CONSTRUCTION	0.022806	0.02178	0.016299	0.01569
30	MAINT. & REPAIR, RESIDENTIAL	0.008251	0.00558	0.005621	0.00370
31	M & R, NONRESIDENTIAL BLDGS.	0.028788	0.02463	0.020407	0.01742
32	M & R, ENERGY ACTIVITY STRUCTS.	0.028320	0.03015	0.021735	0.02320
33	M & R, HIGHWAYS & STREETS	0.104631	0.11647	0.071877	0.07943
34	ALL OTHER M & R	0.037027	0.03610	0.026771	0.02617
35	ORDNANCE	0.032553	0.02802	0.020737	0.01754
36	MEAT PACKING	0.005616	0.00513	0.004303	0.00320
37	DISTILLING	0.014436	0.01656	0.012346	0.01328
38	ALL OTHER FOOD & KINDRED	0.015418	0.01595	0.010825	0.01039
39	TOBACCO	0.005060	0.00464	0.003948	0.00338
40	TEXTILES	0.020641	0.01790	0.016223	0.01319
41	APPAREL	0.010319	0.00780	0.008776	0.00566
42	LOGGING AND SAW MILLS	0.048023	0.04873	0.034028	0.03294
43	OTHER LUMBER AND WOOD	0.026237	0.02639	0.020269	0.01700
44	HOUSEHOLD FURNITURE	0.015685	0.01246	0.014220	0.00941
45	OTHER FURNITURE	0.020930	0.01945	0.016452	0.01255
46	PULP AND PAPER MILLS	0.103603	0.17494	0.068101	0.10857
47	OTHER PAPER PRODUCTS	0.024237	0.02400	0.015375	0.01449
48	PRINTING AND PUBLISHING	0.014253	0.00930	0.010977	0.00599
49	CHEMICALS	0.168639	0.30283	0.132441	0.22498
50	PLASTICS	0.063258	0.09066	0.044910	0.05991
51	DRUGS	0.020426	0.01931	0.013603	0.01216
52	CLEANING & TOILET PREPARATIONS	0.024238	0.02826	0.018071	0.02062
53	PAINTS	0.035047	0.03660	0.027253	0.02838
54	RUBBER	0.035180	0.02879	0.025099	0.01936
55	LEATHER	0.013720	0.01102	0.010826	0.00777
56	GLASS	0.089833	0.116684	0.071604	0.085590
57	CEMENT	0.273321	0.473208	0.212065	0.353509
58	OTHER STONE & CLAY	0.067202	0.089134	0.049444	0.622144

Table 53 (continued)

Sector	1972 Dollars Per Dollar	1972 Million BTU Per Dollar	2000 Dollars Per Dollar	2000 Million BTU Per Dollar
59 IRON & STEEL MFG.	0.099290	0.167269	0.068729	0.106635
60 ALUMINUM MFG.	0.080840	0.088464	0.053276	0.056070
61 OTHER PRIMARY NONFERROUS METALS MFG.	0.023300	0.026316	0.020571	0.020814
62 FABRICATED METALS	0.024758	0.022371	0.019827	0.016260
63 MACHINERY (NON-ELECTRICAL)	0.027210	0.024741	0.019550	0.016386
64 COMPUTING, ELECTRONICS, AND RELATED	0.017506	0.012151	0.011104	0.007043
65 REFRIGERATION & HEATING EQPMT.	0.017494	0.016839	0.011880	0.010829
66 HOUSEHOLD APPLIANCES	0.014695	0.013158	0.011583	0.009375
67 ELECTRIC LIGHTING	0.020895	0.017068	0.015803	0.011092
68 RADIO, TV & COMMUNIC. EQPMT.	0.012303	0.008691	0.007028	0.004699
69 ALL OTHER ELECTRIC MACH.	0.025449	0.022048	0.017444	0.014634
70 MOTOR VEHICLES & PARTS	0.009095	0.007787	0.007080	0.006052
71 TRUCKS, MOTORCYCLES & RELATED	0.009094	0.007369	0.006231	0.004590
72 AIRCRAFT	0.018825	0.015534	0.015024	0.014927
73 OTHER TRANSPORTATION EQPMT.	0.017178	0.014208	0.013829	0.011025
74 SCIENTIFIC INSTRUMENTS & RELATED	0.023028	0.016457	0.015064	0.010117
75 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	0.020052	0.021912	0.013664	0.014275
76 JEWELRY	0.013517	0.009738	0.010048	0.007187
77 OTHER MISCELLANEOUS MFG.	0.024200	0.021038	0.030350	0.017272
78 RAILROADS	0.092109	0.092965	0.069795	0.068009
79 LOCAL, SUBURBAN & INTERURBAN TRANS.	0.159538	0.133385	0.123113	0.101950
80 TRUCKING & WAREHOUSING	0.078544	0.084583	0.055994	0.070332
81 WATER TRANSPORT	0.080212	0.134454	0.062211	0.102241
82 AIR TRANSPORT	0.175927	0.243146	0.101651	0.138043
83 PIPELINES & OTHER TRANS.	0.182663	0.265323	0.156447	0.215240
84 COMMUNICATIONS	0.036253	0.012487	0.022684	0.007929
85 WATER & SANITARY SERVICE	0.097093	0.133797	0.076335	0.103112
86 WHOLESALE TRADE	0.059275	0.035199	0.042165	0.023756
87 RETAIL TRADE	0.124985	0.047249	0.098790	0.033902
88 BANKING	0.039716	0.021419	0.030162	0.013741
89 OTHER FINANCE & INSURANCE	0.014506	0.006672	0.011295	0.004713
90 OWNER OCCUPIED DWELLINGS	0.000000	0.000000	0.000000	0.000000
91 REAL ESTATE	0.053674	0.033816	0.042059	0.023847
92 HOTELS	0.125227	0.072676	0.098675	0.046673
93 PERSONAL SERVICES	0.045349	0.028952	0.030761	0.018723
94 BUSINESS SERVICES	0.026988	0.017063	0.014439	0.009543
95 EATING & DRINKING PLACES	0.022780	0.005482	0.019956	0.004543
96 AUTO REPAIR	0.024535	0.014984	0.018480	0.010773
97 AMUSEMENTS	0.026261	0.011445	0.021195	0.008567
98 HOSPITALS	0.063219	0.068062	0.047151	0.045470
99 OTHER MEDICAL SERVICES	0.037495	0.019101	0.029071	0.013977
100 EDUCATIONAL SERVICES	0.095077	0.072123	0.070434	0.047433
101 NON-PROFIT ORGNS.	0.092970	0.042136	0.075672	0.029264
102 SOCIAL SERVICES	0.099628	0.040293	0.083987	0.030266
103 POSTAL SERVICE & OTHER FED. ENTERP.	0.076021	0.063952	0.057177	0.042824
104 STATE & LOCAL ENTERPRISES	0.108058	0.160036	0.082096	0.109890
105 PERSONAL CONSUMPTION EXPEND.	0.044538	0.025921	0.020662	0.009521
106 GROSS PRIVATE DOMESTIC FIXED INVEST.	0.000281	0.000693	0.000340	0.000842
107 CHANGE IN INVENTORIES	0.008758	0.026358	0.011115	0.030796
108 EXPORTS	0.023538	0.051157	0.020591	0.049961
109 IMPORTS	0.108532	0.212502	0.050958	0.104003
110 FEDERAL GOVT. PURCHASES, DEFENSE	0.033566	0.035273	0.049408	0.056041
111 FEDERAL GOVT. PURCHASES, NON-DEFENSE	0.0161742	0.0151635	0.041794	0.037802
112 STATE & LOCAL, EDU.	0.0972855	0.0927298	0.102888	0.105106
113 STATE & LOCAL, OTHER	0.0308960	0.0182728	0.024552	0.013823

Table 54

Interdependence Coefficients for
Energy Sectors in BTU-Dollar
Inverse Matrix, 1972

ROW	COL1	COL2	COL3	COL4	COL5	COL6	COL7
ROW1	1.14216	0.00396	0.00130	0.01893	0.00963	0.01064	0.01070
ROW2	0.00834	1.02801	0.00157	1.29023	0.65655	0.72529	0.72947
ROW3	0.00448	0.01116	1.07702	0.10074	0.05126	0.05663	0.05695
ROW4	0.00111	0.00092	0.00030	1.00255	0.00130	0.00143	0.00144
ROW5	0.00021	0.00034	0.00011	0.00101	1.00051	0.00057	0.00057
ROW6	0.00002	0.00001	0.00000	0.00023	0.00012	1.00013	0.00013
ROW7	0.00406	0.00164	0.00054	0.00482	0.00245	0.00271	1.00272
ROW8	0.00235	0.00179	0.00059	0.02215	0.01127	0.01245	0.01252
ROW9	0.00029	0.00032	0.00011	0.04161	0.02117	0.02339	0.02353
ROW10	0.00347	0.00141	0.00047	0.07444	0.03788	0.04185	0.04209
ROW12	0.00250	0.00189	0.00062	0.00765	0.00389	0.00430	0.00432
ROW13	0.00008	0.00006	0.00002	0.00025	0.00013	0.00014	0.00014
ROW14	0.00010	0.00008	0.00002	0.00030	0.00015	0.00017	0.00017
ROW15	0.00411	0.01035	0.00341	0.08946	0.04552	0.05029	0.05058

ROW	COL8	COL9	COL10	COL12	COL13	COL14	COL15
ROW1	0.00623	0.00865	0.01177	1.60176	0.01639	0.00673	0.00299
ROW2	0.42492	0.58944	0.80263	0.29700	0.04390	0.02081	0.00405
ROW3	0.03318	0.04602	0.06267	0.83990	0.03351	0.01184	1.07954
ROW4	0.00084	0.00116	0.00159	0.00843	0.01370	0.00909	0.00097
ROW5	0.00033	0.00046	0.00063	0.01294	0.00121	0.00088	0.00028
ROW6	0.00008	0.00011	0.00015	0.00015	0.00014	0.00006	0.00001
ROW7	0.00159	0.00220	0.00300	0.05575	0.00479	0.00326	0.00098
ROW8	1.00729	0.01012	0.01378	0.54060	0.00626	0.00260	0.00122
ROW9	0.01370	1.01901	0.02589	0.00983	0.00156	0.00085	0.00019
ROW10	0.02452	0.03401	1.04631	0.02600	0.01051	0.00629	0.00102
ROW12	0.00252	0.00349	0.00476	1.01181	0.00435	0.00191	0.00141
ROW13	0.00008	0.00011	0.00015	0.00027	1.00015	0.00006	0.00005
ROW14	0.00010	0.00014	0.00019	0.00033	0.00017	1.00008	0.00006
ROW15	0.02946	0.04087	0.05565	0.78155	0.03007	0.01087	1.00617

Table 55

Interdependence Coefficients for Energy Sectors in BTU-Dollar Inverse Matrix, 2000

ROW	COL1	COL2	COL3	COL4	COL5	COL6	COL7
ROW1	1.11921	0.00332	0.00109	0.05025	0.02557	0.02824	0.02841
ROW2	0.00666	1.02623	0.00098	1.11819	0.56900	0.62858	0.63220
ROW3	0.00269	0.00583	1.07526	0.05036	0.02563	0.02831	0.02847
ROW4	0.00073	0.00062	0.00020	1.00163	0.00083	0.00092	0.00092
ROW5	0.00017	0.00035	0.00012	0.00082	1.00042	0.00046	0.00047
ROW6	0.00002	0.00001	0.00000	0.00015	0.00008	1.00009	0.00009
ROW7	0.00405	0.00107	0.00035	0.00325	0.00165	0.00183	1.00184
ROW8	0.00161	0.00100	0.00033	0.01349	0.00686	0.00758	0.00762
ROW9	0.00017	0.00019	0.00006	0.02634	0.01340	0.01481	0.01489
ROW10	0.00337	0.00097	0.00032	0.04747	0.02416	0.02668	0.02684
ROW12	0.00205	0.00149	0.00049	0.00449	0.00229	0.00253	0.00254
ROW13	0.00059	0.00043	0.00014	0.00129	0.00066	0.00073	0.00073
ROW14	0.00006	0.00004	0.00001	0.00013	0.00007	0.00007	0.00007
ROW15	0.00248	0.00548	0.00181	0.04367	0.02222	0.02455	0.02469

ROW	COL8	COL9	COL10	COL12	COL13	COL14	COL15
ROW1	0.01655	0.02295	0.03126	1.82548	0.01173	0.00505	0.01000
ROW2	0.36827	0.51085	0.69561	0.15711	0.03106	0.01333	0.00276
ROW3	0.01659	0.02301	0.03133	0.64172	0.01794	0.00709	1.05925
ROW4	0.00054	0.00074	0.00101	0.00542	0.00886	0.00594	0.00066
ROW5	0.00027	0.00038	0.00051	0.00790	0.00100	0.00080	0.00028
ROW6	0.00005	0.00007	0.00010	0.00010	0.00004	0.00001	0.00001
ROW7	0.00107	0.00148	0.00202	0.03650	0.00361	0.00241	0.00068
ROW8	1.00444	0.00616	0.00839	0.31141	0.00411	0.00166	0.00067
ROW9	0.00868	1.01203	0.01639	0.00389	0.00086	0.00045	0.00011
ROW10	0.01563	0.02169	1.02953	0.01569	0.00816	0.00492	0.00077
ROW12	0.00148	0.00205	0.00280	1.00959	0.00287	0.00139	0.00108
ROW13	0.00043	0.00059	0.00080	0.00178	1.00084	0.00041	0.00031
ROW14	0.00004	0.00006	0.00008	0.00018	0.00008	1.00005	0.00003
ROW15	0.01438	0.01995	0.02717	0.60741	0.01589	0.00657	1.00401

and primary energy sectors do require inputs from secondary energy sectors. (As noted above, the primary energy sectors include [1], [2], [3], [13] and [14].) The direct and indirect requirement results for [15], Natural Gas Utilities and [4] Gasoline also fit expectations, because an increased BTU required of those sectors leads to more than that amount being furnished by the corresponding primary producing sector. This does not happen for the other petroleum products; in those cases, a one BTU increase in demand on refined product leads to less than a one BTU increase in crude oil. A small part of the explanation probably can be ascribed to refinery "processing gain", where total volume of output exceeds the corresponding volume of input, because petroleum products have less weight per volume than the crude oil processed (21). A more important part of the explanation probably hinges on our assumption of the same refinery mix of inputs for all of the petroleum products. Again, some modification of the conventional BTU content ascribed to crude oil may be in order. In any event, improvements in future work would likely emerge from the application of sophisticated information on refinery operations and petroleum engineering (22). Despite this concern, the results in tables 54 and 55 appear to redeem some of the promise of the input-output approach. Tables 56, 57 and 58 employ variations of the total direct and indirect requirements figures obtained from the inverse matrix. To avoid ambiguity, the measures seem worth defining explicitly. Let Z be the inverse matrix in an input-output system, and f the final demand sector, so that in the usual fashion we have Zf = X where X is output. Now we can rewrite Zf as follows:

$$\begin{bmatrix} z_{11} & z_{12} \cdots z_{1n} \\ z_{21} & z_{22} \cdots z_{2n} \\ \cdot & \cdot \quad\quad \cdot \\ \cdot & \cdot \quad\quad \cdot \\ \cdot & \cdot \quad\quad \cdot \\ z_{n1} & z_{n2} \cdots z_{nn} \end{bmatrix} \begin{bmatrix} f_1 \\ f_2 \\ \cdot \\ \cdot \\ \cdot \\ f_n \end{bmatrix} = \begin{bmatrix} z_{11}f_1 & z_{12}f_2 \cdots z_{1n}f_n \\ z_{21}f_1 & z_{22}f_2 \cdots z_{2n}f_2 \\ \cdot & \cdot \quad\quad \cdot \\ \cdot & \cdot \quad\quad \cdot \\ \cdot & \cdot \quad\quad \cdot \\ z_{n1}f_1 & z_{n2}f_2 \cdots z_{nn}f_n \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ \cdot \\ \cdot \\ \cdot \\ 1 \end{bmatrix}$$

The column sum for any column, j, in the Z matrix can be written $\sum_i z_{ij}$, and is interpreted in the usual fashion as the sum of direct and indirect requirements

induced by an expansion of one dollar in final demand on sector [j]. In similar fashion, $\sum_i z_{ij}f_j$ can be interpreted as the sum of direct and indirect requirements induced by the full amount of final demand on sector [j]. To attempt further clarification, let us employ Z and f to refer to conventional dollar measures and Z* and f* to refer to BTU-Dollar measures. All of these definitions are useful in discussing tables 56, 57 and 58.

Table 56 focuses on electricity consumption, first showing million BTU of electricity consumed per dollar of all intermediate input for each sector, in turn; and then million BTU of electricity required (in the form of both direct and indirect requirements) per dollar of induced output in the inverse table. In the latter case, the total of direct and indirect dollars required per dollar of final demand is obtained and employed as the denominator, i.e., corresponding to $\sum_i z_{ij}$ in the above discussion; the numerator is million BTU of electricity required from sectors [12], [13] and [14] combined, measured at the point of consumption, i.e., $z^*_{12,j} + z^*_{13,j} + z^*_{14,j}$. The table presents these data both for 1972 and 2000.

Table 57 first shows the primary energy required by sector to meet both the direct and indirect requirements of all the final demand on each sector, and then it shows the total dollar amount to meet all direct and indirect requirements. These values are presented first for 1972 and then for 2000. Extending the notation, the energy figures are $\sum_i z^*_i f^*_{ij}$, where i = 1, 2, 3, 13, and 14, corresponding to the primary energy sectors. The dollar figures on the other hand are $\sum_i z_i f_{ij}$, where i runs from 1 to 104, i.e., we obtain all direct and indirect dollar requirements in response to final demand on sector [j]. Negative values occur for sectors whose imports outweigh other final demand components, e.g., crude petroleum. Electricity here is measured at point of production, i.e., the BTU per dollar scale factor for nuclear power and hydropower is based on the BTU required to generate a kilowatt-hour.

Finally, table 58 uses the data of table 57 as input, presenting the ratio of primary energy required per dollar of induced output required, first for 1972 and then for 2000. Thus, the entry in the first column of table 57 is divided by the corresponding entry in the second column of that table to obtain million BTU of induced primary energy relative to induced dollars (to meet both direct and indirect requirements), as of 1972. Similarly, the division of the third column by the corresponding fourth column entry in table 57 yields the 2000 figure in table 58. The last column of table 58 exhibits the ratio of the 2000

Table 56

Electricity Requirements, in Terms of Million BTU Required Per Dollar of Total Requirements 1972 and 2000

Sector	1972		2000	
	Direct: BTU Relative to All Intermediate Input	Scaled Direct and Indirect: BTU Relative to Dollars of Induced Output, From Inverse Matrix	Direct: BTU Relative to All Intermediate Input	Scaled Direct and Indirect: BTU Relative to Dollars of Induced Output From Inverse Matrix
1 COAL MINING	0.0124826	0.006585	0.0128889	0.004671
2 CRUDE PETROLEUM	0.0078611	0.011844	0.0077766	0.006607
3 NATURAL GAS EXTRACTION	0.0069099	0.011844	0.0068445	0.006607
4 GASOLINE	0.0036340	0.028997	0.0023838	0.015118
5 JET FUEL	0.0036340	0.028998	0.0023838	0.015118
6 KEROSENE	0.0036340	0.028998	0.0023838	0.015118
7 DISTILLATE FUEL OIL	0.0036340	0.028997	0.0023838	0.015118
8 RESIDUAL FUEL OIL	0.0036340	0.028997	0.0023838	0.015118
9 LPG	0.0036340	0.028997	0.0023838	0.015118
10 ALL OTHER PETROLEUM REFINING	0.0036340	0.028997	0.0023838	0.015118
11 ASPHALT AND TAR PRODUCTS	0.0029087	0.018774	0.0027450	0.010409
12 ELECTRICITY, FOSSIL FUEL	0.0012751	0.064860	0.0012923	0.051301
13 ELECTRICITY, NUCLEAR POWER	0.0000081	0.117456	0.0000079	0.115341
14 ELECTRICITY, HYDROPOWER	0.0000078	0.122491	0.0000075	0.121370
15 NATURAL GAS UTILITIES	0.0010454	0.372104	0.0009362	0.333053
16 MEAT ANIMALS	0.0014751	0.005109	0.0011501	0.003157
17 OTHER LIVESTOCK PRODUCTS	0.0017059	0.005992	0.0013306	0.003691
18 GRAINS	0.0000000	0.012335	0.0000000	0.007579
19 OTHER CROPS AND AG. SERVICES	0.0006737	0.009908	0.0005297	0.005892
20 FORESTRY AND FISHERIES	0.0001477	0.005163	0.0001152	0.002939
21 IRON MINING	0.0212885	0.032145	0.0231601	0.029451
22 NONFERROUS METALS MINING	0.0239319	0.016857	0.0214231	0.013890
23 NONMETALLIC MINERALS	0.0168286	0.030958	0.0152756	0.023083
24 NEW RESIDENTIAL BUILDINGS	0.0001268	0.006135	0.0001139	0.003632
25 MOBILE HOMES	0.0004369	0.007744	0.0005276	0.004745
26 NEW NONRESIDENTIAL BUILDINGS	0.0001010	0.006949	0.0000881	0.004115
27 NEW ENERGY ACTIVITY STRUCTURES	0.0000401	0.008151	0.0000364	0.004607
28 NEW HIGHWAYS & STREETS	0.0000504	0.009683	0.0000470	0.005530
29 ALL OTHER NEW CONSTRUCTION	0.0000601	0.007757	0.0000546	0.004548
30 MAINT. & REPAIR, RESIDENTIAL	0.0001257	0.005586	0.0001124	0.003283
31 M & R, NONRESIDENTIAL BLDGS.	0.0002835	0.005953	0.0002549	0.003461
32 M & R, ENERGY ACTIVITY STRUCTS.	0.0001439	0.000000	0.0001304	0.000000
33 M & R, HIGHWAYS & STREETS	0.0002105	0.006975	0.0002005	0.004005
34 ALL OTHER M & R	0.0002371	0.005329	0.0002120	0.003086
35 ORDNANCE	0.0057345	0.008594	0.0036345	0.004798
36 MEAT PACKING	0.0008399	0.004579	0.0007587	0.002814
37 DISTILLING	0.0015858	0.007118	0.0015470	0.004744
38 ALL OTHER FOOD & KINDRED	0.0016639	0.007827	0.0012908	0.004699
39 TOBACCO	0.0006848	0.003856	0.0006011	0.002293
40 TEXTILES	0.0042854	0.011548	0.0035889	0.006915
41 APPAREL	0.0013351	0.006718	0.0013165	0.004057
42 LOGGING AND SAW MILLS	0.0028944	0.006214	0.0026026	0.003388
43 OTHER LUMBER AND WOOD	0.0036387	0.009803	0.0033845	0.005320
44 HOUSEHOLD FURNITURE	0.0019196	0.007392	0.0020642	0.004403
45 OTHER FURNITURE	0.0020367	0.009853	0.0019254	0.005573
46 PULP AND PAPER MILLS	0.0138516	0.029604	0.0101859	0.014828
47 OTHER PAPER PRODUCTS	0.0030000	0.015552	0.0019727	0.007855
48 PRINTING AND PUBLISHING	0.0019481	0.009140	0.0017032	0.004832
49 CHEMICALS	0.0159058	0.050724	0.0122863	0.027262
50 PLASTICS	0.0090213	0.028945	0.0066590	0.015381
51 DRUGS	0.0025552	0.008173	0.0018389	0.004861
52 CLEANING & TOILET PREPARATIONS	0.0013130	0.010889	0.0010075	0.005892
53 PAINTS	0.0013879	0.016689	0.0010698	0.009146
54 RUBBER	0.0057092	0.013976	0.0043416	0.007961
55 LEATHER	0.0015741	0.006427	0.0013745	0.003759
56 GLASS	0.0092273	0.0331348	0.0089238	0.0224051
57 CEMENT	0.0359687	0.0780542	0.0293612	0.0424427
58 OTHER STONE & CLAY	0.0050821	0.0263589	0.0045814	0.0165964

Table 56 (continued)

Sector	1972 Direct: BTU Relative to All Intermediate Input	1972 Scaled Direct and Indirect: BTU Relative to Dollars of Induced Output, From Inverse Matrix	2000 Direct: BTU Relative to All Intermediate Input	2000 Scaled Direct and Indirect: BTU Relative to Dollars of Induced Output From Inverse Matrix
59 IRON & STEEL MFG.	0.0099777	0.0242086	0.0082282	0.0141861
60 ALUMINUM MFG.	0.0386966	0.0316031	0.0261427	0.0198017
61 OTHER PRIMARY NONFERROUS METALS MFG.	0.0037597	0.0140821	0.0037830	0.0098045
62 FABRICATED METALS	0.0028330	0.0127326	0.0025203	0.0074236
63 MACHINERY (NON-ELECTRICAL)	0.0026986	0.0095198	0.0020921	0.0052521
64 COMPUTING, ELECTRONICS, AND RELATED	0.0032238	0.0068141	0.0021709	0.0040747
65 REFRIGERATION & HEATING EQPMT.	0.0020787	0.0088305	0.0015038	0.0052320
66 HOUSEHOLD APPLIANCES	0.0022006	0.0098553	0.0019188	0.0058520
67 ELECTRIC LIGHTING	0.0027931	0.0101129	0.0024185	0.0060068
68 RADIO, TV & COMMUNIC. EQPMT.	0.0021503	0.0056230	0.0012542	0.0034104
69 ALL OTHER ELECTRIC MACH.	0.0035737	0.0097443	0.0025037	0.0057390
70 MOTOR VEHICLES & PARTS	0.0013429	0.0077878	0.0010458	0.0047634
71 TRUCKS, MOTORCYCLES & RELATED	0.0010302	0.0084287	0.0007728	0.0053848
72 AIRCRAFT	0.0029482	0.0061852	0.0016754	0.0037227
73 OTHER TRANSPORTATION EQPMT.	0.0020632	0.0084726	0.0017268	0.0048924
74 SCIENTIFIC INSTRUMENTS & RELATED	0.0024878	0.0069418	0.0017736	0.0041087
75 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	0.0018318	0.0082592	0.0013698	0.0047679
76 JEWELRY	0.0012905	0.0070687	0.0009914	0.0043246
77 OTHER MISCELLANEOUS MFG.	0.0021555	0.0088450	0.0045712	0.0058442
78 RAILROADS	0.0045854	0.0067515	0.0038134	0.0041463
79 LOCAL, SUBURBAN & INTERURBAN TRANS.	0.0055840	0.0071348	0.0049307	0.0043274
80 TRUCKING & WAREHOUSING	0.0002675	0.0031450	0.0002343	0.0017505
81 WATER TRANSPORT	0.0020076	0.0063665	0.0017920	0.0038062
82 AIR TRANSPORT	0.0008981	0.0066162	0.0008212	0.0035336
83 PIPELINES & OTHER TRANS.	0.0256575	0.0253726	0.0221839	0.0170301
84 COMMUNICATIONS	0.0080331	0.0022947	0.0050110	0.0015873
85 WATER & SANITARY SERVICE	0.0053013	0.0272219	0.0047055	0.0205824
86 WHOLESALE TRADE	0.0035911	0.0030898	0.0029710	0.0020631
87 RETAIL TRADE	0.0125538	0.0050471	0.0106520	0.0036840
88 BANKING	0.0046918	0.0030404	0.0038126	0.0021718
89 OTHER FINANCE & INSURANCE	0.0014334	0.0027234	0.0012196	0.0019324
90 OWNER OCCUPIED DWELLINGS	0.0000000	0.0010872	0.0000000	0.0006937
91 REAL ESTATE	0.0043451	0.0032132	0.0038516	0.0023049
92 HOTELS	0.0151656	0.0134779	0.0134273	0.0077647
93 PERSONAL SERVICES	0.0025620	0.0054699	0.0020235	0.0035863
94 BUSINESS SERVICES	0.0017307	0.0044338	0.0009856	0.0028559
95 EATING & DRINKING PLACES	0.0029925	0.0046465	0.0026587	0.0030811
96 AUTO REPAIR	0.0011419	0.0051959	0.0010102	0.0033241
97 AMUSEMENTS	0.0026677	0.0043032	0.0023148	0.0030495
98 HOSPITALS	0.0051070	0.0100811	0.0043413	0.0070963
99 OTHER MEDICAL SERVICES	0.0028183	0.0043653	0.0023771	0.0031604
100 EDUCATIONAL SERVICES	0.0068343	0.0071284	0.0057979	0.0050844
101 NON-PROFIT ORGNS.	0.0103533	0.0059220	0.0089238	0.0042612
102 SOCIAL SERVICES	0.0109102	0.0082564	0.0096564	0.0059331
103 POSTAL SERVICE & OTHER FED. ENTERP.	0.0090013	0.0065808	0.0078189	0.0042727
104 STATE & LOCAL ENTERPRISES	0.0063617	0.0398044	0.0063527	0.0254921
105 PERSONAL CONSUMPTION EXPEND.	0.0024565	-	0.0016625	-
106 GROSS PRIVATE DOMESTIC FIXED INVEST.	0.0000000	-	0.0000000	-
107 CHANGE IN INVENTORIES	0.0000000	-	0.0000000	-
108 EXPORTS	0.0003259	-	0.0003948	-
109 IMPORTS	0.0005913	-	0.0003686	-
110 FEDERAL GOVT. PURCHASES, DEFENSE	0.0028138	-	0.0037155	-
111 FEDERAL GOVT. PURCHASES, NON-DEFENSE	0.0017125	-	0.0053683	-
112 STATE & LOCAL, EDU.	0.0127690	-	0.0131565	-
113 STATE & LOCAL, OTHER	0.0020094	-	0.0017939	-

Table 57

Primary Energy Requirements (Direct and Indirect)
Induced by Final Demand, in Trillion BTU
and in Millions of 1972 Dollars,
by Sector, 1972 and 2000

Sector	1972		2000	
	Trillion BTU	Million Dollars	Trillion BTU	Million Dollars
1 COAL MINING	2385.9	1339	7062.6	4176
2 CRUDE PETROLEUM	-4895.1	-4108	-9696.5	-8385
3 NATURAL GAS EXTRACTION	316.4	85	266.4	73
4 GASOLINE	12917.8	26665	8797.0	20755
5 JET FUEL	470.7	972	1751.9	4133
6 KEROSENE	334.4	690	245.1	578
7 DISTILLATE FUEL OIL	1380.6	2850	1439.6	3396
8 RESIDUAL FUEL OIL	-1440.3	-2973	-30.0	-71
9 LPG	330.8	683	274.7	648
10 ALL OTHER PETROLEUM REFINING	77.6	160	448.8	1059
11 ASPHALT AND TAR PRODUCTS	15.8	115	7.4	77
12 ELECTRICITY, FOSSIL FUEL	7266.7	24859	9788.4	35949
13 ELECTRICITY, NUCLEAR POWER	8.4	586	59.8	6774
14 ELECTRICITY, HYDROPOWER	1193.0	677	1136.1	649
15 NATURAL GAS UTILITIES	11854.9	15313	10236.8	14867
16 MEAT ANIMALS	19.9	855	-1.6	-109
17 OTHER LIVESTOCK PRODUCTS	97.2	3774	98.5	6055
18 GRAINS	313.5	5946	756.0	21969
19 OTHER CROPS AND AG. SERVICES	553.4	12917	565.7	20404
20 FORESTRY AND FISHERIES	-37.2	-1194	-29.0	-1560
21 IRON MINING	-105.1	-1060	-132.0	-1577
22 NONFERROUS METALS MINING	-18.6	-287	-8.2	-169
23 NONMETALLIC MINERALS	-15.0	-150	3.7	51
24 NEW RESIDENTIAL BUILDINGS	2881.8	118393	3267.5	222636
25 MOBILE HOMES	243.7	8152	93.7	5184
26 NEW NONRESIDENTIAL BUILDINGS	2254.0	81656	2220.8	133328
27 NEW ENERGY ACTIVITY STRUCTURES	1025.9	27713	1230.9	57189
28 NEW HIGHWAYS & STREETS	1157.3	20965	543.0	16733
29 ALL OTHER NEW CONSTRUCTION	913.0	26578	840.6	40962
30 MAINT. & REPAIR, RESIDENTIAL	8.9	353	16.9	1079
31 M & R, NONRESIDENTIAL BLDGS.	200.9	6963	227.1	12903
32 M & R, ENERGY ACTIVITY STRUCTS.	0.0	0	0.0	0
33 M & R, HIGHWAYS & STREETS	328.5	6884	292.6	10485
34 ALL OTHER M & R	66.0	2400	114.8	6814
35 ORDNANCE	417.1	12366	737.9	39169
36 MEAT PACKING	826.1	42829	866.0	70424
37 DISTILLING	326.3	13194	428.2	26934
38 ALL OTHER FOOD & KINDRED	4050.6	143840	4465.6	256811
39 TOBACCO	228.9	13912	228.4	21875
40 TEXTILES	601.8	14170	1243.2	45732
41 APPAREL	1349.4	54147	2603.9	163426
42 LOGGING AND SAW MILLS	-26.8	-692	46.2	2086
43 OTHER LUMBER AND WOOD	15.4	407	20.9	932
44 HOUSEHOLD FURNITURE	444.6	14916	488.6	27251
45 OTHER FURNITURE	252.7	6722	282.1	13203
46 PULP AND PAPER MILLS	-133.5	-1278	-85.7	-1520
47 OTHER PAPER PRODUCTS	408.1	7282	509.6	16683
48 PRINTING AND PUBLISHING	553.3	16657	644.0	34556
49 CHEMICALS	1216.0	6905	1492.7	13400
50 PLASTICS	125.7	1213	175.4	2820
51 DRUGS	330.9	11040	898.9	46290
52 CLEANING & TOILET PREPARATIONS	714.2	16963	1215.8	47691
53 PAINTS	53.0	817	56.6	1383
54 RUBBER	502.5	9930	531.9	16999
55 LEATHER	242.3	9816	163.5	10657
56 GLASS	119.93	1400	200.2	3491
57 CEMENT	-18.06	-75	2.2	15
58 OTHER STONE & CLAY	102.94	1226	110.1	2037

Table 57 (continued)

Sector	1972 Trillion BTU	1972 Million Dollars	2000 Trillion BTU	2000 Million Dollars
59 IRON & STEEL MFG.	-459.82	-4335	-1183.7	-19307
60 ALUMINUM MFG.	-92.33	-818	-77.9	-1191
61 OTHER PRIMARY NONFERROUS METALS MFG.	-121.73	-2619	-112.2	-3582
62 FABRICATED METALS	623.48	12491	741.4	26169
63 MACHINERY (NON-ELECTRICAL)	2130.42	55839	2663.6	125731
64 COMPUTING, ELECTRONICS, AND RELATED	482.18	18793	837.2	54619
65 REFRIGERATION & HEATING EQPMT.	170.40	4954	286.3	14307
66 HOUSEHOLD APPLIANCES	449.88	12402	721.9	34229
67 ELECTRIC LIGHTING	98.10	2688	137.7	6344
68 RADIO, TV & COMMUNIC. EQPMT.	602.32	28473	1333.9	104244
69 ALL OTHER ELECTRIC MACH.	483.68	12928	713.2	32627
70 MOTOR VEHICLES & PARTS	3126.64	101462	2450.9	138128
71 TRUCKS, MOTORCYCLES & RELATED	279.01	8528	265.7	13229
72 AIRCRAFT	661.29	26619	1720.8	110847
73 OTHER TRANSPORTATION EQPMT.	475.20	13585	1009.6	50341
74 SCIENTIFIC INSTRUMENTS & RELATED	272.22	10030	517.3	32058
75 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	203.98	6196	498.5	25023
76 JEWELRY	120.78	4497	220.2	13532
77 OTHER MISCELLANEOUS MFG.	434.61	12439	795.6	38299
78 RAILROADS	289.37	7917	369.5	16286
79 LOCAL, SUBURBAN & INTERURBAN TRANS.	389.20	8274	310.0	10419
80 TRUCKING & WAREHOUSING	475.22	16909	596.4	34281
81 WATER TRANSPORT	311.78	7401	371.1	13861
82 AIR TRANSPORT	685.09	12316	1069.5	37252
83 PIPELINES & OTHER TRANS.	102.21	1177	138.1	2275
84 COMMUNICATIONS	216.90	22304	808.3	131762
85 WATER & SANITARY SERVICE	362.57	4927	599.7	11268
86 WHOLESALE TRADE	1352.88	79541	1874.6	175309
87 RETAIL TRADE	3056.10	143018	4967.0	355479
88 BANKING	275.68	21742	729.7	86770
89 OTHER FINANCE & INSURANCE	574.07	51638	1127.9	152262
90 OWNER OCCUPIED DWELLINGS	453.21	96268	910.4	293433
91 REAL ESTATE	780.08	55352	1377.1	149497
92 HOTELS	442.93	9354	731.0	26659
93 PERSONAL SERVICES	730.09	29525	640.8	41224
94 BUSINESS SERVICES	482.98	25451	1905.5	82247
95 EATING & DRINKING PLACES	1439.45	81043	2673.4	232883
96 AUTO REPAIR	669.03	29881	855.3	62443
97 AMUSEMENTS	255.03	15513	417.6	37955
98 HOSPITALS	1290.13	38183	4291.4	190853
99 OTHER MEDICAL SERVICES	669.97	45589	1621.7	159044
100 EDUCATIONAL SERVICES	556.34	18118	602.7	30550
101 NON-PROFIT ORGNS.	486.78	20090	626.7	40023
102 SOCIAL SERVICES	120.53	3987	150.2	7553
103 POSTAL SERVICE & OTHER FED. ENTERP.	104.90	4329	116.6	7760
104 STATE & LOCAL ENTERPRISES	381.57	3818	534.6	8331

Table 58

Million BTU of Primary Energy Required
Per Dollar of Induced Requirements
(Direct and Indirect)

Sector	1972	2000	2000/1972
1 COAL MINING	1.78235	1.69134	0.948941
2 CRUDE PETROLEUM	1.19158	1.15645	0.970514
3 NATURAL GAS EXTRACTION	3.71476	3.63595	0.978785
4 GASOLINE	0.48445	0.42385	0.874913
5 JET FUEL	0.48445	0.42385	0.874912
6 KEROSENE	0.48445	0.42385	0.874912
7 DISTILLATE FUEL OIL	0.48445	0.42385	0.874913
8 RESIDUAL FUEL OIL	0.48445	0.42385	0.874913
9 LPG	0.48445	0.42385	0.874914
10 ALL OTHER PETROLEUM REFINING	0.48445	0.42385	0.874913
11 ASPHALT AND TAR PRODUCTS	0.13755	0.09576	0.696152
12 ELECTRICITY, FOSSIL FUEL	0.29231	0.27229	0.931481
13 ELECTRICITY, NUCLEAR POWER	0.01441	0.00883	0.612822
14 ELECTRICITY, HYDROPOWER	1.76116	1.74969	0.993488
15 NATURAL GAS UTILITIES	0.77417	0.68858	0.889447
16 MEAT ANIMALS	0.02325	0.01483	0.637694
17 OTHER LIVESTOCK PRODUCTS	0.02576	0.01626	0.631459
18 GRAINS	0.05272	0.03441	0.652721
19 OTHER CROPS AND AG. SERVICES	0.04284	0.02772	0.647126
20 FORESTRY AND FISHERIES	0.03111	0.01860	0.597939
21 IRON MINING	0.09917	0.08369	0.843940
22 NONFERROUS METALS MINING	0.06462	0.04833	0.748002
23 NONMETALLIC MINERALS	0.09959	0.07110	0.713992
24 NEW RESIDENTIAL BUILDINGS	0.02434	0.01468	0.602962
25 MOBILE HOMES	0.02989	0.01807	0.604628
26 NEW NONRESIDENTIAL BUILDINGS	0.02760	0.01666	0.603413
27 NEW ENERGY ACTIVITY STRUCTURES	0.03702	0.02152	0.581418
28 NEW HIGHWAYS & STREETS	0.05520	0.03245	0.587895
29 ALL OTHER NEW CONSTRUCTION	0.03435	0.02052	0.597438
30 MAINT. & REPAIR, RESIDENTIAL	0.02520	0.01569	0.622649
31 M & R, NONRESIDENTIAL BLDGS.	0.02886	0.01760	0.609755
32 M & R, ENERGY ACTIVITY STRUCTS.	0.00000	0.00000	-
33 M & R, HIGHWAYS & STREETS	0.04772	0.02791	0.584753
34 ALL OTHER M & R	0.02749	0.01685	0.612748
35 ORDNANCE	0.03373	0.01884	0.558567
36 MEAT PACKING	0.01929	0.01230	0.637503
37 DISTILLING	0.02473	0.01590	0.642911
38 ALL OTHER FOOD & KINDRED	0.02816	0.01739	0.617488
39 TOBACCO	0.01645	0.01044	0.634575
40 TEXTILES	0.04247	0.02718	0.640058
41 APPAREL	0.02492	0.01593	0.639349
42 LOGGING AND SAW MILLS	0.03870	0.02217	0.572763
43 OTHER LUMBER AND WOOD	0.03786	0.02152	0.568376
44 HOUSEHOLD FURNITURE	0.02981	0.01793	0.601588
45 OTHER FURNITURE	0.03760	0.02136	0.568184
46 PULP AND PAPER MILLS	0.10440	0.05640	0.540193
47 OTHER PAPER PRODUCTS	0.05603	0.03055	0.545174
48 PRINTING AND PUBLISHING	0.03322	0.01864	0.561033
49 CHEMICALS	0.17611	0.11139	0.632540
50 PLASTICS	0.10365	0.06220	0.600135
51 DRUGS	0.02997	0.01942	0.647933
52 CLEANING & TOILET PREPARATIONS	0.04210	0.02549	0.605532
53 PAINTS	0.06484	0.04091	0.631011
54 RUBBER	0.05061	0.03129	0.618329
55 LEATHER	0.02468	0.01534	0.621428

Table 58 (continued)

Sector	1972	2000	2000/1972
56 GLASS	0.085684	0.057357	0.669410
57 CEMENT	0.239792	0.149809	0.624746
58 OTHER STONE & CLAY	0.083936	0.054062	0.644090
59 IRON & STEEL MFG.	0.106061	0.061307	0.578039
60 ALUMINUM MFG.	0.112926	0.065444	0.579528
61 OTHER PRIMARY NONFERROUS METALS MFG.	0.046489	0.031317	0.673653
62 FABRICATED METALS	0.049914	0.028330	0.567585
63 MACHINERY (NON-ELECTRICAL)	0.038153	0.021185	0.555263
64 COMPUTING, ELECTRONICS, AND RELATED	0.025658	0.015328	0.597410
65 REFRIGERATION & HEATING EQPMT.	0.034398	0.020010	0.581726
66 HOUSEHOLD APPLIANCES	0.036276	0.021091	0.581418
67 ELECTRIC LIGHTING	0.036498	0.021700	0.594551
68 RADIO, TV & COMMUNIC. EQPMT.	0.021154	0.012796	0.604906
69 ALL OTHER ELECTRIC MACH.	0.037414	0.021858	0.584233
70 MOTOR VEHICLES & PARTS	0.030816	0.017744	0.575796
71 TRUCKS, MOTORCYCLES & RELATED	0.032717	0.020085	0.613878
72 AIRCRAFT	0.024843	0.015524	0.624907
73 OTHER TRANSPORTATION EQPMT.	0.034980	0.020055	0.573320
74 SCIENTIFIC INSTRUMENTS & RELATED	0.027141	0.016136	0.594505
75 PHOTOGRAPHIC EQUIPMENT & SUPPLIES	0.032922	0.019923	0.605136
76 JEWELRY	0.026856	0.016275	0.605990
77 OTHER MISCELLANEOUS MFG.	0.034940	0.020773	0.594539
78 RAILROADS	0.036550	0.022691	0.620832
79 LOCAL, SUBURBAN & INTERURBAN TRANS.	0.047037	0.029756	0.632597
80 TRUCKING & WAREHOUSING	0.028105	0.017396	0.618967
81 WATER TRANSPORT	0.042126	0.026773	0.635543
82 AIR TRANSPORT	0.055628	0.028711	0.516124
83 PIPELINES & OTHER TRANS.	0.086806	0.060703	0.699292
84 COMMUNICATIONS	0.009724	0.006135	0.630869
85 WATER & SANITARY SERVICE	0.073592	0.053226	0.723246
86 WHOLESALE TRADE	0.017008	0.010693	0.628677
87 RETAIL TRADE	0.021369	0.013973	0.653891
88 BANKING	0.012679	0.008409	0.663230
89 OTHER FINANCE & INSURANCE	0.011117	0.007407	0.666304
90 OWNER OCCUPIED DWELLINGS	0.004708	0.003103	0.659055
91 REAL ESTATE	0.014093	0.009212	0.653636
92 HOTELS	0.047352	0.027421	0.579087
93 PERSONAL SERVICES	0.024728	0.015545	0.628636
94 BUSINESS SERVICES	0.018977	0.012226	0.644249
95 EATING & DRINKING PLACES	0.017762	0.011480	0.646322
96 AUTO REPAIR	0.022390	0.013697	0.611741
97 AMUSEMENTS	0.016440	0.011003	0.669289
98 HOSPITALS	0.033788	0.022485	0.665480
99 OTHER MEDICAL SERVICES	0.014696	0.010196	0.693828
100 EDUCATIONAL SERVICES	0.030707	0.019727	0.642427
101 NON-PROFIT ORGNS.	0.024230	0.015660	0.646302
102 SOCIAL SERVICES	0.030229	0.019880	0.657661
103 POSTAL SERVICE & OTHER FED. ENTERP.	0.024233	0.015027	0.620119
104 STATE & LOCAL ENTERPRISES	0.099931	0.064163	0.642076

to the 1972 figure. Here, the general consistency of most of the ratios is noteworthy, suggesting that interactions for all sectors are so pervasive that the national pattern greatly affects the result for the individual sector. Only the energy sectors show much divergence from the general level of roughly 0.60, the figure that emerged in chapter 5 as the economy-wide intensity of energy use in 2000 relative to that use in 1972.

In their companion study, Lareau and Darmstadter (23) applied data paralleling that of tables 57 and 58 to estimate the effect of changes in PCE on primary energy requirements; those data were obtained from the matrices of this study.

6.3.4 A Possible Extension of the Mixed Unit Matrices

In the mixed BTU-Dollar matrices employed here, an overall scale factor was used to convert dollar flows to BTU for sectors [1] through [10]. It can be hypothesized that a considerable improvement in measurement might be obtained by the use of individual sector scale factors for those cases, paralleling the procedures for the utility sectors. The hypothesis can draw on the argument that sectoral prices for energy can vary between sectors even though sectoral output and specific form of energy are measured in producer prices (24). The source for this variation most likely would be geographic variations in the location of buyers and sellers across sectors. Thus, if industry A purchases energy product, E, from a local seller with high production cost but low transportation cost, while industry B purchases E from a distant seller with low production cost but high transportation cost, then the purchase price of E to the two consumers can be the same while the producer price varies. Hence, the argument on producer prices could have some validity. However, available evidence suggests that the hypothesis of likely considerable improvements in measurement must be sharpened by recognizing an important distinction. It seems likely that little improvement in projections of total output would occur with the further use of individual scale factors, but that some other measures might be improved, e.g., entries in particular cells of an inverse matrix would likely be more precise. The evidence includes the following.

First, the similarity of results for direct scaling and for the mixed unit model (table 44 versus table 50) strongly suggests that further refinements of scale factors would have little effect on total output projections. Second, Herendeen has carried out some analyses of the effect of alternative forms of scaling and has developed an analytic confirmation of the intuition that individual sector scale factors yield more precise results than do overall

scale factors (25). However, it seems to us that our mixed model is close to Herendeen's "best" model, for several reasons. We accounted for a major source of price variation and hence the need for individual scale factors, by the use of individual scale factors for utilities. Again, an important feature of our work was the disaggregation of petroleum products across sectors, which eliminated an important source of price variation because of difference in petroleum product mix between sectors. And available evidence suggests that petroleum product prices are relatively invariant geographically (not surprising, given a world market price for crude oil) and that coal use is highly concentrated to the electric utilities (26), in turn suggesting that only modest impacts can be expected from geographic price variations. Third and last, we have recognized that there could be considerable payoff in understanding of relationships given improved information on individual sector row flows of electricity, in terms of the mix between fossil fuels, nuclear power and hydroelectric and other power, for both dollar and BTU flows. But it is likely that developing such information would be quite costly, so even here, some caution must be exercised in recommending this line of inquiry.

6.4 CONSUMPTION ESTIMATES AND PROJECTIONS

Consumption is obtained as the sum of output plus imports minus exports minus inventory change. Imports minus exports is defined as net imports, with imports measured as positive numbers, in contrast to their appearance as negative numbers in input-output tables. Since a positive inventory change reduces output available for consumption, it is subtracted from output.

It is the convention in energy statistics to exhibit consumption as the sum of primary energy output, plus net imports of all forms of energy (for example, petroleum products as well as crude petroleum) minus inventory change. In projections, inventory change is often set equal to zero.

A number of recent projections of U.S. energy consumption for the year 2000 are presented in table 59. Projections made in the late 1970's were on the order of 120 quads. Apparently, this was representative of projections being made around that time, for in the text accompanying the Department of Commerce forecast of 116 quads, there is this statement: "These values are at the low end of the scale in the forecasting community. Any further reduction would require a significant break with past policies and trends" (27). The DOE projections made in 1980 and 1981, however, suggest that such a break has occurred, with year 2000 projections around 100 quads. The year 2000 projec-

Table 59

Recent Alternative Projections of Energy Consumption for the Year 2000, in Quadrillion BTU (Quads)

Organization and Scenario	Date projection made	Projected Quads consumed, Year 2000
IEA (Oak Ridge) - lower scenario	1976	101.4
" - high scenario	1976	125.9
D & IBA (Commerce)	1977	116.0
DOE - EIA - high	1979	149.5
" - middle	1979	130.3
" - low	1979	121.0
DOE - EIA - high	1980	106.6
" - middle	1980	102.5
" - low	1980	97.2
DOE - OPPA - high	1981	110.0
" - middle	1981	99.4
" - low	1981	90.0

Sources: IEA (Oak Ridge): E.L. Allen, C.L. Cooper, F.C. Edmonds, J.A. Edmonds, D.B. Reister, A.M. Weinberg, C.F. Whittle, L.W. Zelby, U.S. Energy and Economic Growth, Institute for Energy Analysis, Oak Ridge Associated Universities, 1976, p. 50 in particular; D & IBA (Commerce): Domestic & International Business Administration, U.S. Dept. of Commerce, Forecast of Likely U.S. Energy Supply/Demand Balances for 1985 and 2000 and Implications for U.S. Energy Policy, Washington: U.S. National Technical Information Service, PB-266240, 1977, p. 26; DOE-EIA (1979): Extrapolated from 1985, 1990 and 1995 projections in U.S. Energy Information Administration, Energy Supply and Demand in the Mid-term: 1985, 1990 and 1995, DOE/EIA-0102152, April 1979, pp. 23, 25, 27; DOE-EIA (1980): U.S. Energy Information Administration, 1980 Annual Report to Congress, Vol. Three: Forecasts, DOE/EIA-0173(80)/3, table 4.3, p. 124; DOE-OPPA: U.S. Dept. of Energy, Office of Policy, Planning and Analysis, Energy Projections to the Year 2000, DOE/PE-0029, 1981, table 1-2, p. 1-7; those projections also appear in U.S. Department of Energy, The National Energy Policy Plan, DOE/5-0008, 1981, p. 22.

tion in our study is approximately 95 million quads, as shown in table 45, above. This is relatively close to the DOE projection, and if the downward trend in projections continues, the correspondence may well become exact. However, it should be recalled that though totals are close, a number of significant differences occur between the components of the DOE and the RFF projections, as detailed in the discussion of table 45 in section 6.1, above.

This study's consumption results reported in table 45 are amplified here by tables 60 and 61, which respectively show energy consumption in dollars and in BTU for both 1972 and 2000, by sector. Electricity is measured at point of consumption; the primary electricity figures appearing in table 45 are obtained by appropriate scaling of the electricity entries in tables 60 and 61, as discussed in section 6.3.3.

6.5 ENERGY IMPACT OF MANDATED FUEL ECONOMY

An issue raised in chapter 4 was how much of a trade-off occurred as a consequence of mandated increases in automobile fuel economy. Since plastics and aluminum were to be substituted for iron and steel, it seemed likely that the energy requirements of the former inputs, particularly aluminum, would cut into the energy savings brought about by lowered use of gasoline per automobile. The issue was addressed here as follows. The 1972 levels of final demand for [4] Gasoline and [70] Motor Vehicles were treated as the only inputs and multiplied by the 1972 inverse matrix to obtain corresponding output levels. Then, the same level of [70] and .66 the amount of [4] were treated as the "adjusted" level of demand to account only for the effects of increased fuel efficiency, all other things equal. The .66 scale factor was taken as a good approximation to the ultimate impact of increased fuel economy on the intensity of use of gasoline by final demand. The adjusted set of final demand requirements was then multiplied by two alternative inverses, in turn. The first was based on the 1972 technical coefficient matrix as modified to account only for the changes imposed on sector [70] as that sector's presumed response to the mandated fuel economy standards. Those changes are shown in table 24 above, and consist of scaled increases in [50] Plastics (Raw Materials), [54] Rubber and Finished Plastics, and [60] Aluminum, and of decreases in [56] Glass, [59] Iron and Steel and [61] Other Nonferrous Metals. The second inverse was the year 2000 inverse of this study, which accounted for a great many changes in addition to the sector [70] response. The "before" and "after" results are shown in table 62. Limiting the changes only to those presumed to occur for [70] implies a reduction in energy use (in dollars) only slightly below the

Table 60

Consumption of Energy by Sector,
in Million Dollars, 1972 and 2000

	RFF Sector	Output	Imports [109]	Exports [108]	Inventory Change [107]	Consumption[b]
				1972		
[1]	Coal mining	5,439.20	0.70	495.80	81.20	4,862.90
[2]	Crude petroleum	12,691.30	2,762.70	0.50	32.70	15,420.80
[3]	Natural gas extraction	4,039.00	0.00	0.00	42.60	3,996.40
[4]	Gasoline	16,936.40	10.60	3.40	37.80	16,905.80
[5]	Jet fuel	1,381.50	245.10	130.30	158.60	1,337.70
[6]	Kerosene	375.40	1.30	0.70	0.00	376.00
[7]	Distillate fuel oil	4,410.70	412.90	1.40	-80.90	4,903.10
[8]	Residual fuel oil	1,107.20	1,658.80	133.70	-51.40	2,683.70
[9]	LPG	999.10	79.80	37.90	0.00	1,041.00
[10]	All other petroleum ref.	3,617.00	459.80	391.00	-65.30	3,751.10
[12]	Electricity, fossil fuel[a]	29,731.25	62.49	35.25	0.00	29,758.49
[13]	Electricity, nuclear power[a]	849.05	2.02	1.14	0.00	849.93
[14]	Electricity, hydro & other[a]	1,043.60	2.49	1.40	0.00	1,044.69
[15]	Natural gas utilities	20,825.20	347.10	109.80	0.00	21,062.50
	Total	103,445.90	6,045.80	1,342.29	155.30	107,994.11
				2000		
[1]	Coal mining	10,067.89	0.36	1,983.20	162.71	7,922.34
[2]	Crude petroleum	13,378.42	5,800.00	0.00	13.45	19,164.97
[3]	Natural gas extraction	4,652.00	0.00	0.00	17.52	4,634.48
[4]	Gasoline	16,561.48	10.60	0.00	17.30	16,554.78
[5]	Jet fuel	3,814.58	245.10	247.81	72.57	3,739.30
[6]	Kerosene	367.86	1.30	0.00	0.00	369.16
[7]	Distillate fuel oil	6,635.01	206.50	0.00	-37.02	6,878.53
[8]	Residual fuel oil	3,240.59	663.50	254.27	-23.52	3,673.34
[9]	LPG	1,048.67	39.90	42.39	0.00	1,046.18
[10]	All other petroleum ref.	5,678.86	275.80	514.35	-29.88	5,470.19
[12]	Electricity, fossil fuel[a]	46,258.86	93.64	105.25	0.00	46,247.25
[13]	Electricity, nuclear power[a]	11,278.03	23.77	26.73	0.00	11,275.07
[14]	Electricity, hydro & other[a]	1,126.49	2.42	2.72	0.00	1,126.19
[15]	Natural gas utilities	24,250.52	780.98	277.13	0.00	24,754.37
	Total	148,359.26	8,143.87	3,453.85	193.13	152,856.15

[a]At point of consumption.

[b]Consumption = output + imports - exports - inventory change.

Table 61

Consumption of Energy, by Sector
in Trillion BTU, 1972 and 2000

	RFF Sector	Output	Imports [109]	Exports [108]	Inventory Change [107]	Consumption[b]
				1972		
[1]	Coal mining	14,499.49	1.87	1,321.67	214.46	12,965.23
[2]	Crude petroleum	21,927.90	4,773.37	0.86	56.50	26,643.91
[3]	Natural gas extraction	22,207.71	0.00	0.00	234.23	21,973.48
[4]	Gasoline	12,331.22	7.72	2.48	27.52	12,308.94
[5]	Jet fuel	1,976.67	350.69	186.44	226.93	1,913.99
[6]	Kerosene	486.22	1.68	0.91	0.00	486.99
[7]	Distillate fuel oil	5,680.06	531.73	1.80	-104.18	6,314.17
[8]	Residual fuel oil	2,447.74	3,667.19	295.58	-113.63	5,932.98
[9]	LPG	1,592.28	127.18	60.40	0.00	1,659.06
[10]	All other petroleum ref.	4,233.34	538.15	457.63	-76.43	4,390.29
[12]	Electricity, fossil fuel[a]	5,021.77	30.72	17.33	0.00	5,035.16
[13]	Electricity, nuclear power[a]	162.09	1.00	0.56	0.00	162.53
[14]	Electricity, hydro & other[a]	199.24	1.22	0.69	0.00	199.77
[15]	Natural gas utilities	20,182.30	1,804.92	570.96	0.00	21,416.26
	Total	112,948.03	11,837.44	2,917.31	465.40	121,402.76
				2000		
[1]	Coal mining	26,838.37	0.96	5,286.70	433.74	21,118.89
[2]	Crude petroleum	23,115.10	10,021.18	0.00	23.23	33,113.05
[3]	Natural gas extraction	25,578.21	0.00	0.00	96.31	25,481.90
[4]	Gasoline	12,058.25	7.72	0.00	12.59	12,053.38
[5]	Jet fuel	5,457.98	350.69	354.57	103.83	5,350.27
[6]	Kerosene	476.46	1.68	0.00	0.00	478.14
[7]	Distillate fuel oil	8,544.50	265.93	0.00	-47.67	8,858.10
[8]	Residual fuel oil	7,164.12	1,466.83	562.14	-51.99	8,120.80
[9]	LPG	1,671.27	63.59	67.56	0.00	1,667.30
[10]	All other petroleum ref.	6,646.53	322.80	602.00	-34.97	6,402.30
[12]	Electricity, fossil fuel[a]	7,868.67	46.03	51.74	0.00	7,862.96
[13]	Electricity, nuclear power[a]	2,200.23	11.69	13.14	0.00	2,198.78
[14]	Electricity, hydro & other[a]	219.13	1.19	1.34	0.00	218.98
[15]	Natural gas utilities	23,565.88	4,061.10	1,441.08	0.00	26,185.90
	Total	151,404.70	16,621.39	8,380.27	535.07	159,110.75

[a] At point of consumption.

[b] Consumption = output + imports - exports - inventory change.

Note: Small disagreements in output totals with table 44 involve round-off.

Table 62

Projected Outputs for Given Levels of Fuel Economy

Sector	Before 1972 Matrix	After Version (1) 1972 Matrix Modified to Account for [70] Changes	After Version (2) 2000 Matrix
	Final Demand in Millions of 1972 Dollars		
[4] Gasoline	11,798.6	7,787.1	7,787.1
[70] Motor vehicles	41,403.3	41,403.3	41,403.3
	Output in Millions of 1972 Dollars		
[1] Coal	339.4	266.0	242.6
[2] Crude petroleum	6,680.9	4,474.1	3,874.2
[3] Natural gas extraction	172.6	139.8	85.6
[4] Gasoline	11,943.2	7,874.4	7,875.5
[5] Jet fuel	29.6	27.5	23.5
[6] Kerosene	5.9	5.1	3.7
[7] Distillate fuel oil	131.8	114.9	90.3
[8] Residual fuel oil	150.7	118.2	79.0
[9] LPG	234.5	157.3	99.8
[10] All other petroleum products	680.2	493.8	354.7
[12] Electricity, fossil fuel	911.6	809.9	576.3
[13] Electricity, nuclear power	26.0	23.1	147.1
[14] Electricity, hydropower	32.0	28.4	14.9
[15] Natural gas utilities	862.4	703.4	425.7
All energy, total	22,200.8	15,235.9	13,893.6
[50] Plastics	653.3	844.9	1,214.3
[54] Rubber and plastics mfg.	2,007.4	2,913.8	3,122.3
[59] Iron & steel mfg.	7,422.4	4,932.3	3,299.6
[60] Aluminum mfg.	1,214.3	1,699.0	3,308.9
[70] Motor vehicles	53,599.3	53,581.6	53,596.6
All sectors, total	128,127.0	117,127.0	123,019.0

given reduction in gasoline use; the respective "after" percentages are 68.6 percent versus 66 percent. Electricity use declined on net to 89 percent of its "before" level, so the reduction imposed by the fall in gasoline use outweighed the increases from substitution of materials inputs.

With the use of the year 2000 matrix, the effects are even more pronounced. The percentage reduction in total energy use (in dollars) is now somewhat greater than the percentage reduction in gasoline (62.6 percent versus 66 percent); and electricity use falls to 76 percent of the "before" level. Parenthetically, it is of interest to note how much of the change in "After-Version (2)" is accounted for by the change in "After Version (1)"; as might be expected, the change in gasoline consumption has a major impact on all energy use and, more generally, on output of a number of sectors.

It can be concluded that there is little reason for concern that gains from gasoline savings can be offset, or almost offset, by increased electricity use.

Of course, this exercise does not address other economic issues that are involved, including the real cost of the fuel economy in terms of increased real prices of automobiles to consumers, and possible multiplier effects of such cost increases. It is of some interest here that although the decline in gasoline consumption was roughly 4.1 billion dollars, the decline in all sector output was 7.0 billion dollars more in "After Version (1)", and 1.0 billion dollars more in "After Version (2)". (The smaller reduction in the latter case is probably explained by the counter effects of increased computerization, business services, etc.) Whether the decline in output is a good or bad thing must hinge on the implications for real income, as well as on energy savings. Here, input-output results, per se, tend to be ambiguous. In such cases more information is needed. For example, a marked decline in gasoline use could occur solely in response to higher energy prices, with a net reduction in real income an associated consequence (via the "OPEC Tax"). On the other hand, "economic" changes in technology could reduce gasoline consumption markedly at little cost in increased motor vehicle prices or reduced travel, with a net increase in real income the consequence. Finally, it may be that the basic question is not particularly meaningful <u>if</u> the primary concern of policy is to conserve petroleum rather than energy. But given considerable substitutability between different forms of energy, a policy of overall energy conservation seems consistent with, as well as a generalization of, petroleum conservation.

6.6 ENERGY EMBODIED IN IMPORTS, EXPORTS AND PRODUCTION FOR HOME MARKET

The input-output inverse matrix can be applied to develop estimates and insights on energy "embodied" in imports, exports and production for the "home market", consisting of domestic production consumed domestically. To make that application, some brief mathematical development is necessary. Let Z denote the inverse matrix, F the final demand vector, and, in the usual fashion, ZF=X, where X is the vector of output produced by U.S. industries. Now X-F equals the total of "indirect requirements" on U.S. production, equivalent to the amount of processing necessary to deliver the direct requirements, F, to the ultimate consumers. It is possible to extend these relationships to imports and exports, given some important assumptions, and then to develop insights based on that extension.

Let E equal exports and M equal imports, where the entries in M are all positive; this statement on the sign of the entries is stressed to avoid confusion, because imports appear in the flow table with negative signs. Here, the negative signs come after the fact, and are not part of M. The key assumption that is now made is that it is legitimate to write ZE and ZM as a way of calculating both direct and indirect requirements induced in the production of exports and imports, respectively. Treating E and M as direct requirements, it follows that ZE-E and ZM-M account for indirect requirements or processing necessary to produce exports and imports, respectively. In the case of exports, the assumption that ZE properly expresses export production flows directly from the assumption that ZF=X is a good representation of the workings of the U.S. economy. However, the assumption that ZM properly expresses import production corresponds to assuming that the structure of the U.S. economy holds for the rest of the world, in terms of the mix of inputs relative to output, for each sector. Of course, the assumption is open to question. But it can be defended as a very rough approximation that yields some useful insights.

In particular, we can form E, ZE-E, and ZE, and M, ZM-M, and ZM, and examine the energy content of each. Each expression yields a vector of requirements on individual sectors; we find the energy content in each case by summing over the energy sectors, [1] through [10], plus [12] through [15]. Thus, we find the energy embodied not only in direct U.S. export and import requirements, but in the indirect export and import requirements, as well. In the case of exports, the indirect requirements consist of U.S. processing carried out in the U.S. that is needed to produce the goods that are exported to the rest of the

world. In the case of imports, the indirect requirements consist of processing carried out abroad that is needed to produce the goods that the U.S. imports.

We can extend the discussion by introducing the notions of "production for the domestic market" and "U.S. requirements on the world." Let D denote the domestic component of final demand, in practice corresponding to PCE, Gross Private Domestic Fixed Investment, Change in Business Inventories, and government expenditures. Then it follows from previous definitions that F=D+E-M, and consequently ZF=Z(D+E-M) = ZD+ZE-ZM. Since ZF=X, or total U.S. production, we can interpret X-ZE as U.S. production that is produced for the domestic market, i.e., we exclude direct and indirect requirements for exports. We can also define W=X+ZM as the total of U.S. production plus imports and processing abroad that is required for imports, and label W the U.S. requirements on the World. Note that W=ZD+ZE-ZM+ZM, or W=ZD+ZE. W can also be viewed as the total requirements on the U.S. economy if imports from abroad were to be replaced by domestic production while exports remained unchanged.

Finally, if we employ a BTU-Dollar inverse matrix, and translate energy amounts into BTU in the export and import vectors, we can calculate export and import energy requirements in BTU, paralleling the earlier procedures with final demand. In terms of the previous notation, we can obtain direct and indirect BTU requirements for exports and imports from Z*E* and Z*M*, respectively, where the * indicates that energy is measured in BTU.

Those procedures were implemented here with results in the form of transactions shown in table 63 for 1972 and in table 64 for projected 2000. Those tables present total requirements on all sectors (in dollars, of course), and energy requirements in both dollars and BTU. There are three groupings of results: requirements for W,X and X-ZE; for E, ZE-E and ZE; and for M, ZM-M, and ZM. (Those symbols are used here as general notation embracing the BTU cases as well as the dollar cases.)

Tables 63 and 64 show that trade as a whole comprises a relatively small share of the U.S. total. Thus we find these proportions, applying the data in the respective first rows of tables 63 and 64:

Table 63

Energy Requirements and Total Requirements by Forms of Production and Trade, 1972, in Dollars and BTU

Total and Energy Requirements in Millions of 1972 Dollars Energy Requirements in Trillion BTU	U.S. Reqts. on World W	U.S. Production X	U.S. Production for Domestic Market X-ZE	Exports			Imports		
				Direct E	Indirect ZE-E	Direct & Indirect ZE	Direct M	Indirect ZM-M	Direct & Indirect ZM
All Requirements, million dollars	2,090,348	1,964,289	1,849,558	57,026	57,705	114,731	55,705	70,353	126,058
Energy Requirments, million dollars	116,004	103,445	97,378	1,343	4,705	6,048	6,047	6,511	12,558
Coal	5,864	5,439	4,588	496	356	852	1	424	425
Crude Petroleum	17,689	12,691	11,561	1	1,130	1,130	2,763	2,235	4,998
Nat. Gas Extract.	4,333	4,039	3,855	0	184	184	0	294	294
Pet. Products	32,861	28,827	26,935	698	1,193	1,892	2,869	1,165	4,034
Electricity	32,915	31,634	30,573	38	1,006	1,051	67	1,223	1,290
Nat. Gas Utilities	22,342	20,825	19,866	110	829	939	347	1,169	1,517
Energy Requirements, Trillion BTU	137,544	112,948	101,752	2,917	8,279	11,196	11,838	12,759	24,597
Coal	15,884	14,500	12,063	1,322	1,115	2,437	2	1,384	1,385
Crude Petroleum	30,617	21,928	19,941	1	1,986	1,987	4,773	3,916	8,689
Nat. Gas Extract	25,989	22,208	20,179	0	2,029	2,029	0	3,781	3,781
Pet. Products	35,614	28,746	26,110	1,004	1,633	2,636	5,225	1,639	6,864
Electricity	5,772	5,383	5,093	19	271	290	33	356	389
Nat. Gas Utilities	23,670	20,182	18,366	571	1,245	1,816	1,805	1,683	3,488

Table 64

Energy Requirements and Total Requirements by Forms of Production and Trade, Projected 2000, in Dollars and BTU

Total and Energy Requirements in Millions of 1972 Dollars	U.S. Reqts. on World W	U.S. Production X	U.S. Production for Domestic Market X-ZE	Exports			Imports		
				Direct E	Indirect ZE-E	Direct & Indirect ZE	Direct M	Indirect ZM-M	Direct & Indirect ZM
All Requirements, Million Dollars	5,066,858	4,692,728	4,334,340	167,735	190,652	358,388	159,817	214,313	374,130
Energy Requirements, Million Dollars	166,503	148,359	135,259	3,453	9,646	13,100	8,144	9,999	18,143
Coal	10,838	10,068	7,298	1,983	787	2,770	0	770	770
Crude Petroleum	21,213	13,378	11,285	0	2,094	2,094	5,800	2,034	7,834
Nat. Gas Extraction	5,168	4,652	4,314	0	338	338	0	516	516
Pet. Products	40,663	37,347	33,828	1,058	2,461	3,519	1,443	1,874	3,317
Electricity	61,688	58,663	56,002	135	2,526	2,661	120	2,904	3,024
Nat. Gas Utilities	26,933	24,251	22,532	277	1,441	1,718	781	1,901	2,682
Energy Requirements, Trillion BTU	186,914	151,405	126,943	8,380	16,082	24,462	16,621	18,888	35,509
Coal	29,442	26,838	19,032	5,287	2,520	7,806	1	2,602	2,603
Crude Petroleum	36,708	23,115	19,456	0	3,659	3,659	10,021	3,571	13,593
Nat. Gas Extraction	32,463	25,578	21,749	0	3,829	3,829	0	6,885	6,885
Pet. Products	47,094	42,019	37,151	1,586	3,282	4,868	2,479	2,596	5,075
Electricity	11,197	10,289	9,528	66	695	762	59	851	909
Nat. Gas Utilities	30,010	23,566	20,028	1,441	2,097	3,538	4,061	2,383	6,444

	1972	2000
(X-ZE)/W	.885	.855
ZE/W	.055	.071
ZM/W	.060	.074
Total	1.000	1.000

An upward trend in trade is exhibited in these proportions.

Energy requirements, of course, make up a much smaller share of W, as obtained by dividing entries appearing in the respective second rows of tables 63 and 64 by the grand total for W appearing in the first row of each table:

	1972	2000
(X-ZE), energy/W	.0466	.0267
ZE, energy/W	.0029	.0026
ZM, energy/W	.0060	.0036
Total	.0555	.0329

From tables 63 and 64 it can also be seen that the energy embodied in U.S. imports exceeds that in U.S. exports, so that the U.S. was a net importer of both direct and indirect energy in 1972 and is projected to continue in that status in 2000. There are some important caveats, however. First, the indirect energy requirements for exports are much more pronounced than those for imports, relative to the corresponding direct level, and are also more pronounced than is the case for all sector exports and imports. Thus, if we compare indirect to direct requirements for the various trade categories we find:

Energy	1972	2000
(ZE-E)/E	3.504	2.794
(ZM-M)/M	1.077	1.228
All		
(ZE-E)/E	1.012	1.137
(ZM-M)/M	1.270	1.340

Second, the year 2000 projection exhibits a trend to a reduction in the net imports of embodied energy, as is apparent in these comparisons, in billions of 1972 dollars:

1972	Exports	Imports	Net Trade Exports-Imports
Direct Energy	1.343	6.047	-4.704
Indirect Energy	4.705	6.511	-1.806
Total Embodied Energy	6.048	12.588	-6.510
2000			
Direct Energy	3.455	8.144	-4.689
Indirect Energy	9.646	9.999	-0.353
Total Embodied Energy	13.100	18.143	-5.043

Much of the explanation for these patterns involves the higher multiplier effects for refined than for crude petroleum, with substantial U.S. imports of crude petroleum; and the projected shifts to greater exports of coal and reduced imports of refined petroleum products, albeit with considerable imports of crude petroleum in 2000. The following comparisons of direct and total requirements by energy sector document the conclusion:

	2000/1972			
	Exports		Imports	
	E2000/E1972	ZE2000/ZE1972	M2000/M1972	ZM2000/ZM1972
Coal	4.00	3.25	-	1.81
Crude Petroleum	-	1.85	2.10	1.57
Nat. Gas Extract.	-	1.84	-	1.76
Pet. Prod.	1.52	1.86	0.50	0.82
Electricity	3.55	2.53	1.79	2.34
Nat. Gas	2.52	1.83	2.25	1.77

Of course, some effects here must be attributed to trends in imports and exports of nonenergy sectors, e.g., changes in grain exports and in automobile and steel imports. Future work could be directed to disaggregating effects of energy and nonenergy sector trade on indirect requirements for energy, perhaps examining individual effects of important sectors, as well.

Given the transaction values shown in tables 63 and 64, corresponding ratios of energy requirements to total requirements were derived, and are shown in tables 65 and 66, for 1972 and 2000, respectively. The ratios in those tables are indicators of the importance of energy requirements in the various forms of production and trade for both 1972 and 2000. In both years, energy requirements as a fraction of total are a bit higher for U.S. requirements on the world, W, than for U.S. production, X; further, the fraction is higher for X than it is for U.S. production for the home market (X-ZE). The share of direct energy requirements in exports (E) is below the share for all U.S. requirements

Table 65

Energy Requirements as a Share of Total Requirements, by Forms of Production and Trade, 1972, Dollar and BTU Comparisons

Energy Requirements Relative to All Dollar Requirements	U.S. Reqts. on World W	U.S. Production X	U.S. Production for Domestic Market X-ZE	Exports			Imports		
				Direct E	Indirect ZE-E	Direct & Indirect ZE	Direct M	Indirect ZM-M	Direct & Indirect ZM
Dollars per Dollar									
Energy/All	.05549	.05266	.05265	.02355	.08154	.05271	.10855	.09255	.09962
Coal/All	.00281	.00277	.00248	.00870	.00617	.00743	.00002	.00603	.00337
Crude Petrol./All	.00846	.00646	.00625	.00002	.01958	.00985	.04960	.03177	.03965
Nat. Gas Extract./All	.00207	.00206	.00208	.00000	.00319	.00160	.00000	.00418	.00233
Pet. Prods./All	.01572	.01468	.01456	.01224	.02067	.01649	.05150	.01656	.03200
Electricity/All	.01575	.01610	.01653	.00067	.01755	.00916	.00120	.01738	.01023
Nat. Gas Ut./All	.01069	.01060	.01074	.00193	.01437	.00818	.00623	.01662	.01203
Million BTU per Dollar									
Energy/All	.06580	.05750	.05501	.05115	.14347	.09758	.21251	.18136	.19512
Coal/All	.00760	.00738	.00652	.02318	.01932	.02124	.00004	.01967	.01099
Crude Petrol./All	.01465	.01116	.01078	.00002	.03442	.01732	.08568	.05566	.06893
Nat. Gas Extract./All	.01243	.01131	.01091	.00000	.03516	.01768	.00000	.05374	.02999
Pet. Prods./All	.01704	.01463	.01412	.01761	.02830	.02298	.09380	.02330	.05445
Electricity/All	.00276	.00274	.00275	.00033	.00470	.00253	.00059	.00506	.00309
Nat. Gas Ut./All	.01132	.01027	.00993	.01001	.02158	.01583	.03240	.02392	.02767

Table 66

Energy Requirements as a Share of Total Requirements, by Forms of Production and Trade, Projected 2000, Dollar and BTU Comparisons

Energy Requirements Relative to All Dollar Requirements	U.S. Reqts. on World W	U.S. Production X	U.S. Production for Domestic Market X-ZE	Exports			Imports		
				Direct E	Indirect ZE-E	Direct & Indirect ZE	Direct M	Indirect ZM-M	Direct & Indirect ZM
Dollars per Dollar									
Energy/All	.03286	.03161	.03121	.02059	.05059	.03655	.05096	.04666	.04849
Coal/All	.00214	.00215	.00168	.01182	.00413	.00773	.00000	.00359	.00206
Crude Petrol./All	.00419	.00285	.00260	.00000	.01098	.00584	.03629	.00949	.02094
Nat. Gas Extract./All	.00102	.00099	.00100	.00000	.00177	.00094	.00000	.00241	.00138
Pet. Prods./All	.00803	.00796	.00780	.00631	.01291	.00982	.00903	.00874	.00887
Electricity/All	.01218	.01250	.01292	.00080	.01325	.00742	.00075	.01355	.00808
Nat. Gas Ut./All	.00532	.00517	.00520	.00166	.00756	.00479	.00489	.00887	.00717
Million BTU per Dollar									
Energy/All	.03689	.03226	.02929	.04996	.08435	.06826	.10400	.08813	.09491
Coal/All	.00581	.00572	.00439	.03152	.01322	.02178	.00001	.01214	.00696
Crude Petrol./All	.00724	.00493	.00449	.00000	.01919	.01021	.06270	.01666	.03633
Nat. Gas Extract./All	.00641	.00545	.00502	.00000	.02008	.01068	.00000	.03213	.01840
Pet. Prods./All	.00929	.00895	.00857	.00946	.01721	.01358	.01551	.01211	.01356
Electricity/All	.00221	.00219	.00220	.00039	.00365	.00213	.00037	.00397	.00243
Nat. Gas Ut./All	.00592	.00502	.00462	.00859	.01100	.00987	.02541	.01112	.01722

(W) and production (X), but when indirect requirements are considered, the share of energy in all export requirements (ZE) is about the same as that for W and X. The shares for imports are above those for production in both years, and generally above the corresponding shares for exports. However, in the projected 2000 case, the share for indirect requirements in imports is about the same as the share for indirect requirements in exports.

From tables 65 and 66 we can obtain projected changes in intensity of energy use for each category by dividing the 2000 entry by the 1972 entry. For all energy requirements the following values are obtained by carrying out those divisions:

	2000/1972
W	.59
X	.60
X-ZE	.59
E	.87
ZE-E	.62
ZE	.69
M	.47
ZM-M	.50
ZM	.49

For the economy as a whole, the projected decline in energy intensity in 2000 to 0.6 its value in 1972 restates a general result derived at other points in this report. This may seem surprising at first, since a reduction in intensity to 0.6 the base value was a minimum level that held only for gasoline and a number of uses of natural gas. However, the explanation probably lies in the concurrent increase in intensity of use of other sectoral output that was not balanced by compensating decreases for those sectors, in particular the increases in computers, communications and business services.

The greater decrease in import intensity than in export intensity might be rationalized by our projected greater increase in price for oil than for coal, i.e., the assumption was made that coal price increases would lag behind those for oil, and this was a factor explaining our more optimistic projections for coal exports than for oil imports.

6.7 SOME SUGGESTIONS FOR FUTURE RESEARCH

There appear to be some rich opportunities for future research stemming from the developments in this report. For example, the techniques developed in the preceding section could have a number of useful applications. Trends in PCE

and in international trade could be examined in terms of their estimated "full" energy impact. Tax policies could turn on the question of the greatest impact of taxes on use, both direct and indirect, or on indirect effects on imports and exports.

There is considerable scope for improvement in data, for extensions of analysis, and for more realistic assumptions. Improved information on the mix of inputs for individual refined petroleum products will likely improve the estimates of their multiplier effects. Individual sector information on the row flows of electricity output (that is, a detailed breakdown of fossil fuel, nuclear power and hydroelectric and other power use, by sector) would further clarify the interrelationships of the electricity sectors. Further improvement could come from extensions of predictive equations for electricity to explicitly account for cross elasticity effects for substitutes and for structural changes over time. Price controls have likely clouded natural gas price-quantity relationships, so improved estimates should become possible as controls diminish. Variations in projected percentage changes in prices and energy intensities might be established for individual sectors, given enough data and analysis.

Input-output models have the important, but costly, by-product of assembling and integrating a great deal of information on the economy, and in the present case, on energy-economy interrelationships. Though we necessarily devoted a great deal of effort to performing that function, it is obvious that much more could be done. In particular, we accepted the impacts of regional population and income shifts implicit in the BLS and Lareau-Darmstadter forecasts; but further independent analysis and projection of such shifts seems of considerable importance. For example, such shifts should have considerable impact on airconditioning and heating use of energy, and this is worth examination in detail. We also took account of some major trends in technology, but since major transformations of economic structure seem both to be occurring and yet to be difficult to perceive in clear fashion, considerable payoff to additional effort is likely here.

Again, investment and construction projections in final demand could be related to output in a recursive process involving a series of iterations; a related possibility would be to treat investment as an endogenous sector. The modification could be of particular help in comparing impacts of nuclear and fossil fuel power plant construction.

There is potential for further exploration and experimentation with the form of the input-output model. An example emerges from our employment of constant dollar (1972 dollar) tables; the alternative approach of current dollar tables deserves exploration. Bezdek and Wendling (28) have contrasted and compared the two, and summarized the opposing philosophies underlying them, but further examination and perhaps reconciliation appears of considerable merit.

Finally, despite these opportunities for refinement and extension, the current form of our model seems applicable to a number of projection and policy questions, and we hope, will receive such application.

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5. Minerals Yearbook, 1973, pp. 41, 42, 934 and 964.

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18. American Gas Association, 1972 Gas Facts, Arlington, Virginia, and Edison Electric Institute, Statistical Yearbook of the Electric Utility Industry for 1972, New York, 1973.

19. Ibid.

20. Minerals Yearbook, 1972, 1974, pp. 826-827.

21. Energy Information Administration, 1980 Annual Report to Congress, Vol. Two, p. 221.

22. See, for example, James M. Griffin, Capacity Measurement in Petroleum Refining, Lexington, Mass.: Heath Lexington Books, 1971; and G.O. Hobson, ed., Modern Petroleum Technology, New York: Halsted Press, 1973. Griffin presents a table (p. 6) showing the relative importance of various refinery products which includes ratios to total volume and to total value. The former divided by the latter yields scale factors that may be applicable in adjusting the interdependence coefficients of table 53.

23. Thomas Lareau and Joel Darmstadter, Energy and Household Expenditure Patterns, Washington, D.C., Resources for the Future, 1983. The efforts and suggestions of Lareau and Darmstadter, and of Jack Alterman of Resources for the Future, were of help in the development of our BTU-dollar matrix.

24. Personal communication from William D. Watson, Feb. 8, 1983.

25. This is based on our interpretation of Herendeen's case 3 versus his case 5, which seem to correspond to overall scale factors versus individual scale factors, in Robert A. Herendeen, "Input-Output Techniques and Energy Cost of Commodities," Energy Policy, June 1978, pp. 162-165.

26. For some of that evidence, see I. Hoch, Energy Use in the United States by State and Region; tables 68 and 69, pp. 128 and 129, and table A.2.4, p. 383, exhibit information on petroleum prices across states, with very little variation evident; table 170, p. 272, shows electric utility use of coal BTU as a share of total coal BTU was 63 percent of the total in 1972.

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APPENDIXES TO THIS REPORT

In addition to the coverage in the text of this report, a set of 10 appendixes present more detailed and specialized material. Because of their specialized nature, the bulk of those appendixes are not included in this document but can be obtained separately. Information on how to obtain any or all of those appendixes is available from the Renewable Resources Division, Resources for the Future, 1755 Massachusetts Avenue, N.W., Washington, D.C., 20036. This document does contain both the 1972 and projected 2000 inverse matrices because they seem likely to be of more general interest than the other appendixes.

The reference letters and titles of the 10 appendixes are as follows:

A. Cross Classification of BEA Sectors with Corresponding SIC Codes
B. Energy Use Relationships
C. Estimating Flows of Petroleum Products
D. Detail on Electric Utility Use of Inputs
E. Base (1972) Input-Output Tables
F. Utility Technical Coefficients and Prices Over Time
G. Details on Analysis and Projections of Energy Intensity in Use of Coal and Fuel Oil
H. Projected Year 2000 Technical Coefficient and Inverse Matrices
I. Source of Predictions of Residential Energy
J. BTU-Dollar Inverse Matrices

Appendix A supplements the cross-classification of RFF and BEA sectors, which appears at the conclusion of chapter 2, by exhibiting a list cross-classifying the BEA sectors with the corresponding industries in the Standard Industrial Classication (1). Appendix B amplifies table 1 of the text, which appears in chapter 2 and exhibits major energy consuming sectors. Three tables in appendix B show aspects of energy use in 1972 by individual sector. The sector order in the first table is by BEA code number; that table shows energy consumption for each sector in million dollars, sectoral consumption as a percentage of the energy consumed by all sectors, and sectoral consumption as a fraction of all inputs consumed by the individual sector. The second table presents similar information for sectors arrayed in rank order of energy use, running from highest to lowest level of dollar expenditures. Finally, the third table ranks sectors on the basis of energy consumption as a fraction of total inputs used, again running from highest to lowest level of use.

Appendix C supplements section 2.3.2 of the text by supplying detailed information on how Petroleum Refining, BEA sector (31.01000), was disaggregated to the seven RFF refined petroleum product sectors.

Appendix D amplifies the discussion of electric utility use of inputs that was presented in sections 2.3.3 and 2.3.4 of the text. It includes a detailed breakdown of the respective use of commodities by the private utility sector, the federal government utility sector, and the state and local utility sector by applying data developed by Nancy Simon (2).

Appendix E exhibits the three basic RFF input-output tables for 1972, including the commodity flow matrix, the technical coefficient matrix, and the inverse matrix, respectively labeled tables E1, E2 and E3. Table E3 is included in this document.

Appendix F presents underlying data and additional analysis employed in projecting manufacturing sector changes in the use of electricity and natural gas, as discussed in section 3.3 of the text. First, using the BEA sectoral classification, a set of tables show the technical coefficients and prices paid by manufacturing sectors for electricity and natural gas, respectively, both for 1972 and 1976. Then, the appendix presents results obtained in testing the hypothesis that groups of manufactures varied in their response to electricity price changes between 1972 and 1976, with results supporting an invariant response, in the sense that the same demand equation was applicable to all sectors.

Appendix G amplifies the discussion of the projection of energy intensities for coal and fuel oil, appearing in section 3.4 of the text. Energy intensities in manufactures, nonmanufactures and transportation are covered, in turn.

The projected year 2000 technical coefficient and inverse matrices comprise the contents of Appendix H, appearing as tables H1 and H2, respectively. Table H2 is included in this document.

Appendix I presents detailed information on the sources of the predictions of residential energy use, involving both fitted regression equations and an extension of trends for electricity, petroleum products and natural gas, in turn. The discussion amplifies sections 5.3.2 and 5.5 of the text.

Finally, appendix J presents the underlying documentation for section 6.3.3 of the text in the form of the RFF mixed BTU-dollar inverse matrices that were constructed for both 1972 and 2000.

The 1972 inverse matrix, appearing as appendix table E3, and the projected 2000 inverse matrix, appearing as appendix table H2, are now presented. See the appendix to chapter 2 of the text for the sector names and coverage for each RFF sector number.

REFERENCES

1. U.S. Office of Management and Budget, Standard Industrial Classification Manual, 1972, Washington, D.C., 1972.

2. Nancy W. Simon, "Subdivision of Electric Utilities in the 1972 Input-Output Study, 496 Order Tables," U.S. Department of Commerce, Bureau of Economic Analysis, Interindustry Economics Division (BE-51), 1981.

Table E3

The REF 104 Sector Inverse Coefficient Matrix (Direct and Indirect Requirements) - 1972 Base Year

ROW	COL1	COL2	COL3	COL4	COL5	COL6	COL7	COL8	COL9
ROW1	1.141048	0.001935	0.002030	0.003695	0.003695	0.003695	0.003695	0.003695	0.003695
ROW2	0.012545	1.027808	0.004775	0.543205	0.543205	0.543207	0.543205	0.543204	0.543205
ROW3	0.001121	0.001489	1.074900	0.005949	0.005949	0.005949	0.005949	0.005949	0.005949
ROW4	0.004044	0.002146	0.002251	1.002472	0.002472	0.002472	0.002472	0.002472	0.002472
ROW5	0.000381	0.000399	0.000419	0.000485	1.000485	0.000485	0.000485	0.000485	0.000485
ROW6	0.000049	0.000015	0.000016	0.000131	0.000131	1.000131	0.000131	0.000131	0.000131
ROW7	0.008313	0.002143	0.002248	0.002592	0.002592	0.002592	1.002592	0.002592	0.002592
ROW8	0.002379	0.001144	0.001200	0.006690	0.006690	0.006690	0.006690	1.006690	0.006690
ROW9	0.000474	0.000343	0.000359	0.018991	0.018991	0.018991	0.018991	0.018991	1.018991
ROW10	0.007848	0.002053	0.002154	0.046223	0.046223	0.046223	0.046223	0.046223	0.046223
ROW11	0.000298	0.000572	0.000600	0.000667	0.000667	0.000667	0.000667	0.000667	0.000667
ROW12	0.028403	0.013120	0.013762	0.018360	0.018360	0.018360	0.018360	0.018360	0.018360
ROW13	0.000811	0.000375	0.000393	0.000524	0.000524	0.000524	0.000524	0.000524	0.000524
ROW14	0.000997	0.000461	0.000483	0.000644	0.000644	0.000644	0.000644	0.000644	0.000644
ROW15	0.005733	0.007778	0.008159	0.028134	0.028134	0.028134	0.028134	0.028134	0.028134
ROW16	0.000899	0.001162	0.001219	0.001718	0.001718	0.001718	0.001718	0.001718	0.001718
ROW17	0.000244	0.000299	0.000313	0.000510	0.000510	0.000510	0.000510	0.000510	0.000510
ROW18	0.000427	0.000508	0.000533	0.000818	0.000818	0.000818	0.000818	0.000818	0.000818
ROW19	0.001028	0.000999	0.001048	0.001279	0.001279	0.001279	0.001279	0.001279	0.001279
ROW20	0.001907	0.000255	0.000267	0.000439	0.000439	0.000438	0.000439	0.000439	0.000439
ROW21	0.002095	0.000961	0.001008	0.000968	0.000968	0.000968	0.000968	0.000968	0.000968
ROW22	0.001672	0.000712	0.000747	0.001370	0.001370	0.001370	0.001370	0.001370	0.001370
ROW23	0.001204	0.000768	0.000806	0.001490	0.001490	0.001490	0.001490	0.001490	0.001490
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.003156	0.008722	0.009149	0.005850	0.005850	0.005850	0.005850	0.005850	0.005850
ROW31	0.012348	0.006498	0.006816	0.024113	0.024113	0.024113	0.024113	0.024113	0.024113
ROW32	0.002020	0.038863	0.040765	0.024185	0.024185	0.024185	0.024185	0.024185	0.024185
ROW33	0.000029	0.000041	0.000043	0.000070	0.000070	0.000070	0.000070	0.000070	0.000070
ROW34	0.001863	0.001464	0.001536	0.002696	0.002696	0.002696	0.002696	0.002696	0.002696
ROW35	0.000026	0.000024	0.000025	0.000035	0.000035	0.000035	0.000035	0.000035	0.000035
ROW36	0.000636	0.000875	0.000918	0.001250	0.001250	0.001250	0.001250	0.001250	0.001250
ROW37	0.000523	0.000818	0.000858	0.000958	0.000958	0.000958	0.000958	0.000958	0.000958
ROW38	0.001981	0.002478	0.002600	0.004556	0.004556	0.004556	0.004556	0.004556	0.004556
ROW39	0.000085	0.000108	0.000114	0.000132	0.000132	0.000132	0.000132	0.000132	0.000132
ROW40	0.006265	0.000953	0.000999	0.001770	0.001769	0.001769	0.001769	0.001769	0.001769
ROW41	0.001470	0.000373	0.000391	0.000458	0.000458	0.000458	0.000458	0.000458	0.000458
ROW42	0.012318	0.001100	0.001154	0.002061	0.002061	0.002061	0.002061	0.002061	0.002061
ROW43	0.000985	0.000822	0.000862	0.001170	0.001170	0.001170	0.001170	0.001170	0.001170
ROW44	0.000014	0.000019	0.000020	0.000020	0.000020	0.000020	0.000020	0.000020	0.000020
ROW45	0.000047	0.000070	0.000074	0.000057	0.000057	0.000057	0.000057	0.000057	0.000057
ROW46	0.003934	0.001942	0.002038	0.004307	0.004307	0.004307	0.004307	0.004307	0.004307
ROW47	0.005533	0.001621	0.001701	0.006036	0.006036	0.006036	0.006036	0.006036	0.006036
ROW48	0.002350	0.001734	0.001819	0.002688	0.002688	0.002688	0.002688	0.002688	0.002688
ROW49	0.021408	0.011909	0.012492	0.045893	0.045893	0.045893	0.045893	0.045893	0.045893
ROW50	0.003488	0.000995	0.001043	0.001877	0.001877	0.001877	0.001877	0.001877	0.001877
ROW51	0.000023	0.000020	0.000020	0.000047	0.000047	0.000047	0.000047	0.000047	0.000047
ROW52	0.000382	0.000237	0.000248	0.003737	0.003737	0.003737	0.003737	0.003737	0.003737
ROW53	0.001075	0.001414	0.001483	0.001706	0.001706	0.001706	0.001706	0.001706	0.001706
ROW54	0.014134	0.002664	0.002795	0.004731	0.004731	0.004731	0.004731	0.004731	0.004731
ROW55	0.000087	0.000090	0.000094	0.000135	0.000135	0.000135	0.000135	0.000135	0.000135
ROW56	0.000705	0.000662	0.000694	0.000882	0.000882	0.000882	0.000882	0.000882	0.000882

Table E3 (continued)

ROW	COL1	COL2	COL3	COL4	COL5	COL6	COL7	COL8	COL9
ROW57	0.000697	0.000645	0.000677	0.000644	0.000644	0.000644	0.000644	0.000644	0.000644
ROW58	0.007795	0.002895	0.003037	0.004347	0.004347	0.004346	0.004347	0.004347	0.004347
ROW59	0.034595	0.018995	0.019925	0.017528	0.017528	0.017528	0.017528	0.017528	0.017528
ROW60	0.003906	0.001796	0.001884	0.002558	0.002558	0.002558	0.002558	0.002558	0.002558
ROW61	0.011072	0.004245	0.004452	0.007399	0.007399	0.007399	0.007399	0.007399	0.007399
ROW62	0.027004	0.011913	0.012496	0.021790	0.021790	0.021790	0.021790	0.021790	0.021790
ROW63	0.075559	0.024658	0.025865	0.019302	0.019302	0.019302	0.019302	0.019302	0.019302
ROW64	0.001404	0.001378	0.001445	0.001362	0.001362	0.001362	0.001362	0.001362	0.001362
ROW65	0.000882	0.000825	0.000865	0.001287	0.001287	0.001287	0.001287	0.001287	0.001287
ROW66	0.000110	0.000224	0.000235	0.000176	0.000176	0.000176	0.000176	0.000176	0.000176
ROW67	0.003422	0.001737	0.001822	0.001970	0.001970	0.001970	0.001970	0.001970	0.001970
ROW68	0.000345	0.000472	0.000495	0.000554	0.000554	0.000554	0.000554	0.000554	0.000554
ROW69	0.003504	0.008581	0.009001	0.005730	0.005730	0.005730	0.005730	0.005730	0.005730
ROW70	0.003590	0.001733	0.001818	0.002122	0.002122	0.002122	0.002122	0.002122	0.002122
ROW71	0.000108	0.000053	0.000056	0.000070	0.000070	0.000070	0.000070	0.000070	0.000070
ROW72	0.000349	0.000489	0.000513	0.000462	0.000462	0.000462	0.000462	0.000462	0.000462
ROW73	0.000424	0.000176	0.000185	0.000867	0.000867	0.000867	0.000867	0.000867	0.000867
ROW74	0.000624	0.000936	0.000982	0.001429	0.001429	0.001429	0.001429	0.001429	0.001429
ROW75	0.000478	0.000368	0.000386	0.000557	0.000557	0.000557	0.000557	0.000557	0.000557
ROW76	0.000035	0.000044	0.000046	0.000056	0.000056	0.000056	0.000056	0.000056	0.000056
ROW77	0.001506	0.000794	0.000833	0.000961	0.000961	0.000961	0.000961	0.000961	0.000961
ROW78	0.007568	0.002849	0.002988	0.007740	0.007740	0.007740	0.007740	0.007740	0.007740
ROW79	0.001167	0.001116	0.001171	0.001272	0.001272	0.001272	0.001272	0.001272	0.001272
ROW80	0.010170	0.005063	0.005311	0.011866	0.011866	0.011866	0.011866	0.011866	0.011866
ROW81	0.002021	0.000911	0.000956	0.013977	0.013977	0.013977	0.013977	0.013977	0.013977
ROW82	0.005133	0.004872	0.005110	0.006405	0.006405	0.006405	0.006405	0.006405	0.006405
ROW83	0.001433	0.000663	0.000696	0.036832	0.036832	0.036832	0.036832	0.036832	0.036832
ROW84	0.005313	0.005613	0.005888	0.007972	0.007972	0.007972	0.007972	0.007972	0.007972
ROW85	0.001594	0.003126	0.003279	0.003882	0.003882	0.003882	0.003882	0.003882	0.003882
ROW86	0.047307	0.013054	0.013704	0.021902	0.021902	0.021902	0.021902	0.021902	0.021902
ROW87	0.002289	0.002509	0.002631	0.002994	0.002994	0.002994	0.002994	0.002994	0.002994
ROW88	0.006679	0.006191	0.006494	0.010663	0.010663	0.010663	0.010663	0.010663	0.010663
ROW89	0.009735	0.008806	0.009237	0.011575	0.011575	0.011575	0.011575	0.011575	0.011575
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.065481	0.180970	0.189829	0.121371	0.121371	0.121371	0.121371	0.121371	0.121371
ROW92	0.001229	0.001293	0.001356	0.001523	0.001523	0.001523	0.001523	0.001523	0.001523
ROW93	0.001986	0.001404	0.001473	0.001715	0.001715	0.001715	0.001715	0.001715	0.001715
ROW94	0.049267	0.037027	0.038839	0.057094	0.057094	0.057094	0.057094	0.057094	0.057094
ROW95	0.005511	0.008556	0.008975	0.009717	0.009717	0.009717	0.009717	0.009717	0.009717
ROW96	0.007421	0.003791	0.003976	0.004643	0.004643	0.004643	0.004643	0.004643	0.004643
ROW97	0.001071	0.000922	0.000967	0.001402	0.001402	0.001402	0.001402	0.001402	0.001402
ROW98	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
ROW99	0.000036	0.000038	0.000039	0.000049	0.000049	0.000049	0.000049	0.000049	0.000049
ROW100	0.000437	0.000083	0.000087	0.000276	0.000276	0.000276	0.000276	0.000276	0.000276
ROW101	0.001769	0.000844	0.000885	0.001181	0.001181	0.001181	0.001181	0.001181	0.001181
ROW102	0.000047	0.000030	0.000032	0.000041	0.000041	0.000041	0.000041	0.000041	0.000041
ROW103	0.002257	0.001807	0.001895	0.003002	0.003002	0.003002	0.003002	0.003002	0.003002
ROW104	0.000601	0.000643	0.000675	0.000970	0.000970	0.000970	0.000970	0.000970	0.000970
	1.735739	1.529106	1.603950	2.260009	2.260008	2.260010	2.260009	2.260007	2.260008

Table E3 (continued)

ROW	COL10	COL11	COL12	COL13	COL14	COL15	COL16	COL17	COL18
ROW1	0.003695	0.009263	0.114402	0.000978	0.000429	0.001390	0.002790	0.002534	0.001717
ROW2	0.543205	0.108705	0.032576	0.004790	0.002283	0.003432	0.016110	0.013968	0.024836
ROW3	0.005949	0.004922	0.014456	0.000645	0.000266	0.294312	0.001792	0.001805	0.002708
ROW4	0.002472	0.006630	0.002106	0.003585	0.002382	0.001996	0.012641	0.011006	0.018883
ROW5	0.000485	0.000540	0.001708	0.000158	0.000116	0.000287	0.000245	0.000284	0.000208
ROW6	0.000131	0.001324	0.000022	0.000021	0.000008	0.000010	0.000040	0.000051	0.000050
ROW7	0.002592	0.009523	0.008192	0.000694	0.000479	0.001117	0.008026	0.005824	0.011604
ROW8	0.006690	0.005098	0.046551	0.000461	0.000203	0.000708	0.001574	0.001498	0.001250
ROW9	0.018991	0.003834	0.001166	0.000185	0.000101	0.000177	0.002198	0.003102	0.004296
ROW10	1.046223	0.185316	0.004168	0.001705	0.001023	0.001292	0.003330	0.002673	0.005020
ROW11	0.000667	1.006674	0.000475	0.000364	0.000411	0.000514	0.000428	0.000362	0.000472
ROW12	0.018360	0.020715	1.140749	0.002979	0.001630	0.009648	0.020334	0.016658	0.007584
ROW13	0.000524	0.000592	0.000178	1.000395	0.000047	0.000276	0.000581	0.000476	0.000217
ROW14	0.000644	0.000727	0.000219	0.000105	1.000297	0.000339	0.000714	0.000585	0.000266
ROW15	0.028134	0.025271	0.076194	0.003183	0.001373	1.556290	0.009099	0.009224	0.013595
ROW16	0.001718	0.002209	0.001075	0.000944	0.000656	0.000793	1.596732	0.043848	0.047575
ROW17	0.000510	0.001125	0.000322	0.000287	0.000206	0.000205	0.027726	1.038743	0.015512
ROW18	0.000818	0.001387	0.000505	0.000449	0.000310	0.000353	0.404686	0.251567	1.044464
ROW19	0.001279	0.002350	0.004416	0.004032	0.003762	0.000776	0.051939	0.102145	0.029586
ROW20	0.000439	0.001257	0.000431	0.000251	0.000212	0.000211	0.001853	0.003596	0.000485
ROW21	0.000968	0.001082	0.000640	0.000651	0.000327	0.000604	0.000586	0.000620	0.000631
ROW22	0.001370	0.001100	0.000706	0.000788	0.000429	0.000423	0.000919	0.000870	0.001420
ROW23	0.001490	0.052809	0.000870	0.001376	0.000606	0.000738	0.003860	0.003039	0.008487
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.005850	0.002594	0.001843	0.000967	0.001190	0.003497	0.005702	0.004385	0.007919
ROW31	0.024113	0.010642	0.003838	0.001680	0.001003	0.003152	0.015963	0.013671	0.014683
ROW32	0.024185	0.006207	0.053304	0.049252	0.040583	0.042158	0.001899	0.001643	0.001799
ROW33	0.000070	0.000064	0.000056	0.000040	0.000095	0.000576	0.000051	0.000046	0.000083
ROW34	0.002696	0.006301	0.005596	0.001669	0.011695	0.010169	0.003450	0.003603	0.003421
ROW35	0.000035	0.000029	0.000024	0.000019	0.000014	0.000025	0.000025	0.000025	0.000027
ROW36	0.001250	0.001289	0.000767	0.000672	0.000462	0.000595	0.006724	0.013359	0.001144
ROW37	0.000958	0.000897	0.000709	0.000559	0.000458	0.000561	0.001239	0.001726	0.000555
ROW38	0.004556	0.011135	0.002285	0.002059	0.001355	0.001688	0.159657	0.332504	0.011950
ROW39	0.000132	0.000232	0.000103	0.000077	0.000078	0.000088	0.000095	0.000112	0.000076
ROW40	0.001769	0.012964	0.002093	0.001502	0.001085	0.000960	0.004734	0.006521	0.006535
ROW41	0.000458	0.000671	0.001098	0.001262	0.000729	0.000599	0.000405	0.000520	0.000312
ROW42	0.002061	0.007107	0.002338	0.001146	0.001077	0.001001	0.002291	0.003551	0.001883
ROW43	0.001170	0.004126	0.000837	0.000610	0.000738	0.000792	0.001564	0.001968	0.001177
ROW44	0.000020	0.000020	0.000013	0.000009	0.000008	0.000013	0.000018	0.000017	0.000018
ROW45	0.000057	0.000049	0.000062	0.000057	0.000044	0.000053	0.000045	0.000040	0.000044
ROW46	0.004307	0.025414	0.003188	0.002935	0.002668	0.001883	0.005650	0.010686	0.003396
ROW47	0.006036	0.064426	0.003132	0.002840	0.002149	0.001482	0.009643	0.023385	0.004040
ROW48	0.002688	0.003383	0.004805	0.005737	0.005043	0.002414	0.004411	0.005530	0.002542
ROW49	0.045893	0.027655	0.012444	0.040815	0.003247	0.006650	0.059412	0.049420	0.121449
ROW50	0.001877	0.008207	0.001476	0.001333	0.000831	0.000758	0.003446	0.003874	0.003707
ROW51	0.000047	0.000075	0.000045	0.000265	0.000138	0.000026	0.001524	0.004406	0.000160
ROW52	0.003737	0.008183	0.000638	0.000746	0.000554	0.000344	0.000716	0.003331	0.000631
ROW53	0.001706	0.002644	0.000928	0.000717	0.000737	0.000978	0.001225	0.001152	0.001344
ROW54	0.004731	0.022966	0.005200	0.003185	0.002356	0.002119	0.013582	0.013948	0.010680
ROW55	0.000135	0.000121	0.000135	0.000127	0.000092	0.000095	0.000142	0.001811	0.000121
ROW56	0.000882	0.001355	0.000586	0.000580	0.000674	0.000431	0.002930	0.005749	0.000699

Table E3 (continued)

ROW	COL10	COL11	COL12	COL13	COL14	COL15	COL16	COL17	COL18
ROW57	0.000644	0.007279	0.000727	0.004116	0.000529	0.000600	0.000257	0.000250	0.000252
ROW58	0.004347	0.037014	0.003753	0.002791	0.002332	0.002628	0.002077	0.002115	0.002049
ROW59	0.017528	0.018812	0.011595	0.011679	0.006410	0.009758	0.009523	0.010467	0.008302
ROW60	0.002558	0.003006	0.001485	0.001101	0.001075	0.001017	0.001750	0.002075	0.001506
ROW61	0.007399	0.005273	0.004520	0.003655	0.002980	0.002603	0.003491	0.003546	0.004072
ROW62	0.021790	0.025707	0.009394	0.005844	0.004949	0.006899	0.013902	0.019800	0.009051
ROW63	0.019302	0.016203	0.017231	0.009465	0.008484	0.009910	0.018062	0.014523	0.017815
ROW64	0.001362	0.001158	0.001404	0.001303	0.001015	0.001051	0.000899	0.000888	0.000792
ROW65	0.001287	0.001092	0.000782	0.000701	0.000620	0.000699	0.001323	0.001240	0.001156
ROW66	0.000176	0.000106	0.000120	0.000094	0.000085	0.000124	0.000168	0.000145	0.000208
ROW67	0.001970	0.001195	0.003523	0.002983	0.009659	0.002012	0.001081	0.000970	0.000944
ROW68	0.000554	0.000533	0.000411	0.000315	0.000305	0.000384	0.000498	0.000467	0.000376
ROW69	0.005730	0.002689	0.002886	0.002251	0.002158	0.003364	0.002397	0.002116	0.002569
ROW70	0.002122	0.005838	0.002843	0.003887	0.002119	0.001580	0.005288	0.004889	0.003457
ROW71	0.000070	0.000077	0.000064	0.000048	0.000038	0.000045	0.000063	0.000064	0.000056
ROW72	0.000462	0.000405	0.000171	0.000122	0.000090	0.000246	0.000194	0.000238	0.000174
ROW73	0.000867	0.001483	0.000655	0.000231	0.000093	0.000292	0.000683	0.000784	0.000564
ROW74	0.001429	0.001063	0.000573	0.000882	0.000538	0.000689	0.000499	0.000634	0.000485
ROW75	0.000557	0.002796	0.000896	0.000624	0.000813	0.000432	0.000510	0.000566	0.000420
ROW76	0.000056	0.000055	0.000054	0.000048	0.000037	0.000051	0.000048	0.000047	0.000031
ROW77	0.000961	0.001210	0.001256	0.001122	0.000827	0.000677	0.000853	0.000867	0.000706
ROW78	0.007740	0.035829	0.012402	0.005012	0.001449	0.002015	0.015181	0.017494	0.011325
ROW79	0.001272	0.003911	0.000894	0.000708	0.000420	0.001161	0.001154	0.001390	0.001008
ROW80	0.011866	0.077348	0.012776	0.006503	0.004111	0.003840	0.022005	0.038933	0.016132
ROW81	0.013977	0.012391	0.004766	0.001450	0.000408	0.000666	0.004716	0.004355	0.005351
ROW82	0.006405	0.007706	0.002870	0.002275	0.001637	0.003567	0.003087	0.003806	0.002789
ROW83	0.036832	0.008690	0.002858	0.000541	0.000272	0.000441	0.002052	0.001942	0.002835
ROW84	0.007972	0.009775	0.009123	0.006939	0.005753	0.006721	0.011766	0.010329	0.007548
ROW85	0.003882	0.003399	0.002084	0.002547	0.008864	0.002329	0.004160	0.003492	0.007708
ROW86	0.021902	0.063229	0.027691	0.011964	0.008254	0.008859	0.088577	0.075568	0.053356
ROW87	0.002994	0.003308	0.002249	0.001822	0.001684	0.002143	0.004383	0.008651	0.002539
ROW88	0.010663	0.008812	0.007663	0.003829	0.002795	0.008575	0.021595	0.015000	0.011388
ROW89	0.011575	0.013894	0.017123	0.011967	0.009569	0.011535	0.021637	0.018280	0.018038
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.121371	0.053819	0.038226	0.020051	0.024679	0.072535	0.118307	0.090585	0.164313
ROW92	0.001523	0.002031	0.001312	0.001126	0.000671	0.001758	0.001417	0.001542	0.001240
ROW93	0.001715	0.002375	0.007783	0.007744	0.006224	0.004310	0.001940	0.002495	0.001339
ROW94	0.057094	0.054046	0.041753	0.027872	0.023236	0.034191	0.044851	0.046537	0.041763
ROW95	0.009717	0.008479	0.007317	0.005841	0.004543	0.005761	0.006447	0.006398	0.005280
ROW96	0.004643	0.011802	0.006450	0.008372	0.004712	0.003765	0.011289	0.010333	0.007273
ROW97	0.001402	0.001342	0.001171	0.000777	0.000634	0.000788	0.001019	0.001069	0.000907
ROW98	0.000001	0.000001	0.000029	0.000012	0.000038	0.000002	0.000001	0.000001	0.000001
ROW99	0.000049	0.000065	0.000059	0.000043	0.000035	0.000049	0.004239	0.013902	0.000382
ROW100	0.000276	0.000307	0.000178	0.000083	0.000071	0.000060	0.000129	0.000151	0.000125
ROW101	0.001181	0.001809	0.001175	0.000489	0.000481	0.001309	0.001790	0.001702	0.001206
ROW102	0.000041	0.000078	0.000035	0.000028	0.000026	0.000022	0.000042	0.000048	0.000034
ROW103	0.003002	0.003207	0.005328	0.004797	0.004244	0.005410	0.002853	0.002796	0.002080
ROW104	0.000970	0.000792	0.000423	0.000968	0.001228	0.000553	0.000434	0.000459	0.000459
	2.260010	2.202646	1.837753	1.336929	1.257850	2.186428	2.933381	2.466212	1.863105

Table E3 (continued)

ROW	COL19	COL20	COL21	COL22	COL23	COL24	COL25	COL26	COL27
ROW1	0.001867	0.001551	0.010798	0.005799	0.006996	0.003467	0.005171	0.004321	0.005961
ROW2	0.018787	0.016543	0.011520	0.012184	0.020509	0.007326	0.008538	0.007962	0.013824
ROW3	0.002067	0.001020	0.007834	0.003051	0.005196	0.001619	0.002360	0.001887	0.002182
ROW4	0.011512	0.023646	0.003509	0.003305	0.007506	0.004183	0.004973	0.003006	0.010574
ROW5	0.000442	0.000314	0.000486	0.000360	0.000419	0.000423	0.000552	0.000501	0.000464
ROW6	0.000053	0.000614	0.000043	0.000053	0.000074	0.000250	0.000360	0.000115	0.000105
ROW7	0.010969	0.002221	0.007622	0.009243	0.017326	0.002944	0.003556	0.002719	0.006240
ROW8	0.001178	0.000827	0.003686	0.003064	0.004923	0.001290	0.001620	0.001418	0.001644
ROW9	0.002051	0.000806	0.000525	0.000448	0.000751	0.000293	0.000332	0.000308	0.000544
ROW10	0.003921	0.002405	0.004767	0.004022	0.007948	0.003703	0.003528	0.006273	0.005929
ROW11	0.000383	0.000130	0.000824	0.000274	0.000435	0.005414	0.002969	0.007070	0.002462
ROW12	0.008980	0.005830	0.049102	0.039370	0.036050	0.011033	0.016537	0.011785	0.012744
ROW13	0.000256	0.000166	0.001402	0.001124	0.001030	0.000315	0.000472	0.000337	0.000364
ROW14	0.000315	0.000205	0.001724	0.001382	0.001265	0.000387	0.000580	0.000414	0.000447
ROW15	0.010303	0.005143	0.041163	0.015776	0.027203	0.008399	0.012240	0.009787	0.011230
ROW16	0.014116	0.005420	0.001036	0.001007	0.000943	0.001919	0.002322	0.001776	0.001342
ROW17	0.015891	0.005983	0.000288	0.000280	0.000265	0.000609	0.000664	0.000520	0.000387
ROW18	0.011457	0.010228	0.000495	0.000484	0.000456	0.000993	0.001144	0.000869	0.000651
ROW19	1.090029	0.032726	0.001477	0.001009	0.000953	0.005892	0.004869	0.003025	0.001383
ROW20	0.001454	1.004867	0.000889	0.001417	0.000469	0.013941	0.019300	0.003045	0.002117
ROW21	0.000597	0.001237	1.022281	0.002410	0.002435	0.002300	0.004710	0.004228	0.007569
ROW22	0.001305	0.001163	0.013620	1.128792	0.001772	0.003857	0.007435	0.006008	0.010052
ROW23	0.004241	0.000982	0.006592	0.002380	1.031016	0.009087	0.002815	0.012973	0.007882
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.001981	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.005266	0.001522	0.011654	0.001952	0.002969	0.001595	0.001457	0.001601	0.001335
ROW31	0.013768	0.003896	0.030315	0.011838	0.011570	0.005052	0.006663	0.005874	0.006569
ROW32	0.001513	0.001129	0.003902	0.002786	0.003296	0.001076	0.001492	0.001173	0.001510
ROW33	0.000048	0.000024	0.000143	0.000052	0.000086	0.000046	0.000042	0.000044	0.000042
ROW34	0.002580	0.001653	0.004669	0.002592	0.003273	0.004405	0.005624	0.003630	0.003743
ROW35	0.000033	0.000030	0.000031	0.000026	0.000031	0.000105	0.000041	0.000177	0.000166
ROW36	0.001289	0.002115	0.000746	0.000722	0.000680	0.001266	0.001329	0.001258	0.000972
ROW37	0.000701	0.000864	0.000694	0.000640	0.000638	0.001168	0.001226	0.001196	0.000884
ROW38	0.012571	0.037740	0.002328	0.002337	0.002216	0.004474	0.005069	0.004099	0.003139
ROW39	0.000099	0.000120	0.000182	0.000125	0.000135	0.000184	0.000174	0.000209	0.000133
ROW40	0.009128	0.053147	0.003635	0.003824	0.003105	0.021445	0.069759	0.008754	0.003980
ROW41	0.000363	0.000726	0.000478	0.000398	0.001274	0.000886	0.005708	0.000864	0.000724
ROW42	0.004697	0.002193	0.005372	0.008928	0.002611	0.092096	0.127992	0.019243	0.013320
ROW43	0.008488	0.001485	0.001665	0.001037	0.001255	0.101002	0.098951	0.028642	0.019696
ROW44	0.000018	0.000121	0.000033	0.000018	0.000018	0.001585	0.021090	0.000169	0.000028
ROW45	0.000042	0.000137	0.000162	0.000055	0.000079	0.001974	0.005147	0.004683	0.000262
ROW46	0.006232	0.004152	0.003521	0.003223	0.005079	0.008349	0.007428	0.008764	0.006640
ROW47	0.011323	0.004999	0.003267	0.003331	0.007695	0.012322	0.011798	0.009912	0.007785
ROW48	0.003243	0.004749	0.002922	0.002547	0.003103	0.004078	0.003870	0.005402	0.004357
ROW49	0.108664	0.029939	0.033209	0.055448	0.026967	0.020594	0.028247	0.020890	0.028796
ROW50	0.003962	0.008411	0.004118	0.005299	0.003228	0.008021	0.016239	0.006429	0.005185
ROW51	0.000157	0.000321	0.000032	0.000036	0.000028	0.000040	0.000047	0.000042	0.000041
ROW52	0.000622	0.000659	0.000466	0.000441	0.000661	0.000709	0.001625	0.000816	0.000719
ROW53	0.001223	0.005038	0.002180	0.001042	0.001191	0.007522	0.008641	0.007596	0.004481
ROW54	0.010087	0.007424	0.018961	0.026710	0.013831	0.020988	0.035924	0.018094	0.013036
ROW55	0.000345	0.000902	0.000100	0.000092	0.000096	0.000217	0.000362	0.000177	0.000116
ROW56	0.000860	0.001788	0.001431	0.001219	0.000902	0.002880	0.004227	0.005287	0.002813

Table E3 (continued)

ROW	COL19	COL20	COL21	COL22	COL23	COL24	COL25	COL26	COL27
ROW57	0.000307	0.000164	0.000860	0.001690	0.007726	0.008802	0.001820	0.010025	0.010613
ROW58	0.002721	0.001497	0.005214	0.009362	0.003770	0.072570	0.020912	0.075424	0.049684
ROW59	0.008043	0.023319	0.065016	0.045889	0.048501	0.042688	0.093301	0.080135	0.148874
ROW60	0.001546	0.004603	0.004114	0.003216	0.004826	0.008501	0.074536	0.016542	0.018950
ROW61	0.003853	0.006338	0.014249	0.008779	0.011209	0.026739	0.043945	0.042205	0.074504
ROW62	0.009619	0.047057	0.026590	0.021844	0.021511	0.084396	0.090422	0.186646	0.211680
ROW63	0.015886	0.027749	0.041724	0.047832	0.075746	0.018566	0.026791	0.033725	0.035997
ROW64	0.000882	0.001439	0.001553	0.001253	0.001657	0.002575	0.008857	0.003752	0.003055
ROW65	0.001156	0.000965	0.001827	0.000839	0.001154	0.013328	0.094107	0.015207	0.001805
ROW66	0.000155	0.000109	0.000312	0.000082	0.000110	0.003068	0.047037	0.001855	0.000199
ROW67	0.000880	0.001742	0.002430	0.001514	0.001548	0.009095	0.012934	0.019718	0.031100
ROW68	0.000438	0.000758	0.000557	0.000335	0.000483	0.001616	0.000991	0.001842	0.000721
ROW69	0.002578	0.002599	0.005997	0.004808	0.005123	0.011049	0.016225	0.018117	0.010203
ROW70	0.005227	0.005305	0.027443	0.004339	0.012373	0.005074	0.068447	0.004760	0.006557
ROW71	0.000066	0.000104	0.000129	0.000088	0.000124	0.000173	0.000313	0.000161	0.000125
ROW72	0.000673	0.000406	0.000363	0.000292	0.000369	0.000343	0.000477	0.000451	0.000446
ROW73	0.000667	0.030733	0.002347	0.002010	0.000614	0.001241	0.003509	0.000858	0.001011
ROW74	0.000467	0.004414	0.000769	0.000774	0.000571	0.002718	0.005546	0.005907	0.011018
ROW75	0.000562	0.000527	0.000565	0.000478	0.000643	0.000937	0.000698	0.001221	0.000815
ROW76	0.000043	0.000042	0.000040	0.000035	0.000040	0.000093	0.000110	0.000112	0.000081
ROW77	0.000991	0.003993	0.003124	0.002878	0.002742	0.002863	0.004269	0.002147	0.001377
ROW78	0.009532	0.006563	0.011738	0.009518	0.009388	0.020886	0.030663	0.016687	0.019200
ROW79	0.002019	0.002688	0.004761	0.003484	0.003285	0.002184	0.003741	0.002555	0.002392
ROW80	0.013375	0.019431	0.016773	0.012060	0.016202	0.030458	0.028065	0.036536	0.025125
ROW81	0.003609	0.002575	0.002743	0.002938	0.003320	0.004201	0.003931	0.003703	0.005875
ROW82	0.006524	0.004549	0.006279	0.004586	0.005470	0.005943	0.007989	0.006994	0.006574
ROW83	0.002213	0.001968	0.001426	0.001388	0.002243	0.001280	0.001569	0.001269	0.001943
ROW84	0.008556	0.006842	0.006368	0.005383	0.006349	0.010746	0.010148	0.010945	0.008363
ROW85	0.003648	0.001202	0.008334	0.002949	0.005899	0.002669	0.002499	0.002679	0.002220
ROW86	0.056443	0.049862	0.042238	0.046473	0.042185	0.074177	0.116537	0.067985	0.078938
ROW87	0.007225	0.002068	0.003711	0.002082	0.003600	0.056025	0.002655	0.028632	0.018118
ROW88	0.011026	0.008561	0.007963	0.011875	0.011914	0.008978	0.010591	0.008516	0.006474
ROW89	0.017514	0.014203	0.011796	0.016211	0.015132	0.012238	0.011376	0.011120	0.012067
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.109262	0.031572	0.241808	0.040495	0.061595	0.033076	0.030227	0.033199	0.027681
ROW92	0.002170	0.003510	0.001613	0.002165	0.002424	0.002339	0.004561	0.002848	0.002505
ROW93	0.001614	0.001988	0.002292	0.001930	0.002286	0.002160	0.003346	0.002344	0.002083
ROW94	0.048807	0.045293	0.058549	0.043440	0.060015	0.085803	0.053199	0.123780	0.080586
ROW95	0.006594	0.006196	0.006540	0.005906	0.005962	0.011659	0.011398	0.011592	0.008603
ROW96	0.010164	0.013511	0.006851	0.006506	0.013448	0.010804	0.010108	0.008867	0.012489
ROW97	0.001079	0.001014	0.001324	0.000995	0.001293	0.001928	0.001379	0.002545	0.001696
ROW98	0.000000	0.000000	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
ROW99	0.000525	0.000402	0.000050	0.000056	0.000053	0.000055	0.000055	0.000047	0.000046
ROW100	0.000146	0.000582	0.000569	0.000644	0.000186	0.000322	0.000431	0.000350	0.000342
ROW101	0.001735	0.000973	0.001599	0.001779	0.002107	0.001976	0.002470	0.001589	0.001594
ROW102	0.000040	0.000088	0.000057	0.000059	0.000048	0.000106	0.000173	0.000134	0.000132
ROW103	0.002359	0.002009	0.003683	0.002865	0.003103	0.003134	0.003046	0.003340	0.002689
ROW104	0.000472	0.000482	0.003529	0.001105	0.001352	0.000557	0.000659	0.000575	0.000600
	1.802911	1.691302	1.985718	1.759184	1.751660	2.113865	2.545266	2.165413	2.183720

Table E3 (continued)

ROW	COL28	COL29	COL30	COL31	COL32	COL33	COL34	COL35	COL36
ROW1	0.004148	0.004703	0.002477	0.002639	0.003516	0.002091	0.002266	0.005366	0.002899
ROW2	0.032588	0.012656	0.009857	0.012476	0.009324	0.028272	0.011391	0.005517	0.014114
ROW3	0.002214	0.001958	0.001316	0.001378	0.001373	0.001299	0.001065	0.002008	0.001946
ROW4	0.027165	0.008569	0.005734	0.009992	0.003746	0.009451	0.007111	0.001935	0.010992
ROW5	0.000373	0.000395	0.000335	0.000342	0.000258	0.000234	0.000264	0.000658	0.000253
ROW6	0.000121	0.000102	0.000112	0.000101	0.000062	0.000100	0.000087	0.000133	0.000059
ROW7	0.013425	0.005219	0.001929	0.003750	0.003510	0.014523	0.004407	0.002457	0.006970
ROW8	0.001878	0.001500	0.001080	0.001119	0.001006	0.001463	0.000941	0.001325	0.001688
ROW9	0.001182	0.000498	0.000368	0.000480	0.000380	0.001082	0.000476	0.000217	0.001804
ROW10	0.019203	0.007509	0.007571	0.007361	0.007960	0.028391	0.008228	0.002997	0.002931
ROW11	0.032631	0.009710	0.027794	0.013495	0.005850	0.036111	0.010998	0.000208	0.000374
ROW12	0.011456	0.011699	0.008865	0.009035	0.007663	0.007861	0.007081	0.017188	0.020164
ROW13	0.000327	0.000334	0.000253	0.000258	0.000219	0.000224	0.000202	0.000491	0.000576
ROW14	0.000402	0.000411	0.000311	0.000317	0.000269	0.000276	0.000249	0.000603	0.000708
ROW15	0.011399	0.010129	0.006729	0.007087	0.007047	0.006634	0.005472	0.010443	0.009969
ROW16	0.001266	0.001299	0.001738	0.002130	0.001112	0.001350	0.001493	0.003737	1.248942
ROW17	0.000391	0.000387	0.000589	0.000614	0.000319	0.000391	0.000447	0.000926	0.022788
ROW18	0.000627	0.000639	0.000875	0.000985	0.000523	0.000634	0.000713	0.001589	0.323028
ROW19	0.002111	0.002605	0.001956	0.001971	0.001072	0.001089	0.001890	0.001957	0.042117
ROW20	0.001142	0.001763	0.002850	0.003074	0.000794	0.002007	0.003347	0.001215	0.001734
ROW21	0.002554	0.005213	0.001720	0.001898	0.004064	0.001059	0.001851	0.004695	0.000568
ROW22	0.002076	0.017155	0.002841	0.002777	0.003575	0.000919	0.001958	0.007300	0.000828
ROW23	0.056362	0.018728	0.004210	0.007295	0.007629	0.067727	0.015094	0.001263	0.003260
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.001474	0.001308	1.001394	0.001677	0.000978	0.001375	0.001220	0.001261	0.004753
ROW31	0.006264	0.005726	0.004209	1.004582	0.004064	0.004240	0.003698	0.008828	0.014093
ROW32	0.002256	0.001376	0.001028	0.001161	1.000955	0.001759	0.000973	0.001332	0.001828
ROW33	0.000043	0.000039	0.000037	0.000044	0.000036	1.000036	0.000033	0.000032	0.000049
ROW34	0.003751	0.003229	0.002657	0.003006	0.002685	0.002945	1.002338	0.002498	0.003282
ROW35	0.000038	0.000128	0.000039	0.000038	0.000069	0.000096	0.000101	1.039813	0.000029
ROW36	0.000896	0.000924	0.001173	0.001539	0.000802	0.000971	0.001071	0.002824	1.078013
ROW37	0.000802	0.000913	0.000998	0.001451	0.000769	0.000951	0.001007	0.002825	0.001194
ROW38	0.003220	0.003034	0.005262	0.005238	0.002689	0.003330	0.003739	0.007808	0.134007
ROW39	0.000148	0.000153	0.000165	0.000214	0.000166	0.000184	0.000211	0.000452	0.000107
ROW40	0.003657	0.004459	0.010871	0.006420	0.003613	0.004330	0.004216	0.005369	0.004986
ROW41	0.000566	0.000644	0.000673	0.000736	0.000445	0.000506	0.000553	0.003497	0.000606
ROW42	0.006740	0.011002	0.016692	0.018857	0.004514	0.012550	0.021189	0.006267	0.002546
ROW43	0.008152	0.014035	0.023270	0.018107	0.006615	0.012199	0.024972	0.006768	0.001535
ROW44	0.000018	0.000045	0.000932	0.000059	0.000018	0.000016	0.000117	0.000460	0.000017
ROW45	0.000055	0.000960	0.002821	0.000188	0.000771	0.000036	0.000113	0.000229	0.000041
ROW46	0.006768	0.006502	0.007864	0.005508	0.003833	0.003944	0.005986	0.005739	0.007341
ROW47	0.008587	0.007290	0.015085	0.007942	0.004619	0.005699	0.005113	0.008118	0.014237
ROW48	0.003499	0.003881	0.003273	0.003366	0.002433	0.002508	0.002828	0.003962	0.004520
ROW49	0.019840	0.019308	0.032821	0.022642	0.023380	0.012756	0.015380	0.017909	0.049999
ROW50	0.004185	0.005852	0.011649	0.007440	0.003891	0.003750	0.005307	0.005097	0.004068
ROW51	0.000030	0.000032	0.000044	0.000040	0.000027	0.000024	0.000029	0.000051	0.001243
ROW52	0.000951	0.000678	0.000898	0.000692	0.000454	0.000762	0.000535	0.000889	0.001616
ROW53	0.007565	0.003999	0.059354	0.026028	0.007929	0.008272	0.018535	0.001753	0.001115
ROW54	0.009086	0.014573	0.020556	0.018486	0.009788	0.012398	0.014143	0.010046	0.017997
ROW55	0.000140	0.000107	0.000201	0.000191	0.000073	0.000134	0.000086	0.000307	0.000151
ROW56	0.001345	0.002438	0.004056	0.004571	0.001596	0.000791	0.002116	0.001732	0.002596

Table E3 (continued)

ROW	COL28	COL29	COL30	COL31	COL32	COL33	COL34	COL35	COL36
ROW57	0.026769	0.010247	0.002157	0.005585	0.010271	0.004602	0.007010	0.000383	0.000246
ROW58	0.115201	0.064632	0.021769	0.056309	0.044299	0.024875	0.017381	0.004003	0.002051
ROW59	0.046765	0.101151	0.031742	0.035179	0.080419	0.019582	0.035643	0.095120	0.009470
ROW60	0.007278	0.015986	0.008100	0.008261	0.007108	0.003718	0.005978	0.026423	0.001747
ROW61	0.011296	0.135460	0.017870	0.017833	0.024630	0.005040	0.012809	0.053127	0.003281
ROW62	0.088372	0.117322	0.056714	0.056504	0.059687	0.047348	0.054507	0.035131	0.014625
ROW63	0.015892	0.025065	0.027102	0.021740	0.035443	0.010832	0.011268	0.032822	0.016063
ROW64	0.001426	0.002713	0.003022	0.003569	0.001955	0.000818	0.003198	0.035044	0.000889
ROW65	0.000940	0.003270	0.030126	0.029862	0.004643	0.000704	0.015404	0.000840	0.001223
ROW66	0.000081	0.000491	0.022259	0.000370	0.000055	0.000063	0.000096	0.000134	0.000150
ROW67	0.010723	0.019669	0.007984	0.032902	0.021298	0.001526	0.021413	0.001734	0.000994
ROW68	0.000503	0.000908	0.000506	0.002630	0.000545	0.000433	0.006013	0.024443	0.000488
ROW69	0.003448	0.017644	0.010206	0.012822	0.010938	0.001850	0.008000	0.005471	0.002145
ROW70	0.005944	0.005561	0.004033	0.005332	0.003893	0.004857	0.004453	0.005801	0.005046
ROW71	0.000098	0.000117	0.000084	0.000083	0.000075	0.000064	0.000076	0.000109	0.000063
ROW72	0.000296	0.000345	0.000296	0.000294	0.000251	0.000192	0.000227	0.068746	0.000216
ROW73	0.000937	0.000809	0.000609	0.000680	0.000584	0.000750	0.000596	0.000538	0.000645
ROW74	0.000665	0.004064	0.007195	0.005230	0.003633	0.000429	0.002709	0.006852	0.000590
ROW75	0.000814	0.000847	0.000551	0.000603	0.000475	0.000547	0.000527	0.000923	0.000541
ROW76	0.000077	0.000061	0.000083	0.000107	0.000045	0.000084	0.000055	0.000262	0.000057
ROW77	0.006571	0.001839	0.010311	0.003006	0.001232	0.002812	0.002356	0.001528	0.000855
ROW78	0.019643	0.015623	0.011496	0.012491	0.013117	0.014610	0.009881	0.010036	0.014188
ROW79	0.001931	0.002209	0.001694	0.001771	0.001371	0.001237	0.001405	0.003429	0.001188
ROW80	0.047373	0.035324	0.030667	0.032362	0.018621	0.048428	0.024781	0.013507	0.025988
ROW81	0.007375	0.004275	0.003161	0.003906	0.002757	0.005932	0.003992	0.002136	0.004420
ROW82	0.005195	0.005485	0.004832	0.004927	0.003635	0.003272	0.003733	0.007444	0.003132
ROW83	0.003883	0.001682	0.001284	0.001617	0.001125	0.002959	0.001327	0.000912	0.001849
ROW84	0.008126	0.008395	0.008912	0.011899	0.006490	0.008096	0.008375	0.011708	0.011367
ROW85	0.002144	0.002266	0.002027	0.002895	0.002634	0.002213	0.002060	0.002603	0.003873
ROW86	0.071026	0.065687	0.071114	0.060964	0.041818	0.037879	0.048972	0.036415	0.106000
ROW87	0.020073	0.016812	0.066728	0.039519	0.011809	0.015422	0.022443	0.003003	0.004029
ROW88	0.006684	0.006631	0.007202	0.010476	0.005461	0.007345	0.007226	0.005780	0.018877
ROW89	0.012877	0.012239	0.010803	0.013284	0.007269	0.009568	0.009159	0.009357	0.019926
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.030573	0.027117	0.028907	0.034781	0.020286	0.028527	0.025300	0.026135	0.096612
ROW92	0.001966	0.002306	0.001753	0.001912	0.001493	0.001249	0.001577	0.003431	0.001498
ROW93	0.001695	0.001893	0.002166	0.002064	0.001259	0.001284	0.001488	0.005043	0.002257
ROW94	0.073989	0.087174	0.040563	0.045571	0.043101	0.041016	0.045919	0.067577	0.046406
ROW95	0.007949	0.008508	0.009821	0.014505	0.007481	0.009155	0.009886	0.028008	0.007208
ROW96	0.012086	0.010990	0.008336	0.010965	0.008036	0.009681	0.009504	0.006274	0.011063
ROW97	0.001559	0.001815	0.001083	0.001328	0.001028	0.001052	0.001196	0.002192	0.001166
ROW98	0.000001	0.000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001
ROW99	0.000048	0.000047	0.000046	0.000055	0.000030	0.000039	0.000039	0.000051	0.003392
ROW100	0.000243	0.000290	0.000265	0.000285	0.000178	0.000183	0.000170	0.000339	0.000172
ROW101	0.001452	0.001538	0.001569	0.002107	0.001162	0.001429	0.001426	0.002766	0.001861
ROW102	0.000086	0.000095	0.000116	0.000103	0.000066	0.000061	0.000078	0.000145	0.000048
ROW103	0.002521	0.002640	0.002573	0.002849	0.001737	0.001992	0.002095	0.004553	0.003141
ROW104	0.000542	0.000543	0.000464	0.000515	0.000346	0.000451	0.000364	0.000417	0.000476
	2.010258	2.085599	1.899835	1.862850	1.672275	1.693954	1.672750	1.872592	3.524206

Table E3 (continued)

ROW	COL37	COL38	COL39	COL40	COL41	COL42	COL43	COL44	COL45
ROW1	0.002616	0.003149	0.001470	0.005545	0.003238	0.007035	0.005115	0.004527	0.006889
ROW2	0.004769	0.011102	0.006417	0.013194	0.008488	0.020096	0.012134	0.009138	0.007776
ROW3	0.001684	0.002584	0.000899	0.003341	0.002017	0.001596	0.002651	0.002034	0.002750
ROW4	0.002587	0.007466	0.003985	0.003606	0.003231	0.022365	0.009052	0.005861	0.004261
ROW5	0.000581	0.000506	0.000350	0.000798	0.000733	0.000462	0.000662	0.000719	0.000977
ROW6	0.000060	0.000110	0.000030	0.000094	0.000089	0.002649	0.000879	0.000411	0.000200
ROW7	0.002272	0.005500	0.003347	0.003852	0.003191	0.007917	0.005153	0.003636	0.003249
ROW8	0.001354	0.002037	0.001029	0.003579	0.002204	0.001506	0.001849	0.001919	0.001736
ROW9	0.000268	0.001108	0.000538	0.000568	0.000351	0.000782	0.000465	0.000363	0.000307
ROW10	0.001397	0.002514	0.001504	0.004011	0.002486	0.003043	0.003343	0.002712	0.002589
ROW11	0.000171	0.000284	0.000150	0.000257	0.000180	0.000225	0.001512	0.000287	0.000311
ROW12	0.008714	0.015582	0.005916	0.024808	0.016897	0.014969	0.018445	0.016313	0.017477
ROW13	0.000249	0.000445	0.000169	0.000708	0.000483	0.000427	0.000527	0.000466	0.000499
ROW14	0.000306	0.000547	0.000208	0.000871	0.000593	0.000525	0.000647	0.000573	0.000613
ROW15	0.008789	0.013392	0.004578	0.016980	0.010328	0.008219	0.013745	0.010508	0.014274
ROW16	0.005892	0.125492	0.003730	0.013153	0.006187	0.002132	0.001803	0.003563	0.002374
ROW17	0.004709	0.118264	0.003707	0.001985	0.001032	0.001503	0.000762	0.001251	0.000627
ROW18	0.017300	0.110519	0.002902	0.004485	0.002248	0.002511	0.001266	0.001864	0.001088
ROW19	0.018541	0.098703	0.235912	0.062431	0.021889	0.008938	0.003721	0.008431	0.003931
ROW20	0.001334	0.012393	0.001055	0.001250	0.004190	0.199065	0.054088	0.022650	0.008610
ROW21	0.001916	0.001044	0.000326	0.000863	0.000549	0.001805	0.001724	0.002721	0.007093
ROW22	0.001483	0.001110	0.000494	0.001843	0.001049	0.001418	0.001625	0.002060	0.002879
ROW23	0.001431	0.002549	0.001308	0.003173	0.001628	0.001253	0.002671	0.002045	0.002159
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000003	0.000000	0.000001
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.001215	0.002822	0.001738	0.002244	0.001945	0.001338	0.001645	0.001823	0.002059
ROW31	0.006177	0.010068	0.005478	0.009399	0.005944	0.005903	0.006264	0.007238	0.008285
ROW32	0.000864	0.001586	0.000684	0.002192	0.001443	0.001807	0.001779	0.001459	0.001560
ROW33	0.000035	0.000053	0.000024	0.000066	0.000044	0.000050	0.000046	0.000045	0.000059
ROW34	0.002607	0.004438	0.001590	0.003828	0.002620	0.006524	0.009073	0.004885	0.004678
ROW35	0.000039	0.000037	0.000030	0.000043	0.000036	0.000030	0.000032	0.000039	0.000040
ROW36	0.002293	0.049034	0.000723	0.001943	0.002184	0.001172	0.001202	0.001737	0.001450
ROW37	1.030351	0.001667	0.000534	0.001196	0.001168	0.000877	0.001035	0.001160	0.001332
ROW38	0.046308	1.278936	0.005256	0.010545	0.006652	0.009721	0.005658	0.010811	0.004961
ROW39	0.000102	0.000154	1.280025	0.000200	0.000185	0.000122	0.000185	0.000195	0.000297
ROW40	0.002853	0.007894	0.004370	1.515783	0.476837	0.016140	0.007356	0.135579	0.057875
ROW41	0.000492	0.001056	0.000401	0.010551	1.341902	0.001595	0.001388	0.006662	0.008787
ROW42	0.005750	0.006224	0.005586	0.006337	0.005227	1.335922	0.357683	0.150203	0.056279
ROW43	0.006883	0.002727	0.002935	0.005898	0.003572	0.007654	1.111296	0.052703	0.048041
ROW44	0.000014	0.000020	0.000010	0.000032	0.000021	0.000052	0.000241	1.004836	0.000546
ROW45	0.000040	0.000044	0.000020	0.000078	0.000040	0.000090	0.000086	0.000082	1.010658
ROW46	0.013209	0.023285	0.021085	0.016266	0.014260	0.004233	0.007999	0.013939	0.010971
ROW47	0.026038	0.053664	0.014987	0.025437	0.026883	0.005021	0.014291	0.028166	0.019985
ROW48	0.011366	0.013075	0.012664	0.004405	0.004787	0.003364	0.003494	0.004855	0.005182
ROW49	0.013696	0.041349	0.029050	0.127767	0.060356	0.017593	0.039338	0.034118	0.029086
ROW50	0.002984	0.005935	0.004022	0.176059	0.081903	0.005134	0.008532	0.028327	0.018556
ROW51	0.000199	0.004553	0.000056	0.000110	0.000066	0.000084	0.000053	0.000070	0.000044
ROW52	0.001067	0.002315	0.001863	0.005606	0.004528	0.000559	0.000609	0.001130	0.000856
ROW53	0.001607	0.001342	0.000587	0.001989	0.001217	0.003477	0.010865	0.012556	0.010349
ROW54	0.010502	0.023142	0.019234	0.029822	0.018547	0.012806	0.015046	0.065084	0.064073
ROW55	0.000088	0.000357	0.000153	0.002300	0.008543	0.000701	0.000272	0.002864	0.001404
ROW56	0.053245	0.019211	0.000590	0.005970	0.002358	0.001688	0.006174	0.008615	0.010353

Table E3 (continued)

ROW	COL37	COL38	COL39	COL40	COL41	COL42	COL43	COL44	COL45
ROW57	0.000292	0.000319	0.000159	0.000340	0.000231	0.000716	0.001745	0.000934	0.000774
ROW58	0.003015	0.002987	0.001532	0.003087	0.002174	0.007798	0.019895	0.010464	0.008495
ROW59	0.036386	0.018851	0.005393	0.011909	0.008455	0.034785	0.032063	0.052626	0.143669
ROW60	0.008158	0.004056	0.001118	0.002128	0.001691	0.005962	0.006103	0.016645	0.022330
ROW61	0.008929	0.005340	0.001928	0.005490	0.003856	0.008610	0.008680	0.010237	0.015167
ROW62	0.121242	0.049020	0.009396	0.010435	0.008147	0.073724	0.067120	0.087505	0.086255
ROW63	0.010943	0.013061	0.006844	0.023322	0.012963	0.026511	0.018409	0.016524	0.021257
ROW64	0.001201	0.001231	0.000905	0.001879	0.001405	0.001334	0.001284	0.002369	0.001987
ROW65	0.000693	0.001561	0.000531	0.000929	0.000705	0.001333	0.002107	0.000997	0.001191
ROW66	0.000096	0.000142	0.000099	0.000418	0.001037	0.000106	0.000241	0.000146	0.000190
ROW67	0.000749	0.000931	0.000427	0.000907	0.000648	0.001605	0.001834	0.001658	0.001695
ROW68	0.000359	0.000541	0.000297	0.000551	0.000548	0.000621	0.000606	0.000672	0.000652
ROW69	0.002075	0.002138	0.001169	0.001920	0.001469	0.003961	0.002667	0.002700	0.005761
ROW70	0.002995	0.005127	0.002679	0.003526	0.002980	0.011373	0.006692	0.004973	0.005344
ROW71	0.000088	0.000094	0.000092	0.000091	0.000102	0.001113	0.000353	0.000207	0.000446
ROW72	0.000447	0.000394	0.000329	0.000597	0.000511	0.000395	0.000506	0.000539	0.000752
ROW73	0.000533	0.001253	0.000335	0.000677	0.000534	0.007140	0.002907	0.001570	0.001199
ROW74	0.000632	0.000735	0.000284	0.001613	0.000792	0.001741	0.001660	0.001432	0.001232
ROW75	0.000752	0.000860	0.000815	0.001621	0.001059	0.000535	0.000604	0.001259	0.000793
ROW76	0.000035	0.000064	0.000037	0.000088	0.000075	0.000065	0.000054	0.000089	0.000055
ROW77	0.000851	0.001157	0.000798	0.003057	0.022992	0.002008	0.002479	0.004636	0.004043
ROW78	0.011954	0.022364	0.005851	0.014683	0.008525	0.024095	0.038182	0.024435	0.021510
ROW79	0.003172	0.002713	0.001886	0.004936	0.005313	0.002616	0.003801	0.003948	0.008270
ROW80	0.019645	0.037678	0.027270	0.027864	0.021951	0.018954	0.023557	0.023055	0.022374
ROW81	0.002359	0.005882	0.001562	0.004061	0.002266	0.005249	0.005071	0.003586	0.003373
ROW82	0.008666	0.007232	0.004990	0.011594	0.010886	0.006693	0.009680	0.010695	0.014882
ROW83	0.000913	0.001768	0.000916	0.001723	0.001244	0.002774	0.002074	0.001583	0.001486
ROW84	0.005988	0.010661	0.005792	0.012145	0.012650	0.007408	0.009409	0.010949	0.009919
ROW85	0.002477	0.003597	0.001685	0.004990	0.003151	0.002727	0.002604	0.002861	0.004211
ROW86	0.045292	0.095591	0.023860	0.087902	0.085746	0.066996	0.085268	0.088473	0.072482
ROW87	0.001589	0.003926	0.002409	0.002490	0.002168	0.004442	0.003031	0.002553	0.002260
ROW88	0.007393	0.010722	0.005831	0.008977	0.010573	0.008772	0.009966	0.008293	0.011344
ROW89	0.008170	0.015326	0.010507	0.011433	0.011289	0.015324	0.015367	0.015699	0.014233
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.025198	0.058538	0.036041	0.046549	0.040333	0.027763	0.034112	0.037803	0.042707
ROW92	0.002417	0.002563	0.001704	0.004494	0.005330	0.002478	0.002873	0.003210	0.005919
ROW93	0.002233	0.004979	0.004905	0.004991	0.004660	0.002565	0.003023	0.003661	0.003291
ROW94	0.076694	0.074929	0.084715	0.065649	0.065045	0.047099	0.050266	0.064307	0.057183
ROW95	0.005487	0.008775	0.005156	0.011335	0.011393	0.007762	0.009682	0.010974	0.012020
ROW96	0.006265	0.011912	0.005718	0.007806	0.007034	0.020681	0.014171	0.010491	0.010911
ROW97	0.001750	0.001697	0.001803	0.001617	0.001661	0.001111	0.001507	0.001551	0.001516
ROW98	0.000000	0.000001	0.000000	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
ROW99	0.000107	0.001982	0.000139	0.000107	0.000069	0.000125	0.000076	0.000080	0.000061
ROW100	0.000206	0.000243	0.000160	0.000740	0.000596	0.000962	0.000471	0.001107	0.001902
ROW101	0.001175	0.002228	0.001142	0.002678	0.003512	0.001980	0.002434	0.002888	0.002562
ROW102	0.000075	0.000085	0.000046	0.001016	0.000429	0.000073	0.000076	0.000247	0.000282
ROW103	0.002304	0.003895	0.004369	0.004191	0.006016	0.002508	0.003053	0.003823	0.003981
ROW104	0.000397	0.000655	0.000296	0.000718	0.000555	0.001020	0.000714	0.000653	0.000652
	1.770848	2.591195	1.967638	2.556739	2.561319	2.227713	2.263960	2.238338	2.123056

Table E3 (continued)

ROW	COL46	COL47	COL48	COL49	COL50	COL51	COL52	COL53	COL54
ROW1	0.016532	0.007929	0.003956	0.010325	0.011229	0.002680	0.003782	0.005271	C.005411
ROW2	0.020306	0.013965	0.007928	0.056443	0.029106	0.008374	0.016614	0.027285	0.012803
ROW3	0.006645	0.003838	0.002054	0.011208	0.006609	0.001973	0.002931	0.004367	0.003392
ROW4	0.005885	0.003926	0.003819	0.002887	0.002619	0.002979	0.003544	0.003361	0.002497
ROW5	0.000827	0.000782	0.001221	0.000825	0.000931	0.000599	0.001382	0.001187	0.001142
ROW6	0.000673	0.000294	0.000145	0.000392	0.000291	0.000067	0.000123	0.000227	C.000118
ROW7	0.008618	0.005309	0.002833	0.004529	0.004123	0.002159	0.002837	0.003382	0.003170
ROW8	0.014777	0.006607	0.003092	0.006111	0.005239	0.002229	0.002416	0.002989	0.002952
ROW9	0.000758	0.000527	0.000328	0.001948	0.000993	0.000346	0.000634	0.000985	0.000468
ROW10	0.003753	0.005481	0.001723	0.012939	0.010488	0.003219	0.009447	0.018838	0.004668
ROW11	0.000477	0.000348	0.000282	0.000392	0.000373	0.000315	0.000278	0.000326	0.000275
ROW12	0.033282	0.023133	0.014826	0.034177	0.030727	0.013116	0.015246	0.020122	0.023028
ROW13	0.000950	0.000661	0.000423	0.000976	0.000877	0.000375	0.000435	0.000575	0.000658
ROW14	0.001168	0.000812	0.000520	0.001200	0.001079	0.000460	0.000535	0.000706	0.000808
ROW15	0.034660	0.019895	0.010630	0.053002	0.032892	0.010034	0.014775	0.021481	0.017226
ROW16	0.003585	0.002724	0.002857	0.005718	0.003831	0.008385	0.005052	0.006210	0.003245
ROW17	0.002121	0.001272	0.000902	0.001729	0.001345	0.002560	0.002963	0.003691	0.000884
ROW18	0.004036	0.002140	0.001626	0.003020	0.002063	0.005291	0.004636	0.004181	0.001448
ROW19	0.004624	0.003447	0.002335	0.004437	0.003459	0.003949	0.004257	0.010777	0.005263
ROW20	0.031558	0.011352	0.005242	0.001800	0.001656	0.001353	0.001714	0.005118	0.001428
ROW21	0.000993	0.000927	0.000535	0.003403	0.001756	0.000703	0.001577	0.002601	0.001559
ROW22	0.001676	0.001436	0.001080	0.011811	0.005647	0.001501	0.002746	0.008249	C.002449
ROW23	0.009658	0.004903	0.002232	0.021687	0.008809	0.002232	0.004876	0.008965	0.004962
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	C.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	C.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	C.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	C.000000
ROW30	0.001922	0.002178	0.003804	0.002807	0.002364	0.002830	0.003366	0.003231	0.001789
ROW31	0.019663	0.013112	0.008747	0.015114	0.016359	0.014276	0.008369	0.010641	C.010992
ROW32	0.003386	0.002240	0.001343	0.005411	0.003559	0.001254	0.001839	0.002689	0.002104
ROW33	0.000141	0.000077	0.000049	0.000103	0.000088	0.000044	0.000058	0.000060	0.000056
ROW34	0.011067	0.007973	0.004021	0.005691	0.005146	0.002893	0.004337	0.004800	0.004032
ROW35	0.000043	0.000041	0.000049	0.000132	0.000074	0.000094	0.000089	0.000091	0.000068
ROW36	0.001922	0.001578	0.002007	0.004077	0.002567	0.006107	0.003026	0.003522	0.001771
ROW37	0.001094	0.001092	0.001748	0.001422	0.001381	0.003114	0.001511	0.001623	0.001194
ROW38	0.020603	0.012129	0.007977	0.015971	0.012663	0.022129	0.025178	0.037025	0.006678
ROW39	0.000189	0.000207	0.000285	0.000220	0.000241	0.000427	0.000220	0.000269	C.000194
ROW40	0.021039	0.027784	0.010722	0.004538	0.009586	0.005597	0.011344	0.004590	0.081402
ROW41	0.001379	0.001844	0.001904	0.000769	0.001035	0.001032	0.001063	0.000848	0.002522
ROW42	0.207278	0.073880	0.033358	0.007582	0.008181	0.004849	0.007528	0.005631	0.008036
ROW43	0.006143	0.003296	0.001671	0.001538	0.001783	0.001342	0.001785	0.001664	0.005299
ROW44	0.000025	0.000021	0.000022	0.000020	0.000019	0.000023	0.000024	0.000022	0.000025
ROW45	0.000045	0.000042	0.000040	0.000045	0.000037	0.000031	0.000046	0.000048	C.000083
ROW46	1.113734	0.372820	0.174348	0.011668	0.027758	0.018155	0.027570	0.014874	0.020109
ROW47	0.012236	1.046898	0.017801	0.016108	0.023917	0.031018	0.048615	0.020670	C.031412
ROW48	0.003883	0.005729	1.133869	0.004312	0.004375	0.009377	0.013055	0.013730	0.003972
ROW49	0.074448	0.065467	0.038082	1.247861	0.400322	0.073339	0.131220	0.305056	0.132042
ROW50	0.014951	0.027626	0.006606	0.015197	1.048213	0.007276	0.016497	0.104182	0.156281
ROW51	0.000121	0.000104	0.000056	0.000459	0.000196	1.062624	0.002075	0.000248	C.000113
ROW52	0.003224	0.001709	0.001019	0.002737	0.006709	0.002843	1.046606	0.004404	0.002104
ROW53	0.002079	0.001847	0.001452	0.003330	0.003611	0.001278	0.003878	1.012283	0.002880
ROW54	0.012885	0.029869	0.014788	0.014923	0.025790	0.034209	0.071716	0.013391	1.053218
ROW55	0.000321	0.000262	0.000522	0.000399	0.000302	0.000374	0.000347	0.000313	C.000488
ROW56	0.001343	0.001157	0.000833	0.001773	0.002062	0.020775	0.018506	0.002898	0.005984

Table E3 (continued)

ROW	COL46	COL47	COL48	COL49	COL50	COL51	COL52	COL53	COL54
ROW57	0.000745	0.000502	0.000302	0.000743	0.000473	0.000263	0.000431	0.000851	0.000506
ROW58	0.006770	0.004651	0.002890	0.004565	0.003568	0.002398	0.003939	0.008326	0.004680
ROW59	0.016696	0.016031	0.009234	0.024232	0.015868	0.010322	0.024771	0.030601	0.025603
ROW60	0.003106	0.006406	0.004371	0.005187	0.003249	0.002732	0.005875	0.007500	0.004868
ROW61	0.005520	0.005200	0.005161	0.022764	0.013236	0.005883	0.010408	0.028709	0.009181
ROW62	0.030073	0.017122	0.011140	0.023880	0.017109	0.021031	0.065731	0.076349	0.027843
ROW63	0.017725	0.018060	0.010214	0.029700	0.024527	0.008851	0.013874	0.015804	0.022232
ROW64	0.001249	0.001345	0.001515	0.001598	0.001436	0.002266	0.002568	0.001671	0.001738
ROW65	0.001337	0.001063	0.000871	0.001938	0.001431	0.001031	0.001010	0.001227	0.000941
ROW66	0.000103	0.000139	0.000162	0.000125	0.000128	0.000245	0.000227	0.000181	0.000137
ROW67	0.001664	0.001181	0.000811	0.001348	0.001276	0.001001	0.001000	0.001117	0.002011
ROW68	0.000561	0.000558	0.000737	0.000601	0.000586	0.000812	0.000712	0.000678	0.000599
ROW69	0.002273	0.001916	0.001504	0.003305	0.002330	0.001912	0.002681	0.002560	0.002258
ROW70	0.004360	0.003772	0.003562	0.003399	0.003156	0.003120	0.003598	0.003769	0.004388
ROW71	0.000237	0.000139	0.000127	0.000101	0.000102	0.000206	0.000243	0.000107	0.000109
ROW72	0.000608	0.000565	0.000854	0.000606	0.000670	0.000391	0.000959	0.000841	0.001004
ROW73	0.002460	0.001609	0.000737	0.001212	0.001038	0.000506	0.000878	0.001132	0.000802
ROW74	0.002898	0.001427	0.000833	0.001945	0.002030	0.002854	0.001796	0.001549	0.002153
ROW75	0.000709	0.000980	0.009048	0.000818	0.000816	0.001830	0.002040	0.001019	0.000857
ROW76	0.000095	0.000092	0.000114	0.000093	0.000114	0.000185	0.000778	0.000146	0.000121
ROW77	0.001450	0.001781	0.005161	0.001205	0.001129	0.001797	0.002787	0.003369	0.002973
ROW78	0.045406	0.041180	0.015388	0.024918	0.022431	0.009709	0.018314	0.023185	0.018277
ROW79	0.004071	0.004997	0.007008	0.004494	0.004114	0.003390	0.006151	0.005271	0.005559
ROW80	0.026185	0.030897	0.020488	0.027657	0.024021	0.015069	0.023096	0.027350	0.023679
ROW81	0.007764	0.004854	0.002312	0.010511	0.008562	0.002757	0.005395	0.007056	0.005093
ROW82	0.011748	0.011412	0.018765	0.011802	0.013532	0.008151	0.020348	0.018057	0.017244
ROW83	0.002830	0.002184	0.001498	0.004964	0.003015	0.001197	0.002294	0.002967	0.001850
ROW84	0.008604	0.010480	0.015708	0.009921	0.010869	0.014051	0.012889	0.013371	0.010623
ROW85	0.009235	0.005030	0.002892	0.005096	0.004936	0.003010	0.003571	0.003224	0.003445
ROW86	0.072811	0.074199	0.050266	0.048389	0.055157	0.044240	0.059699	0.064474	0.053522
ROW87	0.003164	0.002632	0.002747	0.002799	0.002509	0.003764	0.002448	0.002749	0.002208
ROW88	0.008491	0.007075	0.009379	0.008771	0.009403	0.009020	0.008478	0.009199	0.007986
ROW89	0.012545	0.011381	0.013491	0.013856	0.013439	0.013387	0.012466	0.012649	0.011775
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.039872	0.045178	0.078863	0.058221	0.049045	0.058706	0.069816	0.067023	0.037109
ROW92	0.003893	0.004098	0.007844	0.004501	0.003945	0.004338	0.006101	0.004693	0.005172
ROW93	0.002716	0.007257	0.004131	0.002929	0.004925	0.011156	0.010549	0.009406	0.005277
ROW94	0.061047	0.061482	0.085694	0.076350	0.078925	0.205499	0.239398	0.080704	0.067980
ROW95	0.010792	0.010639	0.017363	0.013984	0.013729	0.031301	0.014777	0.016135	0.012025
ROW96	0.009173	0.008617	0.008812	0.007091	0.007217	0.007987	0.008031	0.008382	0.006875
ROW97	0.001463	0.001485	0.002316	0.001843	0.001855	0.004922	0.004724	0.001956	0.001611
ROW98	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
ROW99	0.000087	0.000063	0.000063	0.000082	0.000071	0.000097	0.000093	0.000108	0.000058
ROW100	0.000411	0.000390	0.000275	0.000620	0.000909	0.002723	0.001069	0.000771	0.000791
ROW101	0.001963	0.002209	0.003339	0.001915	0.002007	0.005397	0.002288	0.002225	0.002254
ROW102	0.000071	0.000189	0.000670	0.000073	0.000090	0.000139	0.000171	0.000103	0.001052
ROW103	0.003447	0.003504	0.017917	0.003720	0.003382	0.005583	0.005602	0.004750	0.003327
ROW104	0.002710	0.001280	0.000832	0.001944	0.001544	0.000611	0.000771	0.000917	0.000714
	2.193863	2.259944	1.995124	2.110989	2.208385	1.938047	2.237511	2.303928	2.055206

Table E3 (continued)

ROW	COL55	COL56	COL57	COL58	COL59	COL60	COL61	COL62	COL63
ROW1	0.003065	0.003828	0.036187	0.010329	0.034019	0.008967	0.005491	0.010865	0.006941
ROW2	0.008971	0.008229	0.016239	0.013558	0.009855	0.013206	0.010375	0.008081	0.007705
ROW3	0.001851	0.009116	0.014742	0.006493	0.006699	0.006909	0.004215	0.003603	0.002426
ROW4	0.004141	0.002582	0.004131	0.004907	0.002550	0.002663	0.002740	0.002866	0.002314
ROW5	0.000640	0.000482	0.000447	0.000766	0.000647	0.000491	0.000597	0.000596	0.000661
ROW6	0.000092	0.000130	0.000057	0.000368	0.000250	0.000159	0.000168	0.000147	0.000106
ROW7	0.003219	0.003584	0.008684	0.008698	0.005068	0.003481	0.004497	0.003082	0.002251
ROW8	0.002225	0.002327	0.010580	0.003754	0.004602	0.003513	0.003231	0.002382	0.001790
ROW9	0.000472	0.000314	0.000594	0.000507	0.000370	0.000483	0.000387	0.000309	0.000292
ROW10	0.002756	0.003547	0.004526	0.004538	0.003526	0.011955	0.005570	0.004107	0.006556
ROW11	0.000203	0.000325	0.003437	0.001074	0.000459	0.000352	0.000264	0.000359	0.000264
ROW12	0.015505	0.022517	0.061796	0.024975	0.034184	0.065073	0.029465	0.022546	0.016846
ROW13	0.000443	0.000643	0.001765	0.000713	0.000976	0.001858	0.000841	0.000644	0.000481
ROW14	0.000544	0.000790	0.002169	0.000877	0.001200	0.002284	0.001034	0.000791	0.000591
ROW15	0.009445	0.047917	0.077630	0.034007	0.034420	0.036190	0.021972	0.018680	0.012580
ROW16	0.124182	0.001659	0.001176	0.001820	0.001378	0.001480	0.001533	0.001758	0.001837
ROW17	0.002871	0.000487	0.000341	0.000542	0.000376	0.000422	0.000433	0.000560	0.000491
ROW18	0.032601	0.000823	0.000578	0.000891	0.000641	0.000702	0.000727	0.000836	0.000829
ROW19	0.010678	0.002436	0.001789	0.001908	0.001310	0.002271	0.002101	0.001970	0.001443
ROW20	0.002463	0.002621	0.001150	0.001800	0.001239	0.001244	0.001575	0.001395	0.001085
ROW21	0.000880	0.000911	0.001907	0.002618	0.060936	0.002088	0.003392	0.015534	0.009387
ROW22	0.001939	0.001433	0.001521	0.003895	0.008455	0.049171	0.193932	0.011043	0.006667
ROW23	0.002156	0.012432	0.055745	0.073139	0.006807	0.002046	0.002189	0.002860	0.002047
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.002155	0.001748	0.001675	0.001920	0.001744	0.001376	0.001662	0.001752	0.001481
ROW31	0.006943	0.011853	0.038621	0.011332	0.020815	0.015002	0.008830	0.011048	0.008692
ROW32	0.001374	0.002707	0.005683	0.002690	0.003000	0.004581	0.002429	0.001930	0.001470
ROW33	0.000036	0.000061	0.000176	0.000070	0.000091	0.000067	0.000072	0.000057	0.000038
ROW34	0.002658	0.006025	0.008789	0.006346	0.008018	0.006304	0.005674	0.004546	0.002977
ROW35	0.000034	0.000028	0.000028	0.000036	0.000076	0.000032	0.000033	0.000149	0.000096
ROW36	0.106138	0.001161	0.000844	0.001265	0.001009	0.001064	0.001083	0.001265	0.001345
ROW37	0.001278	0.000967	0.000752	0.001125	0.000905	0.000997	0.001021	0.001128	0.001273
ROW38	0.018094	0.004027	0.002806	0.004704	0.003135	0.003460	0.003579	0.004246	0.004140
ROW39	0.000286	0.000175	0.000149	0.000228	0.000151	0.000187	0.000185	0.000187	0.000227
ROW40	0.133872	0.008408	0.003026	0.010389	0.003399	0.004729	0.008646	0.005934	0.005887
ROW41	0.007544	0.001558	0.000546	0.000814	0.001188	0.001053	0.000799	0.001441	0.001346
ROW42	0.014377	0.016538	0.007006	0.010379	0.007528	0.007443	0.009667	0.008220	0.006318
ROW43	0.004707	0.014121	0.004673	0.008193	0.004665	0.005958	0.007980	0.006651	0.002786
ROW44	0.000018	0.000030	0.000020	0.000021	0.000031	0.000020	0.000034	0.000037	0.000048
ROW45	0.000037	0.000041	0.000046	0.000050	0.000626	0.000049	0.000052	0.000223	0.000205
ROW46	0.018047	0.023996	0.008497	0.018003	0.004401	0.005120	0.007146	0.009852	0.005358
ROW47	0.027333	0.059667	0.016901	0.022405	0.005459	0.006542	0.008725	0.012986	0.007287
ROW48	0.004131	0.004737	0.003384	0.003387	0.003917	0.003986	0.003616	0.009163	0.003444
ROW49	0.060269	0.048861	0.047377	0.049258	0.037874	0.051800	0.048826	0.030759	0.018684
ROW50	0.028929	0.010769	0.005045	0.010805	0.003344	0.006149	0.023653	0.007306	0.005780
ROW51	0.000190	0.000072	0.000042	0.000045	0.000036	0.000042	0.000041	0.000040	0.000033
ROW52	0.011501	0.000577	0.000565	0.001269	0.000526	0.000546	0.000657	0.001377	0.000515
ROW53	0.001969	0.003812	0.001820	0.003515	0.002250	0.004404	0.002964	0.009332	0.002517
ROW54	0.078872	0.052067	0.010980	0.013385	0.008608	0.016034	0.022395	0.019198	0.020479
ROW55	1.212670	0.000127	0.000244	0.000190	0.000171	0.000151	0.000128	0.000150	0.000171
ROW56	0.001868	1.088633	0.000923	0.001769	0.001281	0.001256	0.002136	0.004751	0.001558

Table E3 (continued)

ROW	COL55	COL56	COL57	COL58	COL59	COL60	COL61	COL62	COL63
ROW57	0.000305	0.001707	1.004460	0.086567	0.001164	0.000655	0.000925	0.000801	0.000876
ROW58	0.002988	0.018715	0.022458	1.041023	0.012105	0.006174	0.008446	0.008406	0.009739
ROW59	0.015002	0.016033	0.017537	0.025033	1.262179	0.037542	0.045417	0.296818	0.191506
ROW60	0.003275	0.002978	0.002495	0.006032	0.013810	1.533574	0.080654	0.067729	0.025543
ROW61	0.011196	0.007575	0.008010	0.007400	0.047389	0.119765	1.595892	0.069327	0.046201
ROW62	0.027889	0.013620	0.014180	0.023844	0.038688	0.024586	0.028395	1.072369	0.051927
ROW63	0.016384	0.022853	0.023615	0.019655	0.057704	0.048075	0.048613	0.048685	1.164973
ROW64	0.001290	0.001312	0.001236	0.001296	0.004902	0.002849	0.003889	0.004433	0.010680
ROW65	0.000773	0.001014	0.001895	0.001116	0.001283	0.001019	0.000886	0.001857	0.001062
ROW66	0.000957	0.000494	0.000088	0.000097	0.000100	0.000091	0.000111	0.000176	0.000115
ROW67	0.000753	0.001967	0.004964	0.002815	0.005267	0.002830	0.003191	0.002597	0.002068
ROW68	0.000520	0.000532	0.000592	0.000607	0.000635	0.000543	0.000970	0.000888	0.000892
ROW69	0.001707	0.003111	0.002537	0.003350	0.013506	0.011459	0.006748	0.011047	0.024370
ROW70	0.003331	0.004159	0.005152	0.006174	0.006910	0.003379	0.004167	0.007348	0.011536
ROW71	0.000103	0.000093	0.000085	0.000086	0.000164	0.000106	0.000103	0.000132	0.000777
ROW72	0.000466	0.000356	0.000354	0.000563	0.000541	0.000389	0.000460	0.001075	0.002131
ROW73	0.000553	0.001117	0.001363	0.001370	0.002817	0.001192	0.001259	0.001292	0.001113
ROW74	0.000781	0.003137	0.001315	0.001041	0.002961	0.001157	0.001102	0.002851	0.002280
ROW75	0.000872	0.000653	0.000621	0.000844	0.000587	0.000691	0.000651	0.000830	0.000655
ROW76	0.000162	0.000054	0.000042	0.000210	0.000068	0.000083	0.000062	0.000109	0.000177
ROW77	0.015969	0.002473	0.005577	0.003258	0.001874	0.001578	0.001848	0.001846	0.001578
ROW78	0.010804	0.034232	0.040494	0.035035	0.045887	0.034661	0.029316	0.022825	0.013697
ROW79	0.002909	0.002240	0.003291	0.004764	0.004035	0.003768	0.004527	0.004491	0.002893
ROW80	0.027682	0.024641	0.041678	0.075322	0.026244	0.019489	0.020392	0.022246	0.016508
ROW81	0.003034	0.003514	0.006921	0.009150	0.012762	0.003360	0.003147	0.005035	0.003248
ROW82	0.009442	0.006831	0.005385	0.011362	0.009169	0.005701	0.008434	0.015031	0.009133
ROW83	0.001283	0.001463	0.002324	0.002323	0.002113	0.001753	0.001603	0.001556	0.001169
ROW84	0.011027	0.008814	0.007975	0.010238	0.008696	0.009493	0.009541	0.009838	0.010588
ROW85	0.002243	0.003565	0.004925	0.003188	0.004261	0.004319	0.005130	0.003353	0.002171
ROW86	0.081579	0.053861	0.034286	0.047286	0.067438	0.071212	0.090973	0.065008	0.059879
ROW87	0.002105	0.002151	0.003843	0.003326	0.002753	0.003943	0.004864	0.002435	0.002305
ROW88	0.011354	0.007266	0.022246	0.009340	0.007503	0.010883	0.010137	0.008534	0.008313
ROW89	0.010576	0.011486	0.012607	0.013741	0.012480	0.014542	0.014642	0.012619	0.009822
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.044694	0.036247	0.034743	0.039824	0.036171	0.028529	0.034471	0.036345	0.030711
ROW92	0.002819	0.002503	0.002949	0.003163	0.003679	0.003377	0.003497	0.004028	0.002639
ROW93	0.003755	0.002870	0.002305	0.002551	0.002807	0.002750	0.002600	0.003575	0.003136
ROW94	0.067785	0.055681	0.056285	0.056076	0.051908	0.060658	0.060342	0.057102	0.050707
ROW95	0.011155	0.010025	0.006998	0.010396	0.008884	0.009288	0.009426	0.011104	0.012471
ROW96	0.007509	0.009758	0.011789	0.012565	0.006625	0.006948	0.008114	0.007380	0.006962
ROW97	0.001643	0.001557	0.001278	0.001389	0.001340	0.001431	0.001421	0.001424	0.001517
ROW98	0.000001	0.000001	0.000002	0.000001	0.000001	0.000002	0.000001	0.000001	0.000001
ROW99	0.000374	0.000047	0.000049	0.000056	0.000048	0.000054	0.000055	0.000051	0.000042
ROW100	0.000300	0.000833	0.001905	0.000400	0.000642	0.000911	0.000786	0.000821	0.000361
ROW101	0.003076	0.002191	0.001644	0.002217	0.002058	0.002052	0.002310	0.002333	0.002342
ROW102	0.000260	0.000104	0.000057	0.000070	0.000058	0.000060	0.000072	0.000402	0.000093
ROW103	0.006966	0.003321	0.003059	0.003422	0.003250	0.003239	0.003408	0.003432	0.003560
ROW104	0.000487	0.000548	0.000921	0.000756	0.002002	0.000841	0.000968	0.000845	0.000584
	2.406808	1.881606	1.906339	1.976112	2.141688	2.466366	2.632726	2.171574	1.994837

Table E3 (continued)

ROW	COL64	COL65	COL66	COL67	COL68	COL69	COL70	COL71	COL72
ROW1	0.003229	0.005913	0.006225	0.005227	0.002782	0.005692	0.007144	0.006357	0.003498
ROW2	0.005742	0.007505	0.006751	0.006640	0.004802	0.008094	0.006566	0.007209	0.006145
ROW3	0.001665	0.002374	0.002700	0.002597	0.001402	0.002481	0.002473	0.002507	0.001544
ROW4	0.002467	0.002436	0.002494	0.002381	0.002378	0.002563	0.002787	0.003523	0.001997
ROW5	0.000901	0.000535	0.000667	0.000633	0.000733	0.000674	0.000577	0.000702	0.002224
ROW6	0.000062	0.000108	0.000127	0.000090	0.000055	0.000110	0.000106	0.000208	0.000069
ROW7	0.001810	0.002044	0.002253	0.002347	0.001585	0.002256	0.002445	0.002888	0.001592
ROW8	0.001567	0.001793	0.001897	0.001785	0.001306	0.001918	0.001733	0.001756	0.001504
ROW9	0.000237	0.000286	0.000263	0.000257	0.000200	0.000310	0.000253	0.000281	0.000245
ROW10	0.002653	0.006054	0.003329	0.003275	0.002152	0.005900	0.003256	0.003211	0.003651
ROW11	0.000210	0.000901	0.000763	0.000213	0.000195	0.000273	0.000711	0.000344	0.000195
ROW12	0.015470	0.016720	0.017343	0.017329	0.013344	0.018430	0.016785	0.017465	0.015358
ROW13	0.000442	0.000477	0.000495	0.000495	0.000381	0.000526	0.000479	0.000499	0.000439
ROW14	0.000543	0.000587	0.000609	0.000608	0.000468	0.000647	0.000589	0.000613	0.000539
ROW15	0.008630	0.012313	0.013997	0.013469	0.007286	0.012844	0.012812	0.013011	0.008032
ROW16	0.003094	0.001679	0.001912	0.001968	0.003085	0.002043	0.001809	0.001854	0.005283
ROW17	0.000798	0.000455	0.000521	0.000525	0.000790	0.000551	0.000458	0.000527	0.001300
ROW18	0.001354	0.000770	0.000892	0.000893	0.001353	0.000930	0.000793	0.000890	0.002215
ROW19	0.001968	0.001462	0.001930	0.001814	0.001978	0.001644	0.003011	0.002779	0.002631
ROW20	0.000852	0.001374	0.001423	0.001229	0.001340	0.001172	0.000899	0.000814	0.000904
ROW21	0.002351	0.006855	0.007308	0.005296	0.002028	0.006148	0.008659	0.007561	0.003074
ROW22	0.007960	0.013297	0.010473	0.011637	0.006920	0.017845	0.005663	0.006134	0.007258
ROW23	0.001422	0.001954	0.002487	0.002343	0.000977	0.002496	0.002309	0.002077	0.000931
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000005	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.002583	0.001535	0.001882	0.001690	0.002071	0.001888	0.001218	0.001608	0.001441
ROW31	0.006740	0.007002	0.008273	0.007172	0.006448	0.007953	0.008434	0.008303	0.007906
ROW32	0.001217	0.001448	0.001493	0.001471	0.001039	0.001569	0.001432	0.001497	0.001213
ROW33	0.000036	0.000043	0.000044	0.000040	0.000031	0.000046	0.000044	0.000041	0.000035
ROW34	0.002391	0.003270	0.003402	0.003126	0.002230	0.003336	0.004158	0.004409	0.002585
ROW35	0.000076	0.000058	0.000050	0.000036	0.000412	0.000049	0.000076	0.000177	0.000647
ROW36	0.002312	0.001226	0.001331	0.001411	0.002303	0.001493	0.001102	0.001200	0.004010
ROW37	0.002258	0.001148	0.001229	0.001335	0.002258	0.001406	0.000978	0.001134	0.003963
ROW38	0.006729	0.003787	0.004348	0.004410	0.006619	0.004660	0.003602	0.004166	0.010965
ROW39	0.000378	0.000197	0.000231	0.000260	0.000339	0.000273	0.000149	0.000197	0.000560
ROW40	0.005088	0.005241	0.015808	0.010759	0.006557	0.006049	0.046106	0.030587	0.005888
ROW41	0.001532	0.001381	0.001245	0.001456	0.001764	0.001792	0.001558	0.002665	0.001485
ROW42	0.004145	0.008246	0.008356	0.007161	0.007403	0.006712	0.005087	0.058006	0.003432
ROW43	0.001796	0.004552	0.006749	0.003678	0.003779	0.004210	0.003883	0.033141	0.002222
ROW44	0.000880	0.000059	0.000035	0.000068	0.019011	0.000086	0.000240	0.008523	0.001079
ROW45	0.000054	0.000103	0.000470	0.000082	0.000054	0.000104	0.003872	0.002783	0.001592
ROW46	0.010710	0.008999	0.013135	0.012402	0.009492	0.010299	0.007374	0.007005	0.005958
ROW47	0.011780	0.014124	0.024700	0.024964	0.010374	0.012021	0.010319	0.010533	0.006100
ROW48	0.005255	0.003716	0.004739	0.003681	0.009666	0.004246	0.004276	0.004173	0.006740
ROW49	0.024291	0.023646	0.032953	0.034147	0.015667	0.033570	0.026088	0.024148	0.012588
ROW50	0.011055	0.007805	0.020063	0.018502	0.010187	0.013956	0.015243	0.013668	0.006936
ROW51	0.000047	0.000043	0.000067	0.000040	0.000043	0.000043	0.000036	0.000038	0.000068
ROW52	0.000663	0.000583	0.000786	0.000671	0.000718	0.000733	0.000801	0.000724	0.000675
ROW53	0.002092	0.004870	0.010159	0.004469	0.002168	0.004301	0.006146	0.007749	0.003064
ROW54	0.030237	0.027220	0.050762	0.035235	0.019974	0.030141	0.047135	0.050647	0.009983
ROW55	0.000285	0.000179	0.000203	0.000162	0.000355	0.000239	0.000215	0.000240	0.000372
ROW56	0.014651	0.003045	0.006937	0.033482	0.007294	0.002303	0.017748	0.007010	0.002193

Table E3 (continued)

ROW	COL64	COL65	COL66	COL67	COL68	COL69	COL70	COL71	COL72
ROW57	0.000557	0.000835	0.001081	0.000774	0.000355	0.001154	0.000840	0.000846	0.000337
ROW58	0.006129	0.009258	0.012178	0.007802	0.003771	0.013027	0.009271	0.009350	0.003507
ROW59	0.045499	0.137747	0.146965	0.102499	0.039411	0.119263	0.174275	0.152219	0.061496
ROW60	0.020103	0.048219	0.037005	0.041559	0.018054	0.034383	0.028600	0.075301	0.032761
ROW61	0.059931	0.097558	0.075243	0.084346	0.052340	0.136206	0.036765	0.032434	0.052312
ROW62	0.055402	0.076114	0.079235	0.059761	0.050325	0.052324	0.157755	0.134073	0.039854
ROW63	0.022515	0.051187	0.038772	0.027467	0.019998	0.048558	0.057104	0.051989	0.059216
ROW64	1.242967	0.049596	0.010533	0.013510	0.237866	0.033119	0.007377	0.003594	0.060242
ROW65	0.000786	1.076077	0.017805	0.001109	0.000758	0.002195	0.008462	0.011621	0.000748
ROW66	0.000169	0.000191	1.011268	0.000120	0.000386	0.000212	0.000243	0.019093	0.000158
ROW67	0.008246	0.006129	0.014994	1.037886	0.013890	0.009764	0.008335	0.007286	0.002112
ROW68	0.004051	0.000851	0.000759	0.001796	1.083023	0.001069	0.007512	0.001625	0.059165
ROW69	0.014964	0.091620	0.061084	0.053978	0.009643	1.053024	0.032691	0.012262	0.009152
ROW70	0.003773	0.005468	0.004161	0.004807	0.003488	0.005833	1.293960	0.120004	0.003389
ROW71	0.000093	0.000121	0.000120	0.000095	0.000110	0.000124	0.001911	1.029158	0.000120
ROW72	0.000776	0.000609	0.000605	0.000507	0.002046	0.001056	0.000822	0.000640	1.198688
ROW73	0.000445	0.000816	0.000824	0.000713	0.000422	0.001453	0.001403	0.004745	0.000498
ROW74	0.003322	0.014361	0.034926	0.001984	0.002841	0.005566	0.003989	0.002918	0.014419
ROW75	0.000941	0.000716	0.000914	0.001060	0.001102	0.000853	0.000715	0.000781	0.002109
ROW76	0.000497	0.000137	0.000162	0.000085	0.000244	0.000178	0.000080	0.000081	0.000266
ROW77	0.002643	0.003795	0.006074	0.001469	0.001990	0.002846	0.001619	0.005697	0.001625
ROW78	0.008037	0.014627	0.015583	0.013923	0.007385	0.014457	0.022282	0.023191	0.007468
ROW79	0.005029	0.003557	0.004117	0.005002	0.004629	0.005101	0.003067	0.004234	0.005679
ROW80	0.013625	0.018842	0.020435	0.018350	0.012445	0.020403	0.023466	0.023179	0.013365
ROW81	0.001773	0.003092	0.003087	0.002719	0.001509	0.002959	0.003507	0.003446	0.001810
ROW82	0.013601	0.007693	0.009779	0.009362	0.010768	0.009619	0.008200	0.010376	0.012596
ROW83	0.001050	0.001151	0.001164	0.001096	0.000900	0.001247	0.001256	0.001368	0.001100
ROW84	0.013077	0.011383	0.009842	0.010551	0.013494	0.011412	0.008978	0.009654	0.012056
ROW85	0.002322	0.002861	0.002863	0.002509	0.002001	0.003097	0.002663	0.002367	0.002288
ROW86	0.054218	0.073760	0.072177	0.061462	0.052712	0.058808	0.098953	0.097139	0.043194
ROW87	0.002663	0.002520	0.002011	0.001957	0.002700	0.002299	0.002361	0.002281	0.004097
ROW88	0.010815	0.007055	0.007811	0.007647	0.008736	0.010051	0.007501	0.008663	0.007540
ROW89	0.012147	0.009804	0.010019	0.009662	0.011442	0.011229	0.010297	0.011014	0.010792
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.053572	0.031841	0.039029	0.035049	0.042957	0.039160	0.025265	0.033345	0.029885
ROW92	0.007898	0.004242	0.003034	0.005014	0.008066	0.006019	0.003639	0.003686	0.010493
ROW93	0.008016	0.003800	0.004810	0.004422	0.012668	0.011208	0.003229	0.003180	0.006347
ROW94	0.063602	0.060796	0.074245	0.055652	0.074326	0.062325	0.058036	0.059229	0.071263
ROW95	0.022325	0.011234	0.011352	0.012282	0.022457	0.013530	0.009783	0.010662	0.040159
ROW96	0.007792	0.009740	0.006665	0.008901	0.007946	0.008576	0.016248	0.010080	0.006519
ROW97	0.002157	0.001491	0.001903	0.001454	0.002490	0.001620	0.001450	0.001457	0.002694
ROW98	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
ROW99	0.000056	0.000041	0.000043	0.000042	0.000054	0.000048	0.000043	0.000048	0.000064
ROW100	0.000493	0.000452	0.000478	0.000549	0.000501	0.000635	0.000539	0.000521	0.000342
ROW101	0.003350	0.002234	0.002283	0.002583	0.003232	0.002569	0.001987	0.002395	0.002937
ROW102	0.000134	0.000108	0.000470	0.000650	0.000387	0.000112	0.000166	0.000171	0.000627
ROW103	0.003956	0.003221	0.004432	0.003143	0.004949	0.003512	0.003651	0.003212	0.005013
ROW104	0.000465	0.000583	0.000594	0.000557	0.000422	0.000577	0.000633	0.000624	0.000460
	2.020689	2.178955	2.169245	2.012829	2.057035	2.071809	2.450567	2.376826	2.076086

Table E3 (continued)

ROW	COL73	COL74	COL75	COL76	COL77	COL78	COL79	COL80	COL81
ROW1	0.007231	0.003326	0.004072	0.003466	0.004654	0.002464	0.002679	0.000781	0.002974
ROW2	0.007516	0.006867	0.007426	0.007343	0.011140	0.017062	0.026784	0.018582	0.030808
ROW3	0.002316	0.001698	0.001705	0.001809	0.002400	0.001332	0.001690	0.000622	0.001957
ROW4	0.002344	0.004311	0.002746	0.004033	0.004417	0.001849	0.022146	0.011953	0.005685
ROW5	0.000511	0.000637	0.000579	0.000850	0.000797	0.000309	0.000236	0.000171	0.000310
ROW6	0.000166	0.000067	0.000081	0.000110	0.000153	0.000028	0.000024	0.000014	0.000032
ROW7	0.002689	0.002069	0.001539	0.002757	0.003155	0.026063	0.023176	0.020256	0.005372
ROW8	0.002028	0.001585	0.002133	0.001888	0.002352	0.001233	0.001407	0.000609	0.043885
ROW9	0.000287	0.000270	0.000278	0.000287	0.000433	0.000620	0.001153	0.000814	0.001114
ROW10	0.005296	0.003137	0.002582	0.002774	0.007293	0.002873	0.004231	0.002561	0.003732
ROW11	0.000240	0.000191	0.000209	0.000199	0.000291	0.001574	0.000444	0.000172	0.000644
ROW12	0.017365	0.014187	0.010863	0.014698	0.017741	0.015531	0.019548	0.004335	0.017347
ROW13	0.000496	0.000405	0.000310	0.000420	0.000507	0.000444	0.000558	0.000124	0.000495
ROW14	0.000610	0.000498	0.000381	0.000516	0.000623	0.000545	0.000686	0.000152	0.000609
ROW15	0.011979	0.008808	0.008608	0.009363	0.012366	0.006891	0.008713	0.003149	0.010104
ROW16	0.002176	0.004472	0.002056	0.003212	0.005336	0.001159	0.000951	0.001303	0.001582
ROW17	0.000580	0.000741	0.000579	0.000532	0.000976	0.000332	0.000260	0.000342	0.000416
ROW18	0.000974	0.001681	0.001005	0.001204	0.002097	0.000551	0.000452	0.000671	0.000715
ROW19	0.002291	0.002611	0.001600	0.001667	0.006798	0.001137	0.001064	0.000923	0.001457
ROW20	0.002698	0.001289	0.001369	0.001298	0.007111	0.000712	0.000411	0.000264	0.000562
ROW21	0.009703	0.002677	0.002025	0.002666	0.003215	0.001395	0.000891	0.000348	0.001595
ROW22	0.006094	0.008734	0.006097	0.038797	0.005429	0.000974	0.000889	0.000368	0.001226
ROW23	0.002103	0.001437	0.002181	0.006631	0.002538	0.002408	0.000942	0.000408	0.001018
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.001389	0.001665	0.001298	0.001916	0.002363	0.001619	0.002117	0.001510	0.003327
ROW31	0.008067	0.006642	0.009899	0.005101	0.009735	0.002584	0.005835	0.005797	0.021057
ROW32	0.001472	0.001207	0.001069	0.001274	0.001656	0.002157	0.002325	0.001222	0.003074
ROW33	0.000039	0.000038	0.000037	0.000052	0.000059	0.000049	0.000168	0.000058	0.001067
ROW34	0.003530	0.002584	0.002455	0.003424	0.004221	0.135576	0.024689	0.002851	0.019136
ROW35	0.000193	0.000179	0.000055	0.000030	0.000047	0.000040	0.000028	0.000024	0.000045
ROW36	0.001527	0.003422	0.001489	0.002525	0.003836	0.000840	0.000668	0.000838	0.001136
ROW37	0.001434	0.001689	0.001090	0.001359	0.001724	0.000778	0.000683	0.000810	0.000984
ROW38	0.004804	0.006191	0.005058	0.004376	0.007866	0.002811	0.002127	0.002457	0.003375
ROW39	0.000239	0.000311	0.000180	0.000257	0.000317	0.000133	0.000119	0.000117	0.000172
ROW40	0.019002	0.023831	0.005417	0.005920	0.058553	0.003103	0.006872	0.004130	0.010637
ROW41	0.001868	0.002072	0.000946	0.000738	0.003173	0.000970	0.007337	0.000698	0.000998
ROW42	0.016737	0.007321	0.008070	0.007084	0.044843	0.004117	0.002141	0.001190	0.003018
ROW43	0.014125	0.004381	0.001369	0.010560	0.022866	0.004049	0.001317	0.000636	0.002089
ROW44	0.003766	0.000148	0.000042	0.000031	0.000083	0.000112	0.000046	0.000025	0.000250
ROW45	0.003554	0.000087	0.000055	0.000046	0.000072	0.000121	0.000145	0.000086	0.000227
ROW46	0.005283	0.013423	0.030248	0.008804	0.032728	0.003289	0.004782	0.003599	0.004778
ROW47	0.006517	0.015081	0.022254	0.015646	0.045454	0.002983	0.004671	0.003910	0.003528
ROW48	0.004286	0.005155	0.003605	0.003737	0.005941	0.004610	0.006298	0.004270	0.005279
ROW49	0.022344	0.021325	0.071910	0.027316	0.047146	0.008914	0.012485	0.006807	0.011039
ROW50	0.013230	0.018019	0.006358	0.008520	0.051962	0.002044	0.003967	0.003081	0.003202
ROW51	0.000041	0.000881	0.000062	0.000040	0.000105	0.000021	0.000032	0.000022	0.000057
ROW52	0.000625	0.001576	0.000699	0.000664	0.001893	0.000421	0.002213	0.000578	0.000787
ROW53	0.011712	0.002264	0.001140	0.001769	0.008566	0.003263	0.001498	0.001020	0.003007
ROW54	0.019691	0.035164	0.020588	0.016689	0.068394	0.005714	0.016703	0.015972	0.005965
ROW55	0.000225	0.000866	0.000246	0.012702	0.004639	0.000108	0.000129	0.000106	0.000124
ROW56	0.010298	0.010954	0.002525	0.002894	0.002375	0.001433	0.002644	0.000960	0.001194

Table E3 (continued)

ROW	COL73	COL74	COL75	COL76	COL77	COL78	COL79	COL80	COL81
ROW57	0.000872	0.000482	0.000248	0.001844	0.000658	0.001077	0.000362	0.000155	0.000409
ROW58	0.007615	0.005198	0.002167	0.020938	0.007031	0.003571	0.002300	0.001437	0.002887
ROW59	0.197854	0.052316	0.038148	0.048884	0.062913	0.027956	0.017394	0.006677	0.032008
ROW60	0.031412	0.021204	0.014775	0.017977	0.016957	0.003461	0.002853	0.001265	0.004210
ROW61	0.039940	0.065769	0.042404	0.316807	0.037278	0.006296	0.005652	0.002193	0.008070
ROW62	0.079199	0.055534	0.024106	0.020013	0.045651	0.018336	0.017608	0.007699	0.019617
ROW63	0.123432	0.025805	0.013790	0.016645	0.018615	0.018904	0.017077	0.005530	0.022573
ROW64	0.010968	0.047751	0.031906	0.003127	0.010204	0.001500	0.004000	0.001068	0.002409
ROW65	0.004974	0.001018	0.000716	0.000674	0.000993	0.002537	0.002652	0.002287	0.001620
ROW66	0.001096	0.000137	0.000100	0.000106	0.000207	0.000109	0.000105	0.000079	0.000220
ROW67	0.002941	0.006248	0.003038	0.001236	0.002746	0.004193	0.002051	0.000816	0.001762
ROW68	0.011938	0.002915	0.000844	0.000754	0.001984	0.001442	0.001150	0.001048	0.003149
ROW69	0.024110	0.015454	0.006066	0.002794	0.007998	0.004667	0.015944	0.003002	0.004041
ROW70	0.014610	0.004951	0.002454	0.003355	0.004390	0.003398	0.036881	0.025178	0.004181
ROW71	0.001267	0.000108	0.000094	0.000092	0.000959	0.000087	0.000129	0.000088	0.000201
ROW72	0.003165	0.002108	0.000512	0.000593	0.000579	0.000292	0.000195	0.000127	0.000349
ROW73	1.058099	0.000702	0.000501	0.000644	0.001192	0.024523	0.005093	0.000486	0.056118
ROW74	0.007560	1.053320	0.012229	0.003974	0.002073	0.001051	0.000575	0.000315	0.004926
ROW75	0.000719	0.002577	1.031897	0.000727	0.001242	0.000554	0.000722	0.000585	0.001119
ROW76	0.000130	0.002448	0.000261	1.091098	0.000207	0.000052	0.000037	0.000057	0.000060
ROW77	0.002433	0.005771	0.004937	0.009428	1.047502	0.001124	0.001680	0.000797	0.002686
ROW78	0.017528	0.009184	0.009565	0.013333	0.017550	1.061296	0.005427	0.006605	0.004957
ROW79	0.003249	0.004741	0.002686	0.006089	0.005056	0.000868	1.007563	0.000844	0.001249
ROW80	0.019355	0.020566	0.012833	0.024254	0.027464	0.018936	0.022563	1.148665	0.011372
ROW81	0.003539	0.001862	0.002916	0.002457	0.003445	0.002366	0.003278	0.001986	1.377882
ROW82	0.006989	0.009120	0.008288	0.012883	0.011720	0.004317	0.002829	0.002262	0.003391
ROW83	0.001189	0.001072	0.001056	0.001291	0.001603	0.016359	0.003259	0.005726	0.019199
ROW84	0.010084	0.013132	0.009646	0.013427	0.013901	0.011144	0.012235	0.023213	0.018496
ROW85	0.002366	0.002471	0.002412	0.003943	0.003187	0.003646	0.005222	0.001065	0.002489
ROW86	0.071044	0.058046	0.041803	0.081263	0.076720	0.024578	0.042408	0.038987	0.033999
ROW87	0.002407	0.002525	0.002062	0.002401	0.002984	0.004603	0.008311	0.013292	0.003362
ROW88	0.007867	0.007892	0.011105	0.008800	0.012930	0.006963	0.010464	0.007305	0.010905
ROW89	0.011489	0.011635	0.012822	0.010631	0.020433	0.012339	0.026698	0.027882	0.070966
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.028806	0.034532	0.026912	0.039728	0.049002	0.033543	0.043914	0.031323	0.069003
ROW92	0.002616	0.004734	0.003580	0.005749	0.005538	0.001049	0.001349	0.001133	0.001676
ROW93	0.003623	0.006007	0.005721	0.002830	0.006515	0.002608	0.002661	0.002095	0.002602
ROW94	0.056532	0.074525	0.070495	0.067266	0.101683	0.042719	0.063399	0.052309	0.091315
ROW95	0.014307	0.016359	0.011065	0.012371	0.015369	0.007903	0.006273	0.008241	0.009120
ROW96	0.006476	0.009087	0.005340	0.007458	0.009323	0.006340	0.044644	0.047809	0.008226
ROW97	0.001554	0.002200	0.001852	0.001663	0.002375	0.001548	0.001336	0.001195	0.001911
ROW98	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000043	0.000000	0.000004
ROW99	0.000049	0.000057	0.000052	0.000049	0.000091	0.000045	0.000158	0.000109	0.000233
ROW100	0.000450	0.000564	0.000671	0.000316	0.000450	0.000232	0.000931	0.000125	0.000211
ROW101	0.002683	0.002854	0.005063	0.002335	0.003756	0.002321	0.002527	0.002054	0.002611
ROW102	0.000121	0.000744	0.001725	0.002485	0.003388	0.000040	0.000050	0.000043	0.000056
ROW103	0.003599	0.004581	0.003123	0.005094	0.005677	0.002672	0.004009	0.003367	0.007331
ROW104	0.000618	0.000599	0.000535	0.000585	0.001382	0.000760	0.007390	0.001860	0.000630
	2.166564	1.929085	1.743107	2.140405	2.205356	1.673670	1.694777	1.622085	2.169005

Table E3 (continued)

ROW	COL82	COL83	COL84	COL85	COL86	COL87	COL88	COL89	COL90
ROW1	0.001182	0.003389	0.000876	0.002808	0.001149	0.002350	0.001392	0.001327	0.000292
ROW2	0.039040	0.019616	0.001503	0.010984	0.006707	0.004912	0.002958	0.003601	0.001184
ROW3	0.001261	0.002654	0.000358	0.006118	0.000638	0.001266	0.000668	0.000815	0.000176
ROW4	0.003708	0.001448	0.001190	0.006684	0.008317	0.005953	0.001468	0.003739	0.000741
ROW5	0.064499	0.000452	0.000157	0.000566	0.000436	0.000169	0.000295	0.000403	0.000066
ROW6	0.000022	0.000014	0.000007	0.000030	0.000011	0.000008	0.000012	0.000014	0.000010
ROW7	0.001282	0.001043	0.000455	0.006816	0.001817	0.001164	0.001118	0.000843	0.000333
ROW8	0.001280	0.011300	0.000416	0.001446	0.000652	0.001208	0.002055	0.001011	0.000160
ROW9	0.001393	0.000320	0.000076	0.000461	0.000287	0.000227	0.000129	0.000173	0.000067
ROW10	0.004261	0.001327	0.000514	0.003989	0.001510	0.000805	0.000532	0.000653	0.000653
ROW11	0.000261	0.000361	0.000397	0.002409	0.000150	0.000231	0.000209	0.000206	0.002070
ROW12	0.007609	0.030225	0.007224	0.014329	0.009065	0.021746	0.011717	0.010555	0.001379
ROW13	0.000217	0.000863	0.000206	0.000409	0.000259	0.000621	0.000335	0.000301	0.000039
ROW14	0.000267	0.001061	0.000254	0.000503	0.000318	0.000763	0.000411	0.000370	0.000048
ROW15	0.006402	0.013959	0.001873	0.032158	0.003312	0.006652	0.003498	0.004267	0.000903
ROW16	0.009010	0.002086	0.000908	0.001579	0.002807	0.000926	0.001680	0.004326	0.000372
ROW17	0.002077	0.000523	0.000265	0.000422	0.000745	0.000244	0.000427	0.001074	0.000192
ROW18	0.003565	0.000898	0.000425	0.000714	0.001230	0.000434	0.000775	0.001856	0.000214
ROW19	0.002950	0.001425	0.003609	0.001689	0.002262	0.001001	0.001067	0.002059	0.007817
ROW20	0.000756	0.000415	0.000275	0.000851	0.000493	0.000285	0.000466	0.000711	0.000258
ROW21	0.000354	0.000415	0.000155	0.000560	0.000180	0.000123	0.000116	0.000151	0.000151
ROW22	0.000619	0.000429	0.000397	0.000774	0.000219	0.000161	0.000183	0.000222	0.000249
ROW23	0.000559	0.000699	0.000576	0.003958	0.000293	0.000263	0.000288	0.000333	0.000384
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.001812	0.002407	0.001429	0.001700	0.001899	0.003554	0.001974	0.003436	0.074240
ROW31	0.005442	0.003573	0.001041	0.008827	0.004497	0.006378	0.009468	0.005336	0.000821
ROW32	0.003100	0.037825	0.000457	0.003166	0.000825	0.001417	0.000776	0.000782	0.000141
ROW33	0.000352	0.000050	0.000024	0.008681	0.000046	0.000112	0.000040	0.000049	0.000006
ROW34	0.009543	0.002012	0.031064	0.175581	0.002347	0.003012	0.001854	0.002771	0.000374
ROW35	0.000061	0.000050	0.000026	0.000042	0.000038	0.000024	0.000046	0.000056	0.000008
ROW36	0.006974	0.001548	0.000658	0.001170	0.002100	0.000690	0.001255	0.003299	0.000204
ROW37	0.002331	0.001606	0.000645	0.001118	0.002049	0.000670	0.001243	0.003280	0.000182
ROW38	0.017052	0.004368	0.001860	0.003496	0.006260	0.001984	0.003540	0.009019	0.000786
ROW39	0.000201	0.000264	0.000094	0.000185	0.000200	0.000093	0.000173	0.000451	0.000027
ROW40	0.003529	0.007363	0.001039	0.002486	0.002976	0.001343	0.003841	0.001737	0.001136
ROW41	0.001672	0.000322	0.000853	0.001806	0.000720	0.000396	0.000341	0.000423	0.000085
ROW42	0.001733	0.001776	0.001383	0.004792	0.001860	0.001442	0.002276	0.002643	0.001442
ROW43	0.000810	0.001940	0.001007	0.004843	0.000781	0.000425	0.000472	0.000525	0.001824
ROW44	0.000066	0.000025	0.000381	0.000034	0.000019	0.000013	0.000017	0.000031	0.000071
ROW45	0.000079	0.000052	0.000015	0.000041	0.000034	0.000024	0.000015	0.000026	0.000211
ROW46	0.005454	0.004308	0.002629	0.003600	0.907057	0.005561	0.009826	0.011624	0.001323
ROW47	0.005443	0.003467	0.001927	0.003334	0.008674	0.007444	0.003909	0.006864	0.001521
ROW48	0.007350	0.005385	0.005383	0.004159	0.005605	0.003688	0.029813	0.023872	0.001194
ROW49	0.009141	0.005004	0.002416	0.027083	0.004081	0.003193	0.003854	0.004490	0.004507
ROW50	0.001904	0.001961	0.000793	0.002099	0.001505	0.001001	0.001151	0.001209	0.001238
ROW51	0.000089	0.000031	0.000014	0.000218	0.000036	0.000020	0.000030	0.000131	0.000009
ROW52	0.000908	0.000366	0.000230	0.002039	0.000863	0.000946	0.000625	0.000603	0.000132
ROW53	0.000871	0.000764	0.000798	0.003835	0.000538	0.000576	0.000544	0.000600	0.004443
ROW54	0.006067	0.005171	0.002031	0.005675	0.005386	0.003622	0.002305	0.003731	0.003601
ROW55	0.000157	0.000141	0.000103	0.000106	0.000159	0.000148	0.000177	0.000318	0.000032
ROW56	0.000903	0.000585	0.000436	0.001092	0.001076	0.000575	0.000426	0.000749	0.000356

Table E3 (continued)

ROW	COL82	COL83	COL84	COL85	COL86	COL87	COL88	COL89	COL90
ROW57	0.000198	0.000672	0.000251	0.001421	0.000105	0.000107	0.000107	0.000106	0.000170
ROW58	0.001314	0.004812	0.000872	0.004646	0.000936	0.000839	0.000947	0.000906	0.001701
ROW59	0.006702	0.007993	0.002950	0.009995	0.003423	0.002290	0.002139	0.002817	0.002747
ROW60	0.002107	0.001240	0.000854	0.001876	0.000748	0.000513	0.000584	0.000721	0.000685
ROW61	0.003993	0.002743	0.002899	0.004089	0.001310	0.000952	0.001078	0.001317	0.001486
ROW62	0.007115	0.008783	0.003913	0.014067	0.004301	0.003019	0.002846	0.003834	0.004712
ROW63	0.006912	0.013226	0.001713	0.006612	0.003321	0.002206	0.002195	0.002581	0.002710
ROW64	0.006786	0.001934	0.007025	0.001340	0.001195	0.000783	0.002504	0.001954	0.000371
ROW65	0.000651	0.000632	0.000748	0.003383	0.001715	0.000773	0.000556	0.000758	0.002282
ROW66	0.000104	0.000093	0.000084	0.000083	0.000162	0.000146	0.000122	0.000183	0.001658
ROW67	0.001139	0.001262	0.001573	0.008694	0.000571	0.000662	0.000669	0.000630	0.000639
ROW68	0.003139	0.000916	0.021442	0.001585	0.000803	0.000452	0.000672	0.001324	0.000092
ROW69	0.004041	0.002781	0.000942	0.002841	0.001344	0.001056	0.000816	0.001103	0.000874
ROW70	0.002364	0.002993	0.001709	0.004216	0.008052	0.003109	0.001545	0.003740	0.000557
ROW71	0.000090	0.000069	0.000047	0.000064	0.000089	0.000067	0.000112	0.000117	0.000021
ROW72	0.043546	0.000305	0.000129	0.000176	0.000232	0.000088	0.000174	0.000252	0.000050
ROW73	0.001023	0.001032	0.000458	0.000542	0.000321	0.000257	0.000246	0.000493	0.000152
ROW74	0.001097	0.002266	0.000227	0.001353	0.000247	0.000185	0.000214	0.000319	0.000558
ROW75	0.000939	0.000834	0.000630	0.000667	0.000988	0.000666	0.001568	0.001793	0.000177
ROW76	0.000102	0.000123	0.000052	0.000086	0.000083	0.000048	0.000076	0.000179	0.000013
ROW77	0.001558	0.001105	0.000921	0.001198	0.001224	0.000805	0.001687	0.002225	0.000885
ROW78	0.004074	0.002541	0.001177	0.005740	0.002447	0.001730	0.002061	0.002524	0.001227
ROW79	0.001485	0.002288	0.001236	0.000919	0.002927	0.000639	0.001172	0.002436	0.000276
ROW80	0.018516	0.009984	0.003783	0.023419	0.021362	0.005576	0.005090	0.007371	0.003446
ROW81	0.003936	0.001296	0.000367	0.002696	0.001102	0.001430	0.000624	0.000829	0.000345
ROW82	1.041013	0.006256	0.002119	0.003418	0.005107	0.001809	0.003828	0.005595	0.000916
ROW83	0.028603	1.001660	0.000246	0.001342	0.001336	0.000643	0.000464	0.000844	0.000172
ROW84	0.017582	0.017213	1.015760	0.016800	0.023986	0.012109	0.020625	0.041327	0.002036
ROW85	0.007128	0.003628	0.001477	1.030630	0.002474	0.001512	0.002699	0.003874	0.000362
ROW86	0.031671	0.014855	0.007291	0.022117	1.026662	0.011268	0.010253	0.015036	0.007081
ROW87	0.002234	0.002250	0.001564	0.008186	0.004721	1.002732	0.001737	0.003510	0.005178
ROW88	0.010894	0.022975	0.005244	0.006579	0.009255	0.011267	1.017526	0.048576	0.006468
ROW89	0.042029	0.029315	0.009817	0.015851	0.011922	0.011363	0.049122	1.323205	0.026740
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
ROW91	0.037575	0.049932	0.029639	0.035246	0.039393	0.073497	0.040841	0.071201	0.031437
ROW92	0.002616	0.002148	0.001890	0.001233	0.005215	0.000970	0.001776	0.003771	0.000359
ROW93	0.003549	0.002577	0.004288	0.002341	0.004545	0.002424	0.004129	0.005232	0.000427
ROW94	0.086154	0.058217	0.041159	0.052626	0.078051	0.065964	0.117108	0.116245	0.018178
ROW95	0.027495	0.015554	0.006533	0.011068	0.021886	0.006835	0.012589	0.033687	0.001825
ROW96	0.005679	0.005802	0.004856	0.010489	0.023771	0.008552	0.004160	0.010579	0.001262
ROW97	0.003357	0.001564	0.001232	0.001301	0.001934	0.001481	0.002631	0.003298	0.000382
ROW98	0.000001	0.000001	0.000000	0.000029	0.000001	0.000001	0.000000	0.000001	0.000000
ROW99	0.000178	0.000099	0.000036	0.000197	0.000054	0.000042	0.000153	0.000828	0.000083
ROW100	0.000260	0.000776	0.000099	0.000116	0.000195	0.000374	0.000173	0.000314	0.000035
ROW101	0.002226	0.003506	0.001552	0.000962	0.003039	0.002048	0.003511	0.009302	0.000382
ROW102	0.000096	0.000054	0.000030	0.000047	0.000062	0.000026	0.000055	0.000097	0.000014
ROW103	0.002908	0.004855	0.005396	0.005270	0.005207	0.007385	0.030297	0.022829	0.006391
ROW104	0.000464	0.000698	0.000605	0.000568	0.001217	0.000687	0.000575	0.000716	0.000086
	1.722266	1.503143	1.277689	1.699588	1.433527	1.351253	1.465844	1.891041	1.255320

Table E3 (continued)

ROW	COL91	COL92	COL93	COL94	COL95	COL96	COL97	COL98	COL99
ROW1	0.001060	0.005158	0.002242	0.001602	0.002648	0.003163	0.001655	0.002454	0.001063
ROW2	0.004052	0.009651	0.009530	0.005948	0.005842	0.007932	0.004863	0.007813	0.002850
ROW3	0.000774	0.003304	0.001391	0.000935	0.001508	0.001617	0.001357	0.002749	0.001313
ROW4	0.003177	0.009398	0.011188	0.005651	0.004041	0.008292	0.004882	0.002190	0.002895
ROW5	0.000102	0.000307	0.000389	0.001220	0.000292	0.000364	0.000296	0.000722	0.000194
ROW6	0.000010	0.000019	0.000033	0.000037	0.000041	0.000045	0.000015	0.000025	0.000011
ROW7	0.002243	0.001510	0.001267	0.001260	0.002687	0.001610	0.001357	0.002693	0.000609
ROW8	0.000747	0.002715	0.001155	0.001165	0.001485	0.001069	0.000927	0.006256	0.000572
ROW9	0.000682	0.000431	0.000396	0.000258	0.000500	0.000326	0.000377	0.000347	0.000145
ROW10	0.000834	0.004063	0.003050	0.001324	0.001359	0.003022	0.000970	0.001453	0.000678
ROW11	0.001595	0.000648	0.000294	0.000238	0.000272	0.000439	0.000436	0.000521	0.000175
ROW12	0.008805	0.041814	0.013129	0.008969	0.019789	0.012431	0.013539	0.015963	0.008262
ROW13	0.000251	0.001194	0.000375	0.000256	0.000565	0.000355	0.000387	0.000456	0.000236
ROW14	0.000309	0.001468	0.000461	0.000315	0.000695	0.000436	0.000475	0.000560	0.000290
ROW15	0.004050	0.017370	0.007198	0.004844	0.007853	0.008407	0.007087	0.014361	0.006885
ROW16	0.000769	0.003354	0.002789	0.002419	0.117100	0.001400	0.007895	0.015351	0.005192
ROW17	0.000228	0.000887	0.000551	0.000697	0.028296	0.000370	0.006021	0.005395	0.002343
ROW18	0.000354	0.001474	0.001130	0.001629	0.046716	0.000628	0.037863	0.006663	0.002561
ROW19	0.002906	0.006500	0.002604	0.001676	0.035696	0.001562	0.011762	0.006919	0.002488
ROW20	0.000275	0.000624	0.000941	0.001282	0.009139	0.000556	0.000621	0.001024	0.000470
ROW21	0.000151	0.000274	0.000726	0.000399	0.000492	0.002868	0.000231	0.000352	0.000170
ROW22	0.000232	0.000389	0.001254	0.000599	0.000566	0.002431	0.000386	0.000694	0.000344
ROW23	0.000357	0.000700	0.001068	0.000744	0.001177	0.001611	0.000821	0.001007	0.000367
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.053961	0.007786	0.003512	0.003307	0.003751	0.002857	0.005393	0.003188	0.002821
ROW31	0.006181	0.026958	0.010730	0.007131	0.008543	0.009387	0.013461	0.029051	0.005408
ROW32	0.000702	0.002893	0.001226	0.000824	0.001402	0.001185	0.001042	0.001479	0.000700
ROW33	0.000034	0.000117	0.000051	0.000043	0.000066	0.000174	0.000047	0.000074	0.000041
ROW34	0.001240	0.004274	0.002614	0.003645	0.003436	0.006151	0.008886	0.002805	0.001518
ROW35	0.000014	0.000054	0.000037	0.000288	0.000027	0.000045	0.000058	0.000034	0.000029
ROW36	0.000554	0.002397	0.002001	0.001768	0.090216	0.000969	0.003373	0.011477	0.003735
ROW37	0.000536	0.000955	0.001206	0.001625	0.070117	0.000899	0.002995	0.001437	0.001180
ROW38	0.001656	0.007814	0.004508	0.005351	0.238675	0.003038	0.012491	0.035832	0.015625
ROW39	0.000077	0.000159	0.000176	0.000223	0.000086	0.000127	0.000386	0.000112	0.000152
ROW40	0.001139	0.014985	0.031411	0.003174	0.004753	0.014184	0.005172	0.019169	0.002840
ROW41	0.000222	0.005221	0.025932	0.001078	0.000746	0.003651	0.000962	0.011732	0.000966
ROW42	0.001380	0.003090	0.004908	0.007352	0.003267	0.002849	0.001957	0.002445	0.001445
ROW43	0.001476	0.002423	0.001827	0.001150	0.001596	0.001885	0.000995	0.001227	0.000658
ROW44	0.000055	0.000021	0.000056	0.000040	0.000016	0.000178	0.000025	0.000020	0.000014
ROW45	0.000159	0.000045	0.000054	0.000037	0.000031	0.000934	0.000035	0.000031	0.000019
ROW46	0.001859	0.008041	0.009733	0.033126	0.011560	0.005203	0.005403	0.006530	0.004796
ROW47	0.001799	0.008748	0.014832	0.007072	0.024311	0.007043	0.004009	0.008713	0.006009
ROW48	0.002109	0.011208	0.005327	0.024128	0.006511	0.003309	0.008807	0.006513	0.007309
ROW49	0.003533	0.009577	0.020077	0.013055	0.017393	0.014116	0.012352	0.026618	0.007974
ROW50	0.001088	0.004036	0.008739	0.002846	0.003102	0.007664	0.001829	0.006190	0.001969
ROW51	0.000014	0.000062	0.000067	0.000118	0.000942	0.000030	0.000084	0.026350	0.022198
ROW52	0.000278	0.008128	0.015575	0.002109	0.003682	0.000553	0.000989	0.003948	0.001286
ROW53	0.003441	0.001551	0.001871	0.001154	0.000955	0.006735	0.001061	0.001422	0.000532
ROW54	0.003133	0.010920	0.020492	0.008586	0.011745	0.029909	0.004662	0.020915	0.008094
ROW55	0.000079	0.000404	0.007727	0.000344	0.000268	0.000161	0.004067	0.000300	0.000319
ROW56	0.000412	0.002760	0.001566	0.001277	0.008637	0.010194	0.000848	0.003993	0.001831

Table E3 (continued)

ROW	COL91	COL92	COL93	COL94	COL95	COL96	COL97	COL98	COL99
ROW57	0.000177	0.000327	0.000511	0.000195	0.000256	0.000981	0.000205	0.000295	0.000106
ROW58	0.001692	0.002980	0.005611	0.001856	0.002486	0.011016	0.001535	0.002781	0.001000
ROW59	0.002794	0.004960	0.013507	0.007429	0.008931	0.056851	0.004103	0.005906	0.003024
ROW60	0.000668	0.001110	0.003405	0.002016	0.002319	0.010883	0.000979	0.001512	0.000843
ROW61	0.001428	0.002193	0.008038	0.003511	0.002901	0.015885	0.002132	0.003585	0.002070
ROW62	0.004461	0.007258	0.020349	0.009862	0.021762	0.066500	0.005241	0.008346	0.004256
ROW63	0.002480	0.004290	0.011535	0.010606	0.006874	0.028693	0.003837	0.004672	0.002311
ROW64	0.000535	0.001703	0.026986	0.006902	0.001147	0.005609	0.001608	0.002083	0.001716
ROW65	0.002016	0.001629	0.003616	0.000997	0.000927	0.039928	0.001099	0.001416	0.000583
ROW66	0.001232	0.000423	0.007863	0.000307	0.000223	0.000167	0.000280	0.000199	0.000205
ROW67	0.000840	0.002073	0.001365	0.000837	0.000811	0.007160	0.001204	0.002222	0.000748
ROW68	0.000247	0.000527	0.001040	0.001246	0.000420	0.008191	0.000767	0.000593	0.000434
ROW69	0.001016	0.001550	0.007099	0.004191	0.001325	0.015333	0.002040	0.001536	0.000922
ROW70	0.001811	0.003839	0.007712	0.005214	0.003073	0.304406	0.003130	0.002477	0.002180
ROW71	0.000035	0.000129	0.001492	0.000961	0.000088	0.000502	0.000106	0.000089	0.000072
ROW72	0.000064	0.000156	0.000282	0.000622	0.000202	0.000382	0.000190	0.000501	0.000143
ROW73	0.000098	0.000497	0.000617	0.000599	0.000743	0.001153	0.001136	0.000957	0.000214
ROW74	0.000482	0.000539	0.004499	0.000516	0.000443	0.001752	0.000457	0.013241	0.012740
ROW75	0.000393	0.001339	0.012025	0.007566	0.000852	0.000619	0.010158	0.011909	0.003922
ROW76	0.000033	0.000159	0.002740	0.000098	0.000578	0.000066	0.000170	0.000489	0.000573
ROW77	0.001055	0.004932	0.024474	0.004305	0.001781	0.001228	0.004113	0.003629	0.002173
ROW78	0.001354	0.003765	0.005510	0.005432	0.011207	0.014833	0.003346	0.005573	0.002351
ROW79	0.000422	0.001089	0.001896	0.005724	0.001395	0.001651	0.001521	0.003144	0.001097
ROW80	0.004713	0.008803	0.012878	0.011224	0.026732	0.015455	0.010225	0.013269	0.005848
ROW81	0.000613	0.001687	0.001875	0.001373	0.002647	0.001990	0.001747	0.001677	0.000671
ROW82	0.001259	0.003067	0.004789	0.013527	0.003745	0.005001	0.003903	0.010796	0.002611
ROW83	0.000618	0.002613	0.001246	0.001104	0.000969	0.001476	0.000766	0.001082	0.000435
ROW84	0.005567	0.009626	0.025255	0.024380	0.010410	0.012675	0.012995	0.013590	0.009580
ROW85	0.002226	0.008931	0.002577	0.002824	0.005110	0.002526	0.003363	0.006595	0.003533
ROW86	0.009861	0.021693	0.045837	0.024205	0.096706	0.081801	0.027963	0.037220	0.021081
ROW87	0.006212	0.006365	0.004238	0.002821	0.002478	0.014261	0.004314	0.002624	0.002038
ROW88	0.008222	0.013957	0.010045	0.010072	0.010859	0.006529	0.012155	0.010395	0.006312
ROW89	0.017296	0.034450	0.013389	0.012756	0.016762	0.019251	0.019065	0.012850	0.020645
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	1.119719	0.161540	0.072865	0.068569	0.077729	0.059277	0.111835	0.066118	0.058496
ROW92	0.000584	1.001544	0.002657	0.010388	0.001652	0.002074	0.002155	0.004585	0.001537
ROW93	0.002775	0.028410	1.036748	0.004180	0.013776	0.003367	0.011714	0.010850	0.015196
ROW94	0.028859	0.089414	0.081527	1.097950	0.065853	0.054897	0.091456	0.072695	0.051219
ROW95	0.005432	0.009565	0.012161	0.016823	1.005984	0.009089	0.029208	0.016889	0.012131
ROW96	0.005222	0.011249	0.020574	0.014395	0.007464	1.009934	0.008680	0.006436	0.006355
ROW97	0.000690	0.001873	0.001852	0.019063	0.011601	0.001292	1.181355	0.002041	0.001295
ROW98	0.000000	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	1.000001	0.000000
ROW99	0.000083	0.000127	0.000056	0.000056	0.000727	0.000069	0.000175	0.000151	1.031560
ROW100	0.000073	0.000232	0.000219	0.000277	0.000278	0.000249	0.000248	0.000411	0.000310
ROW101	0.000748	0.002653	0.003220	0.003514	0.002518	0.001800	0.004127	0.002512	0.002079
ROW102	0.000022	0.000067	0.000181	0.000087	0.002038	0.000092	0.000103	0.000113	0.000062
ROW103	0.002302	0.006666	0.004353	0.011522	0.003842	0.002867	0.004601	0.006760	0.008366
ROW104	0.000765	0.002130	0.001361	0.000698	0.001088	0.001049	0.000839	0.000572	0.000462
	1.370290	1.732009	1.791493	1.607114	2.246302	2.095173	1.797867	1.705361	1.445083

Table E3 (continued)

ROW	COL100	COL101	COL102	COL103	COL104
ROW1	0.003423	0.003460	0.004323	0.001131	0.003080
ROW2	0.008514	0.005832	0.006350	0.005350	0.011647
ROW3	0.002149	0.001721	0.002772	0.001082	0.010064
ROW4	0.008844	0.002383	0.003785	0.003643	0.005893
ROW5	0.000466	0.000396	0.000349	0.002122	0.000875
ROW6	0.000015	0.000016	0.000028	0.000007	0.000042
ROW7	0.001034	0.002810	0.002462	0.002063	0.005383
ROW8	0.004288	0.004271	0.003616	0.000991	0.002065
ROW9	0.000375	0.000270	0.000338	0.000210	0.000525
ROW10	0.001402	0.001026	0.001254	0.001329	0.005580
ROW11	0.000535	0.000613	0.000396	0.000151	0.003558
ROW12	0.018366	0.031489	0.036406	0.009050	0.018710
ROW13	0.000524	0.000899	0.001040	0.000258	0.000534
ROW14	0.000645	0.001105	0.001278	0.000318	0.000657
ROW15	0.011278	0.009039	0.014562	0.005676	0.052952
ROW16	0.001620	0.005507	0.022622	0.000940	0.002003
ROW17	0.001359	0.001446	0.008285	0.000232	0.000540
ROW18	0.001146	0.002497	0.010321	0.000428	0.000909
ROW19	0.004924	0.003560	0.009552	0.000711	0.002254
ROW20	0.000499	0.000803	0.001603	0.000203	0.001189
ROW21	0.000201	0.000219	0.000807	0.000146	0.000753
ROW22	0.000319	0.000326	0.000649	0.000189	0.001037
ROW23	0.000513	0.000556	0.000711	0.000226	0.005916
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.006452	0.004832	0.005118	0.001846	0.002052
ROW31	0.023704	0.031471	0.014309	0.004406	0.014187
ROW32	0.001536	0.001976	0.002374	0.000845	0.004404
ROW33	0.000069	0.000082	0.000100	0.000044	0.015116
ROW34	0.002394	0.003891	0.003351	0.002870	0.251778
ROW35	0.000030	0.000069	0.000024	0.000013	0.000060
ROW36	0.001132	0.004155	0.016517	0.000684	0.001482
ROW37	0.001015	0.004126	0.000756	0.000542	0.001366
ROW38	0.004118	0.012089	0.063360	0.001884	0.004470
ROW39	0.000127	0.000592	0.000064	0.000085	0.000253
ROW40	0.001685	0.002247	0.014221	0.005325	0.003373
ROW41	0.000521	0.001677	0.000614	0.000313	0.002922
ROW42	0.002529	0.002727	0.004322	0.000955	0.006773
ROW43	0.000948	0.001119	0.005394	0.000349	0.006939
ROW44	0.000026	0.000026	0.000018	0.000014	0.000042
ROW45	0.000036	0.000030	0.000038	0.000027	0.000049
ROW46	0.008555	0.008607	0.008817	0.003389	0.004680
ROW47	0.004730	0.004737	0.012284	0.002437	0.004226
ROW48	0.027153	0.031717	0.017292	0.007307	0.005650
ROW49	0.007172	0.005871	0.010931	0.003377	0.041030
ROW50	0.001385	0.001461	0.004910	0.001364	0.002649
ROW51	0.001216	0.000076	0.000258	0.000030	0.000368
ROW52	0.000885	0.002620	0.001516	0.002686	0.003340
ROW53	0.001247	0.001375	0.004517	0.000466	0.005454
ROW54	0.004129	0.003692	0.013742	0.003766	0.006183
ROW55	0.000186	0.000451	0.000200	0.000382	0.000146
ROW56	0.003023	0.001016	0.001521	0.000500	0.001262

Table E3 (continued)

ROW	COL100	COL101	COL102	COL103	COL104
ROW57	0.000219	0.000274	0.000215	0.000088	0.002050
ROW58	0.002003	0.002448	0.001872	0.000704	0.006739
ROW59	0.003663	0.004034	0.015469	0.002757	0.013246
ROW60	0.000920	0.001012	0.002628	0.000725	0.002359
ROW61	0.001884	0.001979	0.003737	0.001132	0.005210
ROW62	0.004659	0.005897	0.031029	0.003456	0.019425
ROW63	0.003061	0.003271	0.005102	0.002166	0.009060
ROW64	0.004121	0.001239	0.001058	0.001063	0.001554
ROW65	0.001469	0.002028	0.001008	0.000620	0.004577
ROW66	0.000221	0.000228	0.000183	0.000309	0.000099
ROW67	0.002485	0.001948	0.001186	0.000539	0.006964
ROW68	0.000872	0.001014	0.000515	0.000475	0.001957
ROW69	0.001238	0.001276	0.001367	0.001176	0.003543
ROW70	0.003182	0.001884	0.002806	0.004711	0.003118
ROW71	0.000073	0.000088	0.000080	0.000046	0.000076
ROW72	0.000301	0.000238	0.000218	0.001428	0.000230
ROW73	0.000403	0.000381	0.000327	0.000794	0.000799
ROW74	0.000615	0.000451	0.000410	0.000253	0.001381
ROW75	0.001864	0.001988	0.001172	0.000782	0.000809
ROW76	0.000069	0.000255	0.000043	0.000180	0.000098
ROW77	0.004446	0.005988	0.013807	0.000665	0.001566
ROW78	0.003033	0.003064	0.005434	0.012313	0.007848
ROW79	0.001304	0.001904	0.002925	0.000830	0.001152
ROW80	0.010058	0.009411	0.022346	0.031423	0.016448
ROW81	0.001233	0.001145	0.001384	0.003239	0.003631
ROW82	0.006719	0.005186	0.004418	0.033837	0.004480
ROW83	0.001085	0.000874	0.000859	0.001637	0.001388
ROW84	0.015221	0.021270	0.014424	0.005453	0.013398
ROW85	0.005157	0.006048	0.008394	0.002120	0.007489
ROW86	0.016024	0.018281	0.032548	0.008680	0.025703
ROW87	0.003195	0.005010	0.002180	0.001137	0.010377
ROW88	0.006116	0.004006	0.006605	0.007462	0.005237
ROW89	0.015622	0.012122	0.014866	0.007327	0.019518
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.133860	0.100176	0.106154	0.034653	0.042574
ROW92	0.001243	0.002552	0.002400	0.000678	0.001532
ROW93	0.005802	0.004053	0.005222	0.003534	0.002436
ROW94	0.062435	0.082491	0.058788	0.036294	0.064730
ROW95	0.010575	0.041874	0.006002	0.005094	0.013982
ROW96	0.009356	0.004785	0.007075	0.008998	0.007447
ROW97	0.007732	0.007577	0.005826	0.001437	0.001580
ROW98	0.000001	0.000001	0.000001	0.000000	0.000050
ROW99	0.000073	0.000073	0.000216	0.000029	0.000314
ROW100	1.000465	0.009742	0.000132	0.000333	0.000159
ROW101	0.003490	1.005722	0.003283	0.000533	0.001031
ROW102	0.000061	0.000131	1.000099	0.000027	0.000057
ROW103	0.006083	0.021221	0.013775	1.002395	0.003248
ROW104	0.001170	0.001644	0.001372	0.000726	1.000363
	1.543323	1.621252	1.751039	1.316617	1.867452

Table H2

The REF 104 Sector Projected Inverse Matrix for the Year 2000

ROW	COL1	COL2	COL3	COL4	COL5	COL6	COL7	COL8	COL9
ROW1	1.118194	0.001582	0.001660	0.012753	0.012753	0.012753	0.012753	0.012753	0.012753
ROW2	0.010127	1.026150	0.003036	0.471050	0.471050	0.471052	0.471050	0.471050	0.471050
ROW3	0.000690	0.000812	1.074190	0.003171	0.003171	0.003171	0.003171	0.003171	0.003171
ROW4	0.002652	0.001446	0.001517	1.001600	0.001600	0.001600	0.001600	0.001600	0.001600
ROW5	0.000306	0.000420	0.000441	0.000408	1.000408	0.000408	0.000408	0.000408	0.000408
ROW6	0.000033	0.000011	0.000011	0.000087	0.000087	1.000087	0.000087	0.000087	0.000087
ROW7	0.008333	0.001414	0.001484	0.001790	0.001790	0.001790	1.001790	0.001790	0.001790
ROW8	0.001728	0.000667	0.000699	0.004249	0.004249	0.004249	0.004249	1.004249	0.004249
ROW9	0.000287	0.000202	0.000212	0.012030	0.012030	0.012030	0.012030	0.012030	1.012030
ROW10	0.007648	0.001411	0.001480	0.029498	0.029498	0.029498	0.029498	0.029498	0.029498
ROW11	0.000302	0.000574	0.000602	0.000622	0.000622	0.000622	0.000622	0.000622	0.000622
ROW12	0.023347	0.010363	0.010870	0.011287	0.011287	0.011287	0.011287	0.011287	0.011287
ROW13	0.005942	0.002638	0.002768	0.002875	0.002875	0.002875	0.002875	0.002875	0.002875
ROW14	0.000603	0.000268	0.000281	0.000291	0.000291	0.000291	0.000291	0.000291	0.000291
ROW15	0.003514	0.004269	0.004478	0.013965	0.013965	0.013965	0.013965	0.013965	0.013965
ROW16	0.001034	0.001255	0.001317	0.001777	0.001777	0.001777	0.001777	0.001777	0.001777
ROW17	0.000273	0.000315	0.000331	0.000538	0.000538	0.000538	0.000538	0.000538	0.000538
ROW18	0.000493	0.000551	0.000578	0.000914	0.000914	0.000913	0.000914	0.000914	0.000914
ROW19	0.001104	0.001044	0.001096	0.001415	0.001415	0.001415	0.001415	0.001415	0.001415
ROW20	0.001753	0.000269	0.000282	0.004042	0.004042	0.004041	0.004042	0.004042	0.004042
ROW21	0.001894	0.000796	0.000835	0.000768	0.000768	0.000768	0.000768	0.000768	0.000768
ROW22	0.001622	0.000679	0.000713	0.001245	0.001245	0.001245	0.001245	0.001245	0.001245
ROW23	0.001229	0.000771	0.000809	0.001438	0.001438	0.001438	0.001438	0.001438	0.001438
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.003194	0.008767	0.009196	0.005306	0.005306	0.005306	0.005306	0.005306	0.005306
ROW31	0.012360	0.006542	0.006862	0.023413	0.023413	0.023413	0.023413	0.023413	0.023413
ROW32	0.001880	0.038684	0.040577	0.020862	0.020862	0.020862	0.020862	0.020862	0.020862
ROW33	0.000029	0.000041	0.000043	0.000063	0.000063	0.000063	0.000063	0.000063	0.000063
ROW34	0.002099	0.001575	0.001652	0.002676	0.002676	0.002676	0.002676	0.002676	0.002676
ROW35	0.000034	0.000029	0.000030	0.000040	0.000040	0.000040	0.000040	0.000040	0.000040
ROW36	0.000714	0.000917	0.000961	0.001244	0.001244	0.001244	0.001244	0.001244	0.001244
ROW37	0.000649	0.000871	0.000914	0.003601	0.003601	0.003601	0.003601	0.003601	0.003601
ROW38	0.002218	0.002605	0.002733	0.004748	0.004748	0.004748	0.004748	0.004748	0.004748
ROW39	0.000096	0.000114	0.000120	0.000132	0.000132	0.000132	0.000132	0.000132	0.000132
ROW40	0.006542	0.001071	0.001123	0.002097	0.002096	0.002096	0.002096	0.002096	0.002096
ROW41	0.001509	0.000400	0.000419	0.000475	0.000475	0.000475	0.000475	0.000475	0.000475
ROW42	0.010744	0.001040	0.001091	0.001931	0.001931	0.001931	0.001931	0.001931	0.001931
ROW43	0.000924	0.000746	0.000783	0.001023	0.001023	0.001023	0.001023	0.001023	0.001023
ROW44	0.000030	0.000030	0.000031	0.000032	0.000032	0.000032	0.000032	0.000032	0.000032
ROW45	0.000047	0.000069	0.000072	0.000052	0.000052	0.000052	0.000052	0.000052	0.000052
ROW46	0.004841	0.002551	0.002676	0.005044	0.005044	0.005044	0.005044	0.005044	0.005044
ROW47	0.005904	0.001812	0.001900	0.006192	0.006192	0.006192	0.006192	0.006192	0.006192
ROW48	0.002962	0.002159	0.002265	0.003185	0.003185	0.003185	0.003185	0.003185	0.003185
ROW49	0.022366	0.012292	0.012894	0.045054	0.045054	0.045054	0.045054	0.045054	0.045054
ROW50	0.004920	0.001445	0.001516	0.002577	0.002577	0.002577	0.002577	0.002577	0.002577
ROW51	0.000035	0.000028	0.000030	0.000064	0.000064	0.000064	0.000064	0.000064	0.000064
ROW52	0.000437	0.000267	0.000280	0.003690	0.003690	0.003690	0.003690	0.003690	0.003690
ROW53	0.001143	0.001438	0.001509	0.001648	0.001648	0.001648	0.001648	0.001648	0.001648
ROW54	0.017237	0.003553	0.003727	0.006035	0.006035	0.006035	0.006035	0.006035	0.006035
ROW55	0.000093	0.000091	0.000096	0.000132	0.000132	0.000132	0.000132	0.000132	0.000132
ROW56	0.000855	0.000725	0.000761	0.000957	0.000957	0.000957	0.000957	0.000957	0.000957

Table H2 (continued)

ROW	COL1	COL2	COL3	COL4	COL5	COL6	COL7	COL8	COL9
ROW57	0.000720	0.000654	0.000686	0.000606	0.000606	0.000606	0.000606	0.000606	0.000606
ROW58	0.007850	0.002915	0.003058	0.004180	0.004180	0.004180	0.004180	0.004180	0.004180
ROW59	0.030493	0.015551	0.016312	0.013392	0.013392	0.013392	0.013392	0.013392	0.013392
ROW60	0.006475	0.002785	0.002921	0.003835	0.003835	0.003835	0.003835	0.003835	0.003835
ROW61	0.010153	0.003803	0.003989	0.006247	0.006247	0.006247	0.006247	0.006247	0.006247
ROW62	0.028046	0.012311	0.012914	0.021821	0.021821	0.021821	0.021821	0.021821	0.021821
ROW63	0.095610	0.024800	0.026014	0.018617	0.018617	0.018617	0.018617	0.018617	0.018617
ROW64	0.017213	0.010564	0.011081	0.012022	0.012022	0.012022	0.012022	0.012022	0.012022
ROW65	0.000911	0.000841	0.000882	0.001242	0.001242	0.001242	0.001242	0.001242	0.001242
ROW66	0.000118	0.000229	0.000241	0.000167	0.000167	0.000167	0.000167	0.000167	0.000167
ROW67	0.003483	0.001789	0.001877	0.001913	0.001913	0.001913	0.001913	0.001913	0.001913
ROW68	0.000630	0.000745	0.000782	0.000851	0.000851	0.000851	0.000851	0.000851	0.000851
ROW69	0.004069	0.008701	0.009127	0.005308	0.005308	0.005308	0.005308	0.005308	0.005308
ROW70	0.003871	0.001822	0.001911	0.002153	0.002153	0.002153	0.002153	0.002153	0.002153
ROW71	0.000140	0.000069	0.000072	0.000089	0.000089	0.000089	0.000089	0.000089	0.000089
ROW72	0.000402	0.000502	0.000527	0.000447	0.000447	0.000447	0.000447	0.000447	0.000447
ROW73	0.000449	0.000179	0.000188	0.000957	0.000957	0.000957	0.000957	0.000957	0.000957
ROW74	0.000827	0.001143	0.001199	0.001662	0.001662	0.001662	0.001662	0.001662	0.001662
ROW75	0.000722	0.000545	0.000572	0.000785	0.000785	0.000785	0.000785	0.000785	0.000785
ROW76	0.000046	0.000049	0.000051	0.000059	0.000059	0.000059	0.000059	0.000059	0.000059
ROW77	0.001627	0.000878	0.000921	0.001038	0.001038	0.001038	0.001038	0.001038	0.001038
ROW78	0.008359	0.002848	0.002987	0.007542	0.007542	0.007542	0.007542	0.007542	0.007542
ROW79	0.001371	0.001234	0.001295	0.001370	0.001370	0.001370	0.001370	0.001370	0.001370
ROW80	0.011390	0.005211	0.005466	0.011723	0.011723	0.011723	0.011723	0.011723	0.011723
ROW81	0.001985	0.000867	0.000909	0.013588	0.013588	0.013588	0.013588	0.013588	0.013588
ROW82	0.005621	0.005143	0.005395	0.006430	0.006430	0.006430	0.006430	0.006430	0.006430
ROW83	0.001376	0.000583	0.000611	0.035881	0.035881	0.035882	0.035882	0.035881	0.035882
ROW84	0.009154	0.009135	0.009582	0.012281	0.012281	0.012281	0.012281	0.012281	0.012281
ROW85	0.001668	0.003165	0.003320	0.003686	0.003686	0.003686	0.003686	0.003686	0.003686
ROW86	0.048267	0.013582	0.014247	0.022028	0.022028	0.022028	0.022028	0.022028	0.022028
ROW87	0.002370	0.002557	0.002682	0.002870	0.002870	0.002870	0.002870	0.002870	0.002870
ROW88	0.006993	0.006373	0.006685	0.010380	0.010380	0.010380	0.010380	0.010380	0.010380
ROW89	0.010087	0.009027	0.009469	0.011191	0.011191	0.011191	0.011191	0.011191	0.011191
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.066276	0.181905	0.190809	0.110084	0.110084	0.110085	0.110084	0.110084	0.110084
ROW92	0.001567	0.001509	0.001582	0.001738	0.001738	0.001738	0.001738	0.001738	0.001738
ROW93	0.002201	0.001523	0.001597	0.001744	0.001744	0.001744	0.001744	0.001744	0.001744
ROW94	0.073500	0.054949	0.057639	0.080425	0.080425	0.080426	0.080425	0.080425	0.080425
ROW95	0.006248	0.008954	0.009392	0.009603	0.009603	0.009603	0.009603	0.009603	0.009603
ROW96	0.007813	0.004057	0.004255	0.004798	0.004798	0.004798	0.004798	0.004798	0.004798
ROW97	0.001512	0.001240	0.001301	0.001792	0.001792	0.001792	0.001792	0.001792	0.001792
ROW98	0.000001	0.000000	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
ROW99	0.000038	0.000039	0.000041	0.000049	0.000049	0.000049	0.000049	0.000049	0.000049
ROW100	0.000446	0.000090	0.000094	0.000281	0.000281	0.000281	0.000281	0.000281	0.000281
ROW101	0.002076	0.001010	0.001059	0.001346	0.001346	0.001346	0.001346	0.001346	0.001346
ROW102	0.000054	0.000033	0.000035	0.000043	0.000043	0.000043	0.000043	0.000043	0.000043
ROW103	0.002186	0.001708	0.001792	0.002649	0.002649	0.002649	0.002649	0.002649	0.002649
ROW104	0.000613	0.000651	0.000683	0.000930	0.000930	0.000930	0.000930	0.000930	0.000930

Table H2 (continued)

ROW	COL10	COL11	COL12	COL13	COL14	COL15	COL16	COL17	COL18
ROW1	0.012753	0.008108	0.131282	0.000714	0.000326	0.005400	0.002190	0.001975	0.001469
ROW2	0.471050	0.079336	0.017367	0.003486	0.001495	0.002365	0.011019	0.009485	0.017407
ROW3	0.003171	0.002652	0.011193	0.000375	0.000172	0.289923	0.001111	0.001121	0.001741
ROW4	0.001600	0.003914	0.001375	0.002372	0.001586	0.001356	0.008280	0.007104	0.012418
ROW5	0.000408	0.000392	0.001049	0.000135	0.000109	0.000298	0.000221	0.000246	0.000194
ROW6	0.000087	0.000986	0.000014	0.000015	0.000006	0.000008	0.000030	0.000037	0.000036
ROW7	0.001790	0.007379	0.005412	0.000541	0.000363	0.000782	0.006896	0.005032	0.010046
ROW8	0.004249	0.003669	0.027032	0.000334	0.000137	0.000404	0.000910	0.000929	0.000863
ROW9	0.012030	0.002055	0.000465	0.000105	0.000055	0.000102	0.001513	0.002207	0.003024
ROW10	1.029498	0.154668	0.002536	0.001357	0.000816	0.000985	0.002423	0.001929	0.003642
ROW11	0.000622	1.006648	0.000466	0.000366	0.000413	0.000509	0.000428	0.000364	0.000468
ROW12	0.011287	0.014183	1.139374	0.002078	0.001227	0.007378	0.013356	0.011081	0.005119
ROW13	0.002875	0.003612	0.001249	1.000847	0.000319	0.001880	0.003399	0.002822	0.001306
ROW14	0.000291	0.000366	0.000126	0.000054	1.000272	0.000190	0.000345	0.000286	0.000132
ROW15	0.013965	0.013614	0.059859	0.001786	0.000891	1.554857	0.005597	0.005704	0.008643
ROW16	0.001777	0.002284	0.001143	0.001017	0.000715	0.000870	1.597079	0.044469	0.047678
ROW17	0.000538	0.001135	0.000333	0.000300	0.000218	0.000220	0.027752	1.038780	0.015528
ROW18	0.000914	0.001432	0.000541	0.000484	0.000338	0.000390	0.404802	0.252160	1.044511
ROW19	0.001415	0.002394	0.004462	0.004073	0.003798	0.000819	0.052016	0.102252	0.029638
ROW20	0.004042	0.001717	0.000556	0.000259	0.000213	0.000227	0.001902	0.003615	0.000570
ROW21	0.000768	0.000871	0.000563	0.000547	0.000273	0.000527	0.000496	0.000523	0.000551
ROW22	0.001245	0.001028	0.000682	0.000757	0.000410	0.000420	0.000917	0.000875	0.001391
ROW23	0.001438	0.052785	0.000871	0.001383	0.000615	0.000750	0.003891	0.003087	0.008498
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.305306	0.002377	0.001778	0.001006	0.001228	0.003523	0.005735	0.004435	0.007914
ROW31	0.023413	0.009905	0.003555	0.001726	0.001062	0.003249	0.015996	0.013770	0.014592
ROW32	0.020862	0.004565	0.052225	0.049143	0.040533	0.041897	0.001417	0.001226	0.001307
ROW33	0.000063	0.000058	0.000050	0.000040	0.000095	0.000576	0.000051	0.000046	0.000081
ROW34	0.002676	0.006351	0.005982	0.001807	0.011820	0.010314	0.003666	0.003820	0.003560
ROW35	0.000040	0.000035	0.000029	0.000023	0.000017	0.000030	0.000031	0.000032	0.000033
ROW36	0.001244	0.001302	0.000794	0.000705	0.000491	0.000632	0.006778	0.013418	0.001181
ROW37	0.003601	0.001350	0.000833	0.000603	0.000493	0.000606	0.001338	0.001826	0.000667
ROW38	0.004748	0.011196	0.002360	0.002162	0.001443	0.001803	0.159852	0.332768	0.012070
ROW39	0.000132	0.000235	0.000108	0.000081	0.000082	0.000093	0.000102	0.000120	0.000081
ROW40	0.002096	0.013338	0.002315	0.001611	0.001171	0.001082	0.005203	0.007213	0.006769
ROW41	0.000475	0.000693	0.001140	0.001284	0.000749	0.000629	0.000445	0.000569	0.000341
ROW42	0.001931	0.006174	0.002274	0.001066	0.000993	0.000990	0.002107	0.003219	0.001729
ROW43	0.001023	0.003667	0.000764	0.000558	0.000671	0.000724	0.001429	0.001802	0.001067
ROW44	0.000032	0.000032	0.000025	0.000018	0.000016	0.000022	0.000031	0.000029	0.000028
ROW45	0.000052	0.000045	0.000061	0.000056	0.000044	0.000053	0.000044	0.000040	0.000043
ROW46	0.005044	0.026192	0.003836	0.003408	0.003066	0.002451	0.006462	0.011602	0.004073
ROW47	0.006192	0.064592	0.003313	0.002998	0.002283	0.001670	0.009981	0.023836	0.004248
ROW48	0.003185	0.003878	0.005250	0.006064	0.005320	0.002812	0.004938	0.006098	0.003000
ROW49	0.045054	0.027541	0.012244	0.041173	0.003548	0.007056	0.060526	0.051122	0.121903
ROW50	0.002577	0.010773	0.002140	0.001851	0.001188	0.001133	0.005228	0.006279	0.004994
ROW51	0.000064	0.000098	0.000059	0.000364	0.000178	0.000036	0.001940	0.005601	0.000207
ROW52	0.003690	0.008114	0.000594	0.000770	0.000574	0.000374	0.000749	0.003377	0.000642
ROW53	0.001648	0.002616	0.000939	0.000738	0.000757	0.001001	0.001260	0.001198	0.001362
ROW54	0.006035	0.027310	0.006684	0.004118	0.003054	0.002902	0.018921	0.022247	0.013075
ROW55	0.000132	0.000120	0.000133	0.000124	0.000091	0.000096	0.000143	0.001714	0.000121
ROW56	0.000957	0.001345	0.000662	0.000605	0.000706	0.000493	0.002837	0.005481	0.000683

Table H2 (continued)

ROW	COL10	COL11	COL12	COL13	COL14	COL15	COL16	COL17	COL18
ROW57	0.000606	0.007262	0.000728	0.004119	0.000532	0.000608	0.000267	0.000260	0.000292
ROW58	0.004180	0.036867	0.003813	0.002812	0.002359	0.002678	0.002104	0.002157	0.002051
ROW59	0.013392	0.014459	0.009905	0.009493	0.005259	0.008099	0.007605	0.008375	0.006639
ROW60	0.003835	0.004612	0.002465	0.001802	0.001701	0.001672	0.002896	0.003413	0.002402
ROW61	0.006247	0.004434	0.004165	0.003271	0.002702	0.002443	0.003202	0.003244	0.003650
ROW62	0.021821	0.025455	0.009863	0.006167	0.005248	0.007327	0.014391	0.020409	0.009338
ROW63	0.018617	0.015743	0.020581	0.009628	0.008647	0.010365	0.018333	0.014884	0.017915
ROW64	0.012022	0.011242	0.010758	0.008085	0.006738	0.008205	0.009973	0.009973	0.008980
ROW65	0.001242	0.001065	0.000784	0.000715	0.000633	0.000715	0.001342	0.001265	0.001165
ROW66	0.000167	0.000105	0.000123	0.000098	0.000088	0.000128	0.000174	0.000152	0.000213
ROW67	0.001913	0.001170	0.003589	0.003027	0.009701	0.002068	0.001133	0.001032	0.000982
ROW68	0.000851	0.000863	0.000708	0.000547	0.000510	0.000638	0.000868	0.000816	0.000647
ROW69	0.005308	0.002570	0.002971	0.002348	0.002250	0.003462	0.002519	0.002254	0.002648
ROW70	0.002153	0.005881	0.002930	0.003956	0.002181	0.001674	0.005409	0.005029	0.003549
ROW71	0.000089	0.000095	0.000083	0.000060	0.000048	0.000060	0.000082	0.000084	0.000073
ROW72	0.000447	0.000406	0.000183	0.000132	0.000099	0.000258	0.000212	0.000260	0.000186
ROW73	0.000957	0.001474	0.000708	0.000234	0.000097	0.000298	0.000691	0.000794	0.000568
ROW74	0.001662	0.001247	0.000690	0.001076	0.000664	0.000847	0.000637	0.000817	0.000598
ROW75	0.000785	0.003258	0.001137	0.000796	0.000987	0.000607	0.000733	0.000808	0.000616
ROW76	0.000059	0.000059	0.000059	0.000052	0.000041	0.000055	0.000054	0.000054	0.000036
ROW77	0.001038	0.001293	0.001352	0.001188	0.000883	0.000759	0.000961	0.000989	0.000794
ROW78	0.007542	0.035631	0.014885	0.005021	0.001482	0.002073	0.015271	0.017647	0.011354
ROW79	0.001370	0.004038	0.001016	0.000802	0.000501	0.001272	0.001318	0.001578	0.001138
ROW80	0.011723	0.077202	0.010982	0.006636	0.004241	0.004013	0.022242	0.039274	0.016282
ROW81	0.013588	0.011887	0.004466	0.001424	0.000399	0.000650	0.004637	0.004305	0.005228
ROW82	0.006430	0.007868	0.003094	0.002475	0.001811	0.003804	0.003457	0.004248	0.003060
ROW83	0.035882	0.007367	0.001894	0.000484	0.000239	0.000396	0.001806	0.001730	0.002474
ROW84	0.012281	0.015203	0.014299	0.010993	0.009134	0.010766	0.018560	0.016501	0.012649
ROW85	0.003686	0.003305	0.002061	0.002582	0.008898	0.002367	0.004210	0.003560	0.007728
ROW86	0.022028	0.063238	0.028622	0.012408	0.008673	0.009508	0.089352	0.076571	0.053887
ROW87	0.002870	0.003251	0.002248	0.001862	0.001722	0.002191	0.004439	0.008720	0.002570
ROW88	0.010380	0.008648	0.007690	0.003983	0.002937	0.008758	0.021802	0.015257	0.011513
ROW89	0.011191	0.013723	0.017187	0.012161	0.009749	0.011764	0.021893	0.018606	0.018206
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.110084	0.049308	0.036869	0.020850	0.025460	0.073083	0.118996	0.092010	0.164207
ROW92	0.001738	0.002275	0.001531	0.001295	0.000815	0.001956	0.001693	0.001845	0.001470
ROW93	0.001744	0.002455	0.007885	0.007843	0.006310	0.004421	0.002084	0.002669	0.001453
ROW94	0.080425	0.077086	0.061059	0.041538	0.034715	0.050905	0.066787	0.069928	0.061454
ROW95	0.009603	0.008633	0.007609	0.006158	0.004818	0.006118	0.006930	0.006961	0.005640
ROW96	0.004798	0.011982	0.006673	0.008577	0.004889	0.004027	0.011617	0.010700	0.007535
ROW97	0.001792	0.001735	0.001510	0.001020	0.000838	0.001084	0.001408	0.001485	0.001253
ROW98	0.000001	0.000001	0.000029	0.000012	0.000038	0.000002	0.000001	0.000001	0.000000
ROW99	0.000049	0.000065	0.000060	0.000044	0.000036	0.000050	0.004241	0.013905	0.000383
ROW100	0.000281	0.000310	0.000188	0.000089	0.000077	0.000068	0.000142	0.000169	0.000133
ROW101	0.001346	0.002053	0.001383	0.000604	0.000587	0.001521	0.002075	0.001994	0.001410
ROW102	0.000043	0.000084	0.000038	0.000031	0.000028	0.000025	0.000050	0.000059	0.000038
ROW103	0.002649	0.002858	0.004670	0.004218	0.003729	0.004768	0.002638	0.002612	0.001942
ROW104	0.000930	0.000768	0.000417	0.000975	0.001235	0.000563	0.000446	0.000475	0.000464

Table H2 (continued)

ROW	COL19	COL20	COL21	COL22	COL23	COL24	COL25	COL26	COL27
ROW1	0.001513	0.001190	0.009687	0.004603	0.005701	0.002401	0.003318	0.002871	0.003594
ROW2	0.013580	0.010300	0.008391	0.009848	0.014337	0.004844	0.005771	0.005667	0.008935
ROW3	0.001292	0.000597	0.007108	0.002527	0.003763	0.000944	0.001367	0.001122	0.001200
ROW4	0.007579	0.015554	0.002307	0.002165	0.004940	0.002467	0.002908	0.001913	0.006890
ROW5	0.000332	0.000256	0.000376	0.000276	0.000334	0.000373	0.000424	0.000476	0.000387
ROW6	0.000037	0.000459	0.000030	0.000037	0.000053	0.000153	0.000223	0.000078	0.000069
ROW7	0.009508	0.001913	0.006687	0.009407	0.014570	0.002155	0.002654	0.002121	0.004462
ROW8	0.000801	0.000551	0.002493	0.002102	0.003494	0.000883	0.001100	0.000983	0.001090
ROW9	0.001400	0.000437	0.000309	0.000273	0.000394	0.000154	0.000175	0.000171	0.000277
ROW10	0.002902	0.001553	0.004023	0.003650	0.006222	0.002961	0.002955	0.005202	0.004638
ROW11	0.000382	0.000129	0.000825	0.000274	0.000431	0.005404	0.002959	0.007076	0.002454
ROW12	0.006058	0.004034	0.042430	0.028597	0.026117	0.007757	0.012249	0.008436	0.008488
ROW13	0.001547	0.001058	0.010800	0.007286	0.006655	0.001995	0.003147	0.002162	0.002168
ROW14	0.000156	0.000104	0.001095	0.000738	0.000674	0.000200	0.000316	0.000218	0.000219
ROW15	0.006320	0.002979	0.037876	0.013200	0.019937	0.004912	0.007105	0.005839	0.006168
ROW16	0.014235	0.005572	0.001161	0.001112	0.001056	0.002077	0.002509	0.002018	0.001482
ROW17	0.015911	0.006004	0.000315	0.000302	0.000289	0.000629	0.000687	0.000570	0.000414
ROW18	0.011513	0.010292	0.000558	0.000535	0.000516	0.001056	0.001207	0.000992	0.000721
ROW19	1.090086	0.032789	0.001563	0.001058	0.001010	0.005896	0.004883	0.003150	0.001439
ROW20	0.001430	1.004916	0.000863	0.001327	0.000546	0.011768	0.016370	0.002638	0.001851
ROW21	0.000519	0.000998	1.021651	0.002001	0.001985	0.001848	0.003641	0.003395	0.006081
ROW22	0.001292	0.001110	0.013400	1.128674	0.001636	0.003427	0.007488	0.005324	0.008602
ROW23	0.004259	0.000991	0.006578	0.002385	1.031004	0.009074	0.002796	0.012961	0.007758
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.001981	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.005297	0.001544	0.011719	0.002001	0.002997	0.001696	0.001545	0.001782	0.001388
ROW31	0.013782	0.003834	0.030297	0.011874	0.011493	0.005133	0.006785	0.006076	0.006263
ROW32	0.001126	0.000778	0.003827	0.002427	0.002668	0.000813	0.001174	0.000910	0.001068
ROW33	0.000047	0.000024	0.000142	0.000051	0.000084	0.000045	0.000041	0.000044	0.000040
ROW34	0.002748	0.001799	0.004783	0.002672	0.003351	0.004527	0.005708	0.003893	0.003769
ROW35	0.000040	0.000036	0.000039	0.000032	0.000039	0.000116	0.000049	0.000194	0.000175
ROW36	0.001336	0.002162	0.000812	0.000774	0.000740	0.001345	0.001426	0.001394	0.001044
ROW37	0.000803	0.000962	0.000796	0.000731	0.000770	0.001266	0.001343	0.001350	0.000995
ROW38	0.012722	0.037904	0.002535	0.002504	0.002403	0.004653	0.005296	0.004501	0.003341
ROW39	0.000106	0.000127	0.000191	0.000132	0.000143	0.000195	0.000188	0.000228	0.000142
ROW40	0.009366	0.053404	0.004007	0.004240	0.003401	0.021688	0.070286	0.009201	0.004230
ROW41	0.000397	0.000761	0.000525	0.000433	0.001313	0.000925	0.005760	0.000945	0.000759
ROW42	0.003983	0.002003	0.004775	0.007870	0.002388	0.077283	0.108046	0.016172	0.011085
ROW43	0.007580	0.001341	0.001488	0.000935	0.001128	0.089851	0.087833	0.025480	0.017460
ROW44	0.000030	0.000135	0.000049	0.000029	0.000034	0.001607	0.021120	0.000202	0.000049
ROW45	0.000042	0.000135	0.000157	0.000052	0.000075	0.001970	0.005137	0.004677	0.000248
ROW46	0.007031	0.004941	0.004525	0.004013	0.006063	0.009699	0.008611	0.010797	0.007874
ROW47	0.011572	0.005274	0.003626	0.003666	0.008014	0.012666	0.012363	0.010555	0.008093
ROW48	0.003790	0.005264	0.003598	0.003040	0.003756	0.004998	0.004555	0.006789	0.005160
ROW49	0.109322	0.030840	0.034386	0.056723	0.027686	0.021650	0.031244	0.022354	0.028973
ROW50	0.005319	0.010720	0.005907	0.007375	0.004598	0.010517	0.022170	0.008716	0.006769
ROW51	0.000204	0.000413	0.000049	0.000051	0.000042	0.000057	0.000067	0.000064	0.000059
ROW52	0.000652	0.000685	0.000522	0.000490	0.000697	0.000788	0.001707	0.000937	0.000773
ROW53	0.001245	0.005069	0.002216	0.001073	0.001220	0.007454	0.008634	0.007653	0.004475
ROW54	0.012476	0.009837	0.023004	0.031584	0.016865	0.025099	0.043890	0.022332	0.015883
ROW55	0.000333	0.000857	0.000105	0.000095	0.000101	0.000213	0.000349	0.000188	0.000121
ROW56	0.000852	0.001819	0.001427	0.001283	0.001009	0.003056	0.004264	0.005799	0.002884

Table H2 (continued)

ROW	COL19	COL20	COL21	COL22	COL23	COL24	COL25	COL26	COL27
ROW57	0.000310	0.000165	0.000891	0.001708	0.007739	0.008788	0.001810	0.010028	0.010593
ROW58	0.002733	0.001501	0.005188	0.009347	0.003743	0.072359	0.020697	0.075397	0.049435
ROW59	0.006404	0.018323	0.051888	0.037364	0.039135	0.033316	0.071021	0.062849	0.118167
ROW60	0.002550	0.007109	0.006782	0.004863	0.007368	0.012597	0.105360	0.024733	0.027582
ROW61	0.003525	0.005425	0.012015	0.007505	0.009681	0.022448	0.038728	0.035108	0.061231
ROW62	0.009988	0.047483	0.027041	0.022239	0.021994	0.084033	0.090400	0.187582	0.211667
ROW63	0.016113	0.027896	0.042157	0.047900	0.075887	0.018515	0.027920	0.033931	0.035094
ROW64	0.010060	0.012546	0.015790	0.012690	0.017632	0.021272	0.043569	0.031641	0.024086
ROW65	0.001172	0.000980	0.001848	0.000855	0.001169	0.013338	0.094115	0.015254	0.001809
ROW66	0.000161	0.000115	0.000320	0.000088	0.000118	0.003077	0.047045	0.001873	0.000208
ROW67	0.000933	0.001802	0.002491	0.001552	0.001600	0.009180	0.013096	0.019867	0.031115
ROW68	0.000749	0.001140	0.000898	0.000579	0.000805	0.002338	0.001579	0.002707	0.001161
ROW69	0.002702	0.002721	0.006123	0.004908	0.005254	0.011264	0.016625	0.018484	0.010242
ROW70	0.005339	0.005407	0.027566	0.004426	0.012487	0.005119	0.068427	0.004997	0.006589
ROW71	0.000086	0.000122	0.000153	0.000105	0.000148	0.000196	0.000321	0.000210	0.000153
ROW72	0.000689	0.000423	0.000384	0.000310	0.000388	0.000368	0.000509	0.000496	0.000467
ROW73	0.000672	0.030733	0.002335	0.002000	0.000607	0.001160	0.003390	0.000840	0.000950
ROW74	0.000585	0.005296	0.000949	0.000955	0.000712	0.003271	0.006677	0.007120	0.013141
ROW75	0.000801	0.000753	0.000844	0.000690	0.000927	0.001347	0.000991	0.001814	0.001189
ROW76	0.000049	0.000050	0.000048	0.000042	0.000049	0.000104	0.000129	0.000131	0.000096
ROW77	0.001097	0.004097	0.003254	0.002978	0.002868	0.003019	0.004409	0.002414	0.001521
ROW78	0.009575	0.006552	0.011568	0.009402	0.009237	0.020329	0.030186	0.016417	0.018227
ROW79	0.002172	0.002840	0.004939	0.003630	0.003467	0.002404	0.003979	0.002924	0.002564
ROW80	0.013585	0.019628	0.016876	0.012157	0.016299	0.030517	0.028199	0.036996	0.024932
ROW81	0.003530	0.002448	0.002608	0.002848	0.003145	0.004055	0.003707	0.003574	0.005520
ROW82	0.006863	0.004883	0.006701	0.004938	0.005877	0.006460	0.008541	0.007876	0.006975
ROW83	0.001973	0.001642	0.001285	0.001308	0.001950	0.001152	0.001423	0.001185	0.001675
ROW84	0.013730	0.011121	0.010657	0.008888	0.010543	0.017573	0.016535	0.018724	0.013785
ROW85	0.003692	0.001238	0.008389	0.002991	0.005930	0.002729	0.002576	0.002808	0.002206
ROW86	0.057087	0.050538	0.042768	0.046926	0.042743	0.074029	0.117108	0.069214	0.078420
ROW87	0.007276	0.002116	0.003780	0.002130	0.003649	0.056078	0.002723	0.028783	0.018146
ROW88	0.011223	0.008755	0.008236	0.012074	0.012121	0.009280	0.010978	0.009146	0.006702
ROW89	0.017762	0.014451	0.012132	0.016414	0.015349	0.012530	0.011717	0.011841	0.012253
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.109896	0.032032	0.243171	0.041517	0.062179	0.035175	0.032047	0.036962	0.028778
ROW92	0.002443	0.003779	0.001948	0.002427	0.002762	0.002791	0.005001	0.003545	0.002902
ROW93	0.001753	0.002142	0.002505	0.002061	0.002446	0.002391	0.003646	0.002724	0.002287
ROW94	0.072175	0.067096	0.086776	0.064454	0.088394	0.126429	0.080311	0.183622	0.117947
ROW95	0.007057	0.006665	0.007161	0.006382	0.006538	0.012442	0.012323	0.012884	0.009285
ROW96	0.010480	0.013824	0.007272	0.006801	0.013827	0.011110	0.010304	0.009668	0.012870
ROW97	0.001491	0.001400	0.001824	0.001367	0.001793	0.002641	0.001873	0.003603	0.002351
ROW98	0.000000	0.000000	0.000002	0.000001	0.000001	0.000000	0.000001	0.000001	0.000000
ROW99	0.000527	0.000403	0.000051	0.000057	0.000054	0.000056	0.000056	0.000050	0.000047
ROW100	0.000155	0.000592	0.000578	0.000653	0.000196	0.000327	0.000447	0.000369	0.000343
ROW101	0.002010	0.001172	0.001880	0.002051	0.002436	0.002322	0.002873	0.002447	0.001881
ROW102	0.000045	0.000094	0.000064	0.000066	0.000054	0.000113	0.000185	0.000145	0.000139
ROW103	0.002223	0.001915	0.003408	0.002629	0.002881	0.003031	0.002878	0.003409	0.002594
ROW104	0.000482	0.000488	0.003536	0.001112	0.001355	0.000562	0.000653	0.000593	0.000574

Table H2 (continued)

ROW	COL28	COL29	COL30	COL31	COL32	COL33	COL34	COL35	COL36
ROW1	0.003278	0.003021	0.001763	0.001942	0.002252	0.001704	0.001647	0.003342	0.002387
ROW2	0.018739	0.008224	0.006935	0.008160	0.006372	0.016008	0.007512	0.004069	0.010028
ROW3	0.001240	0.001119	0.000775	0.000799	0.000769	0.000719	0.000613	0.001114	0.001209
ROW4	0.017667	0.005521	0.003629	0.006428	0.002405	0.005904	0.004562	0.001349	0.007410
ROW5	0.000320	0.000354	0.000268	0.000275	0.000217	0.000191	0.000227	0.000811	0.000254
ROW6	0.000075	0.000069	0.000077	0.000068	0.000043	0.000056	0.000056	0.000098	0.000045
ROW7	0.008938	0.003668	0.001561	0.002679	0.002403	0.009727	0.003082	0.001884	0.006185
ROW8	0.001205	0.001004	0.000748	0.000748	0.000677	0.000898	0.000635	0.000805	0.001076
ROW9	0.000513	0.000254	0.000198	0.000244	0.000206	0.000480	0.000252	0.000126	0.001277
ROW10	0.011620	0.006004	0.006229	0.005924	0.006519	0.017498	0.006686	0.002543	0.002245
ROW11	0.021314	0.009706	0.027794	0.013494	0.005847	0.023525	0.010996	0.000218	0.000390
ROW12	0.007679	0.007945	0.006294	0.006388	0.005157	0.005249	0.004983	0.010940	0.014184
ROW13	0.002005	0.002034	0.001684	0.001648	0.001320	0.001357	0.001285	0.002793	0.003610
ROW14	0.000198	0.000205	0.000162	0.000165	0.000133	0.000135	0.000129	0.000282	0.000366
ROW15	0.006420	0.005806	0.003934	0.004106	0.003931	0.003691	0.003150	0.005807	0.006160
ROW16	0.001349	0.001440	0.001878	0.002280	0.001207	0.001395	0.001613	0.004087	1.292098
ROW17	0.000399	0.000415	0.000613	0.000637	0.000336	0.000386	0.000466	0.000989	0.023568
ROW18	0.000670	0.000712	0.000935	0.001047	0.000568	0.000650	0.000766	0.001736	0.334001
ROW19	0.002140	0.002663	0.002022	0.002033	0.001116	0.001089	0.001938	0.002111	0.043637
ROW20	0.001131	0.001566	0.002488	0.002709	0.000734	0.001832	0.002904	0.001151	0.001835
ROW21	0.002055	0.004209	0.001382	0.001552	0.003315	0.000826	0.001501	0.003923	0.000537
ROW22	0.001881	0.014556	0.002629	0.002554	0.003120	0.000830	0.001789	0.006845	0.000903
ROW23	0.055735	0.018650	0.004232	0.007270	0.007576	0.067052	0.015089	0.001274	0.003446
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.001427	0.001377	1.001452	0.001725	0.001012	0.001297	0.001266	0.001449	0.004967
ROW31	0.005827	0.005557	0.004273	1.004564	0.003926	0.003816	0.003685	0.009110	0.014697
ROW32	0.001465	0.000990	0.000787	0.000852	1.000691	0.001114	0.000710	0.000977	0.001437
ROW33	0.000040	0.000038	0.000037	0.000044	0.000035	1.000034	0.000032	0.000032	0.000051
ROW34	0.003800	0.003301	0.002815	0.003194	0.002746	0.002972	1.002474	0.002769	0.003640
ROW35	0.000046	0.000139	0.000045	0.000044	0.000074	0.000101	0.000107	1.039827	0.000037
ROW36	0.000933	0.000998	0.001238	0.001601	0.000847	0.000979	0.001126	0.002994	1.078269
ROW37	0.000945	0.001024	0.001088	0.001550	0.000842	0.001052	0.001098	0.003006	0.001339
ROW38	0.003246	0.003250	0.005459	0.005421	0.002823	0.003257	0.003897	0.008319	0.138558
ROW39	0.000153	0.000162	0.000173	0.000222	0.000172	0.000185	0.000219	0.000478	0.000119
ROW40	0.003725	0.004683	0.011253	0.006744	0.003806	0.004362	0.004475	0.005858	0.006220
ROW41	0.000595	0.000685	0.000715	0.000775	0.000469	0.000519	0.000589	0.003604	0.000683
ROW42	0.005716	0.009244	0.013928	0.015986	0.003791	0.010577	0.017826	0.005544	0.002468
ROW43	0.007215	0.012400	0.020703	0.016102	0.005860	0.010812	0.022237	0.006087	0.001495
ROW44	0.000033	0.000066	0.000949	0.000087	0.000032	0.000025	0.000158	0.000628	0.000031
ROW45	0.000050	0.000951	0.002818	0.000186	0.000764	0.000033	0.000110	0.000223	0.000043
ROW46	0.007569	0.007809	0.008699	0.006309	0.004538	0.004229	0.004789	0.007318	0.008549
ROW47	0.008107	0.007599	0.015471	0.008137	0.004836	0.005032	0.005392	0.008946	0.015131
ROW48	0.004214	0.004776	0.003780	0.003914	0.002896	0.002877	0.003365	0.004980	0.005260
ROW49	0.019592	0.019563	0.034492	0.023624	0.023731	0.012454	0.016135	0.019719	0.053983
ROW50	0.005416	0.007450	0.015286	0.009764	0.005129	0.004881	0.007035	0.007246	0.007550
ROW51	0.000042	0.000048	0.000062	0.000056	0.000038	0.000032	0.000041	0.000074	0.001637
ROW52	0.000864	0.000740	0.000951	0.000732	0.000486	0.000644	0.000572	0.000983	0.001695
ROW53	0.007543	0.003996	0.059378	0.026044	0.007938	0.008230	0.018543	0.001878	0.001233
ROW54	0.010911	0.017524	0.024697	0.022129	0.011886	0.014452	0.017069	0.013922	0.031689
ROW55	0.000140	0.000113	0.000199	0.000189	0.000076	0.000129	0.000089	0.000312	0.000160
ROW56	0.001399	0.002518	0.004427	0.001802	0.001653	0.000816	0.002172	0.002345	0.002674

Table H2 (continued)

ROW	COL28	COL29	COL30	COL31	COL32	COL33	COL34	COL35	COL36
ROW57	0.026680	0.010232	0.002160	0.005582	0.010264	0.004504	0.007009	0.000402	0.000271
ROW58	0.114699	0.064440	0.021755	0.056244	0.044200	0.024337	0.017332	0.004152	0.002202
ROW59	0.036457	0.080598	0.024684	0.027989	0.064896	0.014791	0.028358	0.079032	0.008583
ROW60	0.011032	0.022002	0.011778	0.012224	0.010319	0.005690	0.009005	0.037232	0.003300
ROW61	0.009140	0.112952	0.015381	0.015258	0.020426	0.004029	0.010881	0.047399	0.003332
ROW62	0.088205	0.117418	0.057204	0.057006	0.059847	0.046943	0.054819	0.037781	0.018248
ROW63	0.015538	0.024311	0.027281	0.021847	0.035087	0.010492	0.011331	0.033541	0.018083
ROW64	0.014814	0.022408	0.019639	0.021285	0.015075	0.008326	0.017245	0.096035	0.010547
ROW65	0.000932	0.003282	0.030143	0.029877	0.004649	0.000686	0.015416	0.000894	0.001292
ROW66	0.000086	0.000501	0.022266	0.000376	0.000061	0.000064	0.000102	0.000151	0.000163
ROW67	0.010739	0.019698	0.008078	0.033000	0.021324	0.001523	0.021497	0.002155	0.001103
ROW68	0.000837	0.001395	0.000869	0.003624	0.000861	0.000701	0.007876	0.031834	0.000888
ROW69	0.003482	0.017726	0.010397	0.013010	0.010984	0.001826	0.008148	0.006201	0.002408
ROW70	0.005981	0.005637	0.004122	0.005417	0.003931	0.004829	0.004527	0.006052	0.005378
ROW71	0.000125	0.000149	0.000100	0.000100	0.000091	0.000077	0.000092	0.000140	0.000087
ROW72	0.000307	0.000366	0.000317	0.000315	0.000264	0.000194	0.000246	0.068809	0.000252
ROW73	0.000904	0.000767	0.000595	0.000663	0.000558	0.000715	0.000575	0.000534	0.000682
ROW74	0.000782	0.004859	0.008634	0.006277	0.004341	0.000492	0.003264	0.008360	0.000793
ROW75	0.001122	0.001246	0.000773	0.000844	0.000683	0.000705	0.000757	0.001323	0.000806
ROW76	0.000084	0.000073	0.000095	0.000118	0.000053	0.000087	0.000064	0.000293	0.000066
ROW77	0.006691	0.001993	0.010422	0.003117	0.001317	0.002868	0.002460	0.001779	0.001023
ROW78	0.018988	0.014850	0.011406	0.012290	0.012682	0.014001	0.009697	0.009976	0.014904
ROW79	0.002073	0.002393	0.001858	0.001939	0.001482	0.001291	0.001557	0.003827	0.001449
ROW80	0.046551	0.035237	0.030898	0.032508	0.018590	0.047444	0.024917	0.014152	0.027087
ROW81	0.006920	0.004020	0.003087	0.003785	0.002581	0.005531	0.003876	0.002043	0.004531
ROW82	0.005481	0.005938	0.005227	0.005313	0.003896	0.003363	0.004083	0.008426	0.003786
ROW83	0.003098	0.001448	0.001150	0.001400	0.000974	0.002251	0.001133	0.000877	0.001701
ROW84	0.013121	0.013930	0.014304	0.018835	0.010478	0.012546	0.013475	0.019654	0.018674
ROW85	0.002108	0.002262	0.002082	0.002935	0.002640	0.002156	0.002098	0.002143	0.004078
ROW86	0.070662	0.065158	0.071809	0.061522	0.041816	0.037193	0.049416	0.038971	0.109825
ROW87	0.020068	0.016839	0.066787	0.039573	0.011837	0.015382	0.022491	0.003182	0.004233
ROW88	0.006739	0.006879	0.007457	0.010717	0.005618	0.007267	0.007442	0.006524	0.019774
ROW89	0.012910	0.012469	0.011098	0.013559	0.007420	0.009448	0.009405	0.010173	0.020919
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.029594	0.028559	0.030101	0.035767	0.020984	0.026908	0.026252	0.030041	0.103052
ROW92	0.002306	0.002730	0.002044	0.002221	0.001727	0.001424	0.001863	0.004139	0.001881
ROW93	0.001836	0.002107	0.002356	0.002262	0.001389	0.001350	0.001666	0.005593	0.002516
ROW94	0.107152	0.127629	0.060889	0.067903	0.063424	0.058617	0.068184	0.103893	0.071948
ROW95	0.008379	0.009224	0.010404	0.015091	0.007904	0.009303	0.010417	0.029630	0.008033
ROW96	0.012338	0.011414	0.008633	0.011260	0.008278	0.009714	0.009781	0.007024	0.011796
ROW97	0.002132	0.002523	0.001449	0.001728	0.001387	0.001353	0.001592	0.002877	0.001629
ROW98	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001
ROW99	0.000049	0.000048	0.000048	0.000056	0.000031	0.000039	0.000040	0.000055	0.003508
ROW100	0.000246	0.000291	0.000277	0.000294	0.000182	0.000182	0.000178	0.000370	0.000197
ROW101	0.001696	0.001828	0.001837	0.002431	0.001359	0.001612	0.001673	0.003332	0.002241
ROW102	0.000090	0.000102	0.000124	0.000110	0.000071	0.000063	0.000084	0.000159	0.000066
ROW103	0.002390	0.002582	0.002402	0.002652	0.001656	0.001808	0.002000	0.004661	0.002996
ROW104	0.000527	0.000530	0.000472	0.000520	0.000336	0.000435	0.000367	0.000435	0.000510

Table H2 (continued)

ROW	COL37	COL38	COL39	COL40	COL41	COL42	COL43	COL44	COL45
ROW1	0.001759	0.002379	0.001157	0.004340	0.002617	0.004604	0.003397	0.002955	0.003930
ROW2	0.003312	0.007879	0.004678	0.011162	0.006713	0.011263	0.007281	0.005980	0.005190
ROW3	0.001125	0.001574	0.000551	0.002019	0.001190	0.000793	0.001307	0.001119	0.001450
ROW4	0.001695	0.004851	0.002598	0.002365	0.002127	0.013179	0.004983	0.003207	0.002500
ROW5	0.000442	0.000429	0.000325	0.000610	0.000539	0.000329	0.000459	0.000509	0.000639
ROW6	0.000043	0.000082	0.000022	0.000076	0.000069	0.001738	0.000530	0.000220	0.000113
ROW7	0.001865	0.004671	0.002952	0.003363	0.002523	0.005474	0.003525	0.002750	0.002525
ROW8	0.000994	0.001461	0.000799	0.002904	0.001859	0.000968	0.001289	0.001368	0.001134
ROW9	0.000163	0.000747	0.000358	0.000376	0.000218	0.000346	0.000217	0.000187	0.000161
ROW10	0.001098	0.001960	0.001174	0.003507	0.002102	0.001804	0.002336	0.002097	0.002023
ROW11	0.000176	0.000295	0.000159	0.000273	0.000192	0.000211	0.001487	0.000266	0.000287
ROW12	0.006487	0.010876	0.004391	0.017899	0.012813	0.009979	0.012538	0.011869	0.011980
ROW13	0.001656	0.002773	0.001123	0.004572	0.003445	0.002551	0.003204	0.003053	0.003076
ROW14	0.000167	0.000281	0.000113	0.000462	0.000330	0.000258	0.000324	0.000306	0.000309
ROW15	0.005927	0.008167	0.002777	0.010071	0.006014	0.004087	0.006760	0.005759	0.007526
ROW16	0.006093	0.127645	0.003890	0.013470	0.006393	0.002160	0.001830	0.003676	0.002493
ROW17	0.004740	0.118352	0.003743	0.002064	0.001084	0.001470	0.000724	0.001236	0.000635
ROW18	0.017389	0.111126	0.002987	0.004641	0.002354	0.002476	0.001223	0.001863	0.001123
ROW19	0.018620	0.098971	0.236013	0.062642	0.022033	0.008694	0.003437	0.008246	0.003911
ROW20	0.001249	0.012383	0.001015	0.001241	0.004170	0.192662	0.046751	0.015437	0.005897
ROW21	0.001511	0.000881	0.000296	0.000824	0.000512	0.001373	0.001323	0.002108	0.005492
ROW22	0.001362	0.001147	0.000555	0.002029	0.001153	0.001249	0.001457	0.002038	0.002722
ROW23	0.001404	0.002685	0.001361	0.003522	0.001808	0.001194	0.002603	0.002052	0.002061
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000003	0.000000	0.000001
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.001319	0.002960	0.001868	0.002409	0.002075	0.001281	0.001613	0.001865	0.002084
ROW31	0.006300	0.010481	0.005762	0.010148	0.006399	0.005499	0.005981	0.007221	0.008013
ROW32	0.000694	0.001215	0.000543	0.001799	0.001214	0.001208	0.001251	0.001123	0.001146
ROW33	0.000035	0.000054	0.000025	0.000068	0.000045	0.000047	0.000042	0.000043	0.000055
ROW34	0.002765	0.004771	0.001828	0.004251	0.002980	0.006409	0.008893	0.004819	0.004587
ROW35	0.000049	0.000049	0.000041	0.000055	0.000046	0.000035	0.000037	0.000047	0.000046
ROW36	0.002370	0.049167	0.000815	0.002101	0.002258	0.001169	0.001200	0.001771	0.001490
ROW37	1.030438	0.001808	0.000640	0.001351	0.001285	0.000946	0.001074	0.001229	0.001394
ROW38	0.046547	1.279552	0.005540	0.011238	0.007088	0.009526	0.005432	0.010774	0.005048
ROW39	0.000113	0.000170	1.280037	0.000219	0.000199	0.000124	0.000185	0.000202	0.000303
ROW40	0.003153	0.009956	0.004787	1.516643	0.477319	0.015861	0.007013	0.136155	0.058721
ROW41	0.000538	0.001164	0.000463	0.010642	1.341969	0.001570	0.001352	0.006667	0.008802
ROW42	0.004980	0.005719	0.005060	0.005813	0.004774	1.292375	0.308159	0.101546	0.037871
ROW43	0.006125	0.002560	0.002672	0.005354	0.003251	0.006598	1.098845	0.036874	0.033637
ROW44	0.000028	0.000037	0.000024	0.000049	0.000037	0.000063	0.000249	1.004849	0.000558
ROW45	0.000037	0.000044	0.000021	0.000079	0.000041	0.000083	0.000080	0.000074	1.010641
ROW46	0.014390	0.025004	0.022492	0.018427	0.015825	0.004823	0.008589	0.015105	0.011996
ROW47	0.026276	0.054745	0.015463	0.026721	0.027653	0.005068	0.014242	0.028604	0.020374
ROW48	0.012206	0.014041	0.013624	0.005350	0.005633	0.003737	0.003882	0.005487	0.005734
ROW49	0.014558	0.045832	0.030423	0.143160	0.067892	0.017440	0.039387	0.037460	0.031414
ROW50	0.004248	0.011891	0.005736	0.214526	0.100067	0.006594	0.010633	0.036637	0.024823
ROW51	0.000258	0.005794	0.000078	0.000155	0.000095	0.000107	0.000067	0.000093	0.000061
ROW52	0.001139	0.002436	0.001948	0.005906	0.004695	0.000547	0.000622	0.001217	0.000928
ROW53	0.001645	0.001458	0.000652	0.002165	0.001325	0.003374	0.010660	0.012392	0.010229
ROW54	0.013490	0.048537	0.023226	0.036661	0.022828	0.015096	0.017424	0.078755	0.077602
ROW55	0.000096	0.000359	0.000159	0.002186	0.008048	0.000645	0.000240	0.002685	0.001323
ROW56	0.050523	0.018418	0.000736	0.005859	0.002399	0.001655	0.005840	0.008321	0.009968

Table H2 (continued)

ROW	COL37	COL38	COL39	COL40	COL41	COL42	COL43	COL44	COL45
ROW57	0.000294	0.000340	0.000173	0.000373	0.000254	0.000691	0.001707	0.000901	0.000737
ROW58	0.002985	0.003123	0.001638	0.003262	0.002299	0.007479	0.019396	0.009991	0.007996
ROW59	0.027946	0.015254	0.004681	0.010328	0.007283	0.025904	0.023848	0.039826	0.110391
ROW60	0.012618	0.006634	0.002073	0.003604	0.002858	0.009038	0.008929	0.024621	0.032724
ROW61	0.007140	0.004873	0.002161	0.005522	0.003906	0.006769	0.006870	0.008494	0.012205
ROW62	0.121799	0.050436	0.010264	0.011787	0.009131	0.071487	0.064248	0.085100	0.084827
ROW63	0.011128	0.013978	0.007442	0.024587	0.013789	0.025605	0.017402	0.015918	0.020209
ROW64	0.014296	0.014756	0.013781	0.015874	0.013682	0.011908	0.011491	0.016402	0.015034
ROW65	0.000722	0.001617	0.000575	0.001011	0.000762	0.001293	0.002055	0.000968	0.001165
ROW66	0.000105	0.000155	0.000112	0.000432	0.001048	0.000106	0.000241	0.000150	0.000194
ROW67	0.000820	0.001058	0.000535	0.001039	0.000760	0.001577	0.001799	0.001676	0.001646
ROW68	0.000651	0.000973	0.000583	0.001014	0.000992	0.000933	0.000938	0.001086	0.001040
ROW69	0.002270	0.002409	0.001448	0.002226	0.001729	0.003888	0.002607	0.002743	0.005651
ROW70	0.003147	0.005410	0.002905	0.003815	0.003208	0.011073	0.006330	0.004702	0.005191
ROW71	0.000119	0.000129	0.000128	0.000124	0.000132	0.001095	0.000331	0.000193	0.000452
ROW72	0.000472	0.000443	0.000360	0.000648	0.000547	0.000394	0.000503	0.000556	0.000765
ROW73	0.000531	0.001280	0.000356	0.000724	0.000565	0.006898	0.002630	0.001307	0.001048
ROW74	0.000786	0.000998	0.000403	0.002069	0.001038	0.002019	0.001913	0.001686	0.001427
ROW75	0.001115	0.001260	0.001220	0.002080	0.001436	0.000734	0.000817	0.001615	0.001074
ROW76	0.000043	0.000076	0.000046	0.000101	0.000085	0.000069	0.000058	0.000097	0.000062
ROW77	0.001009	0.001390	0.000989	0.003257	0.023160	0.002032	0.002488	0.004713	0.004118
ROW78	0.011844	0.022856	0.006105	0.015609	0.009045	0.023142	0.036892	0.023348	0.020198
ROW79	0.003395	0.003079	0.002162	0.005318	0.005603	0.002660	0.003822	0.004090	0.008379
ROW80	0.019918	0.038585	0.027807	0.029079	0.022704	0.018371	0.022810	0.022715	0.021956
ROW81	0.002297	0.005945	0.001589	0.004332	0.002393	0.004864	0.004730	0.003333	0.003012
ROW82	0.009189	0.008167	0.005636	0.012621	0.011610	0.006739	0.009685	0.011045	0.015156
ROW83	0.000858	0.001654	0.000864	0.001712	0.001208	0.002230	0.001750	0.001379	0.001319
ROW84	0.010351	0.017817	0.010300	0.020143	0.020576	0.011484	0.014470	0.017350	0.015674
ROW85	0.002557	0.003768	0.001809	0.005251	0.003323	0.002643	0.002522	0.002867	0.004189
ROW86	0.046083	0.097958	0.025305	0.090946	0.087716	0.065083	0.082611	0.086772	0.071039
ROW87	0.001684	0.004080	0.002535	0.002669	0.002305	0.004320	0.002895	0.002487	0.002235
ROW88	0.007762	0.011293	0.006295	0.009645	0.011075	0.008591	0.009750	0.008328	0.011399
ROW89	0.008602	0.016060	0.011088	0.012310	0.011949	0.014947	0.014903	0.015564	0.014160
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.027365	0.061407	0.038744	0.049961	0.043044	0.026572	0.033468	0.038678	0.043222
ROW92	0.002828	0.003110	0.002182	0.005041	0.005782	0.002643	0.003030	0.003528	0.006188
ROW93	0.002442	0.005321	0.005154	0.005368	0.004948	0.002601	0.003039	0.003815	0.003420
ROW94	0.113539	0.113845	0.126017	0.101764	0.098723	0.066711	0.071161	0.093871	0.083367
ROW95	0.006216	0.009838	0.006022	0.012555	0.012330	0.007886	0.009789	0.011459	0.012439
ROW96	0.006752	0.012601	0.006323	0.008544	0.007632	0.020263	0.013629	0.010172	0.010889
ROW97	0.002398	0.002395	0.002532	0.002274	0.002267	0.001445	0.001860	0.002065	0.001968
ROW98	0.000000	0.000001	0.000000	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
ROW99	0.000110	0.001990	0.000142	0.000112	0.000072	0.000121	0.000072	0.000078	0.000060
ROW100	0.000217	0.000279	0.000177	0.000789	0.000627	0.000938	0.000443	0.001096	0.001900
ROW101	0.001443	0.002675	0.001441	0.003178	0.004050	0.002189	0.002674	0.003244	0.002878
ROW102	0.000081	0.000115	0.000054	0.001029	0.000438	0.000075	0.000078	0.000262	0.000297
ROW103	0.002301	0.003729	0.004116	0.003981	0.005483	0.002241	0.002704	0.003485	0.003578
ROW104	0.000410	0.000692	0.000325	0.000794	0.000603	0.000983	0.000678	0.000634	0.000617

Table H2 (continued)

ROW	COL46	COL47	COL48	COL49	COL50	COL51	COL52	COL53	COL54
ROW1	0.010694	0.005253	0.002821	0.006909	0.007401	0.002320	0.002859	0.003816	0.004020
ROW2	0.012761	0.009380	0.005356	0.049803	0.024620	0.007920	0.013621	0.022489	0.010923
ROW3	0.003125	0.001889	0.001084	0.006399	0.003616	0.001331	0.001746	0.002517	0.001977
ROW4	0.003315	0.002296	0.002467	0.001821	0.001695	0.002419	0.002612	0.002194	0.001660
ROW5	0.000594	0.000563	0.000816	0.000604	0.000679	0.000714	0.001165	0.000808	0.000795
ROW6	0.000422	0.000190	0.000096	0.000292	0.000218	0.000059	0.000094	0.000172	0.000093
ROW7	0.005247	0.003510	0.002060	0.003521	0.003195	0.001905	0.002336	0.002731	0.002562
ROW8	0.010539	0.004644	0.002152	0.004774	0.004066	0.001937	0.001900	0.002281	0.002485
ROW9	0.000366	0.000274	0.000179	0.001335	0.000644	0.000257	0.000405	0.000622	0.000306
ROW10	0.002499	0.004075	0.001293	0.010601	0.008660	0.002998	0.007942	0.015781	0.004075
ROW11	0.000462	0.000347	0.000290	0.000385	0.000375	0.000361	0.000306	0.000334	0.000291
ROW12	0.019809	0.013997	0.010330	0.021858	0.019665	0.010654	0.011265	0.013674	0.016156
ROW13	0.005042	0.003570	0.002667	0.005561	0.005004	0.002726	0.002888	0.003502	0.004129
ROW14	0.000511	0.000361	0.000267	0.000564	0.000508	0.000275	0.000291	0.000353	0.000417
ROW15	0.016314	0.009738	0.005588	0.027983	0.017302	0.006597	0.008624	0.011845	0.009820
ROW16	0.003692	0.002885	0.003068	0.005984	0.004082	0.009359	0.005582	0.006545	0.003572
ROW17	0.002113	0.001295	0.000937	0.001761	0.001390	0.002994	0.003077	0.003753	0.000963
ROW18	0.004053	0.002205	0.001720	0.003127	0.002176	0.006554	0.004907	0.004329	0.001606
ROW19	0.004485	0.003474	0.002425	0.004502	0.003566	0.004999	0.004593	0.010937	0.005489
ROW20	0.027644	0.010011	0.004677	0.001763	0.001611	0.001490	0.001763	0.005159	0.001387
ROW21	0.000791	0.000781	0.000467	0.003177	0.001629	0.000760	0.001398	0.002310	0.001385
ROW22	0.001615	0.001478	0.001123	0.011479	0.005541	0.001927	0.002838	0.007885	0.002561
ROW23	0.009651	0.004967	0.002284	0.021709	0.008920	0.002703	0.004985	0.009150	0.005305
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.001876	0.002222	0.003923	0.002817	0.002439	0.003383	0.003759	0.003345	0.001956
ROW31	0.019448	0.013217	0.008993	0.015169	0.016622	0.015797	0.009273	0.011038	0.011726
ROW32	0.002170	0.001507	0.001007	0.004139	0.002659	0.001152	0.001495	0.002088	0.001687
ROW33	0.000134	0.000074	0.000049	0.000095	0.000084	0.000051	0.000061	0.000059	0.000057
ROW34	0.010984	0.008125	0.004363	0.005753	0.005351	0.003747	0.004965	0.005132	0.004426
ROW35	0.000050	0.000049	0.000061	0.000142	0.000086	0.000135	0.000123	0.000103	0.000080
ROW36	0.001949	0.001646	0.002099	0.004149	0.002669	0.006583	0.003306	0.003654	0.001940
ROW37	0.001181	0.001191	0.001859	0.001545	0.001514	0.003487	0.001802	0.001788	0.001348
ROW38	0.020584	0.012331	0.008257	0.016222	0.013031	0.023797	0.026072	0.037542	0.007365
ROW39	0.000193	0.000216	0.000298	0.000230	0.000254	0.000477	0.000256	0.000285	0.000214
ROW40	0.021002	0.028222	0.011050	0.004919	0.010157	0.007891	0.013399	0.005149	0.082701
ROW41	0.001375	0.001882	0.001965	0.000810	0.001095	0.001270	0.001255	0.000921	0.002624
ROW42	0.180438	0.064457	0.029287	0.006751	0.007355	0.005166	0.007274	0.005213	0.007331
ROW43	0.005352	0.002940	0.001530	0.001381	0.001640	0.001326	0.001708	0.001533	0.004847
ROW44	0.000038	0.000035	0.000042	0.000038	0.000037	0.000063	0.000062	0.000042	0.000043
ROW45	0.000041	0.000040	0.000041	0.000043	0.000036	0.000037	0.000049	0.000047	0.000083
ROW46	1.114629	0.373979	0.175798	0.012930	0.029319	0.023012	0.031638	0.016757	0.022330
ROW47	0.012437	1.047378	0.018288	0.016510	0.024584	0.032832	0.049881	0.021557	0.032848
ROW48	0.004427	0.006410	1.134847	0.005116	0.005280	0.012655	0.015788	0.014723	0.004940
ROW49	0.075516	0.068484	0.039597	1.249711	0.405194	0.100907	0.136901	0.314122	0.146653
ROW50	0.018604	0.034558	0.008760	0.019211	1.059498	0.013771	0.024424	0.126992	0.191637
ROW51	0.000158	0.000138	0.000078	0.000590	0.000258	1.079562	0.002656	0.000327	0.000160
ROW52	0.003250	0.001786	0.001097	0.002808	0.006837	0.003243	1.046888	0.004604	0.002394
ROW53	0.002029	0.001884	0.001513	0.003364	0.003689	0.001561	0.004079	1.012400	0.003062
ROW54	0.015596	0.035568	0.018164	0.018959	0.031387	0.057641	0.094425	0.017674	1.065962
ROW55	0.000298	0.000255	0.000505	0.000388	0.000301	0.000420	0.000376	0.000314	0.000484
ROW56	0.001295	0.001232	0.000977	0.001206	0.002122	0.006399	0.009893	0.002809	0.007085

Table H2 (continued)

ROW	COL46	COL47	COL48	COL49	COL50	COL51	COL52	COL53	COL54
ROW57	0.000731	0.000507	0.000316	0.000747	0.000488	0.000308	0.000460	0.000867	0.000537
ROW58	0.006558	0.004633	0.002969	0.004532	0.003616	0.002698	0.004147	0.008396	0.004865
ROW59	0.012541	0.012893	0.007737	0.019547	0.013044	0.010346	0.020731	0.024168	0.021276
ROW60	0.004686	0.009307	0.006597	0.007553	0.004992	0.005460	0.009833	0.011262	0.007529
ROW61	0.004691	0.004810	0.005007	0.019475	0.011668	0.007163	0.010051	0.024322	0.008490
ROW62	0.028892	0.017267	0.011878	0.024425	0.017932	0.024900	0.068501	0.077309	0.029244
ROW63	0.017129	0.018235	0.010728	0.029722	0.024941	0.011464	0.015582	0.016419	0.023454
ROW64	0.012594	0.013140	0.016639	0.016677	0.016266	0.038585	0.038740	0.017009	0.016169
ROW65	0.001318	0.001082	0.000912	0.001957	0.001471	0.001228	0.001141	0.001284	0.001022
ROW66	0.000106	0.000146	0.000174	0.000133	0.000139	0.000287	0.000261	0.000194	0.000152
ROW67	0.001641	0.001230	0.000925	0.001385	0.001349	0.001389	0.001310	0.001212	0.002143
ROW68	0.000896	0.000947	0.001288	0.001011	0.001022	0.001657	0.001445	0.001187	0.001059
ROW69	0.002287	0.002065	0.001790	0.003449	0.002552	0.002916	0.003473	0.002796	0.002556
ROW70	0.004234	0.003853	0.003755	0.003542	0.003359	0.003978	0.004263	0.004002	0.004682
ROW71	0.000238	0.000158	0.000161	0.000131	0.000136	0.000327	0.000346	0.000142	0.000142
ROW72	0.000616	0.000588	0.000883	0.000630	0.000703	0.000523	0.001060	0.000881	0.001058
ROW73	0.002316	0.001572	0.000737	0.001213	0.001055	0.000612	0.000942	0.001156	0.000845
ROW74	0.003441	0.001744	0.001068	0.002361	0.002496	0.006463	0.002335	0.001940	0.002715
ROW75	0.000979	0.001309	0.010307	0.001176	0.001199	0.003097	0.003168	0.001446	0.001246
ROW76	0.000101	0.000100	0.000124	0.000102	0.000125	0.000225	0.000805	0.000158	0.000135
ROW77	0.001522	0.001910	0.005357	0.001357	0.001309	0.002472	0.003347	0.003565	0.003190
ROW78	0.044901	0.041220	0.015550	0.024915	0.022716	0.010966	0.018986	0.023593	0.019171
ROW79	0.004194	0.005207	0.007289	0.004721	0.004401	0.004433	0.006982	0.005597	0.005958
ROW80	0.025921	0.031169	0.020906	0.027893	0.024563	0.017587	0.024760	0.028117	0.024929
ROW81	0.007502	0.004777	0.002293	0.010417	0.008571	0.003179	0.005541	0.007121	0.005340
ROW82	0.011981	0.011897	0.019347	0.012310	0.014223	0.010694	0.022378	0.018877	0.018325
ROW83	0.002397	0.001955	0.001388	0.004757	0.002870	0.001352	0.002271	0.002816	0.001847
ROW84	0.013578	0.016847	0.025256	0.016108	0.017835	0.026854	0.023991	0.021855	0.017900
ROW85	0.009198	0.005095	0.003007	0.005137	0.005050	0.003565	0.003945	0.003390	0.003704
ROW86	0.071928	0.074899	0.051575	0.049138	0.056608	0.050531	0.064069	0.066425	0.056614
ROW87	0.003099	0.002678	0.002863	0.002847	0.002606	0.004296	0.002821	0.002880	0.002388
ROW88	0.008412	0.007303	0.009819	0.008973	0.009778	0.010861	0.009864	0.009716	0.008668
ROW89	0.012307	0.011615	0.014037	0.014045	0.013874	0.015775	0.014191	0.013300	0.012661
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.038923	0.046086	0.081338	0.058448	0.050598	0.070182	0.077979	0.069401	0.040583
ROW92	0.004156	0.004454	0.008337	0.004908	0.004420	0.006020	0.007496	0.005219	0.005740
ROW93	0.002751	0.007415	0.004388	0.003067	0.005145	0.012198	0.011298	0.009715	0.005665
ROW94	0.087893	0.091069	0.127425	0.112277	0.117575	0.341796	0.357050	0.121574	0.105251
ROW95	0.011104	0.011254	0.018261	0.014645	0.014594	0.034827	0.017325	0.017180	0.013273
ROW96	0.009071	0.008913	0.009372	0.007525	0.007776	0.010177	0.009779	0.009048	0.007632
ROW97	0.001926	0.002007	0.003055	0.002474	0.002540	0.007356	0.006802	0.002686	0.002288
ROW98	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
ROW99	0.000085	0.000064	0.000066	0.000084	0.000073	0.000113	0.000101	0.000112	0.000062
ROW100	0.000402	0.000403	0.000293	0.000634	0.000932	0.002835	0.001124	0.000803	0.000840
ROW101	0.002214	0.002555	0.003866	0.002242	0.002383	0.006659	0.003055	0.002654	0.002719
ROW102	0.000075	0.000197	0.000679	0.000080	0.000100	0.000180	0.000205	0.000112	0.001070
ROW103	0.003079	0.003235	0.015642	0.003427	0.003218	0.006169	0.005911	0.004446	0.003255
ROW104	0.002694	0.001294	0.000859	0.001954	0.001575	0.000757	0.000860	0.000961	0.000785

Table H2 (continued)

ROW	COL55	COL56	COL57	COL58	COL59	COL60	COL61	COL62	COL63
ROW1	0.002311	0.003167	0.033823	0.008568	0.019247	0.006923	0.003962	0.005764	0.004068
ROW2	0.006746	0.006004	0.010974	0.008613	0.006544	0.010261	0.007439	0.005434	0.005582
ROW3	0.001066	0.006134	0.007542	0.004063	0.003683	0.004530	0.002724	0.001923	0.001336
ROW4	0.002665	0.001604	0.002508	0.002832	0.001511	0.001909	0.001700	0.001771	0.001578
ROW5	0.000482	0.000368	0.000332	0.000517	0.000445	0.000457	0.000430	0.000646	0.000593
ROW6	0.000066	0.000092	0.000040	0.000272	0.000178	0.000130	0.000118	0.000099	0.000077
ROW7	0.002754	0.002920	0.006641	0.005441	0.003581	0.002858	0.003571	0.002257	0.001712
ROW8	0.001626	0.001593	0.007734	0.002684	0.003350	0.001892	0.002302	0.001517	0.001204
ROW9	0.000299	0.000177	0.000303	0.000249	0.000189	0.000284	0.000212	0.000161	0.000164
ROW10	0.002240	0.002856	0.003420	0.003483	0.002654	0.011091	0.004539	0.003350	0.005564
ROW11	0.000212	0.000324	0.003420	0.001070	0.000438	0.000386	0.000257	0.000341	0.000271
ROW12	0.011090	0.017093	0.039314	0.017536	0.021800	0.045146	0.021276	0.014755	0.011875
ROW13	0.002948	0.004362	0.010029	0.004480	0.005551	0.011479	0.005418	0.003762	0.003031
ROW14	0.000286	0.000441	0.001015	0.000453	0.000563	0.001166	0.000549	0.000381	0.000307
ROW15	0.005360	0.032609	0.040144	0.021484	0.018784	0.023925	0.014306	0.009994	0.006935
ROW16	0.127231	0.001809	0.001261	0.001949	0.001460	0.001801	0.001635	0.001865	0.002180
ROW17	0.002958	0.000515	0.000356	0.000565	0.000387	0.000499	0.000450	0.000576	0.000567
ROW18	0.033409	0.000891	0.000622	0.000951	0.000679	0.000856	0.000776	0.000886	0.000980
ROW19	0.010852	0.002517	0.001784	0.001963	0.001306	0.002562	0.002105	0.002006	0.001632
ROW20	0.002243	0.002303	0.001088	0.001646	0.001088	0.001296	0.001375	0.001227	0.001048
ROW21	0.000757	0.000773	0.001735	0.002379	0.058593	0.001945	0.002852	0.012010	0.007787
ROW22	0.001846	0.001391	0.001427	0.003853	0.007483	0.053045	0.182978	0.009468	0.006377
ROW23	0.002273	0.012439	0.055740	0.073154	0.006571	0.002290	0.002137	0.002541	0.002005
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.002268	0.001801	0.001623	0.001942	0.001699	0.001566	0.001672	0.001749	0.001689
ROW31	0.007277	0.011994	0.038538	0.011323	0.020059	0.016868	0.008716	0.010288	0.008806
ROW32	0.001096	0.002136	0.003839	0.001995	0.002100	0.003691	0.001950	0.001382	0.001129
ROW33	0.000036	0.000057	0.000163	0.000066	0.000083	0.000070	0.000067	0.000051	0.000037
ROW34	0.002947	0.006133	0.008659	0.006471	0.007803	0.007099	0.005617	0.004364	0.003168
ROW35	0.000044	0.000036	0.000034	0.000044	0.000080	0.000045	0.000040	0.000154	0.000107
ROW36	0.105146	0.001231	0.000879	0.001319	0.001040	0.001259	0.001125	0.001304	0.001553
ROW37	0.001383	0.001052	0.000839	0.001215	0.000967	0.001227	0.001088	0.001190	0.001501
ROW38	0.018683	0.004247	0.002922	0.004879	0.003222	0.004087	0.003712	0.004369	0.004758
ROW39	0.000296	0.000184	0.000154	0.000236	0.000156	0.000219	0.000189	0.000192	0.000260
ROW40	0.133709	0.009140	0.003231	0.010662	0.003449	0.005583	0.008647	0.006148	0.006562
ROW41	0.007547	0.001606	0.000562	0.000849	0.001176	0.001218	0.000825	0.001442	0.001473
ROW42	0.012576	0.014136	0.006082	0.008948	0.006225	0.007199	0.008003	0.006835	0.005676
ROW43	0.004241	0.012567	0.004159	0.007312	0.004008	0.005925	0.006801	0.005769	0.002520
ROW44	0.000034	0.000044	0.000033	0.000035	0.000053	0.000044	0.000055	0.000059	0.000129
ROW45	0.000038	0.000041	0.000043	0.000047	0.000602	0.000051	0.000047	0.000188	0.000192
ROW46	0.019370	0.024989	0.009333	0.018942	0.005114	0.006833	0.007969	0.010696	0.006979
ROW47	0.027910	0.059946	0.017127	0.022711	0.005570	0.007682	0.008831	0.013178	0.008369
ROW48	0.004946	0.005374	0.003906	0.004000	0.004346	0.005171	0.004176	0.009670	0.004362
ROW49	0.064406	0.051002	0.048105	0.050533	0.037214	0.059256	0.049493	0.030764	0.020890
ROW50	0.037408	0.014730	0.006606	0.013693	0.004372	0.008864	0.027982	0.009377	0.008704
ROW51	0.000252	0.000098	0.000058	0.000063	0.000050	0.000067	0.000057	0.000055	0.000050
ROW52	0.011504	0.000648	0.000591	0.001312	0.000548	0.000662	0.000711	0.001416	0.000607
ROW53	0.002047	0.003840	0.001819	0.003540	0.002202	0.004974	0.002920	0.009327	0.002667
ROW54	0.092662	0.060959	0.013281	0.016242	0.010417	0.021582	0.025777	0.022878	0.026845
ROW55	1.199929	0.000132	0.000236	0.000187	0.000165	0.000170	0.000129	0.000147	0.000188
ROW56	0.001971	1.084038	0.000890	0.001773	0.001383	0.001522	0.002177	0.004689	0.002589

Table H2 (continued)

ROW	COL55	COL56	COL57	COL58	COL59	COL60	COL61	COL62	COL63
ROW57	0.000321	0.001713	1.004468	0.086573	0.001130	0.000749	0.000898	0.000755	0.000895
ROW58	0.003074	0.018668	0.022378	1.040997	0.011630	0.006834	0.008079	0.007837	0.009893
ROW59	0.012261	0.013104	0.014005	0.020055	1.213778	0.034113	0.035500	0.223920	0.158162
ROW60	0.005134	0.004589	0.003854	0.008869	0.018913	1.736725	0.105408	0.102329	0.037384
ROW61	0.009778	0.006803	0.006970	0.006483	0.039065	0.113715	1.500125	0.050784	0.041863
ROW62	0.028848	0.014200	0.014399	0.024174	0.037994	0.028092	0.027992	1.071453	0.055512
ROW63	0.017051	0.023170	0.024014	0.019861	0.055464	0.053770	0.046848	0.046429	1.165522
ROW64	0.013841	0.013854	0.012491	0.012499	0.029541	0.024141	0.025217	0.027165	0.111731
ROW65	0.000817	0.001036	0.001892	0.001131	0.001249	0.001155	0.000882	0.001828	0.001113
ROW66	0.000959	0.000500	0.000091	0.000103	0.000102	0.000109	0.000115	0.000180	0.000133
ROW67	0.000858	0.002037	0.004939	0.002855	0.005164	0.003202	0.003163	0.002465	0.002597
ROW68	0.000927	0.000894	0.000932	0.000997	0.001025	0.001036	0.001435	0.001360	0.001739
ROW69	0.001942	0.003283	0.002594	0.003469	0.013288	0.013062	0.006791	0.010780	0.025310
ROW70	0.003533	0.004288	0.005223	0.006280	0.006759	0.003886	0.004126	0.007152	0.011765
ROW71	0.000132	0.000115	0.000106	0.000107	0.000178	0.000144	0.000123	0.000147	0.000803
ROW72	0.000500	0.000382	0.000367	0.000581	0.000542	0.000457	0.000468	0.001077	0.002195
ROW73	0.000567	0.001113	0.001352	0.001364	0.002712	0.001320	0.001203	0.001154	0.001078
ROW74	0.001013	0.003784	0.001582	0.001270	0.003472	0.001594	0.001329	0.003300	0.002962
ROW75	0.001226	0.000933	0.000868	0.001135	0.000811	0.001091	0.000916	0.001106	0.000989
ROW76	0.000171	0.000063	0.000047	0.000216	0.000078	0.000104	0.000072	0.000119	0.000219
ROW77	0.015994	0.002605	0.005670	0.003374	0.001922	0.001900	0.001913	0.001904	0.001850
ROW78	0.011115	0.034240	0.040391	0.035015	0.044211	0.038658	0.028184	0.020826	0.013226
ROW79	0.003181	0.002446	0.003431	0.004935	0.004077	0.004421	0.004551	0.004530	0.003343
ROW80	0.028148	0.024931	0.041635	0.075488	0.025448	0.021818	0.019851	0.021364	0.017124
ROW81	0.003079	0.003494	0.006757	0.009034	0.012219	0.003581	0.002964	0.004336	0.003013
ROW82	0.010097	0.007325	0.005671	0.011735	0.009253	0.006834	0.008590	0.015101	0.010310
ROW83	0.001209	0.001370	0.002052	0.002065	0.001894	0.001736	0.001438	0.001366	0.001097
ROW84	0.017988	0.014303	0.012608	0.016333	0.013534	0.017016	0.014970	0.015423	0.018081
ROW85	0.002377	0.003630	0.004903	0.003227	0.004139	0.004850	0.004983	0.003238	0.002301
ROW86	0.082756	0.054721	0.034464	0.047872	0.065454	0.079950	0.087882	0.063032	0.062901
ROW87	0.002219	0.002214	0.003833	0.003371	0.002690	0.004442	0.004729	0.002403	0.002500
ROW88	0.011762	0.007512	0.022205	0.009518	0.007421	0.012363	0.010074	0.008592	0.009196
ROW89	0.011128	0.011774	0.012448	0.013942	0.012183	0.016344	0.014423	0.012478	0.010730
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.047047	0.037362	0.033669	0.040283	0.035246	0.032470	0.034691	0.036270	0.035041
ROW92	0.003258	0.002846	0.003210	0.003470	0.003891	0.004170	0.003746	0.004255	0.003445
ROW93	0.004003	0.003044	0.002294	0.002685	0.002867	0.003181	0.002730	0.003679	0.003820
ROW94	0.101483	0.082820	0.081503	0.082666	0.073854	0.099742	0.086593	0.082270	0.080464
ROW95	0.011962	0.010638	0.007338	0.010911	0.009205	0.011043	0.009818	0.011496	0.014469
ROW96	0.008029	0.010114	0.012019	0.012900	0.006679	0.008141	0.008204	0.007510	0.007742
ROW97	0.002242	0.002038	0.001715	0.001857	0.001720	0.002162	0.001879	0.001859	0.002110
ROW98	0.000001	0.000001	0.000002	0.000001	0.000001	0.000002	0.000001	0.000001	0.000001
ROW99	0.000384	0.000049	0.000049	0.000057	0.000047	0.000061	0.000055	0.000051	0.000046
ROW100	0.000325	0.000846	0.001912	0.000411	0.000628	0.001032	0.000772	0.000814	0.000395
ROW101	0.003540	0.002531	0.001877	0.002546	0.002294	0.002651	0.002581	0.002614	0.002910
ROW102	0.000276	0.000116	0.000061	0.000075	0.000061	0.000074	0.000077	0.000408	0.000108
ROW103	0.006232	0.003063	0.002702	0.003131	0.002861	0.003304	0.003060	0.003069	0.003459
ROW104	0.000518	0.000564	0.000918	0.000764	0.001935	0.000946	0.000942	0.000760	0.000582

Table H2 (continued)

ROW	COL64	COL65	COL66	COL67	COL68	COL69	COL70	COL71	COL72
ROW1	0.002509	0.003873	0.003495	0.003408	0.002205	0.003696	0.003462	0.003653	0.002531
ROW2	0.004598	0.005843	0.005190	0.004902	0.003983	0.006111	0.004978	0.005335	0.006006
ROW3	0.001086	0.001509	0.001583	0.001516	0.000949	0.001520	0.001471	0.001505	0.001014
ROW4	0.001875	0.001790	0.001659	0.001584	0.001861	0.001781	0.001835	0.002206	0.001555
ROW5	0.000710	0.000497	0.000519	0.000473	0.000659	0.000582	0.000490	0.000529	0.004424
ROW6	0.000051	0.000082	0.000091	0.000065	0.000045	0.000082	0.000073	0.000137	0.000056
ROW7	0.001584	0.001729	0.001717	0.001832	0.001446	0.001823	0.001844	0.002233	0.001420
ROW8	0.001152	0.001300	0.001287	0.001209	0.000989	0.001321	0.001110	0.001208	0.001113
ROW9	0.000152	0.000174	0.000157	0.000148	0.000133	0.000182	0.000148	0.000161	0.000182
ROW10	0.002478	0.005331	0.002853	0.002784	0.002108	0.005054	0.003020	0.003033	0.003327
ROW11	0.000245	0.000929	0.000764	0.000220	0.000235	0.000290	0.000709	0.000348	0.000227
ROW12	0.012144	0.012905	0.012028	0.012658	0.010557	0.013207	0.011797	0.013056	0.010948
ROW13	0.003110	0.003312	0.003106	0.003228	0.002702	0.003380	0.003013	0.003364	0.002797
ROW14	0.000313	0.000333	0.000310	0.000327	0.000273	0.000341	0.000305	0.000337	0.000283
ROW15	0.005630	0.007849	0.008204	0.007871	0.004941	0.007873	0.007654	0.007831	0.005285
ROW16	0.003760	0.002282	0.002227	0.002233	0.003825	0.002491	0.002140	0.002114	0.005965
ROW17	0.000947	0.000596	0.000593	0.000581	0.000957	0.000652	0.000536	0.000581	0.001436
ROW18	0.001644	0.001038	0.001041	0.001012	0.001677	0.001130	0.000946	0.001002	0.002501
ROW19	0.002355	0.001824	0.002121	0.001967	0.002403	0.001898	0.003278	0.002989	0.002978
ROW20	0.000935	0.001363	0.001318	0.001153	0.001302	0.001149	0.000862	0.007615	0.001007
ROW21	0.002186	0.005855	0.004781	0.004420	0.001955	0.005221	0.003997	0.005044	0.002840
ROW22	0.007990	0.012782	0.009822	0.010618	0.007214	0.016091	0.005644	0.007402	0.008083
ROW23	0.001637	0.002076	0.002472	0.002353	0.001217	0.002566	0.002077	0.002052	0.001106
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000005	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.003048	0.001963	0.002044	0.001841	0.002600	0.002184	0.001377	0.001734	0.001871
ROW31	0.007848	0.007851	0.008209	0.007408	0.007734	0.008465	0.008100	0.008592	0.008925
ROW32	0.001071	0.001227	0.001158	0.001169	0.000933	0.001256	0.001122	0.001219	0.001053
ROW33	0.000041	0.000046	0.000043	0.000040	0.000037	0.000047	0.000042	0.000041	0.000039
ROW34	0.003010	0.003752	0.003499	0.003350	0.002928	0.003675	0.004144	0.004630	0.003155
ROW35	0.000097	0.000077	0.000062	0.000046	0.000443	0.000064	0.000087	0.000186	0.000673
ROW36	0.002724	0.001624	0.001512	0.001558	0.002769	0.001771	0.001292	0.001339	0.004386
ROW37	0.002673	0.001555	0.001391	0.001491	0.002725	0.001697	0.001166	0.001277	0.004352
ROW38	0.007960	0.004957	0.004961	0.004868	0.008003	0.005493	0.004240	0.004606	0.012087
ROW39	0.000442	0.000260	0.000254	0.000282	0.000412	0.000316	0.000176	0.000216	0.000617
ROW40	0.006368	0.006454	0.016902	0.011457	0.007864	0.006968	0.048368	0.032734	0.006960
ROW41	0.001806	0.001639	0.001336	0.001550	0.002077	0.001971	0.001682	0.002772	0.001734
ROW42	0.004233	0.007651	0.007318	0.006356	0.006661	0.006119	0.004496	0.049637	0.003589
ROW43	0.001828	0.004243	0.005978	0.003300	0.003484	0.003827	0.003433	0.029568	0.002215
ROW44	0.001040	0.000203	0.000077	0.000119	0.019555	0.000187	0.000325	0.008552	0.001526
ROW45	0.000058	0.000098	0.000447	0.000075	0.000060	0.000098	0.003830	0.002761	0.001595
ROW46	0.013495	0.011670	0.015189	0.013804	0.012630	0.012412	0.009294	0.008696	0.008603
ROW47	0.013902	0.016177	0.025883	0.025720	0.012724	0.013476	0.011699	0.011765	0.007987
ROW48	0.006842	0.005210	0.005708	0.004510	0.011576	0.005449	0.005157	0.005027	0.008370
ROW49	0.029712	0.028353	0.041458	0.037213	0.021271	0.037299	0.032672	0.030442	0.017375
ROW50	0.016406	0.012284	0.042136	0.023935	0.015375	0.018979	0.028852	0.022936	0.010819
ROW51	0.000075	0.000072	0.000104	0.000059	0.000073	0.000068	0.000058	0.000059	0.000103
ROW52	0.000842	0.000748	0.001000	0.000770	0.000920	0.000867	0.000966	0.000860	0.000849
ROW53	0.002447	0.005205	0.010262	0.004587	0.002568	0.004516	0.006341	0.007948	0.003384
ROW54	0.040853	0.037229	0.061081	0.042702	0.029545	0.038780	0.074277	0.077543	0.017140
ROW55	0.000321	0.000219	0.000218	0.000173	0.000394	0.000262	0.000230	0.000247	0.000400
ROW56	0.016017	0.005020	0.007235	0.032327	0.009197	0.003623	0.015309	0.006891	0.003837

Table H2 (continued)

ROW	COL64	COL65	COL66	COL67	COL68	COL69	COL70	COL71	COL72
ROW57	0.000642	0.000903	0.001073	0.000788	0.000448	0.001194	0.000820	0.000847	0.000411
ROW58	0.006972	0.009936	0.011999	0.007877	0.004707	0.013394	0.008974	0.009231	0.004232
ROW59	0.041642	0.116685	0.094160	0.084280	0.037395	0.099948	0.077174	0.099637	0.056193
ROW60	0.031894	0.070309	0.043245	0.058187	0.029639	0.049217	0.079197	0.150127	0.040243
ROW61	0.057599	0.089067	0.068695	0.072771	0.052208	0.118803	0.028014	0.029314	0.057510
ROW62	0.063820	0.084006	0.079416	0.061891	0.059789	0.057422	0.159782	0.134872	0.047275
ROW63	0.025812	0.053794	0.038060	0.027964	0.023783	0.049909	0.074951	0.054349	0.062174
ROW64	1.430754	0.237009	0.058585	0.068438	0.431519	0.160491	0.070240	0.028812	0.206845
ROW65	0.000931	1.076204	0.017845	0.001154	0.000924	0.002280	0.008493	0.011663	0.000883
ROW66	0.000204	0.000224	1.011283	0.000133	0.000429	0.000236	0.000258	0.019105	0.000194
ROW67	0.009483	0.007290	0.015163	1.038188	0.015421	0.010513	0.008501	0.007389	0.003299
ROW68	0.006210	0.002091	0.001371	0.002706	1.107045	0.002101	0.010018	0.002374	0.079362
ROW69	0.017260	0.093786	0.061330	0.054573	0.012174	1.054421	0.033223	0.012643	0.011110
ROW70	0.004461	0.006053	0.004265	0.005004	0.004269	0.006226	1.294097	0.120096	0.004022
ROW71	0.000136	0.000160	0.000150	0.000121	0.000160	0.000158	0.001946	1.029179	0.000165
ROW72	0.000915	0.000741	0.000662	0.000555	0.002229	0.001147	0.000909	0.000690	1.198839
ROW73	0.000506	0.000837	0.000756	0.000702	0.000492	0.001455	0.001274	0.004669	0.000554
ROW74	0.004568	0.017695	0.041772	0.002516	0.004067	0.007008	0.004836	0.003537	0.017731
ROW75	0.001462	0.001196	0.001334	0.001423	0.001708	0.001284	0.001069	0.001132	0.002763
ROW76	0.000577	0.000221	0.000200	0.000111	0.000329	0.000234	0.000113	0.000098	0.000337
ROW77	0.003180	0.004307	0.006308	0.001679	0.002589	0.003214	0.001850	0.005909	0.002122
ROW78	0.009091	0.015149	0.014572	0.013833	0.008615	0.014523	0.020639	0.023243	0.008385
ROW79	0.005970	0.004437	0.004458	0.005343	0.005692	0.005715	0.003442	0.004601	0.006537
ROW80	0.015858	0.020737	0.020775	0.018900	0.014978	0.021573	0.023640	0.023841	0.015375
ROW81	0.001954	0.003092	0.002785	0.002624	0.001732	0.002899	0.002840	0.003150	0.001974
ROW82	0.016067	0.009999	0.010708	0.010230	0.013509	0.011243	0.009239	0.011222	0.015184
ROW83	0.001117	0.001174	0.001103	0.001040	0.001000	0.001215	0.001174	0.001299	0.001236
ROW84	0.023832	0.021055	0.016700	0.017585	0.025068	0.020044	0.015499	0.016290	0.022060
ROW85	0.002731	0.003208	0.002964	0.002627	0.002467	0.003312	0.002740	0.002549	0.002669
ROW86	0.062628	0.081268	0.073447	0.063509	0.062311	0.063304	0.100835	0.099686	0.050846
ROW87	0.003127	0.002942	0.002136	0.002100	0.003235	0.002566	0.002526	0.002471	0.004536
ROW88	0.012715	0.008846	0.008432	0.008282	0.010869	0.011258	0.008306	0.009388	0.009254
ROW89	0.014305	0.011776	0.010659	0.010353	0.013900	0.012534	0.011034	0.011805	0.012768
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.063238	0.040725	0.042401	0.038195	0.053931	0.045298	0.028564	0.035974	0.038797
ROW92	0.009431	0.005710	0.003655	0.005608	0.009818	0.007082	0.004298	0.004233	0.011907
ROW93	0.009382	0.005114	0.005285	0.004876	0.014312	0.012116	0.003799	0.003562	0.007641
ROW94	0.107998	0.102869	0.112931	0.085729	0.126030	0.100160	0.090516	0.091846	0.117947
ROW95	0.026254	0.015015	0.012784	0.013646	0.026936	0.016172	0.011447	0.011846	0.043729
ROW96	0.009393	0.011227	0.007335	0.009519	0.009772	0.009639	0.016933	0.010648	0.008035
ROW97	0.003089	0.002378	0.002613	0.002021	0.003574	0.002379	0.002066	0.002052	0.003650
ROW98	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
ROW99	0.000067	0.000051	0.000047	0.000046	0.000065	0.000054	0.000047	0.000052	0.000074
ROW100	0.000579	0.000531	0.000504	0.000578	0.000599	0.000686	0.000574	0.000568	0.000420
ROW101	0.004363	0.003099	0.002751	0.003082	0.004327	0.003274	0.002457	0.002858	0.003853
ROW102	0.000164	0.000137	0.000490	0.000663	0.000423	0.000133	0.000201	0.000202	0.000658
ROW103	0.004186	0.003504	0.004186	0.003041	0.005170	0.003566	0.003506	0.003112	0.005067
ROW104	0.000546	0.000635	0.000581	0.000570	0.000515	0.000606	0.000566	0.000614	0.000534

Table H2 (continued)

ROW	COL73	COL74	COL75	COL76	COL77	COL78	COL79	COL80	COL81
ROW1	0.004152	0.002426	0.002907	0.002264	0.003241	0.001926	0.002420	0.000820	0.002591
ROW2	0.005317	0.005103	0.005927	0.004848	0.008291	0.010950	0.017708	0.011964	0.020588
ROW3	0.001280	0.001046	0.001087	0.001049	0.001375	0.000797	0.001041	0.000373	0.001200
ROW4	0.001489	0.002911	0.001944	0.002557	0.002877	0.001157	0.014584	0.000930	0.003819
ROW5	0.000444	0.000576	0.000519	0.000574	0.000631	0.000240	0.000249	0.000185	0.000395
ROW6	0.000116	0.000051	0.000061	0.000076	0.000102	0.000019	0.000017	0.000010	0.000022
ROW7	0.002012	0.001760	0.001279	0.002064	0.002451	0.019068	0.019436	0.022470	0.004117
ROW8	0.001394	0.001154	0.001624	0.001285	0.001721	0.000712	0.000776	0.000389	0.033529
ROW9	0.000157	0.000158	0.000173	0.000149	0.000250	0.000299	0.000617	0.000431	0.000556
ROW10	0.004392	0.002725	0.002240	0.002097	0.006119	0.001927	0.002843	0.001635	0.002293
ROW11	0.000236	0.000215	0.000229	0.000195	0.000305	0.001571	0.000443	0.000176	0.000632
ROW12	0.011780	0.010773	0.008292	0.009652	0.012628	0.010577	0.014309	0.003206	0.012613
ROW13	0.003012	0.002785	0.002149	0.002529	0.011860	0.002696	0.003649	0.000822	0.003226
ROW14	0.000304	0.000278	0.000214	0.000249	0.000297	0.000273	0.000369	0.000083	0.000326
ROW15	0.006620	0.005428	0.005412	0.005444	0.007037	0.004151	0.005402	0.001888	0.006244
ROW16	0.002385	0.004940	0.002443	0.003299	0.005727	0.001250	0.001093	0.001423	0.001754
ROW17	0.000619	0.000850	0.000664	0.000550	0.001048	0.000348	0.000292	0.000367	0.000452
ROW18	0.001065	0.001894	0.001180	0.001251	0.002266	0.000595	0.000527	0.000731	0.000806
ROW19	0.002384	0.002863	0.001823	0.001689	0.007018	0.001183	0.001162	0.001025	0.001567
ROW20	0.002354	0.001251	0.001328	0.001140	0.006281	0.000716	0.000538	0.000362	0.000697
ROW21	0.007930	0.002328	0.001811	0.002153	0.002700	0.001139	0.000670	0.000241	0.001317
ROW22	0.005656	0.008227	0.005913	0.032682	0.005093	0.000906	0.000921	0.000401	0.001185
ROW23	0.001995	0.001581	0.002294	0.006575	0.002689	0.002398	0.000965	0.000435	0.001025
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.001483	0.002031	0.001566	0.001959	0.002573	0.001631	0.002160	0.001555	0.003387
ROW31	0.007892	0.007384	0.010526	0.004960	0.010229	0.002478	0.005803	0.005794	0.021004
ROW32	0.001105	0.001007	0.000896	0.000938	0.001718	0.001718	0.001779	0.000902	0.002473
ROW33	0.000037	0.000041	0.000039	0.000050	0.000061	0.000048	0.000168	0.000058	0.001066
ROW34	0.003595	0.003058	0.002848	0.003511	0.004614	0.135750	0.024944	0.003286	0.019503
ROW35	0.000202	0.000192	0.000070	0.000038	0.000063	0.000046	0.000037	0.000031	0.000057
ROW36	0.001633	0.003653	0.001724	0.002506	0.003996	0.000880	0.000749	0.000898	0.001226
ROW37	0.001557	0.002007	0.001330	0.001422	0.001919	0.000876	0.000857	0.000932	0.001183
ROW38	0.005121	0.007087	0.005757	0.004508	0.008460	0.002932	0.002375	0.002643	0.003646
ROW39	0.000254	0.000358	0.000215	0.000262	0.000341	0.000139	0.000131	0.000126	0.000185
ROW40	0.019442	0.024009	0.006200	0.005924	0.059695	0.003256	0.007289	0.004477	0.010915
ROW41	0.001924	0.002236	0.001101	0.000761	0.003297	0.000998	0.007397	0.000747	0.001062
ROW42	0.014129	0.006636	0.007444	0.005794	0.038811	0.003570	0.002046	0.001201	0.002825
ROW43	0.012479	0.003941	0.001348	0.009214	0.020441	0.003611	0.001215	0.000608	0.001895
ROW44	0.003855	0.000283	0.000115	0.000049	0.000126	0.000129	0.000072	0.000044	0.000284
ROW45	0.003538	0.000086	0.000056	0.000041	0.000069	0.000118	0.000144	0.000086	0.000225
ROW46	0.006470	0.015602	0.032279	0.009717	0.035006	0.003968	0.005919	0.004505	0.006230
ROW47	0.007055	0.016435	0.023498	0.015770	0.046622	0.003172	0.005103	0.004230	0.003936
ROW48	0.005004	0.006509	0.004803	0.004392	0.007293	0.005088	0.007058	0.004913	0.006310
ROW49	0.023952	0.026034	0.075056	0.027159	0.053961	0.009141	0.013476	0.007546	0.011579
ROW50	0.017105	0.023769	0.009410	0.010142	0.065462	0.002808	0.005847	0.004551	0.004403
ROW51	0.000060	0.001084	0.000092	0.000055	0.000149	0.000031	0.000047	0.000032	0.000081
ROW52	0.000699	0.001688	0.000823	0.000706	0.002080	0.000434	0.002245	0.000607	0.000830
ROW53	0.011760	0.002493	0.001331	0.001728	0.008697	0.003278	0.001551	0.001062	0.003056
ROW54	0.024388	0.044346	0.026984	0.019373	0.081368	0.007127	0.020799	0.019450	0.007898
ROW55	0.000226	0.000828	0.000263	0.011949	0.004387	0.000108	0.000135	0.000110	0.000132
ROW56	0.010183	0.011863	0.003412	0.002878	0.002813	0.001478	0.002713	0.001022	0.001320

Table H2 (continued)

ROW	COL73	COL74	COL75	COL76	COL77	COL78	COL79	COL80	COL81
ROW57	0.000864	0.000537	0.000291	0.001824	0.000713	0.001080	0.000374	0.000161	0.000418
ROW58	0.007450	0.005725	0.002570	0.020690	0.007167	0.003546	0.002357	0.001481	0.002917
ROW59	0.161013	0.044817	0.033521	0.038967	0.051917	0.022631	0.012721	0.004415	0.026193
ROW60	0.044600	0.031686	0.022319	0.021777	0.024465	0.005156	0.005618	0.002799	0.006450
ROW61	0.034224	0.059342	0.039283	0.265317	0.032694	0.005469	0.005386	0.002155	0.007341
ROW62	0.080102	0.060697	0.028266	0.019790	0.047378	0.018598	0.018545	0.008230	0.020380
ROW63	0.123016	0.027664	0.015438	0.015403	0.019551	0.018897	0.017908	0.006120	0.022833
ROW64	0.050709	0.217143	0.120909	0.018561	0.048901	0.011688	0.026449	0.011271	0.020560
ROW65	0.004989	0.001110	0.000803	0.000677	0.001066	0.002547	0.002678	0.002313	0.001651
ROW66	0.001106	0.000164	0.000122	0.000112	0.000226	0.000114	0.000114	0.000087	0.000232
ROW67	0.003103	0.007090	0.003637	0.001230	0.003022	0.004236	0.002181	0.000896	0.001875
ROW68	0.015575	0.004524	0.001658	0.001221	0.002977	0.002061	0.001773	0.001738	0.004411
ROW69	0.024355	0.016854	0.007230	0.002810	0.008543	0.004752	0.016205	0.003153	0.004275
ROW70	0.014655	0.005377	0.002864	0.003375	0.004710	0.003477	0.037058	0.025326	0.004388
ROW71	0.001288	0.000148	0.000131	0.000116	0.001000	0.000104	0.000156	0.000111	0.000239
ROW72	0.003200	0.002143	0.000592	0.000604	0.000640	0.000304	0.000222	0.000146	0.000378
ROW73	1.058035	0.000725	0.000533	0.000604	0.001186	0.024518	0.005100	0.000498	0.056127
ROW74	0.009074	1.006635	0.014932	0.004749	0.002633	0.001271	0.000750	0.000412	0.005926
ROW75	0.001025	0.003150	1.035551	0.001032	0.001794	0.000768	0.001041	0.000849	0.001576
ROW76	0.000150	0.002411	0.000306	1.091107	0.000229	0.000057	0.000049	0.000064	0.000073
ROW77	0.002586	0.006024	0.005291	0.009515	1.047796	0.001214	0.001841	0.000924	0.002886
ROW78	0.016660	0.009728	0.010091	0.012403	0.017835	1.061185	0.005502	0.006706	0.004962
ROW79	0.003473	0.005420	0.003240	0.006169	0.005518	0.000995	1.007806	0.001029	0.001530
ROW80	0.019350	0.021738	0.014084	0.023923	0.028432	0.019004	0.022894	1.148967	0.011699
ROW81	0.003218	0.001941	0.002988	0.002290	0.003471	0.002214	0.003116	0.001886	1.377686
ROW82	0.007544	0.011045	0.009705	0.013123	0.012889	0.004582	0.003371	0.002663	0.003981
ROW83	0.001077	0.001069	0.001055	0.001148	0.001518	0.016044	0.002815	0.005398	0.018704
ROW84	0.016466	0.022877	0.017181	0.021042	0.023399	0.017495	0.019680	0.036003	0.029453
ROW85	0.002397	0.002749	0.002652	0.003869	0.003413	0.003666	0.005286	0.001128	0.002563
ROW86	0.071573	0.063193	0.046199	0.079383	0.079357	0.024949	0.043674	0.039913	0.035170
ROW87	0.002484	0.002848	0.002329	0.002346	0.003187	0.004638	0.008394	0.013367	0.003461
ROW88	0.008262	0.009326	0.012192	0.008852	0.013735	0.007106	0.010791	0.007581	0.011284
ROW89	0.011849	0.013150	0.014076	0.010617	0.021452	0.012512	0.027107	0.028272	0.071456
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.030760	0.042120	0.032488	0.040633	0.053377	0.033793	0.044808	0.032249	0.070241
ROW92	0.003069	0.005981	0.004500	0.006035	0.006308	0.001289	0.001772	0.001453	0.002187
ROW93	0.003954	0.007013	0.006462	0.002972	0.007076	0.002733	0.002916	0.002299	0.002881
ROW94	0.084859	0.118029	0.110999	0.097454	0.154067	0.062920	0.094363	0.077978	0.134991
ROW95	0.015296	0.019311	0.013267	0.012825	0.016985	0.008302	0.007049	0.008815	0.009995
ROW96	0.006893	0.010213	0.006354	0.007676	0.010230	0.006606	0.045133	0.048217	0.008842
ROW97	0.002074	0.003062	0.002636	0.002189	0.003324	0.001905	0.001890	0.001653	0.002682
ROW98	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000043	0.000000	0.000004
ROW99	0.000051	0.000065	0.000058	0.000049	0.000096	0.000046	0.000160	0.000111	0.000235
ROW100	0.000462	0.000620	0.000722	0.000306	0.000489	0.000239	0.000948	0.000138	0.000227
ROW101	0.003118	0.003640	0.005977	0.002642	0.004437	0.002640	0.002943	0.002390	0.003066
ROW102	0.000132	0.000739	0.001748	0.002490	0.003409	0.000044	0.000058	0.000049	0.000063
ROW103	0.003353	0.004526	0.003229	0.004561	0.005425	0.002460	0.003722	0.003145	0.006653
ROW104	0.000595	0.000648	0.000583	0.000570	0.001431	0.000763	0.007403	0.001876	0.000646

Table H2 (continued)

ROW	COL82	COL83	COL84	COL85	COL86	COL87	COL88	COL89	COL90
ROW1	0.001287	0.002932	0.000675	0.002217	0.001038	0.002038	0.001246	0.001185	0.000228
ROW2	0.019637	0.017040	0.001059	0.007200	0.004237	0.002953	0.001996	0.002425	0.000852
ROW3	0.000712	0.001736	0.000255	0.004668	0.000442	0.000918	0.000490	0.000600	0.000114
ROW4	0.002452	0.000998	0.000860	0.004341	0.005497	0.004007	0.001144	0.002635	0.000495
ROW5	0.035718	0.000340	0.000158	0.001082	0.000532	0.000195	0.000335	0.000397	0.000064
ROW6	0.000014	0.000010	0.000006	0.000021	0.000009	0.000007	0.000010	0.000011	0.000007
ROW7	0.000990	0.000806	0.000371	0.004487	0.001376	0.000793	0.000809	0.000676	0.000271
ROW8	0.000792	0.010044	0.000226	0.000851	0.000387	0.000620	0.001258	0.000627	0.000111
ROW9	0.000526	0.000184	0.000046	0.000244	0.000150	0.000119	0.000073	0.000100	0.000042
ROW10	0.002100	0.000963	0.000449	0.003043	0.001116	0.000553	0.000438	0.000522	0.000538
ROW11	0.000249	0.000366	0.000406	0.002302	0.000161	0.000236	0.000226	0.000226	0.002072
ROW12	0.005381	0.022270	0.004707	0.010457	0.006862	0.016098	0.009007	0.008155	0.001039
ROW13	0.001381	0.005665	0.001204	0.002666	0.001754	0.004095	0.002303	0.002091	0.000271
ROW14	0.000139	0.000575	0.000122	0.000270	0.000177	0.000416	0.000232	0.000210	0.000027
ROW15	0.003657	0.009241	0.001342	0.024856	0.002322	0.004886	0.002589	0.003172	0.000580
ROW16	0.009396	0.002245	0.001053	0.001704	0.003017	0.001050	0.001921	0.004655	0.000410
ROW17	0.002111	0.000550	0.000296	0.000444	0.000781	0.000272	0.000480	0.001130	0.000200
ROW18	0.003704	0.000971	0.000494	0.000773	0.001326	0.000500	0.000900	0.002005	0.000233
ROW19	0.003057	0.001507	0.003704	0.001760	0.002384	0.001078	0.001222	0.002254	0.007840
ROW20	0.000913	0.000454	0.000289	0.000815	0.000534	0.000316	0.000508	0.000751	0.000238
ROW21	0.000309	0.000354	0.000165	0.000467	0.000157	0.000115	0.000142	0.000162	0.000127
ROW22	0.000694	0.000459	0.000470	0.000763	0.000291	0.000216	0.000326	0.000348	0.000247
ROW23	0.000572	0.000729	0.000620	0.003968	0.000336	0.000295	0.000356	0.000404	0.000394
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.001786	0.002487	0.001542	0.001747	0.002027	0.003649	0.002182	0.003656	0.074268
ROW31	0.005065	0.003741	0.001289	0.008874	0.004727	0.006557	0.009908	0.005787	0.000880
ROW32	0.002187	0.037464	0.000359	0.002747	0.000671	0.001199	0.000684	0.000683	0.000115
ROW33	0.000352	0.000049	0.000025	0.008679	0.000048	0.000113	0.000042	0.000051	0.000006
ROW34	0.009899	0.002332	0.031413	0.175861	0.002856	0.003293	0.002392	0.003630	0.000435
ROW35	0.000073	0.000058	0.000035	0.000049	0.000049	0.000033	0.000062	0.000072	0.000010
ROW36	0.007051	0.001617	0.000743	0.001226	0.002190	0.000758	0.001392	0.003440	0.000225
ROW37	0.002516	0.001704	0.000732	0.001206	0.002156	0.000751	0.001383	0.003426	0.000205
ROW38	0.017292	0.004582	0.002114	0.003664	0.006538	0.002194	0.003956	0.009456	0.000850
ROW39	0.000213	0.000274	0.000106	0.000193	0.000212	0.000103	0.000192	0.000471	0.000030
ROW40	0.003815	0.007572	0.001248	0.002669	0.003231	0.001523	0.004128	0.002056	0.001218
ROW41	0.001736	0.000369	0.000912	0.001844	0.000784	0.000443	0.000433	0.000521	0.000099
ROW42	0.001746	0.001682	0.001371	0.004187	0.001861	0.001453	0.002366	0.002690	0.001258
ROW43	0.000764	0.001768	0.000956	0.004339	0.000753	0.000420	0.000507	0.000561	0.001634
ROW44	0.000104	0.000043	0.000504	0.000054	0.000040	0.000027	0.000045	0.000064	0.000074
ROW45	0.000079	0.000052	0.000017	0.000041	0.000035	0.000025	0.000017	0.000029	0.000211
ROW46	0.006807	0.005284	0.003488	0.004455	0.008346	0.006614	0.011751	0.013560	0.001630
ROW47	0.005799	0.003787	0.002325	0.003586	0.009076	0.007752	0.004512	0.007474	0.001628
ROW48	0.008314	0.006084	0.005997	0.004768	0.006545	0.004442	0.031178	0.025304	0.001399
ROW49	0.008994	0.005839	0.003238	0.027625	0.004949	0.003895	0.005142	0.005788	0.004832
ROW50	0.002892	0.002784	0.001391	0.002926	0.002330	0.001561	0.001938	0.002063	0.001699
ROW51	0.000120	0.000045	0.000022	0.000282	0.000052	0.000032	0.000048	0.000175	0.000013
ROW52	0.000886	0.000420	0.000281	0.002074	0.000933	0.001001	0.000732	0.000714	0.000149
ROW53	0.000905	0.000810	0.000867	0.003864	0.000603	0.000624	0.000645	0.000706	0.004457
ROW54	0.008303	0.006717	0.003293	0.007224	0.007212	0.004853	0.003946	0.005683	0.004384
ROW55	0.000162	0.000144	0.000109	0.000109	0.000164	0.000151	0.000187	0.000321	0.000034
ROW56	0.001127	0.000714	0.000855	0.001126	0.001190	0.000670	0.000701	0.000994	0.000414

Table H2 (continued)

ROW	COL82	COL83	COL84	COL85	COL86	COL87	COL88	COL89	COL90
ROW57	0.000198	0.000693	0.000268	0.001429	0.000121	0.000126	0.000133	0.000133	0.000173
ROW58	0.001344	0.004877	0.001009	0.004666	0.001042	0.000916	0.001141	0.001094	0.001722
ROW59	0.005762	0.006689	0.003084	0.008037	0.002871	0.002081	0.002575	0.002945	0.002235
ROW60	0.003209	0.002177	0.001840	0.003057	0.001684	0.001118	0.001541	0.001749	0.001071
ROW61	0.004424	0.002774	0.003257	0.003762	0.001675	0.001248	0.001978	0.002070	0.001382
ROW62	0.007855	0.009473	0.005206	0.014536	0.005170	0.003675	0.004351	0.005259	0.004912
ROW63	0.007110	0.013621	0.002332	0.006860	0.003953	0.002658	0.003129	0.003509	0.002835
ROW64	0.029484	0.013870	0.028060	0.011743	0.014506	0.011049	0.026172	0.022628	0.003874
ROW65	0.000666	0.000664	0.000785	0.003405	0.001760	0.000806	0.000624	0.000834	0.002291
ROW66	0.000113	0.000102	0.000095	0.000090	0.000175	0.000155	0.000139	0.000201	0.001660
ROW67	0.001271	0.001348	0.001795	0.008763	0.000692	0.000744	0.000872	0.000832	0.000666
ROW68	0.004498	0.001501	0.027706	0.002333	0.001473	0.000838	0.001336	0.002442	0.000175
ROW69	0.004269	0.002988	0.001296	0.002995	0.001620	0.001270	0.001296	0.001556	0.000941
ROW70	0.002569	0.003156	0.001884	0.004342	0.008276	0.003284	0.001871	0.004081	0.000601
ROW71	0.000125	0.000094	0.000066	0.000085	0.000122	0.000095	0.000163	0.000168	0.000028
ROW72	0.043571	0.000327	0.000164	0.000194	0.000261	0.000110	0.000215	0.000295	0.000057
ROW73	0.001030	0.001047	0.000476	0.000548	0.000345	0.000274	0.000282	0.000532	0.000155
ROW74	0.001354	0.002753	0.000363	0.001648	0.000356	0.000268	0.000362	0.000482	0.000681
ROW75	0.001352	0.001144	0.000875	0.000934	0.001392	0.000982	0.002179	0.002433	0.000265
ROW76	0.000114	0.000132	0.000063	0.000093	0.000092	0.000055	0.000090	0.000192	0.000016
ROW77	0.001747	0.001244	0.001058	0.001315	0.001409	0.000952	0.001964	0.002509	0.000928
ROW78	0.004155	0.002674	0.001393	0.005788	0.002668	0.001898	0.002409	0.002876	0.001260
ROW79	0.001765	0.002485	0.001453	0.001088	0.003189	0.000847	0.001568	0.002836	0.000337
ROW80	0.018813	0.010272	0.004225	0.023632	0.021843	0.005894	0.005758	0.008089	0.003537
ROW81	0.003564	0.001276	0.000400	0.002629	0.001100	0.001417	0.000675	0.000880	0.000346
ROW82	1.041573	0.006696	0.002621	0.003774	0.005697	0.002263	0.004634	0.006432	0.001033
ROW83	0.027487	1.001592	0.000248	0.001157	0.001233	0.000555	0.000456	0.000827	0.000162
ROW84	0.027920	0.027051	1.024888	0.026258	0.037678	0.019448	0.033373	0.064650	0.003413
ROW85	0.007158	0.003709	0.001578	1.030684	0.002595	0.001602	0.002885	0.004074	0.000388
ROW86	0.032932	0.015816	0.008810	0.022842	1.028033	0.012281	0.012453	0.017212	0.007394
ROW87	0.002300	0.002337	0.001675	0.008249	0.004850	1.002827	0.001934	0.004120	0.005206
ROW88	0.011155	0.023289	0.005655	0.006813	0.009720	0.011606	1.018232	0.049319	0.006569
ROW89	0.042413	0.029706	0.010330	0.016153	0.012535	0.011791	0.050026	1.324195	0.026867
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
ROW91	0.037041	0.051590	0.031977	0.036226	0.042032	0.075462	0.045185	0.075772	0.032036
ROW92	0.003121	0.002495	0.002262	0.001535	0.005673	0.001338	0.002473	0.004470	0.000466
ROW93	0.003837	0.002766	0.004579	0.002503	0.004816	0.002613	0.004517	0.005653	0.000484
ROW94	0.126657	0.086764	0.063053	0.078067	0.116518	0.097987	0.174726	0.174018	0.027067
ROW95	0.028283	0.016204	0.007352	0.011602	0.022748	0.007498	0.013910	0.035052	0.002023
ROW96	0.006245	0.006247	0.005302	0.010853	0.024376	0.009027	0.005040	0.011501	0.001388
ROW97	0.004072	0.002073	0.001638	0.001752	0.002619	0.002046	0.003654	0.004332	0.000539
ROW98	0.000001	0.000001	0.000000	0.000029	0.000000	0.000001	0.000000	0.000001	0.000000
ROW99	0.000181	0.000101	0.000038	0.000198	0.000057	0.000044	0.000157	0.003833	0.000083
ROW100	0.000274	0.000791	0.000116	0.000126	0.000213	0.000387	0.000199	0.000346	0.000039
ROW101	0.002635	0.003994	0.001866	0.001174	0.003531	0.002396	0.004143	0.010527	0.000462
ROW102	0.000102	0.000059	0.000037	0.000051	0.000068	0.000030	0.000063	0.000106	0.000016
ROW103	0.002854	0.004421	0.004870	0.004728	0.004842	0.006596	0.026353	0.020055	0.005520
ROW104	0.000470	0.000720	0.000629	0.000582	0.001249	0.000711	0.000621	0.000769	0.000092

Table H2 (continued)

ROW	COL91	COL92	COL93	COL94	COL95	COL96	COL97	COL98	COL99
ROW1	0.000912	0.004245	0.001911	0.001645	0.002155	0.001992	0.001444	0.002032	0.000937
ROW2	0.002443	0.006013	0.006444	0.005077	0.004000	0.005259	0.003257	0.005093	0.002000
ROW3	0.000557	0.001768	0.000989	0.000771	0.001002	0.001057	0.000996	0.002034	0.000991
ROW4	0.002114	0.006293	0.007531	0.004455	0.002637	0.005493	0.003322	0.001523	0.001992
ROW5	0.000102	0.000359	0.000469	0.001809	0.000284	0.000332	0.000306	0.000529	0.000198
ROW6	0.000007	0.000014	0.000026	0.000033	0.000031	0.000032	0.000012	0.000020	0.000009
ROW7	0.001452	0.001046	0.001058	0.001208	0.002270	0.001227	0.001116	0.001931	0.000505
ROW8	0.000415	0.001404	0.000784	0.000952	0.000896	0.000671	0.000544	0.003885	0.000364
ROW9	0.000469	0.000226	0.000217	0.000178	0.000329	0.000174	0.000241	0.000190	0.000087
ROW10	0.000589	0.003193	0.002484	0.001332	0.001051	0.002479	0.000741	0.001092	0.000562
ROW11	0.001597	0.000651	0.000316	0.000302	0.000280	0.000442	0.000447	0.000532	0.000184
ROW12	0.006496	0.030788	0.010262	0.008460	0.014460	0.009068	0.010180	0.011931	0.006294
ROW13	0.001659	0.007860	0.002811	0.002192	0.003688	0.002315	0.002621	0.003061	0.001617
ROW14	0.000168	0.000795	0.000264	0.000218	0.000373	0.000234	0.000263	0.000308	0.000162
ROW15	0.002955	0.009390	0.005144	0.004009	0.005252	0.005535	0.005257	0.010735	0.005251
ROW16	0.000834	0.003578	0.003134	0.003253	0.120821	0.001602	0.008151	0.016019	0.005500
ROW17	0.000240	0.000924	0.000634	0.000904	0.028392	0.000415	0.006063	0.005468	0.002396
ROW18	0.000385	0.001577	0.001295	0.002082	0.047699	0.000724	0.037977	0.006925	0.002711
ROW19	0.002941	0.006592	0.002846	0.002218	0.035917	0.001710	0.011878	0.007103	0.002617
ROW20	0.000276	0.000649	0.000977	0.001451	0.009144	0.000572	0.000658	0.001068	0.000499
ROW21	0.000127	0.000245	0.000694	0.000546	0.000422	0.001639	0.000219	0.000336	0.000171
ROW22	0.000241	0.000455	0.001585	0.001294	0.000608	0.002405	0.000465	0.000786	0.000424
ROW23	0.000371	0.000745	0.001198	0.001016	0.001239	0.001586	0.000872	0.001096	0.000428
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.053996	0.007890	0.003776	0.004139	0.003868	0.002969	0.005544	0.003331	0.002937
ROW31	0.006233	0.027167	0.011318	0.008987	0.008817	0.009438	0.013781	0.029431	0.005720
ROW32	0.000570	0.002349	0.001034	0.000844	0.001165	0.000941	0.000883	0.001213	0.000599
ROW33	0.000034	0.000116	0.000053	0.000053	0.000067	0.000174	0.000049	0.000075	0.000042
ROW34	0.001361	0.004501	0.003273	0.004951	0.003711	0.006385	0.009247	0.003171	0.001789
ROW35	0.000018	0.000066	0.000053	0.000348	0.000036	0.000054	0.000071	0.000046	0.000038
ROW36	0.000584	0.002488	0.002184	0.002313	0.090312	0.001081	0.003457	0.011625	0.003846
ROW37	0.000577	0.001072	0.001448	0.002165	0.070213	0.001028	0.003017	0.001574	0.001275
ROW38	0.001750	0.008103	0.005177	0.006992	0.239293	0.003397	0.012814	0.036349	0.015996
ROW39	0.000081	0.000172	0.000209	0.000300	0.000097	0.000143	0.000401	0.000129	0.000165
ROW40	0.001241	0.015311	0.032128	0.004395	0.005395	0.015084	0.005427	0.019799	0.003211
ROW41	0.000243	0.005282	0.026083	0.001430	0.000808	0.003729	0.001029	0.011812	0.001024
ROW42	0.001247	0.002897	0.004698	0.007874	0.003044	0.002634	0.001980	0.002419	0.001472
ROW43	0.001330	0.002209	0.001770	0.001361	0.001484	0.001714	0.000948	0.001172	0.000644
ROW44	0.000062	0.000039	0.000125	0.000145	0.000030	0.000243	0.000045	0.000040	0.000028
ROW45	0.000159	0.000046	0.000056	0.000047	0.000032	0.000924	0.000036	0.000032	0.000021
ROW46	0.002328	0.009484	0.011793	0.040273	0.012759	0.006471	0.006921	0.008065	0.005877
ROW47	0.001943	0.009188	0.015981	0.009548	0.024816	0.007729	0.004485	0.009482	0.006555
ROW48	0.002440	0.012207	0.006627	0.029097	0.007306	0.004059	0.009876	0.007501	0.008022
ROW49	0.003878	0.010856	0.023230	0.018259	0.019193	0.016772	0.013476	0.029607	0.009956
ROW50	0.001541	0.005562	0.012403	0.005757	0.005157	0.012516	0.002738	0.008752	0.003090
ROW51	0.000020	0.000088	0.000097	0.000184	0.001208	0.000045	0.000114	0.033473	0.028197
ROW52	0.000299	0.008203	0.015694	0.002551	0.003757	0.000638	0.001075	0.004051	0.001362
ROW53	0.003460	0.001610	0.002054	0.001565	0.001022	0.006833	0.001134	0.001510	0.000597
ROW54	0.003957	0.013715	0.026762	0.015334	0.018808	0.040017	0.006543	0.026648	0.011004
ROW55	0.000080	0.000395	0.007295	0.000408	0.000266	0.000169	0.003840	0.000303	0.000315
ROW56	0.000465	0.002701	0.002280	0.002694	0.008316	0.009516	0.000986	0.003641	0.001651

Table H2 (continued)

ROW	COL91	COL92	COL93	COL94	COL95	COL96	COL97	COL98	COL99
ROW57	0.000184	0.000355	0.000557	0.000286	0.000275	0.000987	0.000225	0.000316	0.000122
ROW58	0.001718	0.003063	0.006015	0.002724	0.002575	0.011017	0.001663	0.002918	0.001112
ROW59	0.002271	0.004293	0.012588	0.010011	0.007383	0.031202	0.003787	0.005410	0.002933
ROW60	0.001131	0.002112	0.006870	0.006147	0.003831	0.024962	0.001947	0.002774	0.001683
ROW61	0.001397	0.002467	0.009911	0.008084	0.002854	0.013191	0.002519	0.003900	0.002434
ROW62	0.004739	0.008138	0.024107	0.016731	0.022808	0.067830	0.006292	0.009682	0.005283
ROW63	0.002659	0.004853	0.013300	0.014588	0.007526	0.033243	0.004523	0.005439	0.002906
ROW64	0.005683	0.017014	0.104726	0.123806	0.012639	0.036380	0.017461	0.018162	0.013850
ROW65	0.002030	0.001668	0.003706	0.001256	0.000968	0.039963	0.001150	0.001470	0.000625
ROW66	0.001236	0.000435	0.007884	0.000379	0.000234	0.000178	0.000294	0.000213	0.000215
ROW67	0.000877	0.002173	0.001913	0.001763	0.000906	0.007326	0.001340	0.002373	0.000868
ROW68	0.000435	0.000936	0.002079	0.002773	0.000786	0.010801	0.001301	0.001093	0.000798
ROW69	0.001107	0.001829	0.008151	0.006318	0.001561	0.015690	0.002375	0.001886	0.001199
ROW70	0.001885	0.004069	0.008145	0.006512	0.003280	0.304576	0.003385	0.002740	0.002370
ROW71	0.000047	0.000167	0.001534	0.001144	0.000117	0.000528	0.000146	0.000124	0.000097
ROW72	0.000074	0.000186	0.000357	0.000808	0.000231	0.000427	0.000224	0.000542	0.000173
ROW73	0.000104	0.000516	0.000661	0.000742	0.000762	0.001133	0.001162	0.000985	0.000235
ROW74	0.000596	0.000708	0.005654	0.001105	0.000595	0.002169	0.000632	0.016007	0.015362
ROW75	0.000542	0.001808	0.013654	0.009978	0.001197	0.000918	0.011558	0.013457	0.004556
ROW76	0.000037	0.000169	0.002778	0.000164	0.000587	0.000083	0.000180	0.000507	0.000588
ROW77	0.001120	0.005128	0.024815	0.005352	0.001946	0.001402	0.004325	0.003849	0.002332
ROW78	0.001411	0.003982	0.006133	0.007068	0.011470	0.014567	0.003621	0.005943	0.002616
ROW79	0.000515	0.001372	0.002450	0.007256	0.001640	0.001922	0.001822	0.003461	0.001325
ROW80	0.004850	0.009204	0.014120	0.014459	0.027239	0.015839	0.010786	0.013966	0.006353
ROW81	0.000591	0.001645	0.001946	0.001715	0.002667	0.001809	0.001772	0.001712	0.000716
ROW82	0.001463	0.003701	0.006169	0.017225	0.004328	0.005683	0.004600	0.011526	0.003119
ROW83	0.000538	0.002441	0.001153	0.001269	0.000902	0.001353	0.000716	0.000973	0.000419
ROW84	0.008913	0.016067	0.040757	0.045379	0.017029	0.020523	0.021331	0.022204	0.015704
ROW85	0.002261	0.009038	0.002828	0.003557	0.005227	0.002617	0.003503	0.006747	0.003648
ROW86	0.010297	0.023020	0.050113	0.033604	0.098202	0.083347	0.029566	0.039268	0.022600
ROW87	0.006251	0.006478	0.004511	0.003588	0.002595	0.014382	0.004460	0.002782	0.002160
ROW88	0.008364	0.014362	0.011106	0.012931	0.011296	0.007029	0.012685	0.010943	0.006725
ROW89	0.017475	0.034939	0.014677	0.016273	0.017298	0.019812	0.019733	0.013564	0.021185
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	1.120440	0.163690	0.078327	0.085846	0.080165	0.061594	0.114964	0.069089	0.060912
ROW92	0.000748	1.002041	0.003572	0.013050	0.002058	0.002542	0.002683	0.005502	0.001911
ROW93	0.002862	0.028642	1.037467	0.005743	0.014003	0.003716	0.012003	0.011213	0.015468
ROW94	0.042840	0.132469	0.126778	1.304881	0.098630	0.083553	0.136291	0.111984	0.079411
ROW95	0.005724	0.010437	0.014266	0.022054	1.006752	0.010114	0.030196	0.018038	0.012997
ROW96	0.005428	0.011867	0.021636	0.017772	0.008000	1.010470	0.009365	0.007113	0.006848
ROW97	0.000937	0.002632	0.002711	0.022761	0.012184	0.001818	1.182151	0.002752	0.001807
ROW98	0.000000	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	1.000001	0.000000
ROW99	0.000084	0.000129	0.000062	0.000072	0.000738	0.000072	0.000178	0.000156	1.031563
ROW100	0.000079	0.000250	0.000266	0.000379	0.000297	0.000271	0.000270	0.000451	0.000342
ROW101	0.000887	0.003104	0.003941	0.004938	0.002934	0.002171	0.004753	0.003004	0.002465
ROW102	0.000025	0.000074	0.000200	0.000120	0.002048	0.000107	0.000111	0.000127	0.000071
ROW103	0.002094	0.006063	0.004323	0.011951	0.003604	0.002770	0.004367	0.006178	0.007429
ROW104	0.000774	0.002159	0.001418	0.000870	0.001115	0.001050	0.000874	0.000609	0.000490

Table H2 (continued)

ROW	COL100	COL101	COL102	COL103	COL104
ROW1	0.002651	0.002958	0.003541	0.000983	0.002647
ROW2	0.005098	0.003458	0.003877	0.003178	0.008152
ROW3	0.001594	0.001228	0.001986	0.000686	0.006409
ROW4	0.005896	0.001654	0.002455	0.002275	0.003870
ROW5	0.000361	0.000341	0.000287	0.001228	0.001781
ROW6	0.000011	0.000012	0.000020	0.000005	0.000029
ROW7	0.000787	0.001871	0.001819	0.001603	0.003562
ROW8	0.002571	0.002460	0.002035	0.000584	0.001257
ROW9	0.000191	0.000140	0.000188	0.000100	0.000300
ROW10	0.000958	0.000719	0.000900	0.000973	0.004378
ROW11	0.000542	0.000622	0.000399	0.000153	0.003367
ROW12	0.013670	0.023267	0.026655	0.006704	0.014715
ROW13	0.003509	0.005959	0.006883	0.001709	0.003750
ROW14	0.000353	0.000601	0.000688	0.000173	0.000380
ROW15	0.008478	0.006528	0.010561	0.003642	0.034117
ROW16	0.001798	0.005797	0.023375	0.001027	0.002152
ROW17	0.001395	0.001483	0.008322	0.000249	0.000566
ROW18	0.001232	0.002614	0.010543	0.000470	0.000979
ROW19	0.005029	0.003669	0.009650	0.000759	0.002328
ROW20	0.000528	0.000820	0.001558	0.000230	0.001115
ROW21	0.000199	0.000203	0.000662	0.000124	0.000630
ROW22	0.000439	0.000386	0.000645	0.000233	0.001013
ROW23	0.000556	0.000598	0.000745	0.000246	0.005921
ROW24	0.000000	0.000000	0.000000	0.000000	0.000000
ROW25	0.000000	0.000000	0.000000	0.000000	0.000000
ROW26	0.000000	0.000000	0.000000	0.000000	0.000000
ROW27	0.000000	0.000000	0.000000	0.000000	0.000000
ROW28	0.000000	0.000000	0.000000	0.000000	0.000000
ROW29	0.000000	0.000000	0.000000	0.000000	0.000000
ROW30	0.006559	0.004953	0.005194	0.001893	0.002096
ROW31	0.023900	0.031704	0.014443	0.004483	0.014266
ROW32	0.001251	0.001679	0.002001	0.000665	0.003729
ROW33	0.000070	0.000083	0.000099	0.000044	0.015110
ROW34	0.002737	0.004328	0.003616	0.003005	0.251952
ROW35	0.000039	0.000080	0.000032	0.000018	0.000068
ROW36	0.001227	0.004243	0.016584	0.000726	0.001545
ROW37	0.001132	0.004229	0.000836	0.000601	0.001464
ROW38	0.004405	0.012374	0.063629	0.002018	0.004665
ROW39	0.000141	0.000604	0.000073	0.000091	0.000261
ROW40	0.001935	0.002469	0.014588	0.005467	0.003579
ROW41	0.000585	0.001739	0.000661	0.000343	0.002964
ROW42	0.002411	0.002606	0.003793	0.000946	0.005879
ROW43	0.000900	0.001050	0.004841	0.000337	0.006203
ROW44	0.000054	0.000047	0.000032	0.000026	0.000065
ROW45	0.000037	0.000031	0.000037	0.000027	0.000048
ROW46	0.009701	0.009937	0.009824	0.004008	0.005710
ROW47	0.005165	0.005130	0.012646	0.002647	0.004519
ROW48	0.027952	0.032678	0.017972	0.007733	0.006373
ROW49	0.008124	0.006808	0.012236	0.003863	0.041729
ROW50	0.002213	0.002208	0.006752	0.001965	0.003635
ROW51	0.001551	0.000104	0.000335	0.000041	0.000473
ROW52	0.000940	0.002686	0.001570	0.002714	0.003388
ROW53	0.001314	0.001436	0.004559	0.000497	0.005483
ROW54	0.005900	0.005273	0.017660	0.004914	0.007921
ROW55	0.000190	0.000438	0.000199	0.000366	0.000148
ROW56	0.003089	0.001054	0.001556	0.000566	0.001278

Table H2 (continued)

ROW	COL100	COL101	COL102	COL103	COL104
ROW57	0.000240	0.000301	0.000238	0.000097	0.002057
ROW58	0.002131	0.002544	0.001907	0.000755	0.006750
ROW59	0.003553	0.003649	0.012389	0.002281	0.010691
ROW60	0.002003	0.001878	0.004218	0.001395	0.003766
ROW61	0.002605	0.002250	0.003353	0.001343	0.004736
ROW62	0.005903	0.006751	0.031612	0.003960	0.019953
ROW63	0.003687	0.003816	0.005445	0.002486	0.009308
ROW64	0.029134	0.014692	0.011291	0.010769	0.013791
ROW65	0.001508	0.002071	0.001036	0.000638	0.004599
ROW66	0.000232	0.000239	0.000191	0.000314	0.000107
ROW67	0.002662	0.002058	0.001250	0.000607	0.007034
ROW68	0.001477	0.001706	0.000942	0.000753	0.002775
ROW69	0.001608	0.001551	0.001536	0.001329	0.003713
ROW70	0.003391	0.002100	0.002953	0.004815	0.003262
ROW71	0.000101	0.000123	0.000104	0.000061	0.000103
ROW72	0.000331	0.000265	0.000238	0.001442	0.000251
ROW73	0.000422	0.000401	0.000333	0.000803	0.000804
ROW74	0.000829	0.000600	0.000534	0.000337	0.001686
ROW75	0.002308	0.002505	0.001514	0.001002	0.001131
ROW76	0.000081	0.000264	0.000049	0.000185	0.000105
ROW77	0.004619	0.006176	0.013942	0.000752	0.001704
ROW78	0.003260	0.003250	0.005512	0.012415	0.007907
ROW79	0.001565	0.002170	0.003120	0.000959	0.001346
ROW80	0.010514	0.009760	0.022565	0.031639	0.016698
ROW81	0.001207	0.001122	0.001331	0.003214	0.003571
ROW82	0.007314	0.005708	0.004819	0.034132	0.004908
ROW83	0.000923	0.000764	0.000737	0.001529	0.001230
ROW84	0.024324	0.033587	0.022812	0.008920	0.021272
ROW85	0.005263	0.006163	0.008471	0.002169	0.007543
ROW86	0.017600	0.019564	0.033415	0.009389	0.026531
ROW87	0.003313	0.005133	0.002260	0.001191	0.010441
ROW88	0.006553	0.004436	0.006893	0.007664	0.005475
ROW89	0.016166	0.012675	0.015218	0.007578	0.019812
ROW90	0.000000	0.000000	0.000000	0.000000	0.000000
ROW91	0.136071	0.102715	0.107731	0.035630	0.043476
ROW92	0.001694	0.003023	0.002742	0.000904	0.001884
ROW93	0.006089	0.004300	0.005395	0.003661	0.002601
ROW94	0.093914	0.122696	0.087401	0.054068	0.095668
ROW95	0.011484	0.042739	0.006618	0.005514	0.014592
ROW96	0.009900	0.005381	0.007494	0.009275	0.007865
ROW97	0.008302	0.008290	0.006332	0.001753	0.002126
ROW98	0.000001	0.000001	0.000001	0.000000	0.000050
ROW99	0.000075	0.000076	0.000220	0.000030	0.000315
ROW100	1.000485	0.009761	0.000146	0.000341	0.000170
ROW101	0.004023	1.006482	0.003743	0.000675	0.001262
ROW102	0.000067	0.000137	1.000106	0.000030	0.000062
ROW103	0.005520	0.018452	0.011991	1.002213	0.003027
ROW104	0.001196	0.001676	0.001392	0.000738	1.000377