CONTRIBUTION OF THE AUTOMOTIVE INDUSTRY TO THE U.S. ECONOMY IN 1998: THE NATION AND ITS FIFTY STATES

A STUDY PREPARED FOR THE

ALLIANCE OF AUTOMOBILE MANUFACTURERS, INC.

AND THE

ASSOCIATION OF INTERNATIONAL AUTOMOBILE MANUFACTURERS, INC.

BY

INSTITUTE OF LABOR AND INDUSTRIAL RELATIONS
UNIVERSITY OF MICHIGAN

AND

OFFICE FOR THE STUDY OF AUTOMOTIVE TRANSPORTATION
UNIVERSITY OF MICHIGAN TRANSPORTATION RESEARCH INSTITUTE

AND

CENTER FOR AUTOMOTIVE RESEARCH
ENVIRONMENTAL RESEARCH INSTITUTE OF MICHIGAN

WINTER 2001

The statements, findings, and conclusions herein are those of the authors and do not necessarily reflect the views of the project sponsors.

ACKNOWLEDGEMENTS

This study is the product of a team effort. It represents the contributions of a number of staff members from three institutions—the Institute of Labor and Industrial Relations (ILIR) at the University of Michigan, the Center for Automotive Research (CAR) at the Environmental Research Institute of Michigan (ERIM), and the University of Michigan Transportation Research Institute (UMTRI).

At ILIR, we would like to give special recognition to Jackie Murray. She edited the entire study, including text, formatting, and citation of reference material. The quality of the presentation has been greatly enhanced by her efforts. We would also like to thank the staff at Regional Economic Models, Inc. (REMI) for their dedicated work on the economic model used in part 2 of the study.

At CAR, we would like to acknowledge the significant efforts of Diana Douglass and Bernard Swiecki. Diana contributed greatly to the logistic coordination of the project and the production of the document. Bernard administered the critical industry data collection effort of the study and coordinated the study research meetings with Alliance members.

At UMTRI, Christopher Booms, Kelly O'Connor, Karen Roach, and Jason Newby, students at the University of Michigan, assisted in conducting the literature search and performing analyses. Their efficient and accurate efforts are greatly appreciated.

We would like to recognize the important contribution of DesRosiers Automotive Consultants Inc., especially Andrew King.

Finally, we would like to thank the Alliance of Automobile Manufacturers, Inc. and the Association of International Automobile Manufacturers, Inc. for the opportunity to carry out this study. In particular, we express our appreciation to the representatives of the automakers who served on the study advisory panel. Staff from twenty-one companies contributed their time and wisdom to the study process and research results. We are heavily indebted to a number of these key policy staff. We wish them well in their future endeavors.

George A. Fulton, Donald R. Grimes, Lucie G. Schmidt
Institute of Labor and Industrial Relations
University of Michigan

Sean P. McAlinden
Center for Automotive Research
Environmental Research Institute of Michigan

Barbara C. Richardson
University of Michigan Transportation Research Institute

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

STUDY INTRODUCTION

The automotive industry is the largest manufacturing industry in the United States. No other single industry is linked to as much of U.S. manufacturing or generates as much retail business and employment. Our study describes the economic and social contributions of the automotive industry to the U.S. economy and to the economies of the fifty states and the District of Columbia. The automotive industry in this study includes companies that make, sell, or service (under warranty) new passenger cars and light-duty trucks in the United States.[1]

Our study is divided into three parts. In the first part of the study, researchers formerly employed by the University of Michigan Transportation Research Institute (UMTRI), now at the Center for Automotive Research (CAR) at the Environmental Research Institute of Michigan (ERIM), present an empirical overview of the current scope and significance of the automotive industry in the United States. CAR's sources of economic information are data provided by various departments of the U.S. government, industry data from public sources, and data assembled from a national survey of twenty-one motor vehicle firms that currently sell light vehicles in the U.S. market.

The Institute of Labor and Industrial Relations (ILIR) at the University of Michigan carried out the second part of this study. ILIR estimates the total contribution of the U.S. automotive manufacturing industry and new light vehicle dealers to employment and income in the U.S. economy and in the economies of each of its fifty states. ILIR used economic modeling techniques, incorporating special state-level industry data collected by the Office for the Study of Automotive Transportation (OSAT) at UMTRI from twenty-one light vehicle manufacturing firms and from the National Automobile Dealers Association.

The third part of this study, provided by OSAT, describes the contributions the automobile has made to American society in addition to employment and income. Consumers as well as producers of automobiles have benefited from the economic and social opportunities that personal mobility creates.

---

[1] We define the auto industry to include the value of the production or sale of light vehicles by the following vehicle manufacturers: Audi, BMW, DaimlerChrysler, Fiat, Ford, General Motors, Honda, Hyundai, Isuzu, Mazda, Mercedes, Mitsubishi, Nissan, Porsche, Renault, Saab, Subaru, Subaru of America, Toyota, Volkswagen, and Volvo. We also include in our industry definition the sales and service activities connected to new vehicle sales located at new light vehicle dealerships.

PART 1

OVERVIEW

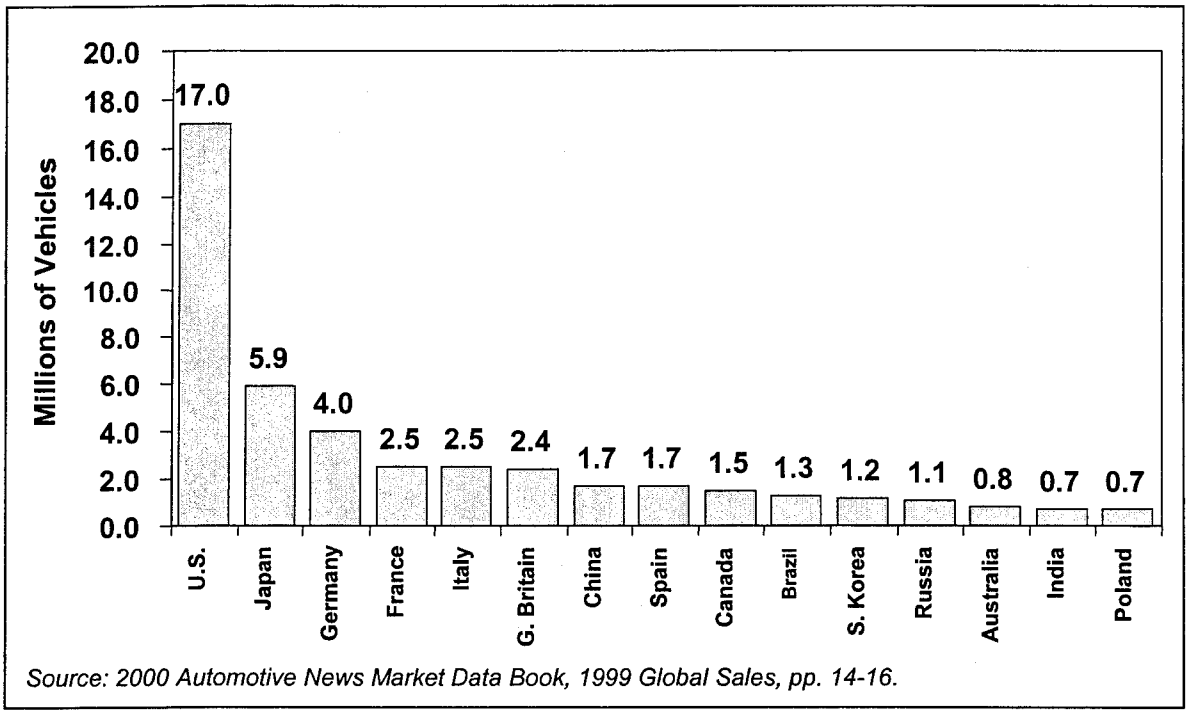
1.1 THE SIZE AND RECENT GROWTH OF THE U.S. MOTOR VEHICLE INDUSTRY

The U.S. automotive industry is once again the largest automotive industry in the world. To a certain extent, the international position of the industry can be directly related to the size of the U.S. market for light vehicles. Figure 1.1 ranks the largest national markets in 1999 in terms of light vehicle sales. The U.S. market was almost three times larger than the next largest market in Japan. Figure 1.2 ranks the largest vehicle-producing nations in 1999 in terms of vehicle production. The U.S. industry produced 30 percent more vehicles than the next largest vehicle industry in Japan.

Recent growth in the production of light vehicles in the United States has been impressive. As shown in figure 1.3, vehicle production increased by 48 percent between the recession year of 1991 and 1999. The 13 million vehicles produced in 1999 were a record high for the U.S. industry, breaking the previous record set in 1978. The recovery of the U.S. motor vehicle manufacturing industry from a period of relative stagnation in the 1980s can be attributed to three major factors. The first factor is a decision by international producers to source many of their U.S. vehicle sales from assembly plants in the United States. The second factor is the reestablishment of the United States as a leading site for vehicle production due to location, resource availability, and the efficiency of its economy. The third factor is the continuing popularity of the private motor vehicle as the transportation mode of choice for the vast majority of Americans—and, especially in recent years, the popularity of U.S.-built trucks and truck-like vehicles that now comprise almost 56 percent of U.S. light vehicle production. As shown in figure 1.4, light truck production in the United States more than doubled between 1990 and 1999.

Figure 1.1

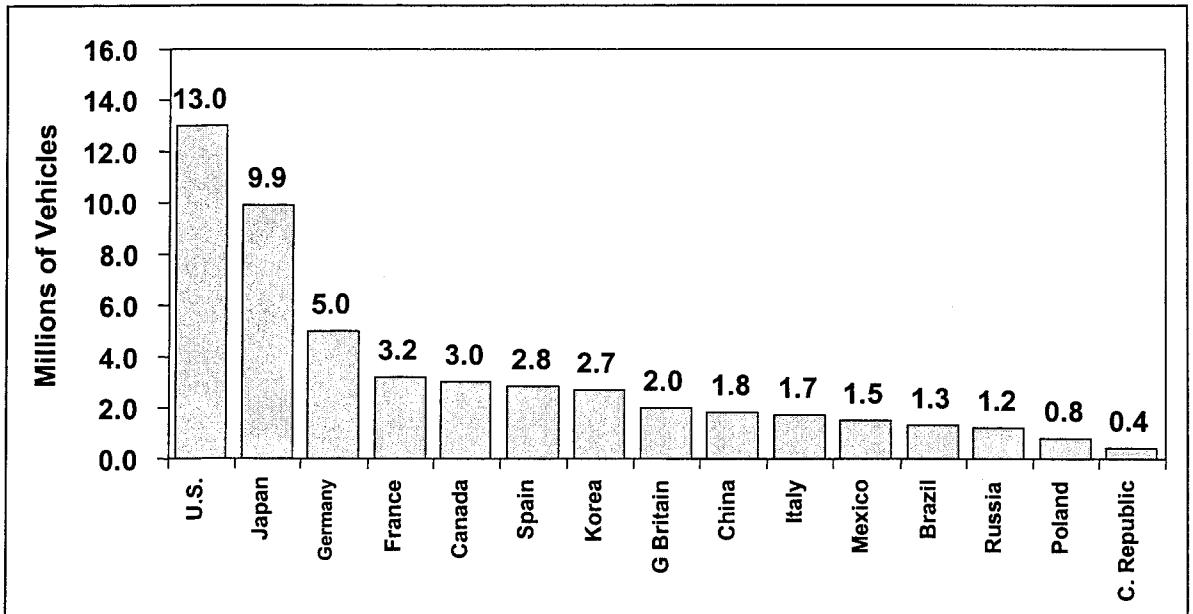
1999 Vehicle Sales in Major Countries



Source: 2000 Automotive News Market Data Book, 1999 Global Sales, pp. 14-16.

Figure 1.2

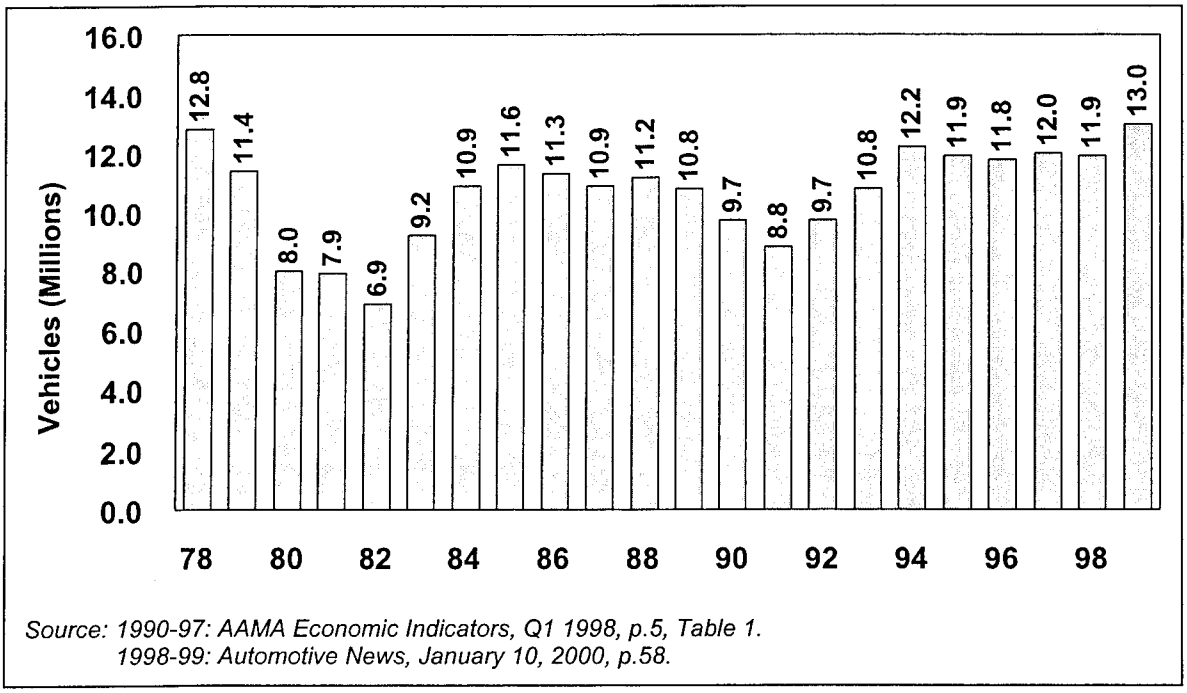
1999 Vehicle Production in Major Countries



Source: 2000 Automotive News Market Data Book, 1999 Global Production, pp. 9-12.

Figure 1.3

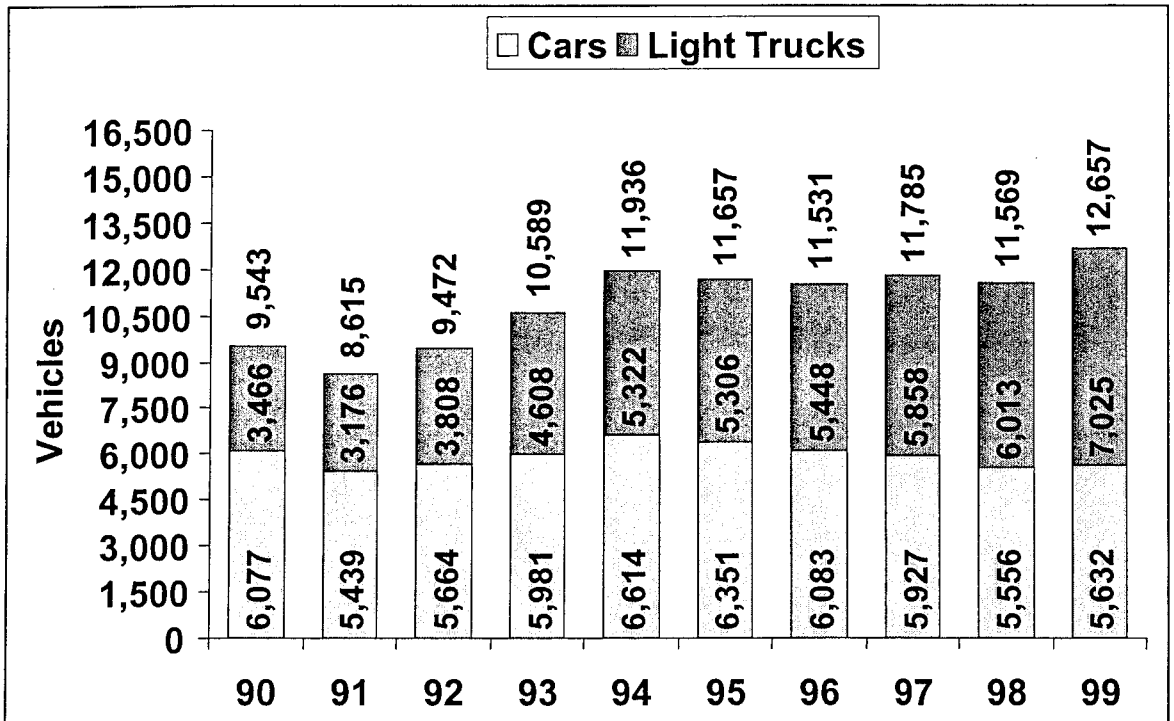
Total U.S. Motor Vehicle Production 1978-1999



Source: 1990-97: AAMA Economic Indicators, Q1 1998, p.5, Table 1.
1998-99: Automotive News, January 10, 2000, p.58.

Figure 1.4

U.S. Light Vehicle Production 1990-1999



Source: 1990-97: AAMA Economic Indicators, Q1 1998, p.5, Table 1.
1998-99: Automotive News, January 10, 2000, p.58.

1.2 ELEMENTS OF SIGNIFICANCE IN THE U.S. ECONOMY

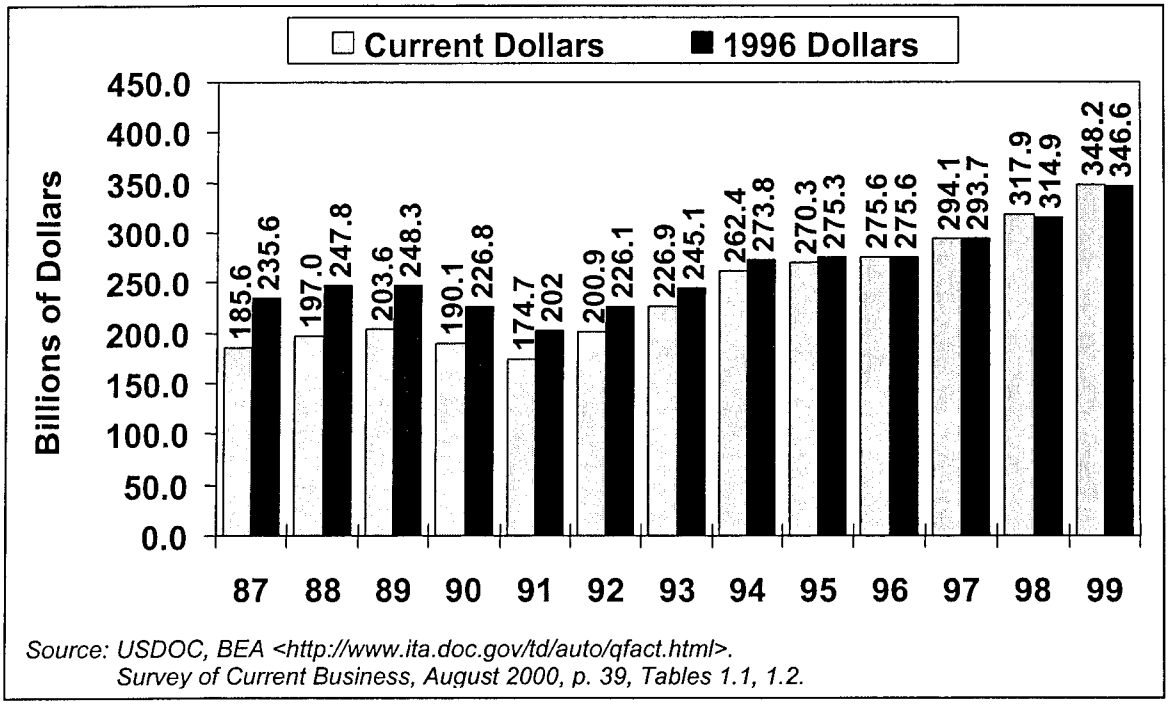
The automotive industry produces a higher level of output in the United States than any other single industry, and this output has been growing. Figure 1.5 shows a noteworthy record of growth in the constant dollar value of automotive output during the 1987-1999 period. The U.S. Bureau of the Census (USBOC) produces the data series illustrated in figure 1.5 for the Bureau of Economic Analysis of the U.S. Department of Commerce (USDOC). The dollar totals are estimates of the retail value of light motor vehicles sold to individuals, businesses, and governments in a given year. They include the value contributed by new vehicle dealerships. The figures are adjusted for import value and inventory adjustment between years. The figures thus represent the U.S. value-added for vehicles sold in the United States.

Measured in constant 1996 dollars, automotive output increased by 47 percent during 1987-1999. More important, recent growth in automotive output contributed significantly to the record growth of the U.S. economy. Figure 1.6 measures year-over-year growth in both constant-dollar gross domestic product (GDP) of the U.S. economy and in constant-dollar motor vehicle output during 1987-1999. Annual growth in constant dollar automotive output averaged 3.6 percent during this period compared with 3.2 percent for GDP. Growth in constant dollar automotive output significantly exceeded growth in the U.S. economy during 1997-1999. The contribution of automotive output to the U.S. GDP has remained substantial despite structural change in the overall economy. As shown in figure 1.7, U.S. motor vehicle output represented 3.7 percent of U.S. GDP in 1999, well above the industry's average share in the early 1990s.

The U.S. automotive industry has contributed to lower rates of inflation in the United States for a number of years. Figure 1.8 shows that in only two years during the period 1986-1999 did year-to-year growth in the consumer price index for new vehicle sales (CPI-U, new vehicles) exceed growth in the overall consumer price index for urban consumers (CPI-U). In fact, during 1998-1999, the consumer price index for new vehicles declined. This performance has improved the affordability of new vehicles in the United States compared with the weighted average of commodities and services included in the CPI-U.

Figure 1.5

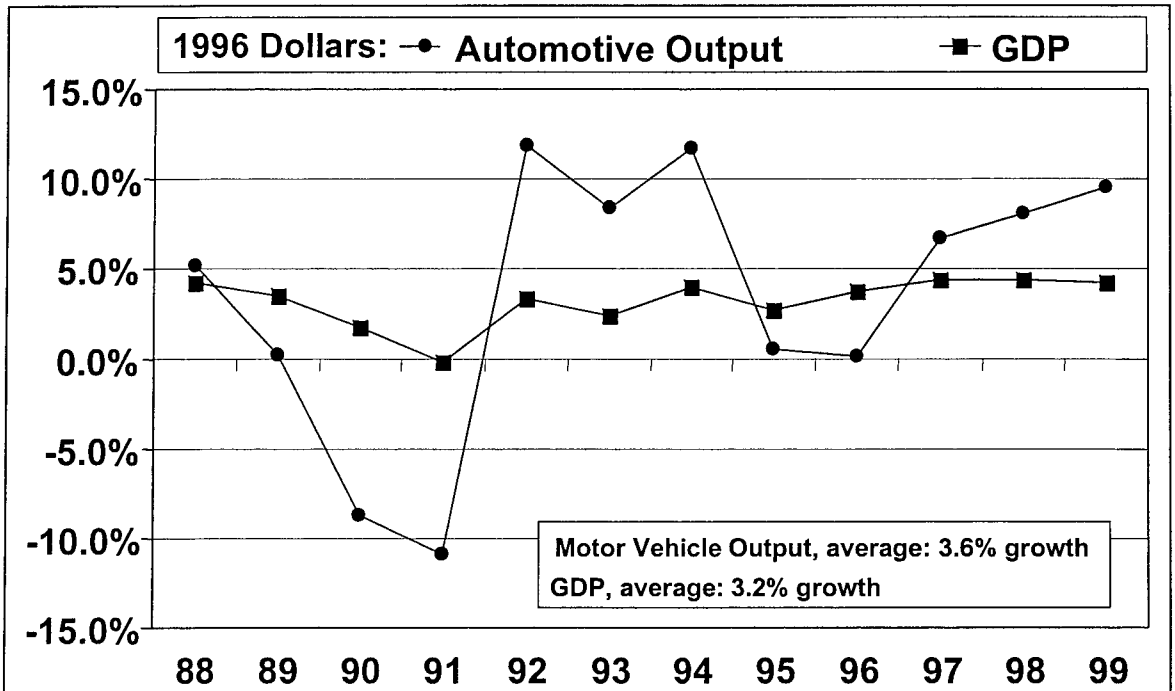
U.S. Automotive Output 1987-1999



Source: USDOC, BEA <http://www.ita.doc.gov/td/auto/qfact.html>.
Survey of Current Business, August 2000, p. 39, Tables 1.1, 1.2.

Figure 1.6

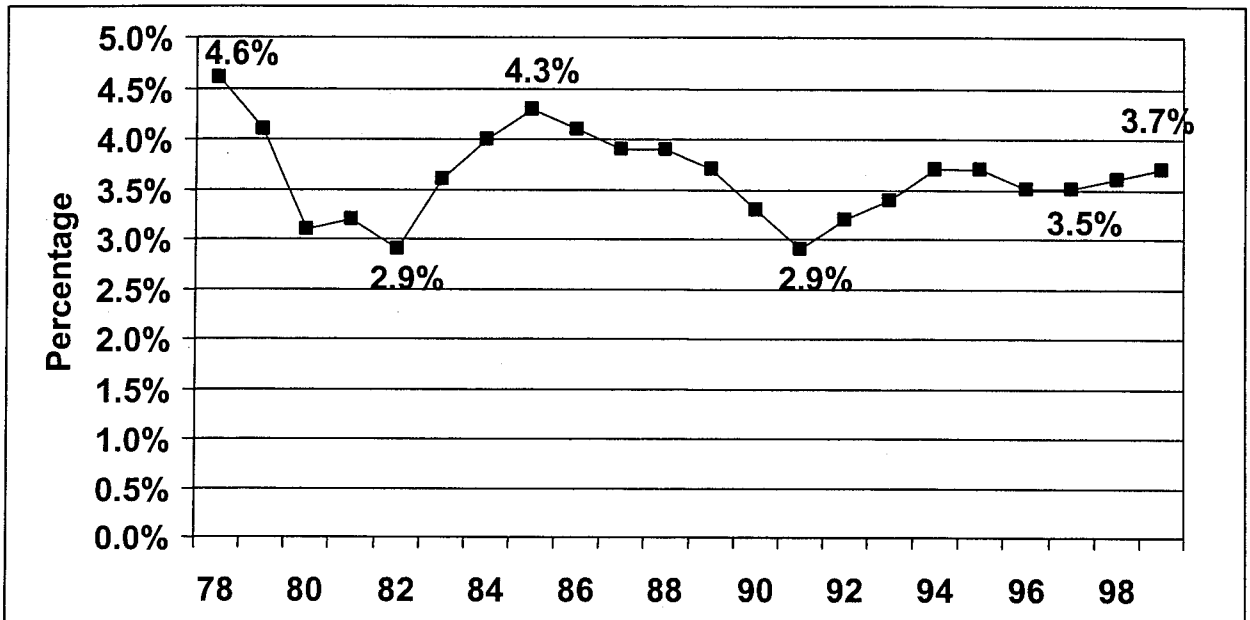
Annual Percentage Change in Output 1987–1999



Source: 2000 Economic Report of the President, NIPA Table B81, p. 402.
Survey of Current Business, August 2000, p. 39, Tables 1.1, 1.2.
USDOC, BEA <http://www.bea.doc.gov/bea/dn1.html> NIPA Table 8.8B, Motor Vehicle Output.
USDOC, BEA <http://www.ita.doc.gov/td/auto/qfact.html>.

Figure 1.7

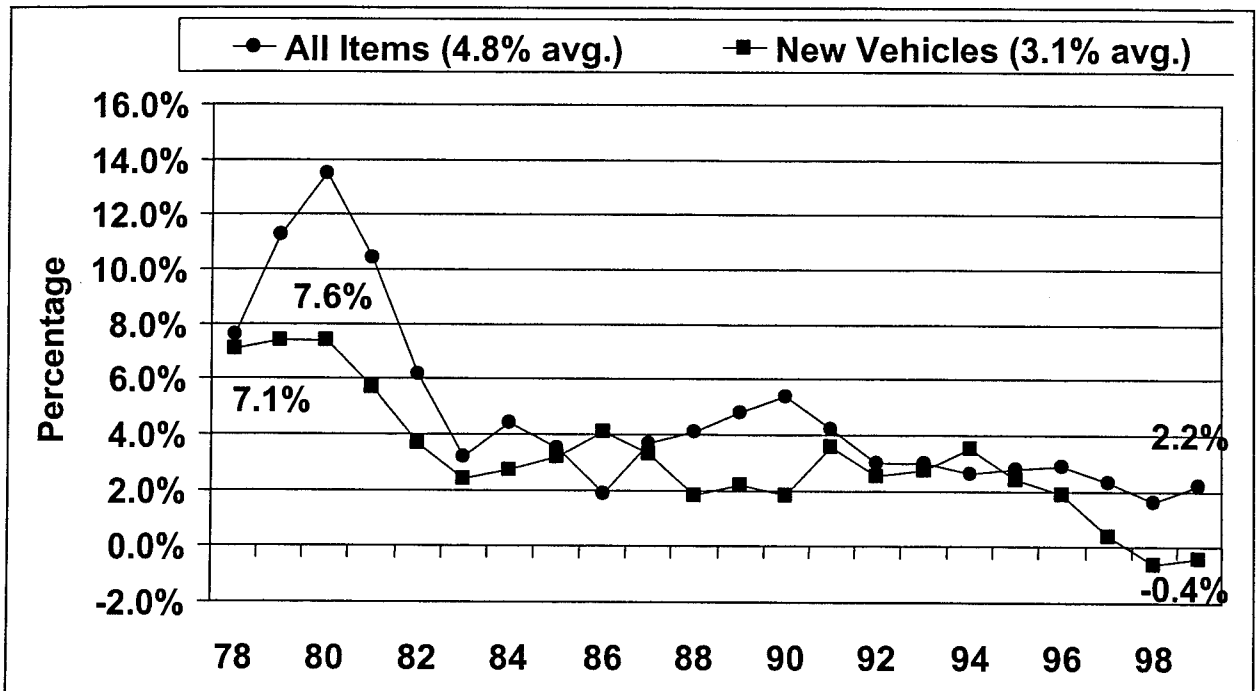
U.S. Motor Vehicle (Auto & Truck) Output Share of Constant and Current GDP 1978-1999



Source: 2000 Economic Report of the President, NIPA Table B-83, p. 402.
Survey of Current Business, August 2000, p. 39, Tables 1.1, 1.2.
USDOC, BEA, <http://www.bea.doc.gov/bea/dn1.html>, NIPA Table 8.8B Motor Vehicle Output.

Figure 1.8

Annual Price Inflation 1978-1999 (year-over-year, CPI-U)

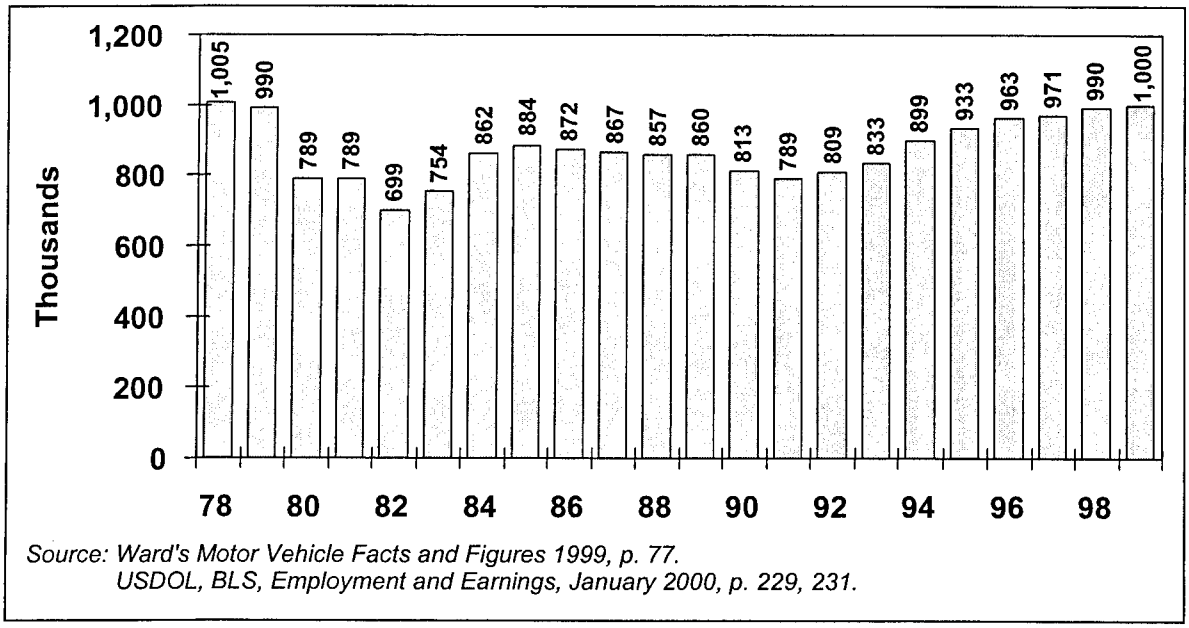


Source: USDOL, BLS <http://www.bls.gov/cpihome.htm> Table: Consumer Price Index—All Urban Consumers.

Employment is always a major factor when measuring the significance of any economic activity. The total contribution of the automotive industry to U.S. employment and income is the focus of part 2 of this study, but several initial observations can be made about the significance of the industry in this regard. Employment in motor vehicle manufacturing is tabulated by the U.S. Department of Labor's Bureau of Labor Statistics for the three-digit industrial classification SIC 371: the motor vehicle and motor vehicle equipment industry. The data are based on employer establishment surveys. This industry classification, however, does not include all employment generated by auto parts manufacturing. These employment figures do cover vehicle assembly and most major component manufacturing. Figure 1.9 tells an interesting story. Employment in SIC 371 in 1999 was equal to the industry's all-time record in 1978 of one million employees, and thus has now fully recovered from its formerly depressed levels. Compared with 1978, however, the productivity of today's employees is much higher.

Figure 1.9

Total U.S. Employment: Motor Vehicles and Equipment 1978-1999

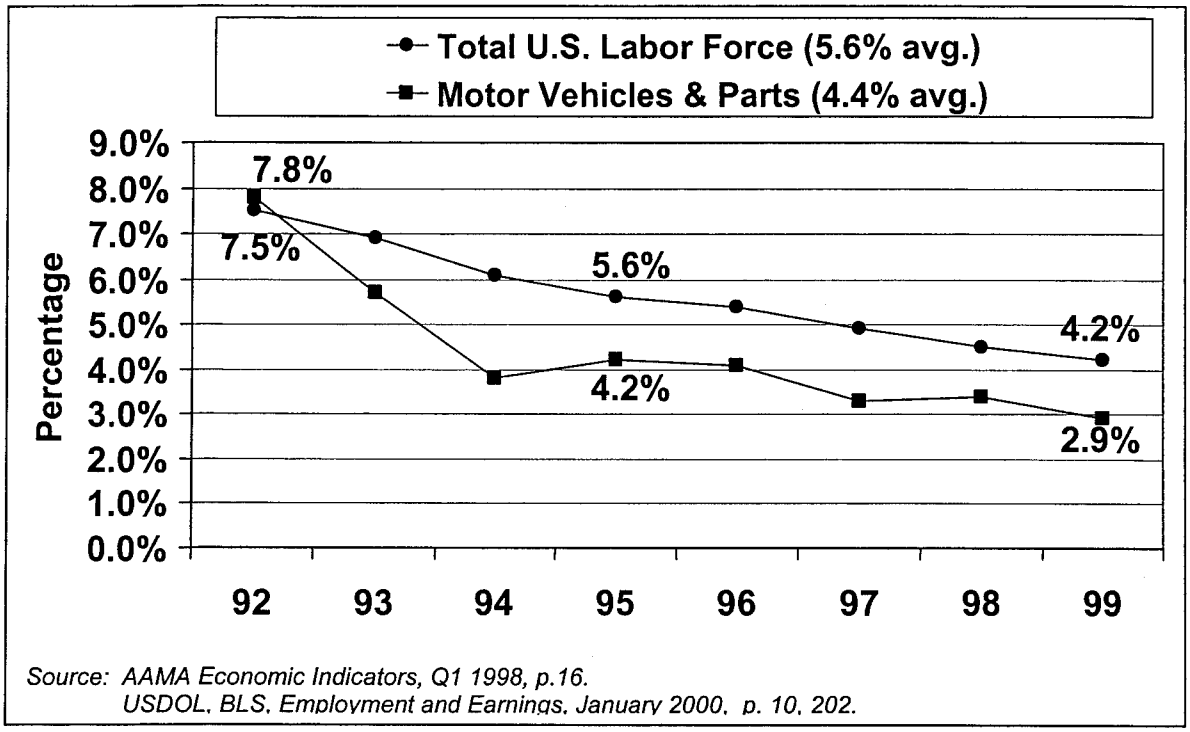


Source: Ward's Motor Vehicle Facts and Figures 1999, p. 77.
USDOL, BLS, Employment and Earnings, January 2000, p. 229, 231.

The unemployment rate is a strong indicator of national well-being. As figure 1.10 illustrates, the measured unemployment rate for those who report employment in the U.S. automotive industry has consistently been lower than the overall U.S. rate of unemployment since 1993. In 1999, for example, the national unemployment rate was 4.2 percent compared with only 2.9 percent in the automotive industry. Clearly, the auto industry has contributed to the record low rates of U.S. unemployment observed in the mid-to-late 1990s.

Figure 1.10

Unemployment Rate 1992-1999

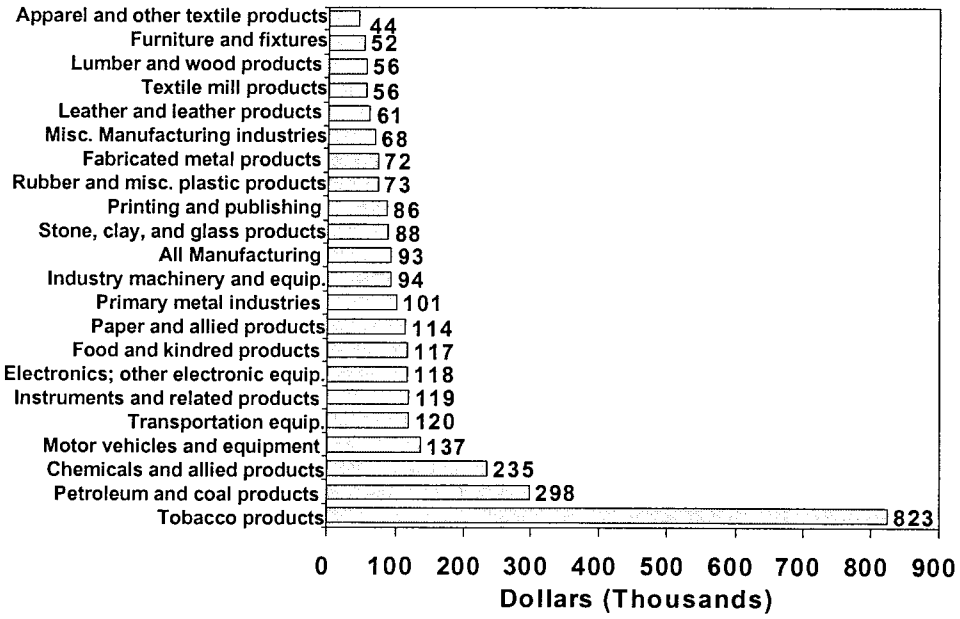


Source: AAMA Economic Indicators, Q1 1998, p.16.
USDOL, BLS, Employment and Earnings, January 2000, p. 10, 202.

The productivity of the automotive industry can be compared with other U.S. industries in terms of value added per employee. Value added includes the sum of profits, rent, interest, and labor compensation paid within the industry. It is thus a measure of the actual value produced by an industry. As shown in figure 1.11, the motor vehicle manufacturing industry ranked fourth among major manufacturing industry groups in terms of value added per employee. The industry's value added of $137,000 per worker was 47 percent higher than the overall value-added ratio for U.S. manufacturing ($93,000). Only three major industries exceeded the motor vehicle industry's level of productivity (tobacco products, petroleum and coal products, and chemicals and allied products). All three of these industries employed far fewer workers in 1996 and had far higher levels of capital investment per worker.

Figure 1.11

1996 Value Added per Employee
($ thousands 1996)



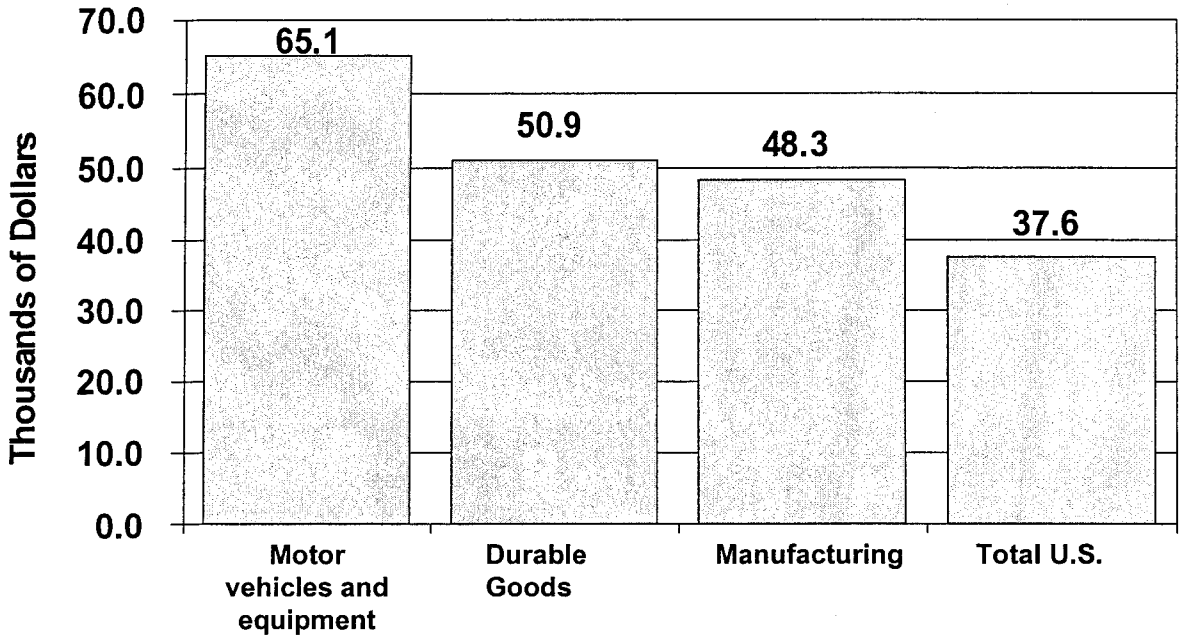
Source: U.S. Census Bureau, 1999 Statistical Abstract of the United States, p. 748.

High levels of automotive productivity are suggested by high relative levels of compensation (wages plus benefits) paid to employees within the industry. The average compensation received by employees in SIC 371 in 1998 was $65,100. As shown in figure 1.12, this compares favorably with the average compensation received by employees in all of durable goods manufacturing ($50,900), and with total U.S. manufacturing ($48,300). In fact, the average compensation per employee nationwide in 1998 only reached $37,600. The average job in the automotive manufacturing sector was compensated at a level 73 percent higher than the average U.S. job. As will be seen below, the average compensation at motor vehicle firms was even higher relative to the U.S. average (figure 1.16).

The U.S. automotive industry has also contributed to the nation's rising export activity in recent years. As shown in figure 1.13, exports of light-duty vehicles increased by 37 percent, from 970,000 units in 1989 to 1.33 million vehicles in 1998. As shown in figure 1.14, total dollar exports of vehicles and parts may have increased by a larger percentage. Measured in current dollars, U.S. exports of vehicles and automotive parts rose from $33.4 billion in 1988 to a record $74 billion in 1997, an increase of 122 percent. In 1998, automotive exports represented 12 percent of total U.S. exports of nonagricultural products.

Figure 1.12

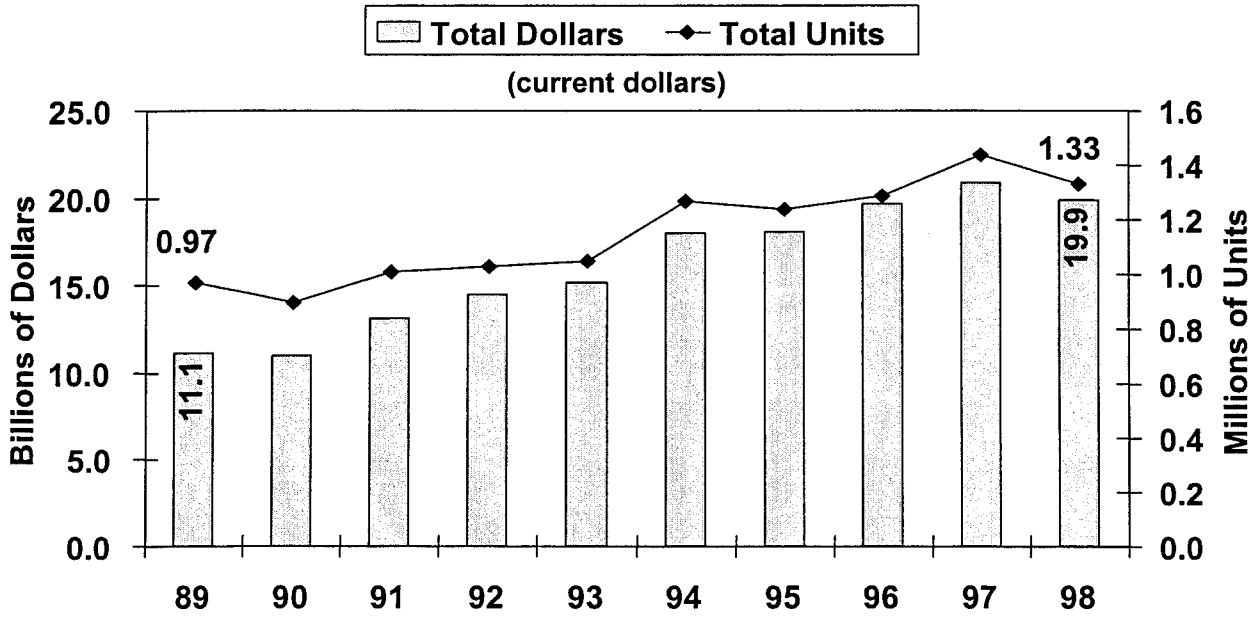
1998 Compensation per Full and Part-time Employee for U.S. Economic Sectors



Source: USDOC, BEA. <http://www.bea.doc.gov/bea/dn/nipaweb/PopularTables.osp> Table 2.1, Personal Income and Its Disposition.

Figure 1.13

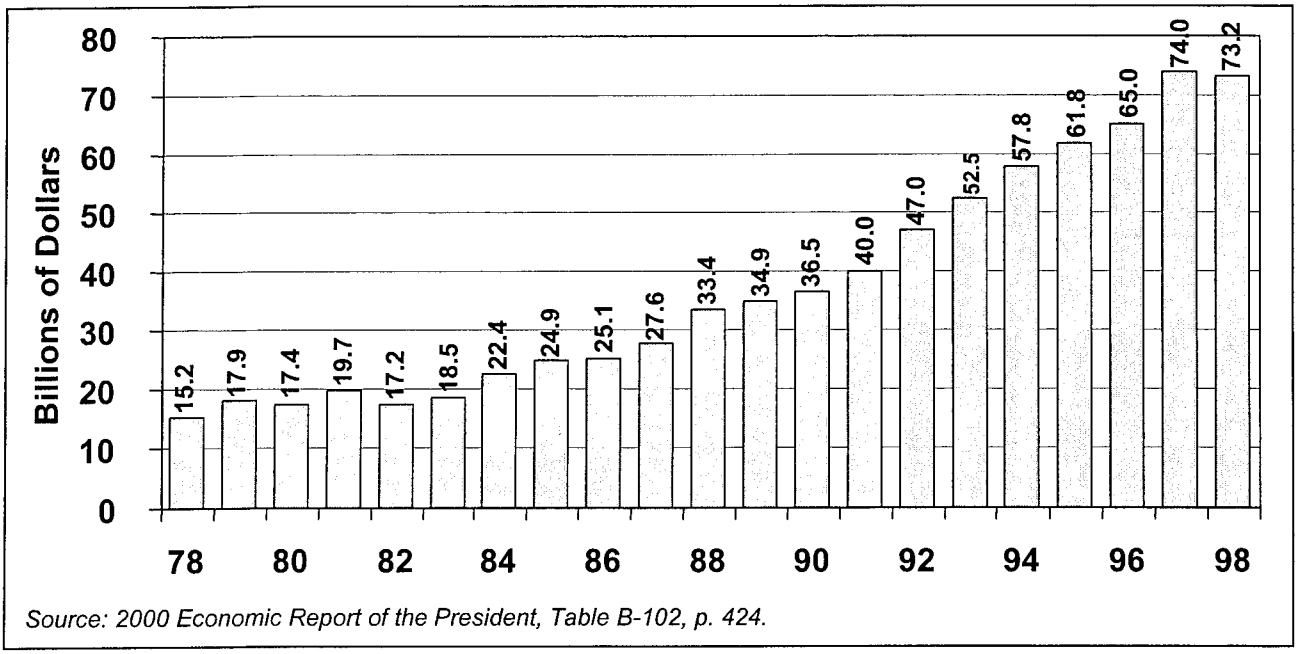
New Car and Light Truck Exports 1989-1998



Source: USDOC, BEA, Office of Automotive Affairs. <http://www.ita.doc.gov/td/auto/indata199.html> Table: U.S. Exports to the World of Selected Road Motor Vehicles.

Figure 1.14

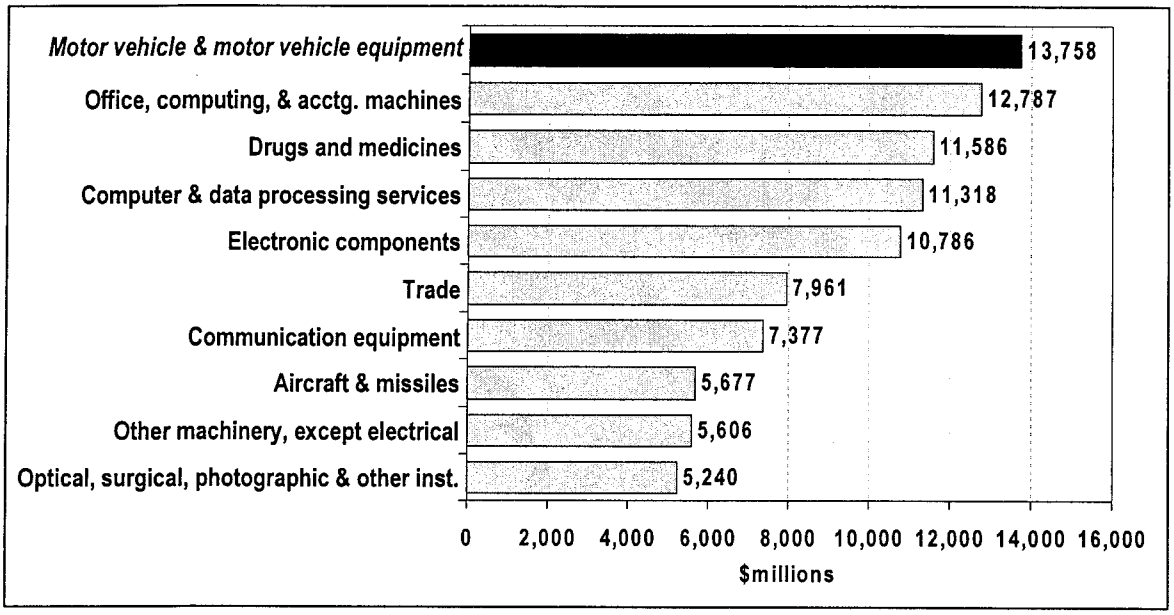
U.S. Exports of Motor Vehicles and Parts to All Countries 1978-1999



Source: 2000 Economic Report of the President, Table B-102, p. 424.

Finally, the automotive industry has traditionally ranked at or very near the top among all U.S. industries in terms of R&D expenditures. The National Science Foundation (NSF) recently ranked the 39 largest "3-digit" industry groups in terms of 1997 industrial R&D spending in the United States. As shown in figure 1.15, the motor vehicle and motor vehicle equipment manufacturing industry group (SIC 371) ranked first by a considerable margin over manufacturing industries such as computer equipment, drugs and medicines, and even the large computer services industry. In a separate analysis of 10-K statements of Fortune 500 firms for 1997, the NSF tabulated total R&D spending for the automotive industry at about $18.4 billion. The high level of automotive R&D spending and the relatively high employment of research scientists and engineers in the U.S. auto industry has traditionally earned it a place in any U.S. government listing of high technology industries generally thought to be central to the long-term performance of the U.S. economy.

Figure 1.15
R&D Spending by Industry, 1997
Motor Vehicle Industry Is First of 39 Major U.S. Industry Groups



Source: National Science Foundation/SRS, Survey of Industrial Research and Development, 1997.

1.3 Survey Results of Motor Vehicle Firms

The economic model used by the Institute of Labor and Industrial Relations (ILIR), University of Michigan, to generate the economic contribution estimates presented in the second part of this study required direct information from automotive firms on their employment and payroll for the fifty states and the District of Columbia. The Office for the Study of Automotive Transportation (OSAT) and ILIR developed a questionnaire for collecting state-level automotive employment and payroll data from twenty-one automotive firms that sell new light vehicles in the United States. Similar information for new light vehicle dealerships was available from a major publication of the National Automobile Dealers Association (reproduced in appendix A).

The survey was carried out in partnership with DesRosiers Automotive Consultants Inc. DesRosiers surveyed the International Original Equipment Manufacturers (OEMs) operating in the United States. OSAT was responsible for collecting data from DaimlerChrysler, Ford Motor Company, General Motors Corporation, and Mazda of America, as well as for editing and additional follow-up to complete the data collection from all of the firms.

The questionnaire collected salaried and hourly employment and payroll by state. The salaried category was broken out into finance and lending, and other salaried employees. The hourly category was broken out into vehicle assembly, metal stamping, powertrain component production, other automotive parts and components, service parts, and warehousing, and other hourly employees. This detail by activity improved the accuracy of the ILIR modeling effort.

Data collection began in January 2000 and was completed in mid-May. The response rate to the survey was 100 percent, with all twenty-one firms participating. The responding firms were Audi, BMW, DaimlerChrysler, Fiat, Ford, General Motors, Honda, Hyundai, Isuzu, Mazda, Mercedes, Mitsubishi, Nissan, Porsche, Renault, Saab, Subaru, Subaru of America, Toyota, Volkswagen, and Volvo.

All data used in the study were collected for 1998. Although in some cases more recent data were available from the participating firms, the most recent government information required for various analyses as well as for the economic model was available only for 1998.

In 1998, the U.S. auto industry directly employed 621,255 workers. Total payroll for the industry was $41.7 billion. As shown in table 1.1, salaried workers made up 31 percent of total employment and received 36 percent of the total payroll disbursed by the twenty-one firms. The table also shows a breakout of salaried and hourly employment and payroll by activity. Salaried employment is split into two categories, finance and lending and an "other salaried" category. Hourly employment is broken out into six categories, the largest being assembly (30 percent of total employment), parts and component manufacturing (16 percent), and powertrain manufacturing (11 percent).

Table 1.1
1998 U.S. Direct Employment and Payroll at Automotive Firms

National activity	Employment	% of total	Total payroll ($ millions)	% of total
Finance and lending	36,500	5.9	1,858	4.5
Other salaried	155,523	25.0	13,174	31.6
Salaried total	192,023	30.9	15,031	36.0
Assembly	185,468	29.9	11,077	26.5
Metal stamping	42,600	6.9	2,849	6.8
Powertrain	66,401	10.7	4.453	10.7
Components	99,811	16.1	6,551	15.7
Service parts and warehousing	15,836	2.5	941	2.3
Other hourly	19,116	3.1	832	2.0
Hourly total	429,232	69.1	26,703	64.0
National total	621,255	100.0	41,735	100.0

Source: Company surveys

The U.S. auto industry provides direct employment in every state, from fifteen employees in South Dakota to 260,444 in Michigan (see appendix B for a complete list of direct employment and payroll). A breakout of direct industry employment and payroll by U.S. Bureau of Census regions, presented in table 1.2, shows a strong concentration of direct employment and payroll in certain regions. Automotive employment and payroll are heavily concentrated in the East North Central region (Illinois, Indiana, Michigan, Ohio, and Wisconsin). This region accounts for 69 percent of the nation's direct automotive employment and 71 percent of the associated payroll. In fact, two states, Michigan and Ohio, dominate this automotive region in terms of direct industry employment, with almost 60 percent of the national total. Four other U.S. regions each account for 5 to 7 percent of the industry's direct employment. The two regions with the lowest automotive employment are the Mountain states and the New England states.

Table 1.2

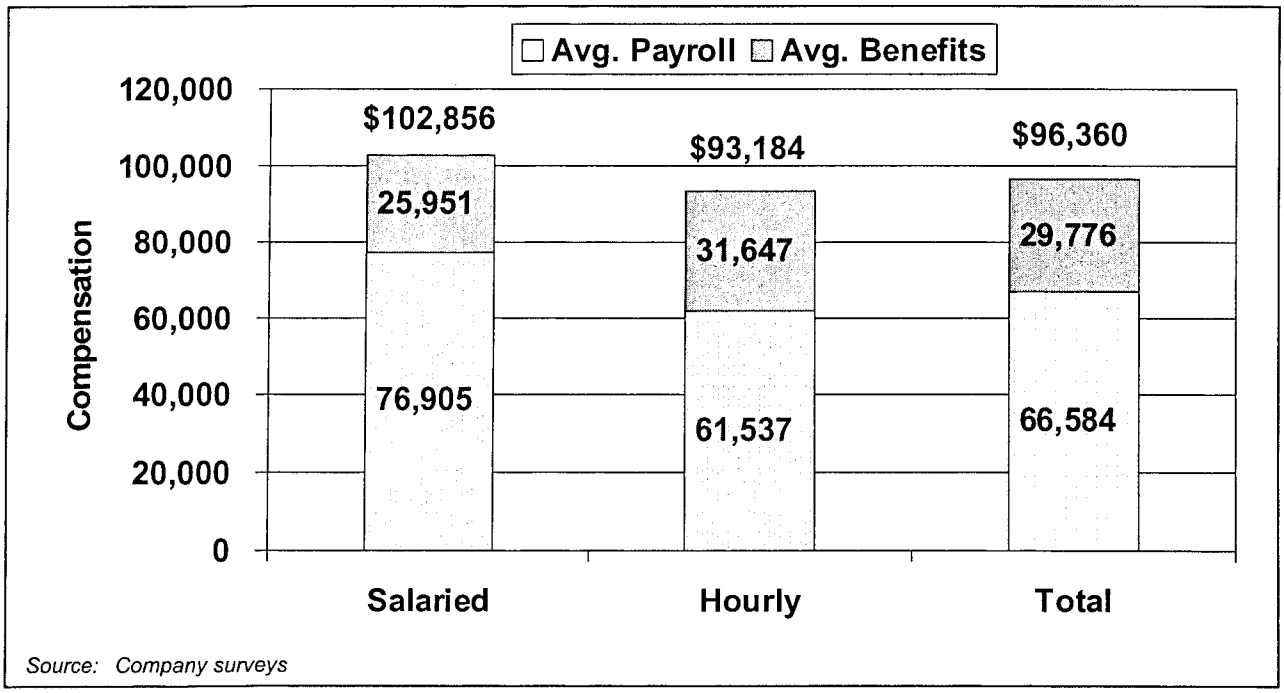
1998 Direct Automotive Employment by Census Region

Census region	Employment	Employment share	Payroll ($ millions US)	Payroll share (%)
East North Central	427,864	68.9	29,571	70.9
East South Central	46,759	7.5	3,047	7.3
Middle Atlantic	36,590	5.9	2,713	6.5
Mountain	3,284	0.5	191	0.5
New England	2,361	0.4	135	0.3
Pacific	24,615	4.0	1,434	3.4
South Atlantic	32,806	5.3	1,981	4.7
West North Central	30,930	5.0	1,743	4.2
West South Central	16,046	2.6	918	2.2
Total	621,255	100.0	41,735	100.0

Source: Company surveys

Other ancillary data were collected by OSAT as part of the industry survey. For example, in addition to payroll totals, the costs of benefits in 1998 were collected from the individual firms. Total compensation is the sum of earnings, other payments to employees, and the costs of all benefits. Total payroll and compensation disbursed by the twenty-one automotive firms in 1998 summed to $18.5 billion. As shown in figure 1.16, average compensation per employee for these firms was $96,360 in 1998. Salaried workers averaged $102,856 and hourly workers averaged $93,184 for that year. The industry averages for employee compensation compare very favorably with 1998 levels in the U.S. private sector of $37,600 per employee, and with U.S. manufacturing compensation of $48,300 per employee.

Figure 1.16
1998 Automotive Compensation per Employee



Source: Company surveys

1.4 SUMMARY

The overview to this study has investigated a number of well-known measures of the contribution of the automotive industry to the U.S. economy. We have shown the U.S. industry to be the largest automotive industry in the world. It is an industry that has matched its peak historical employment and maintained its share of GDP. In recent years, the industry has contributed to lower rates of U.S. inflation and unemployment, and to rising U.S. exports. Finally, the industry ranks among the top industries in the nation in terms of R&D spending and the compensation of employees. Yet this overview does not fully cover the widespread linkages the automotive industry maintains with many other large manufacturing and service industries in the United States. A full accounting of the presence of the automotive industry in the economy must estimate the industry's creation of jobs and income throughout the U.S. economy. This involves the estimation of jobs and income created in the production of commodities and services supplied to the industry by other industries; and jobs and income created as a result of spending by industry employees on products and services produced by other industries. This estimation is presented in part 2 of this study.

PART 2

ESTIMATES OF THE ECONOMIC CONTRIBUTION OF THE AUTOMOTIVE INDUSTRY TO THE UNITED STATES AND ITS FIFTY STATES IN 1998

2.1 INTRODUCTION

The statistics in part 1 of this report confirm the continued importance of the automotive industry to the health of the U.S. economy. Significant as they are, however, these statistics still understate the contribution of the industry, since they refer only tangentially to new motor vehicle dealer retail activities, and they focus on direct activity in manufacturing, ignoring spin-off activities related to automotive production. Spin-off activities come from two sources: indirect effects, or purchases from domestic suppliers (for example, steel); and expenditure-induced effects, or spending by people who receive income attributable to automotive industry activity (for example, realtors who sell homes to auto workers). It is the sum of these direct and spin-off activities that determines the total contribution of the automotive industry to the domestic economy. Therefore, our study includes the effects of new motor vehicle dealer retail activities and spin-off activities.

The purpose of part 2 of this report is to provide the most thorough and up-to-date estimates available of the economic contribution associated with the automotive industry in the United States. There have been a few attempts in the past to estimate the contribution of the industry, but they differ from the current study in a few critical aspects. First, previous studies tend to be dated, not capturing the more contemporary technological and purchasing relationships among sectors. Second, some of the studies define the direct industry too broadly, thus making the results less defensible. Third, the current study has the advantage of considerably more powerful economic modeling capabilities and the richest data set ever assembled on the industry; as a result, we had a more complete set of factors to incorporate into the analysis. Finally, the current study provides information on the regional distribution of the industry's contribution to the domestic economy, including estimates for each of the fifty states and the District of Columbia.

The following section of the report summarizes our estimates of the contribution of the automotive industry to the regional economies of the United States. More details on the methods of the study, including the macroeconomic model, data, and research procedures, are consolidated in section 2.3. Section 2.4 contains an overview of the model used to generate the results.

2.2 RESULTS

The tables in this section show our estimates of the economic contribution associated with the automotive industry in the United States. The estimates include both direct employment and payroll, and the spin-off jobs and compensation that result from the industry's direct activity. Data on direct employment and compensation for the manufacturing component of the industry are from the survey of twenty-one participating automotive firms described in part 1. Similar information for new light vehicle dealerships is from the National Automobile Dealers Association. The results are presented in three parts: the contributions of automotive manufacturing, those associated with new vehicle retail activities, and a combination of the two to represent the total automotive industry.

2.2.1 CONTRIBUTION OF AUTOMOTIVE MANUFACTURING

Summary estimates of the employment and income contributions of automotive manufacturing to the private sector of the U.S. economy for 1998 are shown in table 2.1.[2] Both blue-collar and white-collar workers employed by the manufacturing firms are included in the direct effect. According to the data compiled from the survey of motor vehicle firms (reported in appendix B), 621,255 workers were employed in automotive manufacturing nationwide in 1998. This is shown as direct employment in table 2.1. (All of the estimates reported in this section are rounded to the nearest hundred workers. Thus, the number of direct employees in auto manufacturing is represented herein as 621,300). Indirect employment from these automotive manufacturing activities (i.e., automotive suppliers) is estimated to be 1,796,000 jobs. The sum of direct and indirect jobs equals 2,417,300 private sector jobs. The resulting number of jobs created (direct plus indirect) for every direct job introduced constitutes the "employment multiplier." In this case, the employment multiplier is 3.9. This employment multiplier can be interpreted in two ways: (1) there are 3.9 times as many jobs generated as there are direct jobs (2,417,300 ÷ 621,300 = 3.9), or (2) there are 2.9 indirect jobs generated for every direct job (1 direct job + 2.9 indirect jobs = 3.9 jobs).

---

[2]The following definitions will assist in interpreting the tables: Employment represents the total number of private sector jobs, including the self-employed. All of the employment numbers in the tables have been rounded to the nearest hundred. Compensation in the private sector consists of wage and salary disbursements, fringe benefits, and net incomes of owners of unincorporated businesses. We selected 1998 because it was the most recent year for which all primary and secondary data were available.

The contribution of automotive manufacturing to compensation in the private sector (calculated as the direct plus indirect effects) is estimated to be about $111 billion, measured in 1998 dollars. This estimate of compensation is prior to deductions for personal income taxes and contributions to social insurance programs, and does not include transfer payments.

To put the employment and compensation contributions in some context, these contributions are represented in table 2.1 as a share of the total private sector economy for the United States. The economic contribution of direct and indirect automotive manufacturing activities in 1998 represents 1.8 percent of the private sector jobs and 2.6 percent of the private sector compensation in the U.S. economy. The compensation share is greater than the employment share because compensation in the auto industry is higher on average than in other industries.

In the bottom panel of table 2.1, we show the total spin-off effect, which includes the expenditure-induced effect in addition to the indirect effect. Our estimate of the expenditure-induced effect is 2,290,700 jobs which, when added to the 2,417,300 direct plus indirect jobs, equals 4,708,000 total jobs. The corresponding employment multiplier equals 7.6 (4,708,000 total jobs ÷ 621,300 direct jobs). The corresponding contribution to compensation in the private sector is approximately $177 billion, measured in 1998 dollars. These contributions represent 3.5 percent of the private sector jobs and 4.1 percent of the private sector compensation in the U.S. economy.

As mentioned earlier, the estimate of compensation is prior to deductions for personal income taxes and contributions to social insurance programs, and does not include transfer payments. As shown in the bottom panel of table 2.1, a reduction in transfer payments of over $15 billion is associated with automotive manufacturing activity in 1998, and personal income tax revenues are increased by over $30 billion. The implication for disposable personal income, or personal income after taxes and including transfers, is an increase of over $119 billion in the domestic economy for 1998.[3]

---

[3]Because of the procedures used to isolate the indirect effects from the total effects, this detail on compensation can be provided only for the results that include the expenditure-induced effects.

Table 2.1

Summary

Private Sector Contributions of Automotive Manufacturing in the United States, 1998

Activities excluding expenditure-induced effect	
Employment	
Direct	621,300
Indirect	1,796,000
Total (direct + indirect)	2,417,300
Multiplier	3.9
Compensation ($billions US)	111.22
Contributions as a % of total U.S. economy	
Employment	1.8
Compensation	2.6
Activities including expenditure-induced effect	
Employment	
Expenditure-induced	2,290,700
Total (direct + indirect + expenditure-induced)	4,708,000
Multiplier	7.6
Compensation ($billions US)	176.99
Plus: transfer payments	-15.28
Less: social insurance contributions	12.21
Less: personal income taxes	30.34
Equals: Private disposable personal income	119.16
Contributions as a % of total U.S. economy	
Employment	3.5
Compensation	4.1

NOTE: Values for employment are rounded to the nearest hundred workers.

In summary, the employment contribution currently associated with automotive manufacturing activity in the United States is estimated to be about 2.4 million jobs in the private sector attributable to the industry directly and its suppliers, and 4.7 million when all spin-off effects are included. The compensation contribution is estimated to be about $111 billion attributable to the industry directly and its suppliers, and $177 billion when all spin-off effects are included.

The automotive manufacturing contribution to employment is distributed across major industry divisions, as shown in table 2.2. The employment contribution is shown for both indirect and expenditure-induced effects; direct employment is 621,300 jobs. (This number includes some auto company jobs that are traditionally classified as indirect; adjustments were made to avoid double-counting jobs.)

Table 2.2

Private Sector Contributions of Automotive Manufacturing by Industry in the United States, 1998

Industry division (SIC code)	Indirect	Expenditure-induced	Total spin-off
Manufacturing	724,900	272,300	997,200
Durable goods	488,300	146,100	634,400
Primary metals (33)	59,100	7,100	66,200
Fabricated metals (34)	181,100	18,700	199,800
Machinery and computers (35)	78,500	32,500	111,000
Electrical equipment (36)	59,400	18,300	77,700
Other durable goods	110,200	69,500	179,700
Nondurable goods	236,600	126,200	362,800
Apparel (23)	34,400	18,400	52,800
Printing and publishing (27)	40,600	26,200	66,800
Plastics products (30)	95,200	13,600	108,800
Other nondurable goods	66,400	68,000	134,400
Private nonmanufacturing	1,071,100	2,018,400	3,089,500
Construction (15-17)	91,300	65,200	156,500
Trucking (42)	70,700	34,200	104,900
Credit and finance (61, 62, 67)	16,700	44,600	61,300
Wholesale trade (50-51)	226,300	103,500	329,800
Retail trade (52-59)	109,100	642,900	752,000
Services (70-89)	427,100	871,500	1,298,600
Business services (73)	208,700	167,100	375,800
Professional services (81, 87, 89)	101,300	108,500	209,800
Nonprofit services (83, 84, 86)	9,000	148,800	157,800
Other private nonmanufacturing	129,900	256,500	386,400
Total private nonfarm employment	1,796,000	2,290,700	4,086,700
Total direct + indirect = 2,417,300			
Total direct + indirect + expenditure-induced = 4,708,000			

As shown in table 2.2, there are 2.9 supplier jobs for every direct automotive manufacturing job (1,796,000 ÷ 621,300). There are 3.7 expenditure-induced jobs for every direct job (2,290,700 ÷ 621,300). This indicates that automotive manufacturing jobs are leveraged into a much higher proportion of spin-off jobs; specifically, 6.6 spin-off jobs per direct job (2.9 supplier jobs + 3.7 expenditure-induced jobs), yielding the relatively large multiplier of 7.6 in table 2.1.

As might be expected, the majority of the supplier jobs are in the manufacturing sector. Within durable manufacturing, major auto suppliers are: fabricated metals (e.g., automotive stampings), machinery and computers (e.g., investment in machinery and equipment), electrical equipment (e.g., semiconductors, batteries, equipment for internal combustion engines), and primary metals (e.g., steel mills, foundries). Within nondurable manufacturing, key suppliers are: plastics (e.g., exterior and interior trim), and apparel (e.g., automotive fabric). What is less well known is the high level of indirect employment in the private nonmanufacturing sector that is linked to automotive manufacturing. Activities such as business and professional services, wholesale trade, trucking, and finance are more linked to the supplier network for automotive manufacturing than is often recognized. The industrial sector, in this sense, extends well beyond the official designations for manufacturing activity.

Most of the expenditure-induced activity is in the private nonmanufacturing sector, particularly in industries such as services and retail trade, due to household purchasing activity.

A major objective of this study was to break out the economic contribution into sub-regions of the country. We have generated estimates consistent with the national results for all fifty states and the District of Columbia.[4] To provide an initial and broader summary of these results, we have also combined our state estimates into the nine official census regions of the United States. The composition of the regions by state is mapped in figure 2.1 and enumerated in table 2.3.

[4]In fact, our estimates are generated by a "bottom-up" process, in which estimates for each state are summed to derive the results for the nation. More detail is provided in the Methods section.

Figure 2.1

Census Regions of the United States

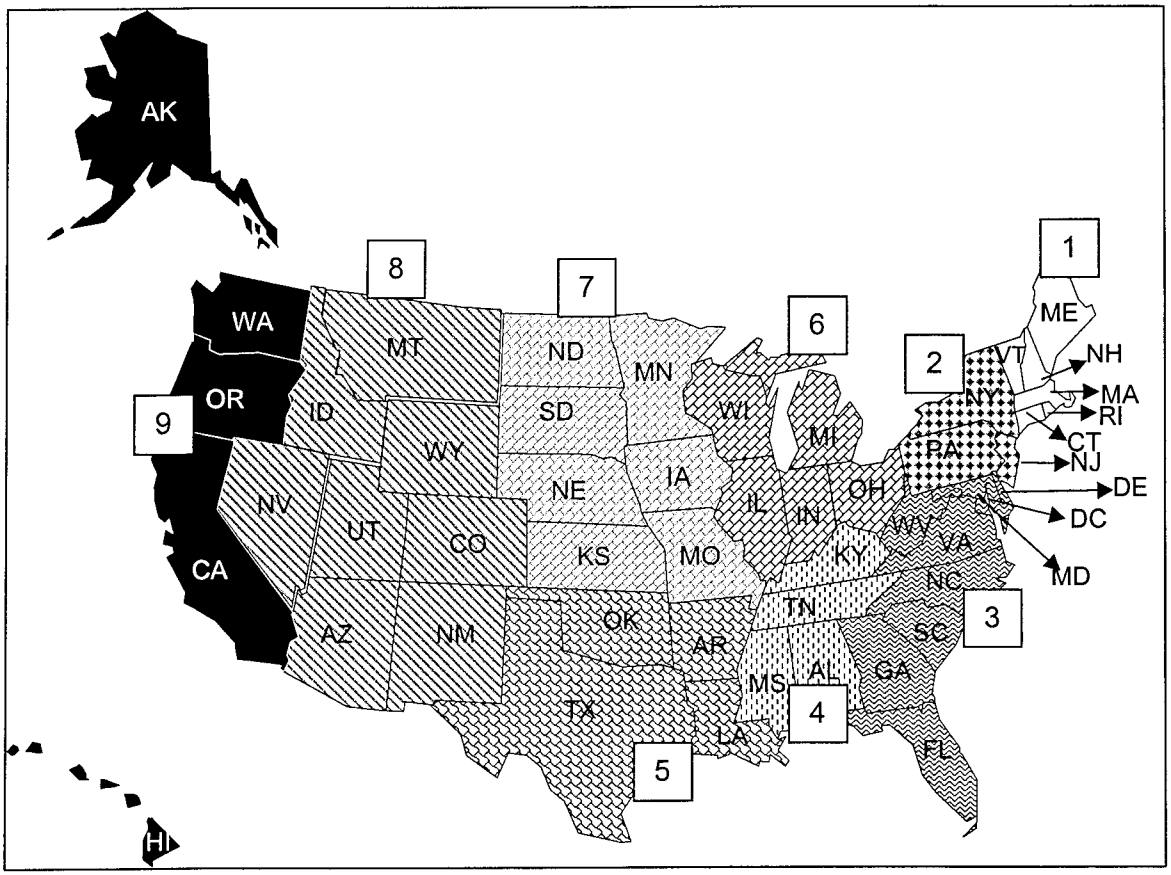


Table 2.3

Census Regions of the United States

1	New England	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
2	Middle Atlantic	New Jersey, New York, Pennsylvania
3	South Atlantic	Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia
4	East South Central	Alabama, Kentucky, Mississippi, Tennessee
5	West South Central	Arkansas, Louisiana, Oklahoma, Texas
6	East North Central	Illinois, Indiana, Michigan, Ohio, Wisconsin
7	West North Central	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
8	Mountain	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming
9	Pacific	Alaska, California, Hawaii, Oregon, Washington

The distribution across census regions is shown in table 2.4. The distribution of the 2,417,300 jobs and $111 billion in compensation contributed nationwide by direct and indirect activities associated with automotive manufacturing is shown in the top panel of the table. The contributions range from a high of 1,147,000 jobs and $58.0 billion in compensation for the East North Central region to a low of 57,700 jobs and $2 billion in compensation for the Mountain region.

In the bottom panel of table 2.4, we show the distribution of direct and total spin-off activities, which includes the expenditure-induced effect in addition to the indirect effect. When the expenditure-induced effect is added, the total contributions are 4,708,000 jobs and $177 billion in compensation. The distribution ranges from a high of 2,016,700 jobs and $81.3 billion in compensation for the East North Central region to a low of 154,400 jobs and $4.6 billion in compensation for the Mountain region.

Table 2.4
Private Sector Contributions of Automotive Manufacturing by U.S. Census Region, 1998

Census Region	Employment	Share of Region's Employment (%)	Compensation ($billions US)
Activities excluding expenditure-induced effect			
East North Central	1,147,000	5.060	58.00
East South Central	244,000	3.190	9.73
Middle Atlantic	193,500	1.056	9.42
Mountain	57,700	0.676	2.05
New England	66,100	0.892	2.96
Pacific	132,000	0.626	6.00
South Atlantic	252,900	1.070	10.05
West North Central	196,400	1.964	7.79
West South Central	127,700	0.905	5.22
Total United States	2,417,300	1.8	111.22
Activities including expenditure-induced effect			
East North Central	2,016,700	8.879	81.33
East South Central	427,500	5.591	14.29
Middle Atlantic	424,400	2.312	18.01
Mountain	154,400	1.806	4.63
New England	161,500	2.167	6.15
Pacific	326,900	1.556	12.28
South Atlantic	526,500	2.216	17.79
West North Central	377,800	3.751	12.51
West South Central	292,300	2.078	10.00
Total United States	4,708,000	3.5	176.99

NOTE: Values for employment are rounded to the nearest hundred workers.

Two general observations can be made on these regional results. First, the concentration of auto-related employment and compensation in the East North Central region is striking: 43 percent of the jobs and 46 percent of the compensation nationwide (including total spin-off) reside in these five states. The industry is important to the health of the national economy, but it is life-sustaining to the health of this regional economy. The next largest concentrations of activity are in the South Atlantic, East South Central, and Middle Atlantic regions. The sparsest concentrations are generally in the western parts of the country. In terms of auto share within a region, the East North Central region and the East South Central region both have a substantial proportion of their employment associated with auto manufacturing activities.

The second observation is that despite the regional concentration of activity, the industry contributes significantly to regions with little if any direct automotive manufacturing activity because spin-off employment is generated by direct automotive employment in other regions. Our economic model is sufficiently sophisticated to capture these interregional trade flows.

Estimates of automotive manufacturing's contributions to each of the fifty states and the District of Columbia are shown in table 2.5. For each state, the employment contributions are segmented into direct, indirect, and expenditure-induced effects. Estimates of total employment and compensation are presented, both including and excluding the expenditure-induced effect.

The employment contributions among states range from a high of 534,800 jobs in Michigan to a low of 1,500 jobs in Alaska (918,600 in Michigan and 4,600 in both Alaska and Wyoming when expenditure-induced effects are included). As a share of total state employment, the employment contributions associated with automotive manufacturing are again highest in Michigan, at 11.2 percent, and are lowest in Florida, at 0.4 percent (19.3 percent in Michigan and 1.0 percent in Florida, including total spin-off effects). A number of states have high shares of employment related to automotive activity, such as Ohio, Kentucky, and Indiana. Less obvious is that, due to trade with other states, there are states with relatively little direct automotive manufacturing activity that nevertheless have a considerable share of auto-related employment (e.g., New Hampshire, Arkansas, and Iowa). The contribution of automotive manufacturing to compensation in Michigan is $31.2 billion ($41.4 billion including expenditure-induced effects). From there, compensation contributions range down to $0.06 billion in Wyoming ($0.13 billion including expenditure-induced effects).

Table 2.5

Private Sector Contributions of Automotive Manufacturing by State, 1998

State	Direct employment	Indirect employment	Total (direct + indirect)			Expenditure-induced employment	Total (direct + indirect + expenditure-induced)		
			Employment	As a % of state	Compensation ($billions US)		Employment	As a % of state	Compensation ($billions US)
Alabama	9,000	29,100	38,100	1.990	1.43	31,500	69,600	3.638	2.22
Alaska	0	1,500	1,500	0.502	0.06	3,100	4,600	1.553	0.15
Arizona	1,300	13,419	14,700	0.673	0.55	22,200	36,900	1.689	1.14
Arkansas	100	15,700	15,800	1.342	0.48	15,600	31,400	2.659	0.84
California	23,000	79,500	102,500	0.650	4.82	147,100	249,600	1.596	9.69
Colorado	1,200	13,600	14,800	0.650	0.58	26,800	41,600	1.813	1.37
Connecticut	600	17,400	18,000	0.997	0.93	24,000	42,000	2.325	1.86
Delaware	5,900	8,800	14,700	3.684	0.77	9,100	23,800	5.967	1.04
D.C.	100	3,200	3,300	0.719	0.20	6,900	10,200	2.222	0.53
Florida	2,700	24,600	27,300	0.398	0.97	44,500	71,800	1.026	2.18
Georgia	10,200	53,400	63,600	1.669	2.64	63,800	127,400	3.366	4.51
Hawaii	100	2,600	2,700	0.473	0.09	6,600	9,300	1.622	0.27
Idaho	0	4,000	4,000	0.686	0.13	6,000	10,000	1.707	0.27
Illinois	14,600	97,400	112,000	1.792	5.20	112,400	224,400	3.596	8.90
Indiana	44,700	81,200	125,900	4.119	5.24	90,800	216,700	7.058	7.48
Iowa	1,500	19,600	21,100	1.418	0.74	22,500	43,600	2.879	1.29
Kansas	4,700	18,600	23,300	1.745	0.94	23,700	47,000	3.488	1.53
Kentucky	18,300	68,000	86,300	4.876	3.49	54,700	141,000	7.972	4.76
Louisiana	3,800	15,000	18,800	0.996	0.75	22,200	41,000	2.187	1.35
Maine	100	4,600	4,700	0.742	0.15	7,200	11,900	1.854	0.31
Maryland	4,200	19,800	24,000	0.993	1.02	25,900	49,900	2.061	1.80
Massachusetts	1,400	26,500	27,900	0.799	1.30	44,600	72,500	2.063	2.88
Michigan	260,400	274,400	534,800	11.247	31.22	383,800	918,600	19.320	41.39
Minnesota	3,950	29,350	33,300	1.224	1.38	40,000	73,300	2.690	2.54
Mississippi	2,400	13,100	15,500	1.364	0.45	16,100	31,600	2.804	0.82
Missouri	20,300	82,900	103,200	3.674	4.25	75,100	178,300	6.322	6.21
Montana	0	2,500	2,500	0.590	0.07	4,100	6,600	1.530	0.15
Nebraska	400	8,900	9,300	1.013	0.30	11,700	21,000	2.264	0.59
Nevada	500	6,400	6,900	0.699	0.24	14,400	21,300	2.151	0.67
New Hampshire	200	7,200	7,400	1.122	0.29	9,200	16,600	2.497	0.55
New Jersey	10,800	41,700	52,500	1.342	2.70	53,700	106,200	2.706	4.72
New Mexico	100	3,800	3,900	0.537	0.12	6,900	10,800	1.487	0.28
New York	20,400	57,100	77,500	0.904	4.01	103,400	180,900	2.123	8.34
North Carolina	2,700	43,600	46,300	1.194	1.64	49,700	96,000	2.474	2.98
North Dakota	0	2,700	2,700	0.814	0.08	3,600	6,300	1.876	0.15
Ohio	98,400	215,700	314,100	5.425	13.93	227,100	541,200	9.319	19.72
Oklahoma	4,500	22,600	27,100	1.810	1.01	24,000	51,100	3.385	1.58
Oregon	900	11,000	11,900	0.705	0.46	16,300	28,200	1.652	0.91
Pennsylvania	5,400	58,100	63,500	1.086	2.71	73,800	137,300	2.323	4.95
Rhode Island	0	4,800	4,800	0.980	0.18	5,900	10,700	2.159	0.34
South Carolina	2,450	29,150	31,600	1.764	1.13	28,500	60,100	3.355	1.81
South Dakota	0	3,500	3,500	0.887	0.10	4,800	8,300	2.070	0.20
Tennessee	17,100	87,000	104,100	3.681	4.36	81,200	185,300	6.530	6.49
Texas	7,600	58,400	66,000	0.691	2.98	102,800	168,800	1.777	6.23
Utah	100	9,100	9,200	0.826	0.30	13,400	22,600	2.065	0.62
Vermont	0	3,300	3,300	1.008	0.11	4,500	7,800	2.363	0.21
Virginia	3,500	30,100	33,600	1.014	1.37	36,600	70,200	2.113	2.42
Washington	600	12,800	13,400	0.482	0.57	21,800	35,200	1.259	1.26
West Virginia	1,200	7,300	8,500	1.227	0.31	8,600	17,100	2.443	0.52
Wisconsin	9,700	50,500	60,200	2.138	2.41	55,600	115,800	4.076	3.84
Wyoming	0	1,700	1,700	0.703	0.06	2,900	4,600	1.889	0.13
Total U.S.	**621,300**	**1,796,000**	**2,417,300**	**1.8**	**111.22**	**2,290,700**	**4,708,000**	**3.5**	**176.99**

NOTE: Values for employment are rounded to the nearest hundred workers.

The same two general observations on table 2.4 are pertinent for table 2.5. First, the activity is concentrated in those states with significant direct employment, as is evident from scanning the table. The eleven states with direct employment in excess of 10,000 jobs contribute 65 percent of the total employment and 69 percent of the total compensation associated with automotive manufacturing. Second, in most states the contributions are again in excess of what may be expected by considering only the direct effects, because of the influence of activity in other states.

2.2.2 Contribution of New Vehicle Dealers

Little analysis exists to date on the economic contribution of dealer activity. Summary estimates of the employment and income contributions of new vehicle dealers to the U.S. private sector economy for 1998 are shown in table 2.6. The new vehicle share of sales and parts and service has been isolated from total dealer activity obtained from the National Automobile Dealers Association (NADA) (see appendix A) to provide estimates of new-vehicle-related employment and payroll. In other words, we have excluded from the direct dealer effect the activity associated with the sale of previously owned vehicles and non-warranty repair work.[5] Our estimates constitute the direct effect, amounting to 717,400 jobs (out of 1,062,800 total dealer jobs identified by NADA), as shown in table 2.6.

Indirect employment from the new vehicle dealer activities is estimated to be 366,200 jobs. Thus, the sum of direct and indirect jobs equals 1,083,600 private sector jobs (717,400 direct jobs + 366,200 indirect jobs). The resulting employment multiplier is 1.5; that is, there are 1.5 times as many jobs generated as there are direct jobs (1,083,600 ÷ 717,400 = 1.5). The employment multiplier for dealer activity is considerably lower than the multiplier for manufacturing activity because the supplier chain is not as extensive for dealers, and employee compensation for expenditures is not as high on average.

The contribution of new vehicle dealers to compensation in the private sector (calculated as the direct plus indirect effects) is estimated to be about $41 billion, measured in 1998 dollars. The economic contribution of direct and indirect new vehicle dealer activities in

---

[5]To a much lesser degree, a comparable adjustment is appropriate for automotive manufacturing, but no information is currently available to make this adjustment adequately.

1998 represents 0.8 percent of the private sector jobs and 1.0 percent of the private sector compensation in the U.S. economy.

Table 2.6

Summary

Private Sector Contributions of New Vehicle Dealers (Retail) in the United States, 1998

Activities excluding expenditure-induced effect	
Employment	
Direct	717,400
Indirect	366,200
Total (direct + indirect)	1,083,600
Multiplier	1.5
Compensation ($billions US)	41.08
Contributions as a % of total U.S. economy	
Employment	0.8
Compensation	1.0
Activities including expenditure-induced effect	
Employment	
Expenditure-induced	843,000
Total (direct + indirect + expenditure-induced)	1,926,600
Multiplier	2.7
Compensation ($billions US)	65.83
Plus: transfer payments	-6.34
Less: social insurance contributions	4.70
Less: personal income taxes	11.12
Equals: Private disposable personal income	43.67
Contributions as a % of total U.S. economy	
Employment	1.4
Compensation	1.5

NOTE: Values for employment are rounded to the nearest hundred workers.

In the bottom panel of table 2.6, we show the total spin-off effect, which includes the expenditure-induced effect in addition to the indirect effect. Our estimate of the expenditure-induced effect is 843,000 jobs which, when added to the 1,083,600 direct plus indirect jobs,

equals 1,926,600 total jobs. The corresponding employment multiplier equals 2.7 (1,926,600 ÷ 717,400). The corresponding contribution to compensation in the private sector is approximately $66 billion, measured in 1998 dollars. These contributions represent 1.4 percent of the private sector jobs and 1.5 percent of the private sector compensation in the U.S. economy.

The estimate of compensation is prior to deductions for personal income taxes and contributions to social insurance programs, and does not include transfer payments. As shown in the bottom panel of table 2.6, a reduction in transfer payments of over $6 billion is associated with new vehicle dealer activity in 1998, and personal income tax revenues are increased by over $11 billion. The implication for disposable personal income, or personal income after taxes and including transfers, is an increase of over $43 billion in the domestic economy for 1998.

In summary, the employment contribution currently associated with new vehicle dealer activity in the United States is estimated to be about 1.1 million jobs in the private sector attributable to the industry directly and its suppliers, and 1.9 million jobs when all spin-off effects are included. The compensation contribution is estimated to be about $41 billion attributable to the industry directly and its suppliers, and $66 billion when all spin-off effects are included.

The new vehicle dealer contribution to employment is distributed across major industry divisions, as shown in table 2.7. The employment contribution is shown for both indirect and expenditure-induced effects; direct dealer employment is 717,400 jobs.

As might be expected, most of the jobs that new vehicle dealer activity contributes to the economy are in the private nonmanufacturing sector; in fact, about nine jobs in ten are found here, whereas only one job in ten is located in manufacturing. When direct dealership employment is included, about half of the jobs are in retail trade. Also, much of the spin-off employment contribution is from expenditure-induced activity due to household purchasing, and this activity is heavily concentrated in the private nonmanufacturing sector.

Table 2.7

Private Sector Contributions of New Vehicle Dealers (Retail) by Industry in the United States, 1998

Industry Division (SIC code)	Indirect	Expenditure-induced	Total spin-off
Manufacturing	65,600	102,400	168,000
Durable goods	49,300	54,000	103,300
Nondurable goods	16,300	48,400	64,700
Private nonmanufacturing	300,600	740,600	1,041,200
Construction (15-17)	22,800	24,100	46,900
Trucking (42)	5,100	12,800	17,900
Credit and finance (61, 62, 67)	5,500	17,000	22,500
Wholesale trade (50-51)	20,800	38,500	59,300
Retail trade (52-59)	24,100	236,400	260,500
Eating and drinking establishments (58)	10,000	80,000	90,000
Retail excluding eating & drinking (52-57, 59)	14,100	156,400	170,500
Services (70-89)	173,500	316,000	489,500
Business services (73)	110,900	61,200	172,100
Professional services (81, 87, 89)	24,800	41,500	66,300
Nonprofit services (83, 84, 86)	2,100	52,500	54,600
Other private nonmanufacturing	48,800	95,800	144,600
Total private nonfarm employment	366,200	843,000	1,209,200
Total direct + indirect = 1,083,600			
Total direct + indirect + expenditure-induced = 1,926,600			

The distribution across census regions is shown in table 2.8. The distribution of the 1,083,600 jobs and $41 billion in compensation contributed nationwide by direct and indirect activities associated with new vehicle dealers is shown in the top panel of the table. The contributions range from a high of 205,000 jobs for the South Atlantic region and $7.6 billion in compensation for the East North Central region to a low of 54,700 jobs for New England and $2.2 billion in compensation for both the New England region and the East South Central region.

In the bottom panel of table 2.8, we show the distribution of direct and total spin-off activities, which includes the expenditure-induced effect in addition to the indirect effect. When the expenditure-induced effect is added, the total contributions are 1,926,600 jobs and $65.8 billion

Table 2.8

Private Sector Contributions of New Vehicle Dealers (Retail) by U.S. Census Region, 1998

Census region	Employment	Share of region's employment (%)	Compensation ($billions US)
Activities excluding expenditure-induced effect			
East North Central	200,500	0.885	7.58
East South Central	62,900	0.822	2.18
Middle Atlantic	130,800	0.714	5.34
Mountain	74,100	0.868	2.70
New England	54,700	0.738	2.18
Pacific	154,100	0.730	6.49
South Atlantic	205,000	0.868	7.39
West North Central	81,300	0.813	2.77
West South Central	120,200	0.852	4.45
Total United States	1,083,600	0.8	41.08
Activities including expenditure-induced effect			
East North Central	354,400	1.560	12.04
East South Central	111,500	1.458	3.42
Middle Atlantic	232,400	1.266	9.01
Mountain	132,300	1.547	4.21
New England	99,200	1.331	3.62
Pacific	284,000	1.352	10.55
South Atlantic	353,000	1.486	11.44
West North Central	145,100	1.441	4.41
West South Central	214,700	1.526	7.13
Total United States	1,926,600	1.4	65.83

NOTE: Values for employment are rounded to the nearest hundred workers.

in compensation. The distribution ranges from a high of 354,400 jobs and $12 billion in compensation for the East North Central region to a low of 99,200 jobs for New England and $3.4 billion in compensation for the East South Central region.

Activity associated with dealers is not nearly as geographically concentrated, of course, as activity associated with automotive manufacturing. About 18 percent of the jobs and compensation (including total spin-off) contributed nationwide by dealers reside in the East North Central region, compared with over 40 percent for automotive manufacturing. As with automotive manufacturing, the largest concentrations of activity for dealers are in the East North

Central and South Atlantic regions. Unlike automotive manufacturing, however, activity associated with dealers is fairly prominent in the Pacific region. The share of dealer-related employment as a percentage of total regional employment is similar for all regions.

Estimates of new vehicle dealers' contributions to each of the fifty states and the District of Columbia are shown in table 2.9. For each state, the employment contributions are broken out into direct, indirect, and expenditure-induced effects. Estimates of total employment and compensation are presented, both including and excluding the expenditure-induced effect.

The employment contributions among states range from a high of 114,600 in California to a low of 900 in the District of Columbia (a high of 213,300 jobs in California to a low of 3,300 in Wyoming when expenditure-induced effects are included). As a share of total state employment, the employment contributions associated with new vehicle dealers are highest in Michigan, with a share of 1.1 percent, and lowest in the District of Columbia, with a share of 0.2 percent (1.9 percent in Michigan and 0.7 percent in D.C., including total spin-off). In most cases, however, there is little variation in state share. With a few exceptions, the state share of total dealer-related employment is within a few tenths of a percentage point of the national average, which is 1.4 percent. The contribution of new vehicle dealer activity to compensation is highest in California, at $4.94 billion ($8.12 billion including expenditure-induced effects). On the low end is the District of Columbia, at $0.04 billion (when the expenditure-induced effects are included, the low is in Wyoming, at $0.09 billion).

As with the U.S. census regions, dealer activity is not as concentrated geographically as is automotive manufacturing. Whereas the top eleven states for total automotive manufacturing activity contributed 65 percent of the jobs and 69 percent of the compensation in the nation, the comparable shares for the top eleven dealer states were 56 percent and 59 percent, respectively. Thus, the rest of the states, at least collectively, have a greater share of activity associated with dealers than they do with automotive manufacturing.

Table 2.9

Private Sector Contributions of New Vehicle Dealers (Retail) by State, 1998

State	Direct employ-ment	Indirect employ-ment	Total (direct + indirect)			Expenditure-induced employment	Total (direct + indirect + expenditure-induced)		
			Employ-ment	As a % of state	Compensation ($billions US)		Employ-ment	As a % of state	Compensation ($billions US)
Alabama	10,500	4,700	15,200	0.794	0.52	11,400	26,600	1.390	0.81
Alaska	1,400	500	1,900	0.636	0.08	1,500	3,400	1.148	0.12
Arizona	14,700	7,800	22,500	1.029	0.84	15,900	38,400	1.758	1.25
Arkansas	5,900	2,800	8,700	0.739	0.27	6,700	15,400	1.304	0.42
California	75,700	38,900	114,600	0.727	4.94	98,700	213,300	1.364	8.12
Colorado	11,600	6,900	18,500	0.813	0.71	15,900	34,400	1.499	1.16
Connecticut	9,300	4,600	13,900	0.770	0.62	10,800	24,700	1.367	1.03
Delaware	2,600	1,100	3,700	0.927	0.14	2,600	6,300	1.580	0.22
D.C.	200	700	900	0.196	0.04	2,500	3,400	0.741	0.16
Florida	42,700	22,700	65,400	0.953	2.37	45,700	111,100	1.587	3.56
Georgia	21,000	11,000	32,000	0.840	1.19	25,400	57,400	1.517	1.92
Hawaii	2,200	1,100	3,300	0.578	0.13	3,100	6,400	1.117	0.21
Idaho	3,300	1,400	4,700	0.806	0.16	3,600	8,300	1.417	0.24
Illinois	30,800	17,500	48,300	0.773	1.91	39,200	87,500	1.402	3.20
Indiana	16,400	9,900	26,300	0.860	0.92	20,700	47,000	1.531	1.46
Iowa	8,600	3,600	12,200	0.820	0.38	9,400	21,600	1.426	0.60
Kansas	7,700	3,200	10,900	0.816	0.37	8,400	19,300	1.432	0.58
Kentucky	9,800	4,600	14,400	0.814	0.47	10,100	24,500	1.385	0.72
Louisiana	11,700	4,100	15,800	0.837	0.54	11,100	26,900	1.435	0.82
Maine	3,200	1,400	4,600	0.726	0.14	3,500	8,100	1.262	0.22
Maryland	15,200	7,100	22,300	0.923	0.83	13,400	35,700	1.474	1.23
Massachusetts	15,500	8,800	24,300	0.696	1.00	21,000	45,300	1.289	1.72
Michigan	28,900	21,700	50,600	1.064	2.16	38,300	88,900	1.870	3.30
Minnesota	13,500	7,200	20,700	0.761	0.74	17,200	37,900	1.391	1.22
Mississippi	6,400	2,500	8,900	0.783	0.29	6,900	15,800	1.402	0.45
Missouri	15,900	8,300	24,200	0.862	0.86	18,700	42,900	1.521	1.37
Montana	2,500	900	3,400	0.803	0.10	2,500	5,900	1.368	0.15
Nebraska	4,900	2,200	7,100	0.773	0.23	5,600	12,700	1.369	0.36
Nevada	5,000	2,800	7,800	0.791	0.33	7,000	14,800	1.495	0.53
New Hampshire	4,200	1,900	6,100	0.925	0.23	4,600	10,700	1.609	0.35
New Jersey	21,200	11,500	32,700	0.836	1.46	23,100	55,800	1.422	2.31
New Mexico	4,500	1,800	6,300	0.868	0.20	4,300	10,600	1.459	0.30
New York	33,200	16,400	49,600	0.579	2.14	43,500	93,100	1.093	3.92
North Carolina	21,800	10,700	32,500	0.838	1.16	25,300	57,800	1.489	1.82
North Dakota	2,300	700	3,000	0.904	0.09	2,000	5,000	1.489	0.13
Ohio	33,200	18,800	52,000	0.898	1.83	37,600	89,600	1.543	2.85
Oklahoma	8,800	4,200	13,000	0.868	0.41	9,300	22,300	1.477	0.63
Oregon	9,600	4,700	14,300	0.847	0.54	10,900	25,200	1.476	0.83
Pennsylvania	34,300	14,200	48,500	0.829	1.74	35,000	83,500	1.413	2.78
Rhode Island	2,100	1,100	3,200	0.653	0.11	2,600	5,800	1.170	0.18
South Carolina	9,400	4,700	14,100	0.787	0.47	11,200	25,300	1.412	0.74
South Dakota	2,300	900	3,200	0.811	0.10	2,500	5,700	1.422	0.15
Tennessee	15,500	8,900	24,400	0.863	0.90	20,200	44,600	1.572	1.44
Texas	55,300	27,400	82,700	0.866	3.23	67,400	150,100	1.580	5.26
Utah	5,800	3,200	9,000	0.808	0.30	7,600	16,600	1.517	0.49
Vermont	1,800	800	2,600	0.794	0.08	2,000	4,600	1.394	0.12
Virginia	19,100	8,800	27,900	0.842	1.01	18,400	46,300	1.393	1.53
Washington	14,000	6,000	20,000	0.720	0.80	15,700	35,700	1.277	1.27
West Virginia	4,700	1,500	6,200	0.895	0.18	3,500	9,700	1.386	0.26
Wisconsin	15,800	7,500	23,300	0.827	0.76	18,100	41,400	1.457	1.23
Wyoming	1,400	500	1,900	0.786	0.06	1,400	3,300	1.355	0.09
Total U.S.	**717,400**	**366,200**	**1,083,600**	**0.8**	**41.08**	**843,000**	**1,926,600**	**1.4**	**65.83**

NOTE: Values for employment are rounded to the nearest hundred workers.

2.2.3 Contribution of the Total Automotive Industry

Combining the estimates for automotive manufacturing in section 2.2.1 with the estimates for new vehicle dealers in section 2.2.2 yields the "bottom line" for the automotive industry as a whole. This results in the estimates of total U.S. private sector contributions from automotive industry activities shown in table 2.10.

Table 2.10

Summary

Private Sector Contributions of the Automotive Industry in the United States, 1998

Activities excluding expenditure-induced effect	
Employment	
Direct	1,338,700
Indirect	2,162,200
Total (direct + indirect)	3,500,900
Multiplier	2.6
Compensation ($billions US)	152.10
Contributions (as a % of total U.S. economy)	
Employment	2.6
Compensation	3.6
Activities including expenditure-induced effect	
Employment	
Expenditure-induced	3,133,700
Total (direct + indirect + expenditure-induced)	6,634,600
Multiplier	5.0
Compensation ($billions US)	242.80
Plus: transfer payments	-21.62
Less: social insurance contributions	16.91
Less: personal income taxes	41.46
Equals: Private disposable personal income	162.81
Contributions (as a % of total U.S. economy)	
Employment	4.9
Compensation	5.6

NOTE: Values for employment are rounded to the nearest hundred workers.

Direct employment of 1,338,700 jobs (621,300 automotive manufacturing jobs + 717,400 new vehicle dealer jobs) combined with indirect employment of 2,162,200 sums to a contribution to private sector employment of 3,500,900. The corresponding employment multiplier is 2.6 (3,500,900 ÷ 1,338,700); that is, there are 2.6 times as many jobs generated as there are direct jobs. The compensation contribution (calculated as the direct plus indirect effects) is estimated to be $152.10 billion, measured in 1998 dollars. The economic contribution of direct and indirect automotive industry activities in 1998 represents 2.6 percent of the private sector jobs and 3.6 percent of the private sector compensation in the U.S. economy.

In the bottom panel of table 2.10, we show the total spin-off effect, which includes the expenditure-induced effect in addition to the indirect effect. Our estimate of the expenditure-induced effect is 3,133,700 jobs which, when added to the 3,500,900 direct plus indirect jobs, equals 6,634,600 total jobs. The corresponding employment multiplier is 5.0 (6,634,600 ÷ 1,338,700). The corresponding contribution to compensation in the private sector is approximately $243 billion, measured in 1998 dollars. These contributions represent 4.9 percent of the private sector jobs and 5.6 percent of the private sector compensation in the U.S. economy.

The estimate of compensation is prior to deductions for personal income taxes and contributions to social insurance programs, and does not include transfer payments. As shown in the bottom panel of table 2.10, a reduction in transfer payments of over $21 billion dollars is associated with the total automotive industry in 1998, and personal income tax revenues are increased by over $41 billion. The implication for disposable income, or personal income after taxes and including transfers, is an increase of almost $163 billion in the domestic economy for 1998.

In summary, the employment contribution currently associated with total automotive industry activity in the United States is estimated to be about 3.5 million jobs in the private sector attributable to the industry directly and its suppliers, and 6.6 million when all spin-off effects are included. The compensation contribution is estimated to be about $152 billion attributable to the industry directly and its suppliers, and $243 billion when all spin-off effects are included.

The total automotive industry contribution to employment is distributed across major industry divisions, as shown in table 2.11. The employment contribution is shown for both indirect and expenditure-induced effects; direct employment is 1,338,700.

Table 2.11

Private Sector Contributions of the Automotive Industry by Industry in the United States, 1998

Industry division (SIC code)	Indirect	Expenditure-induced	Total
Manufacturing	790,500	374,700	1,165,200
Durable goods	537,600	200,100	737,700
Nondurable goods	252,900	174,600	427,500
Private nonmanufacturing	1,371,700	2,759,000	4,130,700
Construction (15-17)	114,100	89,300	203,400
Trucking (42)	75,800	47,000	122,800
Credit and finance (61, 62, 67)	22,200	61,600	83,800
Wholesale trade (50-51)	247,100	142,000	389,100
Retail trade (52-59)	133,200	879,300	1,012,500
Services (70-89)	600,600	1,187,500	1,788,100
Business services (73)	319,600	228,300	547,900
Professional services (81, 87, 89)	126,100	150,000	276,100
Nonprofit services (83, 84, 86)	11,100	201,300	212,400
Other private nonmanufacturing	178,700	352,300	531,000
Total private nonfarm employment	2,162,200	3,133,700	5,295,900
Total direct + indirect = 3,500,900			
Total direct + indirect + expenditure-induced = 6,634,600			

NOTE: Values for employment are rounded to the nearest hundred workers.

Almost four in ten indirect jobs generated are in manufacturing, and most of them are in durable goods. On the other hand, nine in ten expenditure-induced jobs are in the private nonmanufacturing sector, three-quarters of them in retail trade and services. When direct employment is included in the total, three out of ten jobs generated are in manufacturing; the rest are in the private nonmanufacturing sector, and about three-quarters of those are in retail trade and services.

The distribution across census regions is shown in table 2.12. The distribution of the 3,500,900 jobs and $152.1 billion in compensation contributed nationwide by direct and indirect activities

associated with the automotive industry as a whole is shown in the top panel of the table. The contributions range from a high of 1,347,500 jobs and $65.6 billion in compensation for the East North Central region to a low of 120,800 jobs for New England and $4.8 billion in compensation for the Mountain region.

Table 2.12

Private Sector Contributions of the Automotive Industry by U.S. Census Region, 1998

Census region	Employment	Share of region's employment (%)	Compensation ($billions US)
Activities excluding expenditure-induced effect			
East North Central	1,347,500	5.945	65.58
East South Central	306,900	4.012	11.91
Middle Atlantic	324,300	1.769	14.76
Mountain	131,800	1.544	4.75
New England	120,800	1.631	5.14
Pacific	286,100	1.356	12.49
South Atlantic	457,900	1.938	17.44
West North Central	277,700	2.778	10.56
West South Central	247,900	1.756	9.67
Total United States	3,500,900	2.6	152.10
Activities including expenditure-induced effect			
East North Central	2,371,100	10.440	93.37
East South Central	539,000	7.049	17.71
Middle Atlantic	656,800	3.578	27.02
Mountain	286,700	3.353	8.84
New England	260,700	3.497	9.77
Pacific	610,900	2.908	22.83
South Atlantic	879,500	3.702	29.23
West North Central	522,900	5.192	16.92
West South Central	507,000	3.604	17.13
Total United States	6,634,600	4.9	242.80

NOTE: Values for employment are rounded to the nearest hundred workers.

In the bottom panel of table 2.12, we show the distribution of direct and total spin-off activities, which includes the expenditure-induced effect in addition to the indirect effect. When the expenditure-induced effect is added, the total contributions are 6,634,600 jobs and $242.8 billion in compensation. The distribution ranges from a high of 2,371,100 jobs and $93.4 billion

in compensation for the East North Central region to a low of 260,700 jobs for New England and $8.8 billion in compensation for the Mountain region.

About 36 percent of the jobs and 38 percent of the compensation (including total spin-off) contributed nationwide by the automotive industry as a whole are located in the East North Central region. Although industry activity is less prominent in the other regions, it does make an important contribution to their economies. In terms of auto share within a region, the East North Central region and the East South Central region both have a substantial proportion of their employment associated with auto industry activities.

Estimates of the automotive industry's total contributions to each of the fifty states and the District of Columbia are shown in table 2.13. For each state, the employment contributions are broken out into direct, indirect, and expenditure-induced effects. Estimates of total employment and compensation are presented both including and excluding the expenditure-induced effect.

The employment contributions among states range from a high of 585,400 jobs in Michigan to a low of 3,400 in Alaska (a high of 1,007,500 jobs in Michigan and a low of 7,900 in Wyoming when expenditure-induced effects are included). As a share of total state employment, the employment contributions associated with automotive manufacturing are again highest in Michigan, at 12.3 percent, and lowest in the District of Columbia, at 0.9 percent (21.2 percent in Michigan and 2.5 percent in the state of Washington, including total spin-off). The compensation contributions range from $33.4 billion for Michigan to $0.12 billion for Wyoming ($44.7 billion for Michigan to $0.2 billion for Wyoming when expenditure-induced effects are included).

There are yet more potential benefits that cannot be quantified. For instance, our estimates do not include the qualitative effects that would produce additional economic benefits for the domestic economy, such as the intangible advantages of technological transfers associated with the automotive industry in the United States. The results of the study do confirm, though, that the health of the automotive industry is very important to the overall health of the United States economy.

Table 2.13

Private Sector Contributions of the Automotive Industry by State, 1998

State	Direct employment	Indirect employment	Total (direct + indirect)			Expenditure-induced employment	Total (direct + indirect + expenditure-induced)		
			Employment	As a % of state	Compensation ($billions US)		Employment	As a % of state	Compensation ($billions US)
Alabama	19,500	33,800	53,300	2.784	1.95	42,900	96,200	5.028	3.03
Alaska	1,400	2,000	3,400	1.138	0.14	4,600	8,000	2.701	0.27
Arizona	16,000	21,219	37,200	1.702	1.39	38,100	75,300	3.447	2.39
Arkansas	6,000	18,500	24,500	2.081	0.75	22,300	46,800	3.963	1.26
California	98,700	118,400	217,100	1.377	9.76	245,800	462,900	2.960	17.81
Colorado	12,800	20,500	33,300	1.464	1.29	42,700	76,000	3.312	2.53
Connecticut	9,900	22,000	31,900	1.768	1.55	34,800	66,700	3.692	2.89
Delaware	8,500	9,900	18,400	4.611	0.91	11,700	30,100	7.547	1.26
D.C.	300	3,900	4,200	0.915	0.24	9,400	13,600	2.963	0.69
Florida	45,400	47,300	92,700	1.351	3.34	90,200	182,900	2.613	5.74
Georgia	31,200	64,400	95,600	2.508	3.83	89,200	184,800	4.883	6.43
Hawaii	2,300	3,700	6,000	1.051	0.22	9,700	15,700	2.739	0.48
Idaho	3,300	5,400	8,700	1.492	0.29	9,600	18,300	3.124	0.51
Illinois	45,400	114,900	160,300	2.564	7.11	151,600	311,900	4.998	12.10
Indiana	61,100	91,100	152,200	4.979	6.16	111,500	263,700	8.589	8.94
Iowa	10,100	23,200	33,300	2.238	1.12	31,900	65,200	4.305	1.89
Kansas	12,400	21,800	34,200	2.561	1.31	32,100	66,300	4.920	2.11
Kentucky	28,100	72,600	100,700	5.690	3.96	64,800	165,500	9.357	5.48
Louisiana	15,500	19,100	34,600	1.834	1.29	33,300	67,900	3.622	2.17
Maine	3,300	6,000	9,300	1.468	0.29	10,700	20,000	3.116	0.53
Maryland	19,400	26,900	46,300	1.916	1.85	39,300	85,600	3.535	3.03
Massachusetts	16,900	35,300	52,200	1.495	2.30	65,600	117,800	3.352	4.60
Michigan	289,300	296,100	585,400	12.311	33.38	422,100	1,007,500	21.190	44.69
Minnesota	17,450	36,550	54,000	1.984	2.12	57,200	111,200	4.081	3.76
Mississippi	8,800	15,600	24,400	2.147	0.74	23,000	47,400	4.206	1.27
Missouri	36,200	91,200	127,400	4.536	5.11	93,800	221,200	7.843	7.58
Montana	2,500	3,400	5,900	1.393	0.17	6,600	12,500	2.898	0.30
Nebraska	5,300	11,100	16,400	1.786	0.53	17,300	33,700	3.633	0.95
Nevada	5,500	9,200	14,700	1.490	0.57	21,400	36,100	3.646	1.20
New Hampshire	4,400	9,100	13,500	2.047	0.52	13,800	27,300	4.106	0.90
New Jersey	32,000	53,200	85,200	2.179	4.16	76,800	162,000	4.128	7.03
New Mexico	4,600	5,600	10,200	1.405	0.32	11,200	21,400	2.946	0.58
New York	53,600	73,500	127,100	1.483	6.15	146,900	274,000	3.216	12.26
North Carolina	24,500	54,300	78,800	2.032	2.80	75,000	153,800	3.963	4.80
North Dakota	2,300	3,400	5,700	1.718	0.17	5,600	11,300	3.365	0.28
Ohio	131,600	234,500	366,100	6.324	15.76	264,700	630,800	10.862	22.57
Oklahoma	13,300	26,800	40,100	2.678	1.42	33,300	73,400	4.862	2.21
Oregon	10,500	15,700	26,200	1.551	1.00	27,200	53,400	3.128	1.74
Pennsylvania	39,700	72,300	112,000	1.915	4.45	108,800	220,800	3.736	7.73
Rhode Island	2,100	5,900	8,000	1.633	0.29	8,500	16,500	3.329	0.52
South Carolina	11,850	33,850	45,700	2.552	1.60	39,700	85,400	4.767	2.55
South Dakota	2,300	4,400	6,700	1.699	0.20	7,300	14,000	3.492	0.35
Tennessee	32,600	95,900	128,500	4.544	5.26	101,400	229,900	8.102	7.93
Texas	62,900	85,800	148,700	1.557	6.21	170,200	318,900	3.357	11.49
Utah	5,900	12,300	18,200	1.635	0.60	21,000	39,200	3.582	1.11
Vermont	1,800	4,100	5,900	1.803	0.19	6,500	12,400	3.757	0.33
Virginia	22,600	38,900	61,500	1.855	2.38	55,000	116,500	3.506	3.95
Washington	14,600	18,800	33,400	1.202	1.37	37,500	70,900	2.536	2.53
West Virginia	5,900	8,800	14,700	2.122	0.49	12,100	26,800	3.829	0.78
Wisconsin	25,500	58,000	83,500	2.965	3.17	73,700	157,200	5.533	5.07
Wyoming	1,400	2,200	3,600	1.490	0.12	4,300	7,900	3.244	0.22
Total U.S.	**1,338,700**	**2,162,200**	**3,500,900**	**2.6**	**152.10**	**3,133,700**	**6,634,600**	**4.9**	**242.80**

NOTE: Values for employment are rounded to the nearest hundred workers.

2.3 METHODS

The general approach is to use a state-of-the-art economic model, in conjunction with primary data from a survey of twenty-one automotive firms and a well-articulated research design, to generate estimates of the contribution associated with the automotive industry in the U.S. economy. A summary of the model, data, and procedures follows.

2.3.1 MACROECONOMIC MODEL

To simulate the contribution of the automotive industry, we use a macroeconomic model of the U.S. economy constructed by Regional Economic Models, Inc. (REMI) of Amherst, Massachusetts, and adapted by our research team for the purposes of this study. The REMI model has been fully documented and peer-reviewed in the professional literature (Treyz 1993, Treyz et al. 1992). The REMI model has been designed particularly for carrying out simulations of the type generated for this study, and has been used extensively for such studies over the past two decades.

The interindustry interactions associated with the presence (or absence) of an activity are captured by input-output methods, which identify the buying and selling relationships among industries. The REMI model is much more complex than its input-output component, though, with a very detailed calibration of the workings of the macroeconomy.

The REMI model is designed as a "bottom-up" regional model of the U.S. economy. That is, events and changes at the regional level sum to total results at the national level. This innovative design is in contrast to most multiregional models, where total results are determined at the national level and then simply allocated among constituent regions. This design also enables the regions to interact with each other, so that interregional migration and trade flows simulated by a change in any given region are identified, including the feedback effects among regions. In the real economy, spin-off activity is not generated solely by changes in direct activity within the same region, but also by changes in activity in other regions. Because of its design, the REMI model is able to provide estimates of the effects of these interregional trade flows, resulting in much more accurate estimates of the regional contribution of automotive industry activity.

In this study, we divided the United States into its fifty states and the District of Columbia. Thus, we are able to identify automotive-related activity in those states that don't have a significant direct automotive presence. The country can be divided into more regions if desired; in fact, the minimum size for a region is a county. For the purposes of this study, though, we judged the fifty-state breakout to be appropriate.

For this study, the greatest advantage of the structure of the REMI model is that it is so detailed and flexible that it could be tailored to the specific issue, rather than giving only generic representations of the question.

2.3.2 DATA

This study had access to the richest data set ever assembled on domestic auto industry employment and compensation. State-level employment and payroll data were collected from twenty-one automotive firms that sell new light vehicles in the United States (identified in the Study Introduction). Salaried and hourly employees were broken out into eight different categories (shown in table 1.1). This detail aided the research design in two important ways. First, we were able to control for the risk of double-counting jobs. Second, we were able to communicate to the model the correct functional activities that these workers were involved in, and their actual compensation (an example will be discussed in the next section). Further detail on the survey of automotive firms is provided in part 1 of the study.

Similar information for new light vehicle dealerships was available from NADA. Secondary data were collected by REMI and the University of Michigan. We selected 1998 as our year of analysis because it was the most recent year for which all primary and secondary data were available.

2.3.3 PROCEDURES

The general approach to estimating the economic contribution of the automotive industry is to remove the industry from each of the state economies and then have the model generate the economywide losses, including the loss of spin-off activities. We begin by generating a baseline simulation for the economy of each state in 1998, before any changes are made. To evaluate the contribution of the industry to the state economies, we then generate an alternative simulation in which we remove the industry from the baseline simulation, to determine hypothetically how much smaller the economies would be. The decrease in activity associated

with removing automotive activity constitutes the contribution of the industry to the state economies. The contribution to the entire national economy is calculated by summing the regional contributions.

This study should not be interpreted as representing the economic activity that would be lost if the automotive industry did not operate in the United States. That catastrophic scenario would generate significant compensating adjustments over time in the economy, which are inappropriate to include in an analysis whose purpose is to dissect the industry's current presence in the domestic economy. The impact of lost production, particularly related to a downturn in the automotive economy, is an important issue that can be addressed using the research tools assembled for the current study. That is a different issue, though, and is not the focus of this study.

The general approach here is straightforward, but its actual application is much more complex for several reasons. First, for the model to be able to distinguish between a catastrophic impact scenario and a contribution scenario, we had to neutralize several compensating adjustments in the model that would otherwise respond to the complete loss of the industry. Second, since the survey data were collected by type of activity and the model requires these activities to be sorted by Standard Industrial Classification (SIC) code, we made the necessary assignments based on function of activity. For example, our analysis suggests that white-collar workers in the automotive industry are functionally most like workers in professional services, or in finance. Consequently, we input these workers in their functional category (with the correct assignment of wages), for the purpose of having the model generate more accurate numbers of spin-off jobs. In our final accounting, the direct jobs are still included in the motor vehicle industry to conform with official government data. Third, adjustments were made to avoid double-counting jobs. Also, the model was adjusted so that the correct payroll values were used for all of the direct employees.

Several adjustments were also made to generate accurate estimates of dealer contributions. The NADA data were adjusted by estimates of the new vehicle share of sales as well as parts and service, in order to compute new-vehicle-related employment. Dealer payroll and productivity estimates generated by the model were also adjusted to be consistent with the NADA data.

This is the first study to account fully for all of these factors.

2.4 Overview of the REMI EDFS-53 Model

Regional Economic Models, Inc. (REMI) was established in 1980 to respond to the demand for regional forecasting and simulation models. The REMI methodology was first initiated in the mid-1970s as the TFS methodology, named after its original authors, Treyz, Friedlander, and Stevens. The Massachusetts Economic Policy Analysis model, developed in 1977, was the first implementation of this methodology. A core version of the model was then developed for the National Academy of Sciences. Now available for any county/state or combination of counties/states in the United States, the standard REMI model is the Economic and Demographic Forecasting and Simulation 53-sector (EDFS-53) model.

Policymakers and analysts can use the EDFS-53 model to forecast and simulate policy changes in a regional economy. The baseline forecast (also called a control forecast) does not include any policy variable changes. A forecast that does include one or more policy variable changes is called an alternative forecast or a simulation. The difference between the control and alternative forecasts shows the effects of the policy change. Examples of such policy changes include decisions relating to tourism, the environment, transportation, energy, taxation, utility rates, and a wide variety of regional development projects.

Interindustry relationships are included in the REMI model, as well as behavioral equations from economic theory. This creates a model that will respond in a logical way to changes in an area's economy. The coupling of proven economic theory with customized data ensures state-of-the-art accuracy of the REMI EDFS-53 forecast and simulation. The result of the REMI modeling technique is a representation of a regional economy that predicts demand and supply conditions across 53 sectors, 94 occupations, 25 final-demand sectors, and 202 age/sex cohorts.

In contrast to traditional regional econometric models, REMI models are estimated using data from all regions and then calibrated to the specific region. This method ensures that estimated model parameters produce more econometrically consistent results than would be possible using data from only a single area. The model embodies a consistent internal structure that is widely documented in academic publications. Users benefit from the ongoing model research and development program at REMI.

Finally, the product of the automotive industry, the private motor vehicle itself, contributes to the economic, social, and political well-being of the nation through its very use by private individuals. This obvious fact is rarely remarked upon. Part 3 of this study seeks to describe these benefits of the motor vehicle that extend beyond the accounting of employment and income produced by the manufacture and sales of the automobile.

PART 3

CONTRIBUTIONS TO AMERICAN SOCIETY

The contributions of the automobile go beyond the employment it provides and the income it generates. The automobile provides benefits for those who purchase and drive it as well as for those who earn their living producing it.

Over the ages, humans progressed from travel by foot, to animal, to water vessels, to trains, to horseless carriages, and, finally, to air travel. With each step, we increase our ability to travel farther, faster, safer, more comfortably, and more economically. The increased range that we can cover gives us economic and social opportunity. The advent of the automobile at the start of the twentieth century ushered in an era of unprecedented mobility for the citizens of the United States. Increased use of the private vehicle enabled people to travel farther and thus enabled and promoted decreased localization of employment, residences, shopping, and other trip destinations. This decrease in density, in turn, enabled people to choose from a wider range of employment, residences, and other trip destinations.

The value of increased employment, housing, shopping, and educational opportunities is difficult to quantify, but key indicators of mobility demonstrate the value of personal vehicles to consumers. There were about 16 million vehicles sold in the United States in 1998, contributing to the 210 million vehicles on the road in 1999 that were driven by over 180 million drivers. In addition, as of 1990, we had 1.77 vehicles per household and 1.01 vehicles per licensed driver. About 95 percent of ground vehicle miles of personal travel in this country (2.6 trillion miles) are by personal vehicles (as opposed to ground public transportation of all types). Vehicles in the United States account for about one-quarter of the 686 million vehicles worldwide.

These data tell only part of the story of the value of personal transportation. The personal vehicle is tightly woven into the fabric of American culture, society, and business. It is the tool that provides access to societal and economic opportunity, and many of us are unable to envision life without it. It is a staple of modern life in this country.

Impact on American Culture

Very few products have had the impact the automobile has had on American culture. Over the course of the past century, it has been celebrated in clothing, movies, dance, and music. People have sung about merry Oldsmobiles, seeing the USA in a Chevrolet, Mustang Sally, pink Cadillacs, the Dodge of the little old lady from Pasadena, fun in the T-bird, supplications for a Mercedes Benz, and jealousy over Porsches. Automobiles have been celebrated, denigrated,

nearly worshipped, sometimes banned, increasingly used, and are now relied upon for virtually all of our ground-based travel.

We have evolved into an auto-based society, and our living, working, shopping, recreational, and family lives reflect the personal mobility we enjoy. We drive to and from school, work, worship, malls, and friends' and relatives' homes. We stay in motels, refuel our bodies at drive-through restaurants and our cars at drive-in service stations. We even have access to drive-through dry-cleaning, prescriptions, and funeral-home visitations.

Words describing America's relationship with cars typify the American spirit in the eyes of many: freedom, power, autonomy, mobility, importance, liberty, and adventure. They recall the American pioneer spirit of the eighteenth and nineteenth centuries. Individually, people feel free in being able to travel great distances under the power of great engines darting them along the open road. They feel liberated and empowered as youths emerging into adulthood and also later as adults.

Benefits to Individuals

The benefits of automobility accrue to individuals and society. Automobiles have indeed affected American culture, but more fundamentally, they provide benefits to individuals in personal ways. Economic progress brings the mobility that gives people greater opportunities in employment, housing, education, and health care. Low car ownership is correlated with low income and low education levels. As automobility increases, it allows access to more employment opportunities, more goods to purchase, more places to shop, and more things to see and do. With that comes a greater exposure to learning opportunities: the ability to attend concerts, visit museums, and experience and learn from our natural environment. A personal vehicle allows people to choose among a range of many recreational and educational experiences. It affords the pleasure of a drive in the countryside, or a trip from the country into the city. It further enhances the economic system, as individuals see their property values rise.

Automobility facilitates individual determination, individual freedom of movement, self-directedness, privacy, choice of destination arrival time, and control over immediate environment. To many, automobility is at the core of individualism in America.

Benefits to Society

Automobiles and trucks have greatly increased consumer choice and competition by expanding the geographic boundaries of local markets (often local monopolies). High-cost local markets protected by high costs of transportation have yielded to highly competitive, efficient, low-cost regional and national markets with the expansion of automobility. It has further separated the decision on housing and employment, yielding a much greater freedom of choice. Other societal benefits are increased access to health care, educational services, and recreational activities. In addition, the nation's defense system has been improved by the building of the Interstate Highway System and the vehicles we drive upon it.

Today, further advances in transportation and communications are leading to highly efficient global markets and even broader consumer choice and economic opportunity for billions of people around the globe. The costs of goods and services have declined, while their quality and diversity have improved with increased automobility. Automobility has also lowered costs by reducing travel time, which greatly increases business and personal productivity.

Sharing in these benefits are women and minorities who have joined the mainstream of American economic society. In the past three decades, women and minorities have entered the workforce in record numbers. The automobile has given them the personal mobility and individual freedom needed to participate more fully in the economic system.

Challenges of Automobility

Unless there is some fundamental paradigm shift in the United States, the core of the transportation system will continue to be personal transportation because of the great economic, social, and cultural benefits it provides. These benefits to society, however, are accompanied by a range of challenges: pollution, traffic congestion, injuries and deaths from crashes, a changed landscape, and limited access to social and economic opportunity for those who do not have a personal vehicle available to them. The future, therefore, calls for individuals, all levels of government, and industry to share the responsibility of addressing these challenges by doing all they can to provide safe, efficient, and economical mobility to all members of society without harm to the environment, or threat to natural resources. Solutions will come from a combination of new technology and changes in human behavior that preserve the benefits of automobility.

APPENDIX A

STATE VEHICLE DEALERSHIP EMPLOYMENT AND PAYROLL, 1998

	Dealership Employment	Payroll ($Billions)		Dealership Employment	Payroll ($Billions)
Alabama	15,510	0.53	Montana	3,646	0.11
Alaska	2,028	0.08	Nebraska	7,221	0.23
Arizona	21,850	0.87	Nevada	7,414	0.34
Arkansas	8,709	0.27	New Hampshire	6,200	0.23
California	112,089	4.75	New Jersey	31,338	1.37
Colorado	17,198	0.69	New Mexico	6,699	0.22
Connecticut	13,807	0.58	New York	49,113	1.89
Delaware	3,908	0.14	North Carolina	32,294	1.18
District of Columbia	314	0.01	North Dakota	3,349	0.1
Florida	63,218	2.46	Ohio	49,191	1.68
Georgia	31,136	1.16	Oklahoma	13,095	0.41
Hawaii	3,343	0.13	Oregon	14,226	0.54
Idaho	4,887	0.17	Pennsylvania	50,883	1.69
Illinois	45,625	1.75	Rhode Island	3,089	0.11
Indiana	24,266	0.84	South Carolina	13,976	0.48
Iowa	12,729	0.39	South Dakota	3,473	0.11
Kansas	11,399	0.38	Tennessee	22,956	0.86
Kentucky	14,462	0.45	Texas	81,951	3.17
Louisiana	17,362	0.58	Utah	8,525	0.3
Maine	4,814	0.15	Vermont	2,708	0.08
Maryland	22,580	0.84	Virginia	28,311	1.02
Massachusetts	22,970	0.89	Washington	20,691	0.79
Michigan	42,820	1.81	West Virginia	6,922	0.19
Minnesota	20,085	0.7	Wisconsin	23,401	0.74
Mississippi	9,451	0.31	Wyoming	2,036	0.06
Missouri	23,530	0.85	**National Total**	**1,062,798**	**39.68**

Source: NADA data, 1999

APPENDIX B

DIRECT AUTOMOTIVE INDUSTRY EMPLOYMENT AND COMPENSATION BY STATE

	Employment	Payroll		Employment	Payroll
Alabama	9,045	521.76	Montana	42	2.96
Alaska	30	1.53	Nebraska	436	15.14
Arizona	1,281	76.29	Nevada	540	34.29
Arkansas	90	5.18	New Hampshire	212	11.32
California	23,047	1,348.23	New Jersey	10,784	1,064.08
Colorado	1,181	65.69	New Mexico	66	3.31
Connecticut	584	40.01	New York	20,434	1,345.52
Delaware	5,865	353.48	North Carolina	2,707	137.77
District of Columbia	93	20.02	North Dakota	46	1.99
Florida	2,655	158.51	Ohio	98,383	5,981.78
Georgia	10,219	654.32	Oklahoma	4,509	254.22
Hawaii	53	6.29	Oregon	861	44.49
Idaho	48	2.70	Pennsylvania	5,372	303.90
Illinois	14,603	933.43	Rhode Island	43	4.11
Indiana	44,694	2,667.95	South Carolina	2,450	142.67
Iowa	1,505	65.78	South Dakota	15	0.97
Kansas	4,691	279.89	Tennessee	17,100	1,234.62
Kentucky	18,251	1,186.76	Texas	7,617	436.56
Louisiana	3,830	222.09	Utah	97	4.97
Maine	73	3.55	Vermont	21	1.26
Maryland	4,179	209.28	Virginia	3,481	231.49
Massachusetts	1,428	75.00	Washington	624	33.63
Michigan	260,444	19,387.32	West Virginia	1,157	73.15
Minnesota	3,950	160.77	Wisconsin	9,740	600.99
Mississippi	2,363	104.17	Wyoming	29	1.16
Missouri	20,287	1,218.48	**National Total**	**621,255**	**41,734.82**

Source: Survey of twenty-one motor vehicle firms that currently sell light vehicles in the U.S. market (see section 1.3).

BIBLIOGRAPHY

American Automobile Manufacturers Association. *Economic Indicators* (1st quarter 1998).

Automotive News, North America Car and Truck Production (January 10, 2000).

Automotive News. *2000 Automotive News Market Data Book.* Detroit: Crain Publications, 2000.

Burns, Elizabeth. "Low Density Drives Traffic in the Valley." *The Arizona Republic*, Sunday Final Chaser (October 18, 1998):E-11.

Chevrot, Frederique. *The Mapping Project: Mobility.* Accessed at <http://www.cei.mit.edu/Research/AGS/mobility.html>, February 16, 2000.

Doherty, Brian. "Guilt-Free Gas Guzzling." *Reason* (May 1996). Accessed at <http://www.reason.com/9605/Dept.Trd.BRIANcars.html>.

Harrigan, Stephen. "Turn up the Beach Boys." *Life* 19, no. 2 (Winter 1996):74.

Johnston, James. *Driving America*: *Your Car, Your Government, Your Choice.* Washington, D.C.: American Enterprise Institute for Public Policy Research, 1997.

Leinbach, T. R. "Mobility in Development Context: Changing Perspectives, New Interpretations, and the Real Issues." *The Journal of Transport Geography* 8, no. 1 (January 21, 2000):1-9.

Lomasky, Loren. *Autonomy and Automobility.* Washington D.C.: Competitive Enterprise Institute, 1995.

Pisarski, Alan. *Cars, Women, and Minorities: The Democratization of Mobility in America.* 1999. Accessed at <http://www.cei.org/PDFs/pisarski.pdf>, January 12, 2001.

Pucher, John. Review of *Driving Forces: The Automobile, Its Enemies and the Politics of Mobility*, by James A. Dunn, Jr. *Transportation Research Part A: Policy and Practice* 34, no. 8 (November 1, 2000):645-48. Accessed at <http://www.science direct.com/science>, August 15, 2000.

Treyz, George I. *Regional Economic Modeling: A Systematic Approach to Economic Forecasting and Policy Analysis.* Boston: Kluwer Academic Publishers, 1993.

Treyz, George I., Dan S. Rickman, and Gang Shao. "The REMI Economic-Demographic Forecasting and Simulation Model." *International Regional Science Review* 14, no. 3 (1992):221-53.

U.S. Census Bureau. *1999 Statistical Abstract of the United States* (119th Edition). Washington, D.C.: U.S. Government Printing Office, 1999.

U.S. Department of Commerce, Bureau of Economic Analysis. <http://www.bea.doc.gov/bea/dn/nipaweb/PopularTables.asp> Table 2.1, Personal Income and Its Disposition.

U.S. Department of Commerce, Bureau of Economic Analysis. *Survey of Current Business* (August 2000).

U.S. Department of Commerce, Bureau of Economic Analysis. *Survey of Current Business* (February 2000).

U.S. Department of Commerce, Bureau of Economic Analysis, Office of Automotive Affairs. Accessed at <http://www.ita.doc.gov/td/auto/qfact.html>, June 29, 1999.

U.S. Department of Labor, Bureau of Labor Statistics. *Employment and Earnings* 47, no. 1 (January 2000).

U.S. Department of Labor, Bureau of Labor Statistics. <http://www.bls.gov/cpihome.htm> Table: Consumer Price Index—All Urban Consumers.

Varella, Flavia. "The Car Trap." *World Press Review* (December 1996):6-11. Reprinted from *Veja* (August 7, 1996).

Ward's Communications. *Ward's Motor Vehicle Facts and Figures.* Southfield, MI: Ward's Communications, 1999.

Ward's Communications. *World Auto Atlas and Directory.* Southfield, MI: Ward's Communications, 1997.

Yates, Brock. "An American Love Affair." *Life* 19, no. 2 (Winter 1996):11.