The Contribution of the International Auto Sector to the U.S. Economy

A study prepared for the

Association of International Automobile Manufacturers, Inc.

by

The University of Michigan

Transportation Research Institute

The Office for the Study of Automotive Transportation
and

The Institute of Labor and Industrial Relations

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Acknowledgments

This study is the product of a team effort. It represents the contributions, over a period of ten months, of a number of staff members from two University of Michigan research institutes—the Office for the Study of Automotive Transportation (OSAT) and the Institute of Labor and Industrial Relations (ILIR)—as well as several automotive consulting firms.

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EXECUTIVE SUMMARY

PART 1

Scope and Significance of the International Auto Sector in the United States

Introduction

The motor vehicle industry is the largest manufacturing industry in the United States. No other single industry is linked to so much of U.S. manufacturing or directly generates so much retail business and employment. Our study describes the economic contribution of an important sector of the U.S. motor vehicle industry: the United States International Auto Sector (USIAS). The USIAS will be defined in this study as international automakers that sell passenger cars and light-duty trucks in the United States.[1]

Our study has yielded two major research products. First, The Office for the Study of Automotive Transportation (OSAT) present an empirical overview of the current scope and significance of the international auto industry in the United States. This part of the study details the contribution of USIAS operations to a variety of economic activities in the U.S. economy and gauges this contribution relative to other nonautomotive industries. We also assess the scope and significance of the USIAS within the U.S. and world automotive industries. Finally, this first part of the study reviews a series of important "noneconomic" contributions by the USIAS to many areas of societal concern in recent years. Our sources of information include economic information provided by various departments of the U.S. government, industry data from public sources, and data provided by the special annual membership survey of the Association of International Automobile Manufacturers (AIAM).

The second part of this study was performed by the Institute of Labor and Industrial Relations (ILIR) at the University of Michigan. ILIR estimates the total contribution of the USIAS to the U.S. economy. ILIR used economic modeling techniques incorporating appropriate industry data. The results are discussed in the second part of this summary.

Overview

Our study contains a comprehensive overview of USIAS sales and production of vehicles in the United States during the years 1982 through 1996. In 1982, USIAS sales consisted almost exclusively of imported vehicles (U.S. production amounted to only 90,000 vehicles that year). As figure ES.1 shows, sales of both imported and domestically produced vehicles rose sharply during the 1982 to 1986 period. By 1986, domestic production by USIAS firms amounted to 700,000 vehicles, and sales of imported vehicles reached 4.2 million. After 1986, however, U.S. sales of imported USIAS vehicles fell while U.S. production of USIAS vehicles continued to increase. As can be seen in figure 1, U.S. production of USIAS vehicles equaled sales of imported vehicles in 1994, and exceeded import sales in both 1995 and 1996.

[1]The USIAS comprises the following motor vehicle firms: Acura, Audi, Bentley, BMW, Daewoo, Ferrari, Fiat, Honda, Hyundai, Infiniti, Isuzu, Kia, Land Rover, Lexus, Mazda, Mercedes-Benz, Mitsubishi, Nissan, Peugeot, Porsche, Renault, Rolls-Royce, Saab, Subaru, Suzuki, Toyota, Volkswagen, and Volvo.

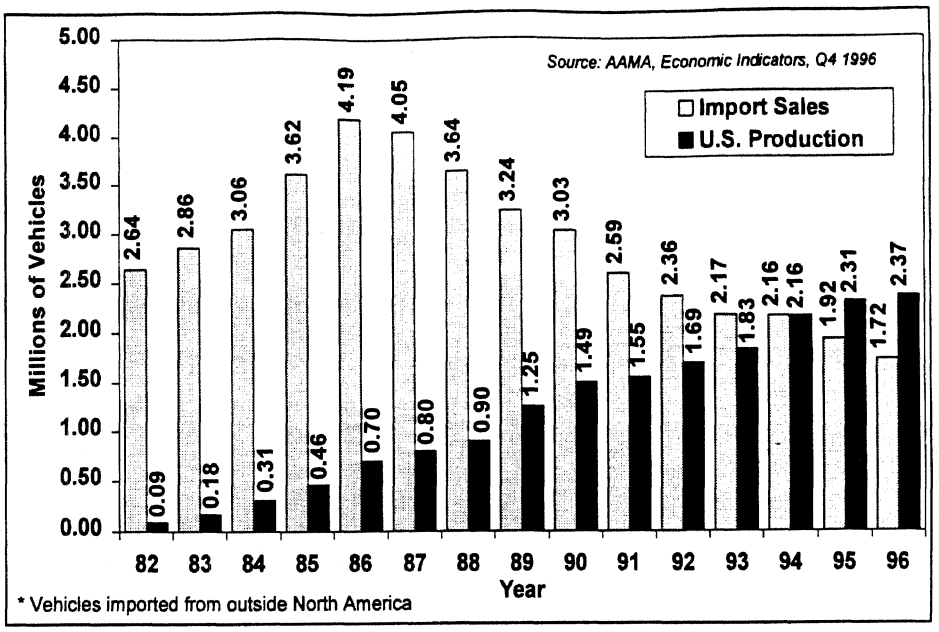

Figure ES.1
USIAS U.S. Vehicle Production and Sales of Imports* 1982 - 1996

The real story of the growth of the USIAS in the U.S. economy, of course, lies in the sector's ever-increasing local production of vehicles. The USIAS's share of total U.S. light vehicle production is shown in figure ES.2. This chart illustrates the rapid acceleration of the USIAS's share of U.S. production with the start-up of many of their initial plants during 1982-1991. The USIAS's share of U.S. production temporarily reached a plateau of about 17.5 percent during 1991-1994, only to rise again in 1995 and 1996 to achieve a new peak of 20.1 percent.

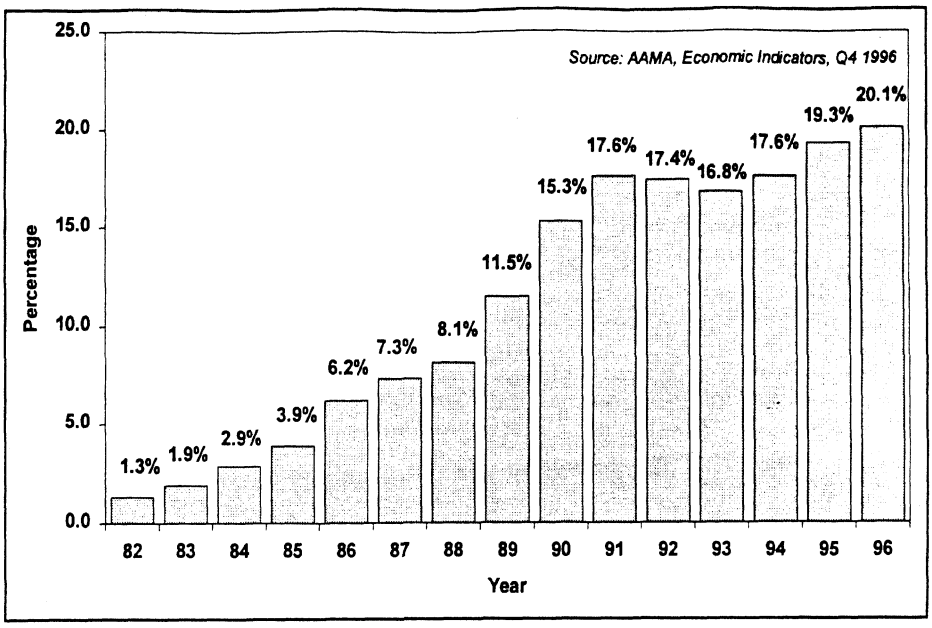

Figure ES.2
USIAS Share of Total U.S. Vehicle Production 1982 - 1996

The current 20 percent USIAS share of U.S. vehicle production will soon be exceeded with the construction of new plants, the further expansion of current plants, and the ramp-up to capacity of the new BMW and Mercedes-Benz plants.[2] Even at current levels, if 1996 USIAS production is ranked against the motor vehicle output of other countries, as shown in figure ES.3, the USIAS places just below Canada and above the United Kingdom.

Plants now operated by the USIAS represent 22 percent of U.S. vehicle production capacity and 14 percent of U.S. vehicle engine capacity. These capacity figures reflect the $12.3 billion the USIAS has invested in its major U.S. production plants since 1982, and the hiring of over 41,000 workers at these plants.

[2]For example, Toyota has recently commenced minivan production at its Georgetown assembly facility and plans to increase total vehicle assembly capacity there by 100,000 in 1998. In the fall of 1998, Toyota will open a pickup assembly facility in Princeton, Indiana, with potential output of 100,000 light trucks and an engine plant in Buffalo, West Virginia, with a capacity of 300,000 units. Nissan plans to begin transaxle production in the spring of 1998 at its Decherd, Tennessee, facility with the potential to produce 200,000 units. Figures were reported by company staff in response to OSAT phone inquiries.

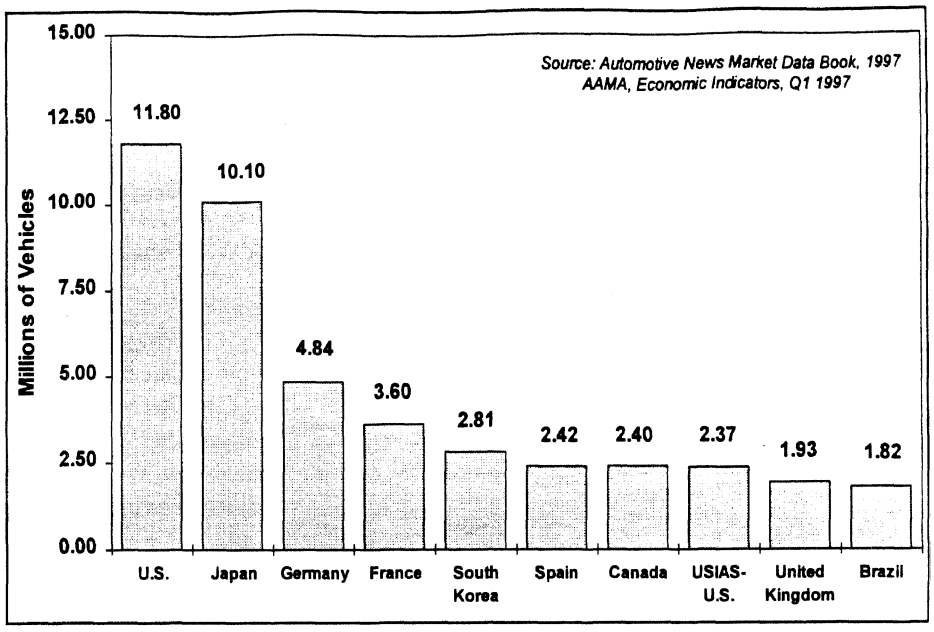

Figure ES.3
Top 1996 National Motor Vehicle Industries Production

Principal Economic Contributions — A Special USIAS Survey

An annual survey has been conducted since 1995 on the behalf of the AIAM by DesRosiers Automotive Consultants, Inc. The purpose of this membership survey is to measure the contribution of USIAS activities to the U.S. economy. The 1997 survey was enlarged and changed somewhat to provide special information for this study's estimation of the direct economic contribution of the USIAS.

The most recent AIAM survey shows that international automakers directly spent about $43.2 billion on all types of purchasing and employee compensation in 1996. A detailed breakout of 1996 spending is shown in figure ES.4. About 58 percent of USIAS spending is on purchases of U.S.-produced parts, components, and materials ($23.1 billion), as well as other goods and services by international automaker manufacturing facilities ($1.5 billion). The second-largest category of spending is "Other Purchases," not including spending on advertising or transportation. "Other Purchases" includes expenses for goods and services used in engineering and design activities, as well as automotive parts purchased by dealerships, and other goods and services bought by operations in sales, distribution, finance, and port services.

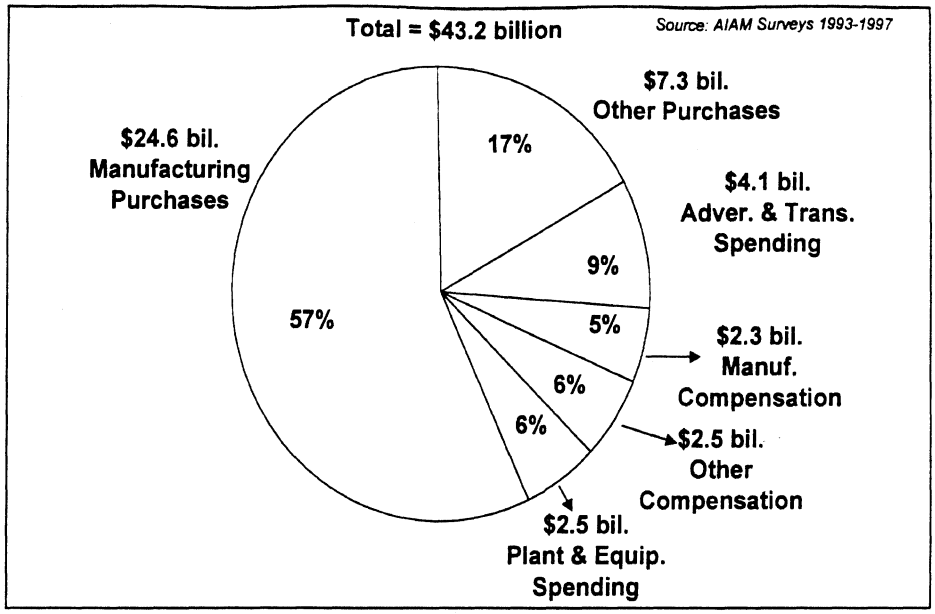

Figure ES.4
USIAS 1996 Spending (U.S. Dollars)

Figure ES.4 also shows total spending in 1996 on employee compensation in both manufacturing and nonmanufacturing. Compensation includes amounts paid to employees in the form of wages and salaries, as well as the cost of total benefits. The final two categories in figure ES.4 are 1996 investment spending on all types of plant and equipment ($2.5 billion) and expenses for advertising and transportation ($4.1 billion).

Previous surveys of the AIAM membership provide significant trend information on USIAS employment and U.S. purchasing per vehicle sold and produced. For example, figure ES.5 provides survey information on USIAS employment totals for 1992-1996. Total USIAS employment grew by 18 percent during the period, and manufacturing employment grew by 23 percent. Figure ES.6 combines information from the AIAM surveys on employee compensation, both manufacturing and nonmanufacturing, with reported employment totals, yielding employee compensation averages for 1992-1996. As can be seen, average compensation for all employees rose 23 percent over the period—from about $56,000 in 1992 to almost $70,000 in 1996. Nonmanufacturing compensation rose from an average of about $76,000 to $93,000 per employee.

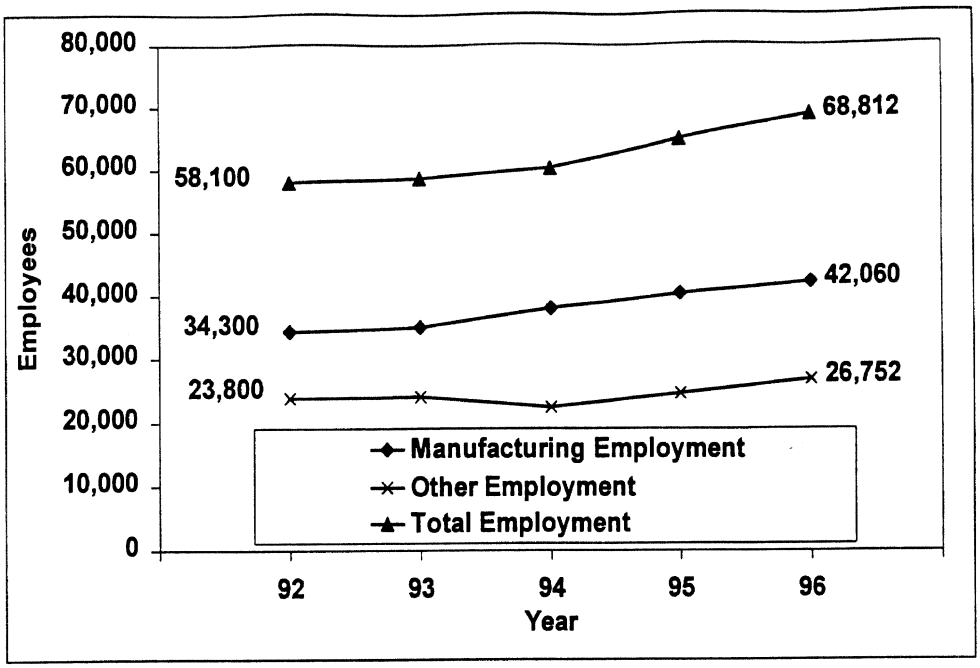

Figure ES.5
USAIS Employment 1992 - 1996

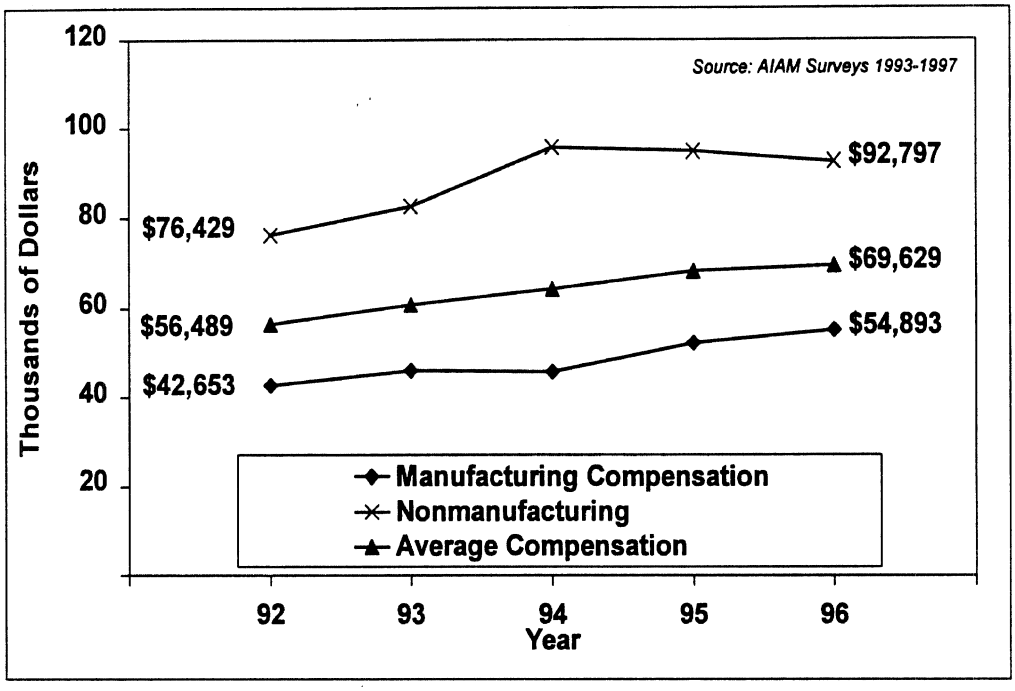

Figure ES.6
Average USIAS Employee Compensation 1992 - 1996

The employment and employee compensation data shown in figures ES.5 and ES.6 are important parameters for the economic contribution section of this study. Also important are U.S. purchasing averages per vehicle sold and per vehicle manufactured in the United States. Figure ES.7 shows two series of estimates for these averages. The average of total spending per vehicle sold is computed by dividing the total spending levels by corresponding total USIAS vehicle sales. As figure ES.7 shows, total U.S. spending by USIAS firms rose from about $7,696 per vehicle in 1992 to $10,371 in 1996—an increase of 35 percent.

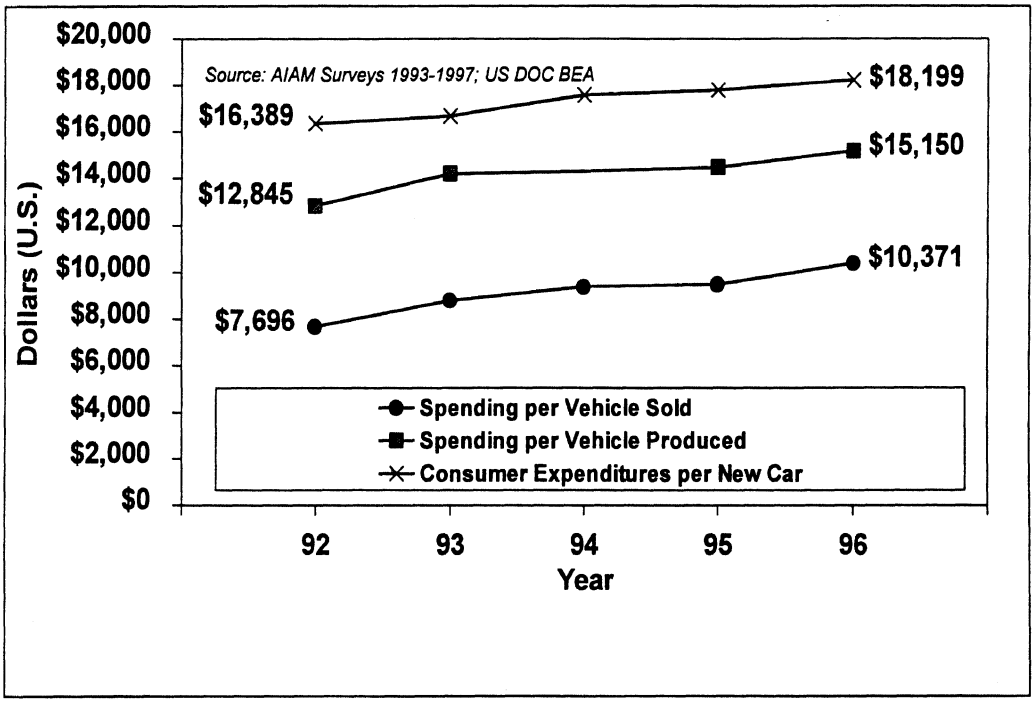

Figure ES.7
USIAS Spending per Vehicle Sold and per Vehicle Produced
1992 - 1996

Spending increases are also illustrated for U.S.-assembled USIAS vehicles. In this case, manufacturing purchases and capital spending on manufacturing plants and equipment are combined with a proportional share of other spending categories, such as advertising or transportation, to yield an estimate of total spending related to sales of U.S.-built vehicles. Our results indicate that the USIAS spent about $12,845 per domestic vehicle in 1992 and about $15,150 per domestic vehicle in 1996—an increase of about 18 percent.

Other Economic and Noneconomic Contributions

Contributions to the performance of a nation's economy can be made in other areas apart from direct employment, income, or investment. Other positive changes often introduced by international industries include new technologies, product innovations, and the development of new economic activities not present before the appearance of international firms. The USIAS can certainly claim that it has provided a host of such improvements, even if only through the harsh process of competition. In particular, this study discusses the well known differences in productivity and quality that still exist between USIAS manufacturing operations and the traditional U.S. motor vehicle industry. Other differences in vehicle technology in the areas of fuel economy and vehicle emissions performance are also examined.

Our estimation of the USIAS's contribution to the U.S. economy must take into account productivity differences between USIAS manufacturing operations and those for the U.S. motor vehicle industry as a whole. We use employment, output, and productivity data taken from the widely respected Harbour & Associates, Inc. annual report (Harbour & Associates, Inc. 1997) to create a series of comparative ratios for three major areas of manufacturing productivity. The differences in 1996 productivity revealed in this simple comparison of major operations are significant. Compared with the U.S. auto industry as a whole, USIAS manufacturing plants enjoy a 26 percent labor productivity advantage in assembly of vehicles, a 44 percent productivity advantage in the assembly of engines, and an 80 percent labor productivity advantage in the production of major stampings.

The Initial Quality Survey, released annually by J. D. Power and Associates, a U.S.-based consulting and market research organization, has become an accepted industry standard for measuring vehicle quality. The data comprise customer-reported new vehicle defects during the first 100 days of ownership. J. D. Power reports these survey results on a defect-per-100-vehicles basis. Figure ES.8 shows the sales-weighted industry average and the USIAS average for the Initial Quality Survey from 1987 to 1996.[3] Over the past nine years, the USIAS average has been lower than the industry average. Reported defects for USIAS vehicles were, on average, approximately 50 percent lower in 1997 than 1987. As is the case for manufacturing productivity,

the USIAS has set a new standard for quality, and the IQS data suggest that the rest of the industry has followed its lead.

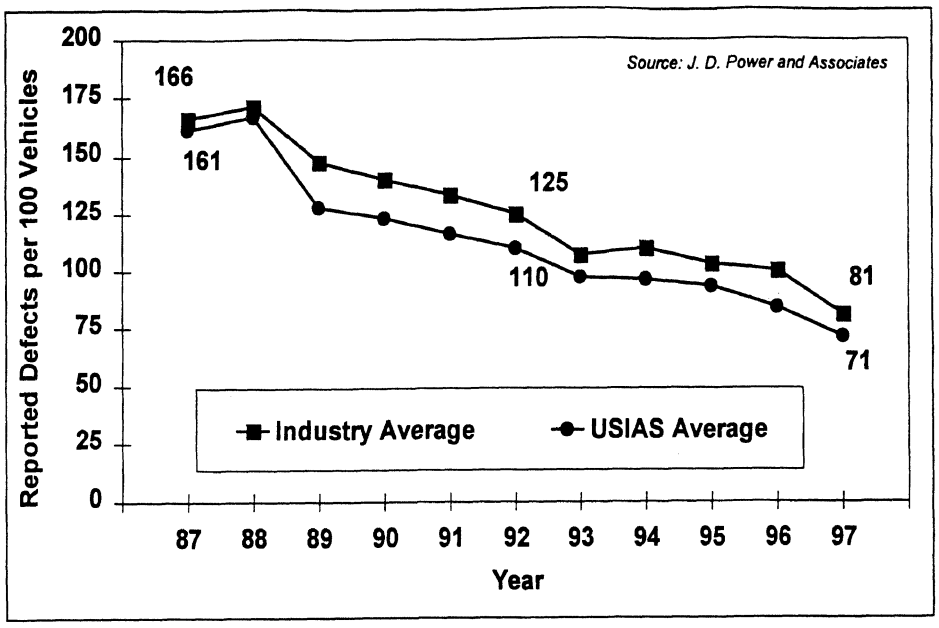

Figure ES.8
J. D. Power Initial Quality Survey 1987 - 1997

Many international automakers gained a foothold in the U.S. market by providing smaller fuel-efficient cars during the energy crises of the 1970s. Twenty-five years later, the USIAS maintains a combined corporate average fuel economy (CAFE) higher than the U.S. industry average. Figure ES.9 compares USIAS sales-weighted passenger car fuel economy performance with the overall U.S. industry average for: 1986, 1991, and 1996 (U.S. Department of Transportation 1997). The USIAS maintains its leadership in this area while shifting its product mix to include larger, more powerful vehicles.

[3]Special data provided to OSAT by J. D. Power in a letter dated November 13, 1997.

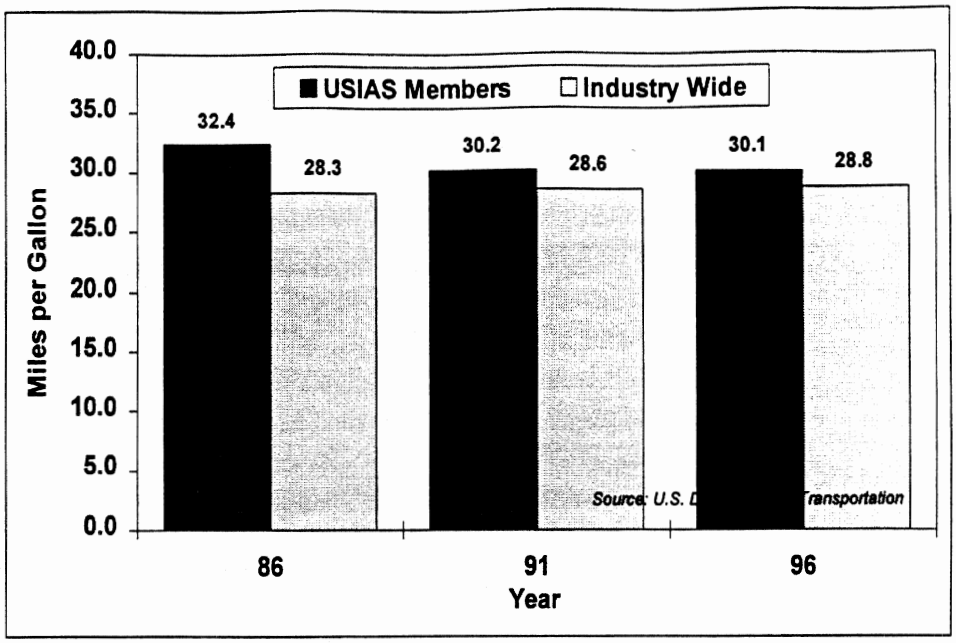

Figure ES.9
Corporate Average Fuel Economy: Passenger Car

Figure ES.10 shows the 1996 car models with the highest fuel economy performance ratings in the U.S. market. The thirteen most fuel-efficient cars are all offered by USIAS firms. More recently, as discussed in our study, USIAS vehicle makers have made significant breakthroughs in the development of new vehicle technologies needed to meet the environmental challenges of the twenty-first century.

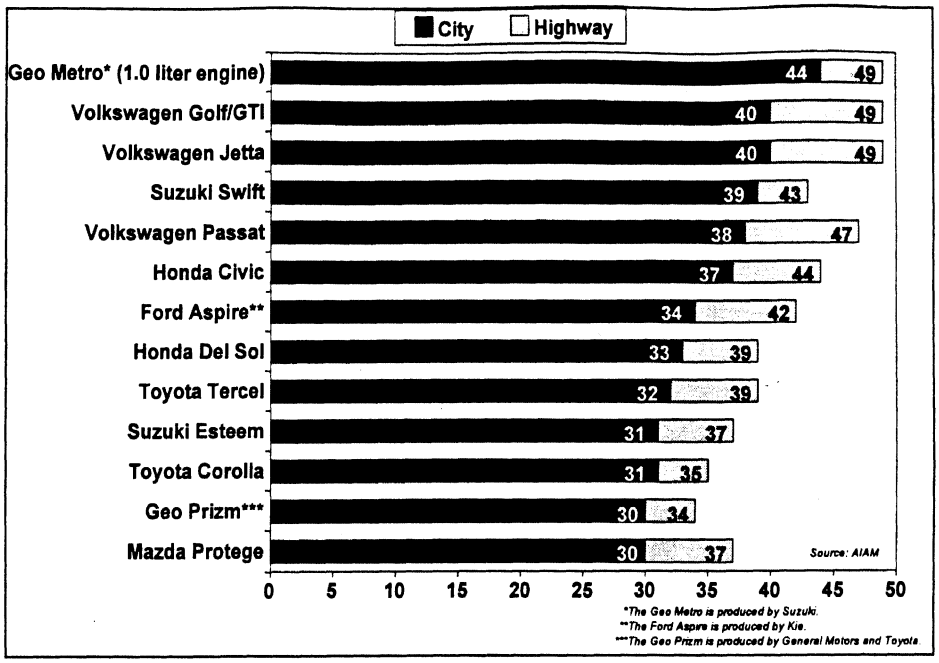

Figure ES.10
1996 Fuel Economy Leaders

Other noneconomic contributions made by the USIAS that are examined in this study include the important commitment by international automakers to the training of their new employees, and their contribution to the development of new education standards in the United States for future employees across all industries. The development of new partnerships between international automakers and American suppliers, involving the sharing of innovative management practices and technologies, are also identified as a major contribution in this study. Finally, the international automakers have made significant commitments and contributions to the communities in which they have located their manufacturing and nonmanufacturing facilities. These contributions include the establishment of a number of local, regional, and national education and charitable foundations.

PART 2

Estimates of the Economic Contribution of the International Auto Sector in the United States

Introduction

The fastest-growing segment of the motor vehicle and equipment industry in the 1980s and 1990s has been the United States international auto sector (USIAS). The statistics in part 1 of the full report confirm the USIAS's growing importance as a player in the domestic economy. Significant as they are, however, these statistics still understate the contributions of the USIAS, since they exclude motor vehicle dealer activities altogether, and they account for only its direct activity in manufacturing, ignoring spin-off activities. Spin-off activities are those that come from two sources: indirect effects, or purchases from domestic suppliers (for example, steel); and induced effects, or spending by people who receive income attributable to USIAS activity (for example, in restaurants). It is the sum of these direct and spin-off activities that determines the total contribution of the USIAS to the domestic economy.

The study should not be interpreted as representing the economic activity that would be lost if the USIAS did not assemble vehicles in the United States. There would be some replacement activity, and the economy would make other compensating adjustments over time. That is a different issue, and it is not the focus of this study. This study provides the most thorough estimates to date of the economic contribution currently associated with the presence of the international auto sector in the United States.

Results

The summary table (table ES.1) shows our estimates of the USIAS's contribution to the domestic economy for 1996. This contribution includes both direct employment and the spin-off jobs that result from its direct employment. Direct employment includes both manufacturing and support (including white-collar workers) and motor vehicle dealer activities.

Total Private Sector Activities Associated with the U.S. International Auto Sector*	
Direct employment	402,700
+ Spin-off employment	869,600
= Total contribution to employment	1,272,300
Employment multiplier (total ÷ direct)	3.2
Total contribution to compensation (wages, salaries, fringe benefits)	$49 billion
Contributions as a percentage of the total U.S. economy	
Employment	1.0%
Compensation	1.3%

*The following definitions will assist in interpreting the table. Employment is based on the total number of private sector jobs, including the self-employed. Compensation in the private sector consists of wage and salary disbursements, fringe benefits, and net incomes of owners of unincorporated businesses. The total number of jobs created (direct plus spin-off) for every direct job introduced constitutes the employment multiplier.

Table ES.1

Direct employment of 402,700 combined with spin-off employment of 869,600 produces a total contribution to private sector employment of 1,272,300. In summary, the employment contribution currently associated with the presence of the international auto sector in the United States is estimated to be about 1.3 million jobs in the private sector. The compensation contribution is estimated to be about $50 billion. Additionally, a reduction of transfer payments of about $4 billion is associated with the presence of the USIAS, and personal income tax revenues are increased by about $7 billion. The corresponding employment multiplier is 3.2. The employment multiplier can be interpreted in two ways: (1) there are 3.2 times as many total jobs generated as there are direct jobs, or (2) there are 2.2 spin-off jobs generated for every direct job. As shown in the table, the economic contribution of the USIAS in 1996 represents 1.0 percent of the private sector jobs and 1.3 percent of the private sector compensation in the U.S. economy. The compensation share is greater than the employment share because the jobs associated with USIAS activity are higher paid on average than the average job economywide.

Of the 1,272,300 job contributions for the country, 701,500 are in the eleven states where the USIAS has a significant presence in manufacturing and distribution, and 570,800 are in the rest of the United States. Of the $49 billion in compensation contributions, $29 billion can be attributed to the region with a significant presence in manufacturing and distribution, and $20 billion to the

balance of the country. Thus, although the contributions of the USIAS are smaller in the parts of the country where they do not have a significant presence in manufacturing and distribution, their contributions are nevertheless important there as well.

The contribution of the manufacturing and distribution activities of the USIAS to the domestic economy for 1996 is shown in the summary table that follows. Three other manufacturing industries are included as well, to provide some context: electronic computing equipment, household audio and video equipment, and telephone and telegraph apparatus. These three were chosen because they are important contributors to the new technology-based economy, all with a favorable outlook for the future. (All four of these industries include white-collar workers as well as production workers.)

USIAS manufacturing has a smaller number of jobs than do the others, albeit only slightly smaller than household audio and video equipment. On the other hand, the USIAS has the highest employment multiplier among these industries, reflecting the strong leverage these jobs have in the U.S. economy. The average compensation per job associated with USIAS activity—which includes compensation for both direct and spin-off jobs—is also highest, chiefly reflecting the comparatively high pay for the direct jobs. In fact, auto manufacturing's multiplier and its compensation level are among the highest of all manufacturing industries in the U.S. economy.

Private Sector Contributions of Selected Manufacturing Industries to the U.S. Economy, 1996

	Electronic computing equipment (SIC 3571-77)	Household audio & video equipment (SIC 365)	Telephone & telegraph apparatus (SIC 3661)	U.S. international auto sector: manufacturing & distribution
Employment				
Direct	313,100	82,700	112,800	68,800
Spin-off	1,203,600	389,000	509,100	381,200
Total	**1,516,700**	**471,700**	**621,900**	**450,000**
Multiplier (Total ÷ direct)	**4.8**	**5.7**	**5.5**	**6.5**
Compensation	**$65 billion**	**$19 billion**	**$26 billion**	**$20 billion**
Annual compensation per job	$42,900	$39,600	$41,600	$44,200
Contributions as % of total U.S. economy				
Employment	1.20%	0.37%	0.49%	0.36%
Compensation	1.68%	0.48%	0.67%	0.51%

Table ES.2

The international auto sector is associated with greater economic activity in the United States than has been estimated to date by the industry trade association, AIAM. This is undoubtedly the case as well for the traditional auto industry.

Methods

The general approach is to use a state-of-the-art economic model in conjunction with detailed survey data on the USIAS and the data from OSAT on productivity and domestic content discussed in part 1. We use a macroeconomic model of the U.S. economy constructed by Regional Economic Models, Inc. (REMI)—a model that has been fully documented and peer-reviewed in the professional literature. Primary data were collected in an independent survey of USIAS member companies by DesRosiers Automotive Consultants, Inc. The study is carried out for 1996, the most recent year for which we had this survey data on the USIAS. The research design combines the model and the data to generate estimates of the contribution associated with the USIAS's presence in the domestic economy.

In this study a number of important factors were accounted for in the comparison between the USIAS and the U.S. motor vehicle industry as a whole including,

(1) Differences in worker productivity were accounted for in motor vehicle assembly.
(2) Differences in domestic content were accounted for.
(3) Differences in the ratio of white-collar workers to blue-collar workers were accounted for.
(4) Pay differentials, although modest, were accounted for.
(5) The different geographic distribution of activity was accounted for.

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

STUDY INTRODUCTION

The motor vehicle industry is the largest manufacturing industry in the United States. No other single industry is linked to so much of U.S. manufacturing or directly generates so much retail business and employment. Our study describes the economic contribution of an important sector of the U.S. motor vehicle industry: the United States International Auto Sector (USIAS). The USIAS will be defined in this study as international automakers that sell passenger cars and light-duty trucks in the United States.[4]

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[4]The USIAS comprises the following motor vehicle firms: Acura, Audi, Bentley, BMW, Daewoo, Ferrari, Fiat, Honda, Hyundai, Infiniti, Isuzu, Kia, Land Rover, Lexus, Mazda, Mercedes-Benz, Mitsubishi, Nissan, Peugeot, Porsche, Renault, Rolls-Royce, Saab, Subaru, Suzuki, Toyota, Volkswagen, and Volvo.

PART 1

Scope and Significance of the International Auto Sector in the United States

Overview

Early History of the USIAS

From its very beginnings, the automotive industry has been an intensely international industry. The development of vehicles powered by internal combustion was pioneered in Germany in the mid-1880s. A few years later, in 1888, Daimler Motor Co. licensed William Steinway of New York City to sell the innovation in the United States. Daimler motor cars were frequent and dominant participants in early U.S. motor vehicle events, along with vehicles produced by Renault. In fact, the word *automobile* is French and reflects the location of the first mass market for motor cars in and around the Paris of the 1890s—a region with the finest paved roads in the world at that time.

International automotive firms also produced vehicles in the United States at the turn of the century. Daimler converted a Long Island, New York, facility for production of cars in 1905. This plant was followed by a longer-lived Rolls Royce facility in 1921. It is clear, however, that early contributions European firms were in the area of vehicle technology, while American firms contributed their greatest share of early innovation in manufacturing. Ford Motor Co. constructed its first European plant in 1912, and quickly spread its mass-production system across Europe. Ford was later followed overseas by General Motors (GM) in the 1920s. The example of these powerful American firms was dramatic, and their techniques were quickly copied by surviving international competitors. Ford and GM of Europe, who have long been considered integral parts of the European industry, are now accepted members of the European auto industry and the Western European economy, having a combined market share of 25 percent of the continental vehicle market for many years.[5]

The pattern of shared innovation in vehicle technology and production techniques across the world motor vehicle industry has continued to this day. Japanese producers are now the acknowledged masters of the most efficient and imitated production technologies; American-owned firms have contributed a number of innovative light truck designs in recent years (i.e., minivans and sport utilities). The first 100 years of the world motor vehicle industry provides conclusive evidence that

no national motor vehicle industry can develop or progress in isolation from the global industry. The historical record seems to indicate a pattern of rapid innovation by national motor vehicle industries subsequent to their exposure to significant international competition.

Sales of international motor vehicles in the United States are as old as the automobile itself. As table 1.1 documents, the majority of international motor vehicle firms have been selling vehicles in the United States for almost thirty years. The benefits of direct international competition, in terms of expanded consumer choice or price competition, are not debated in this study. Rather, a thorough accounting of a new period in international automotive presence is described, to provide the structure for our estimation of the current economic contribution of this industry to the U.S. economy.

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[5]For an excellent summary of the early international history of the developing world auto industry, see Flink 1988.

U.S. History of the USIAS	
Year	**Event**
1888	William Steinway becomes the American representative of Daimler Motor Co.
1895	Half of the cars in America's first auto race are Benzes.
1905	Steinway produces first American Mercedes under license at Long Island City, NY plant.
1906	First Rolls Royce exports to the U.S.
1921	Rolls Royce cars assembled in U.S.(through 1935).
1949	Jaguar imports commence, 1953 import company established.
1949	U.S. VW sales begin.
1950	Max Hoffman first sold Porsches in U.S.
1956	Saab Motors established in New York.
1956	Volvo importing company established.
1957	First Toyota sales in U.S.
1960	Max Hoffman began to import BMWs (through 1975 when BMW of North America took over).
1960	Nissan Motor Corp. U.S.A. established.
1968	Subaru of America established.
1969	Audi enters U.S. as division of VW of America.
1970	First Hondas sold in U.S.
1970	First Mazdas sell in U.S.
1978	VWA begins manufacturing of vehicles in Westmoreland, PA.
1980	American Isuzu Motors established.
1982	Mitsubishi Motor Sales of America established.
1985	American Suzuki Motor Company established.
1986	Acura Legend and Integra debut as first Japanese luxury brands in the U.S.
1986	Hyundai U.S. sales begin.
1986	Range Rover of America formed, name changed to Land Rover in 1992.
1987	Infiniti established.
1989	U.S. Lexus sales begin.
1994	U.S. Kia sales begin.

Source: Automotive News 1996, The 100-Year Almanac

Table 1.1

USIAS History during 1982-1996

The USIAS entered into a new relationship with the U.S. economy in 1978 when Volkswagen of America (VWA) purchased a Chrysler plant in Westmoreland, Pennsylvania, for the purpose of

assembling passenger cars. The 1970s saw record growth in the sale of high fuel economy USIAS vehicles in the U.S. market. The increase in sales was largely due to soaring demand for such vehicles in the wake of the energy crises. The Volkswagen plant was eventually followed by the construction of a Honda auto assembly plant in Marysville, Ohio. Honda had already been manufacturing large motorcycles at this site since 1979.

The start-up of the Honda Accord plant in November, 1982, may have marked a turning point in the traditional role of international competitors in the U.S. market. Nissan, USA, started a plant seven months later in June, 1983, in Smyrna, Tennessee, and it was quickly followed by Toyota's joint operations with GM in Fremont, California, in December, 1984 (see table 1.2). The start-up of these facilities is remarkable in light of the high value of the U.S. dollar in the 1979-1986 period. The USIAS plants were established essentially to satisfy strong demand for vehicles produced by these firms.

USIAS Assembly Facilities: 1996 Capacity

Company	Location	Car Capacity	Truck Capacity	Total Capacity	Actual 1996 Production	Employment	Investment ($Millions)	Start-up Date
AutoAlliance	Flat Rock, MI	240,000	-	240,000	129,441	3,665	1,000	9/87
BMW	Spartanburg, SC	90,000	-	90,000	50,278	1,350	400	9/94
Honda	Marysville, OH	430,000	-	430,000	424,462	5,800	1,700	11/82
	East Liberty, OH	230,000	-	230,000	209,912	2,500	659	12/89
Mercedes-Benz	Vance, AL	-	70,000	70,000	-	1,500	300	2/97
Mitsubishi	Normal, IL	240,000	-	240,000	192,961	4,000	650	9/88
NUMMI	Fremont, CA	240,000	150,000	390,000	365,469	4,600	1,700	12/84
Nissan	Smyrna, TN	310,000	140,000	450,000	414,031	6,000	1,350	6/83
Subaru-Isuzu	Lafayette, IN	90,000	90,000	180,000	194,871	2,300	670	9/89
Toyota	Georgetown, KY	400,000	-	400,000	385,657	6,000	3,000	5/88
AIAM Total		2,270,000	450,000	2,720,000	2,367,082	37,715	11,429	

Source: company reports

Table 1.2

As figure 1.1 illustrates, the USIAS sold 2.7 million vehicles in the United States in 1982. Fewer than 100,000 of these sales were vehicles produced in North America. In 1986, the USIAS set an all-time U.S. sales record of 4.7 million vehicles. U.S. sales of USIAS vehicles produced in North America had quadrupled since 1982, yet still constituted only 10 percent of total USIAS sales in 1986. The 1986-1996 period, however, saw a shift in the sourcing of the U.S. sales of the USIAS. As figure 1.1 shows, U.S. sales of imported USIAS vehicles continuously declined from a peak of 4.2 million units in 1986 to 1.7 million units in 1996, or a percentage decline of 59 percent. In the

same period, U.S. sales of North American-built USIAS vehicles continuously increased from a level of 0.5 million in 1986 to a level of 2.4 million in 1996, or a percentage increase of 480 percent. Figure 1.2 gives an alternative view of the shift in the sourcing of USIAS sales. U.S. sales of imported USIAS vehicles are plotted against U.S. produced USIAS vehicles during 1982-1996. As can be seen, U.S. production of USIAS vehicles equaled sales of imported vehicles in 1994, and exceeded import sales in both 1995 and 1996.

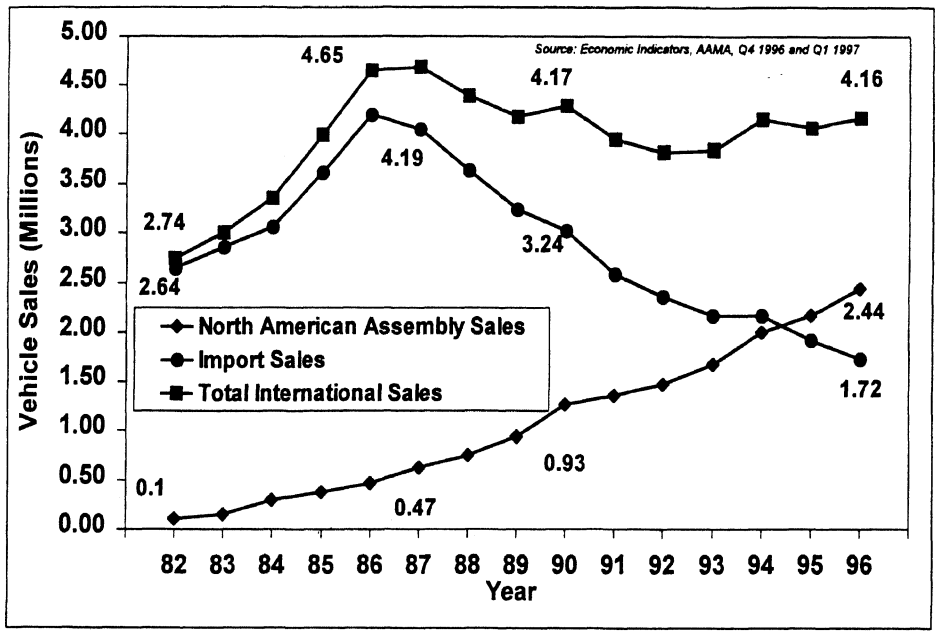

Figure 1.1
U.S. Vehicle Sales of USIAS 1982 - 1996

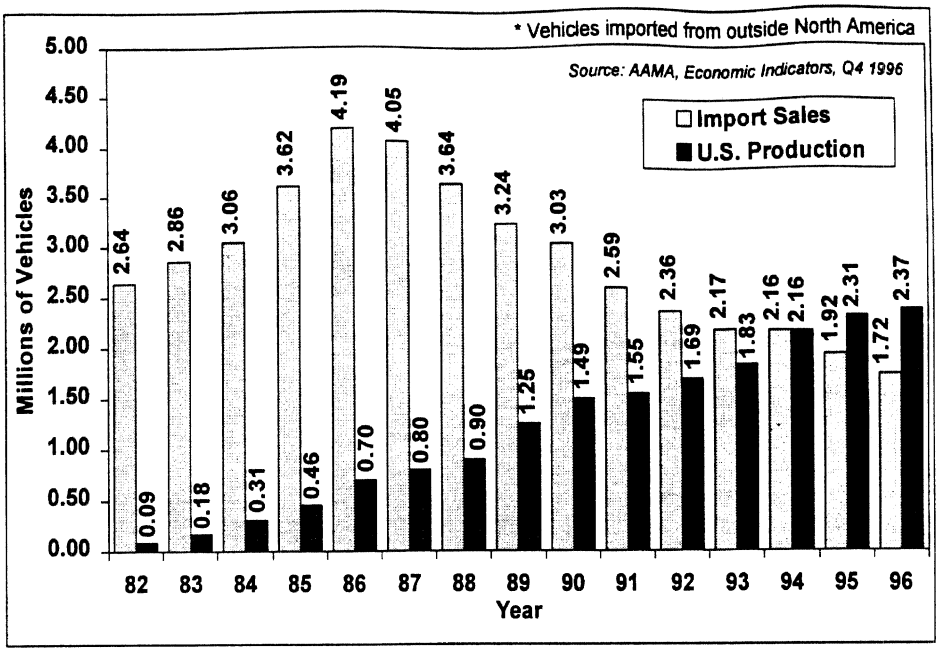

Figure 1.2
USIAS U.S. Vehicle Production and Sales of Imports* 1982 - 1996

The U.S. sales totals of the USIAS have been substantial for over two decades. Figure 1.3 presents the percentage market shares of total U.S. vehicle sales for the USIAS during 1982-1996. As shown, USIAS vehicles have comprised at least 25 percent of U.S. vehicle sales since 1985. Finally, figure 1.4 shows that if USIAS U.S. sales in 1996 were ranked against national markets worldwide, sales of international vehicles in the United States would rank third—between the total national vehicle markets of Japan and Germany.

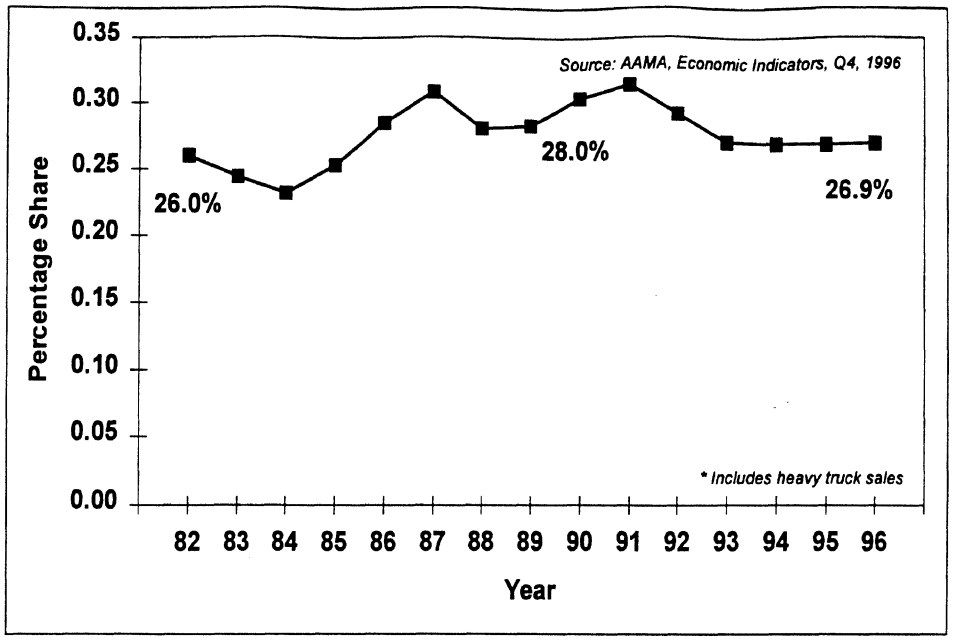

Figure 1.3
USIAS Share of U.S. Vehicle Market* 1982 - 1996

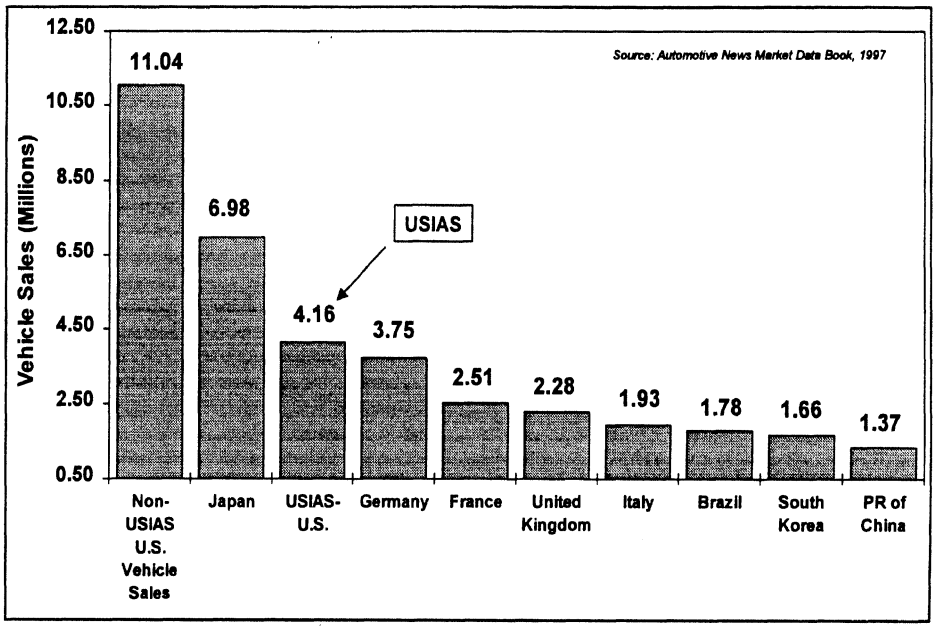

Figure 1.4
Top 1996 National Sales Markets

The real story of the growth of the USIAS in the U.S. economy, of course, is the sector's ever-increasing domestic production of vehicles. The USIAS's share of total U.S. light vehicle production is shown in figures 1.5 and 1.6. The latter illustrates the rapid acceleration of the USIAS's share of U.S. production with the start-up of many of their initial plants during 1982-1991. The USIAS's share of U.S. production temporarily reached a plateau of about 17.5 percent during 1991-1994, only to rise again in 1995 and 1996 to achieve a new peak of 20.1 percent.

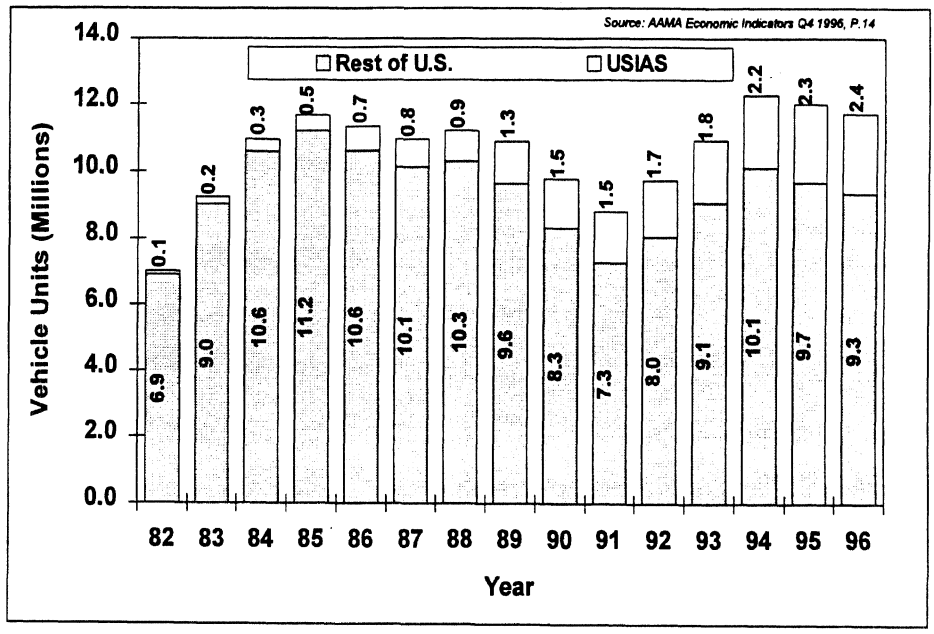

Figure 1.5
U.S. Light Vehicle Production 1982 - 1996

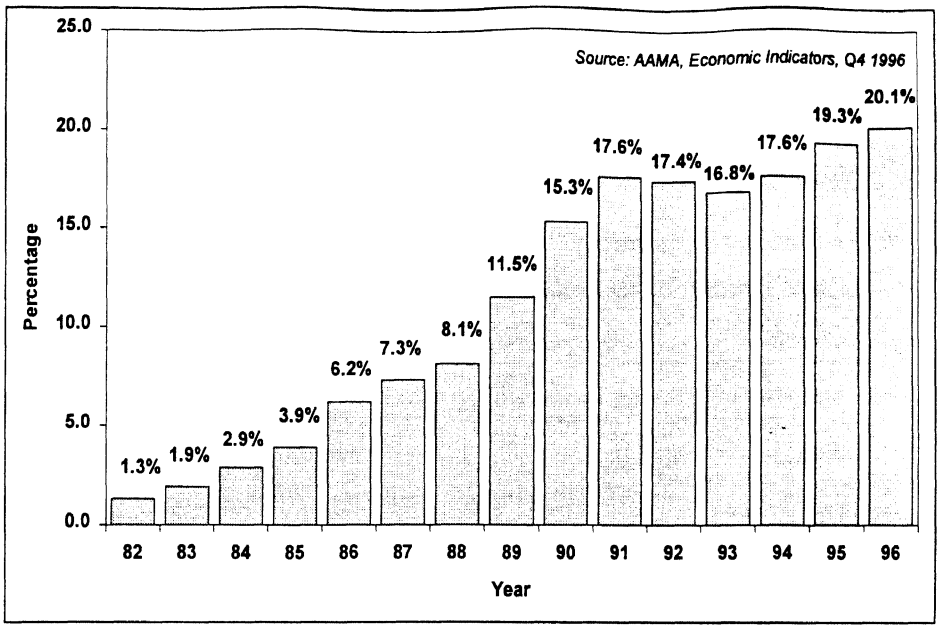

Figure 1.6
USIAS Share of Total U.S. Vehicle Production 1982 - 1996

The current 20 percent USIAS share of U.S. production will soon be exceeded with the construction of new plants, the further expansion of current facilities, and the ramp-up to capacity of the new BMW and Mercedes-Benz plants.[6] Even at current levels, if 1996 USIAS U.S. production is ranked against the motor vehicle output of other countries, as shown in figure 1.7, the USIAS would be placed just below Canada and above the United Kingdom. Also, USIAS producers now manufacture powertrain components, vehicles, and stampings in the United States (see table 1.3). The level of U.S. powertrain production is also expected to rise in the near term, raising once again the USIAS's level of local purchasing of U.S.-made parts and components. The 1996 USIAS shares of U.S. light motor vehicle and vehicle engine capacities are shown in table 1.4. These shares were calculated using figures contained in the well respected *Harbour Reports—1997* (Harbour and Associates, Inc. 1997). The 22 percent share of vehicle capacity

[6]For example, Toyota has recently commenced minivan production at its Georgetown assembly facility and plans to increase total vehicle assembly capacity there by 100,000 in 1998. In the fall of 1998, Toyota will open a pickup assembly facility in Princeton, Indiana, with potential output of 100,000 light trucks and an engine plant in Buffalo, West Virginia, with a capacity of 300,000 units. Nissan plans to begin transaxle production in the spring of 1998 at its Decherd, Tennessee, facility with the potential to produce 200,000 units. Figures reported by company staff in response to OSAT phone inquiries.

and 14 percent share of engine capacity reflect the $12.3 billion the USIAS has invested in its major production plants since 1982, and the hiring of over 41,000 workers at these plants.

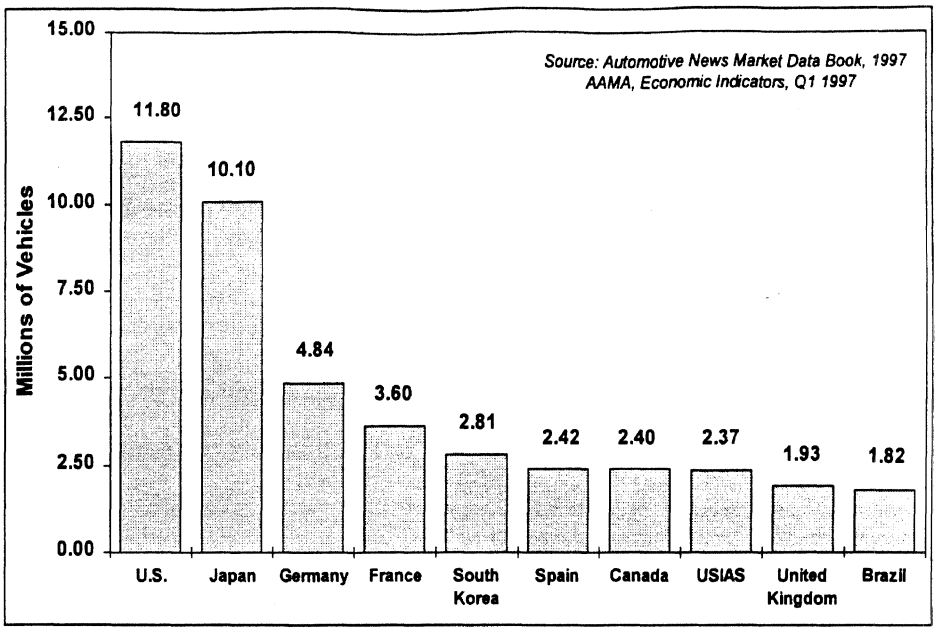

Figure 1.7
Top 1996 National Motor Vehicle Industries Production

1996 USIAS Powertrain Facilities					
Company	**Location**	**Capacity: Engines**	**Capacity: Transaxles**	**Employment**	**Investment ($ millions)**
Honda	Anna, OH	720,000	200,000	2,400	870
Nissan	Decherd, TN	200,000	N.A.	200	30
Toyota	Georgetown, KY	574,000	N.A.	850	N.A.

Source: company reports

Table 1.3

USIAS U.S. Capacity in 1996		
	Capacity	**Share of U.S. Capacity**
Vehicles *	2.7 million	22%
Engines **	1.5 million	14%

*Source: company reports, * Automotive News Market Data Book, ** Harbour & Associates, 1997*

Table 1.4

How much of the reemergence of the U.S. auto industry's prominence can be attributed to the USIAS? The Japanese motor vehicle industry set a world record output level of 13.5 million vehicles in 1990, as shown in figure 1.8. That same year, the U.S. motor vehicle industry produced about 9.9 million vehicles. In 1996, the Japanese industry produced only 10.2 million vehicles of all types, and the U.S. industry had increased its output to 11.8 million vehicles. Yet, as figure 1.5 shows, 0.9 million units, or 47 percent of the 1.9-million-unit increase in U.S. production, occurred at USIAS facilities. In fact, the same figure of 0.9 million represents about 27 percent of the decline in Japanese motor vehicle production during 1990-1996. If the USIAS had not contributed its share of the positive comeback achieved by the U.S. motor vehicle industry—largely by transferring production from Japan to the United States—the Japanese motor vehicle industry would still hold the title of the largest national motor vehicle industry worldwide.

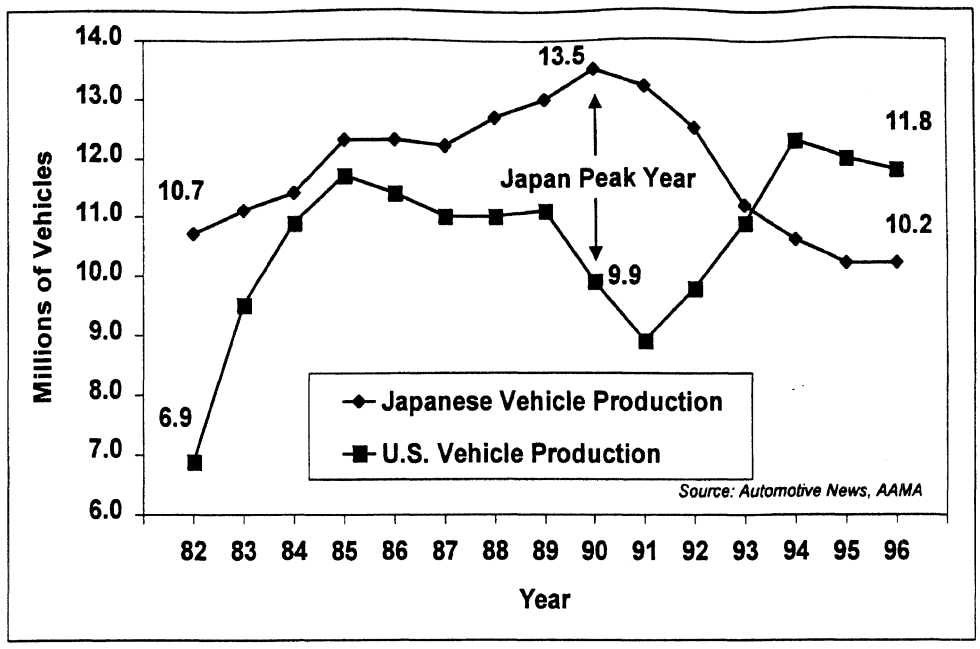

Figure 1.8
U.S. and Japanese Total Vehicle Production 1982 - 1996

AIAM Survey Information

An annual survey has been conducted on behalf of AIAM by DesRosiers Automotive Consultants Inc. since 1995. The general purpose of this membership survey is to measure the contribution of USIAS activities to the U.S. economy. The 1997 survey was enlarged and changed somewhat to provide special information for this study's estimation of the total economic contribution of the USIAS (DesRosiers 1997). The comprehensive survey contains two major sections: a national section that measures 1996 vehicle sourcing, manufacturing output, vehicle domestic content, employment, payroll, and purchasing by all types of USIAS activity; and a regional section that covers a smaller set of measures on a state-by-state basis. The detail contained in the survey is extensive and includes information on such contributions as taxes and tariffs paid, as well as charitable contributions made by member firms in the United States. The material on employee compensation and state-by-state economic activity is particularly useful for this study. The results pertain only to light vehicle operations and sales. Highlights of the AIAM survey results for 1992-1996 are reviewed in this section to provide background for our overall estimation of the USIAS's contribution to the U.S. economy.

USIAS-U.S. vehicle sales and production data are reviewed in the overview section of this report. The AIAM survey provides some additional detail on the sales destinations of USIAS produced vehicles. Figure 1.9 shows that exports of USIAS vehicles to the rest of the world (ROW) outside of North America increased by 71 percent during 1992-1996. The USIAS share of total U.S. auto industry exports to the rest of the world, outside of North America, rose from 27 percent in 1992 to 36 percent in 1996. About 8 percent of USIAS output is exported to destinations outside of North America. This share is certainly above that for the U.S. motor vehicle industry as whole, and it is a significant contribution to U.S. economic growth through export sales.[7]

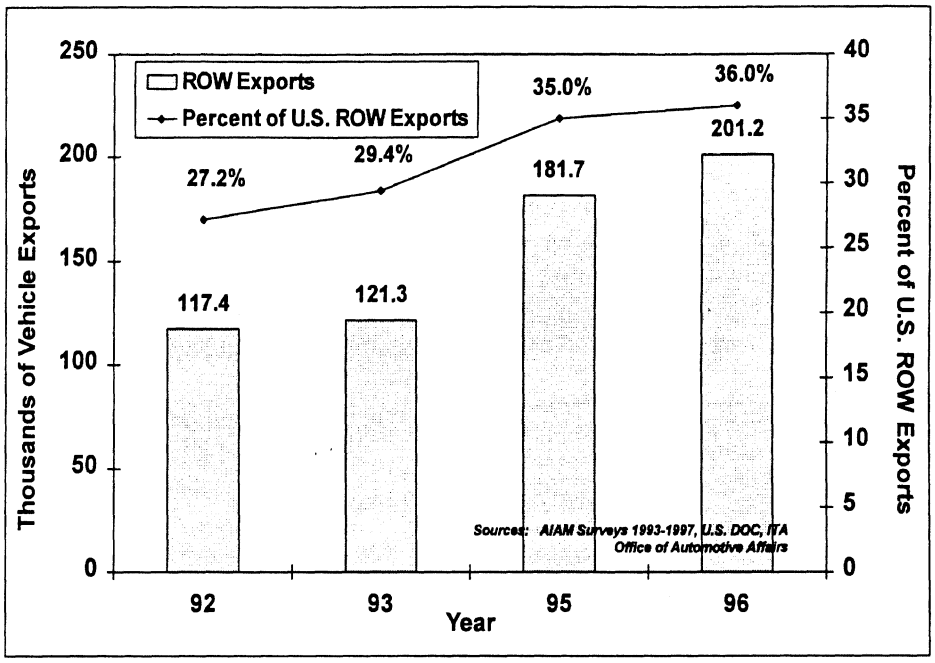

Figure 1.9
USIAS Vehicle Exports and Share of U.S. Vehicle Exports to Rest of World (Excluding Canada/Mexico)

The most recent AIAM survey shows that the USIAS directly spent about $43.2 billion on all types of purchasing and employee compensation in 1996. This total does not include taxes and tariffs paid that year, or charitable contributions.[8] A detailed breakout of 1996 spending is shown in figure 1.10. About 57 percent of USIAS spending is on purchases of U.S.-produced parts, components, and materials ($23.1 billion), as well as other goods and services by international

[7]For example, total U.S. vehicle exports to countries outside of North America were 560,263 in 1996. About 5 percent of total U.S. production was exported to other markets not including Mexico and Canada. See U.S. Department of Commerce, International Trade Administration 1997.

[8]The sum of these payments to taxes and tariffs, plus charitable contributions, is $2.56 billion in 1996 (DesRosiers 1997).

automaker manufacturing facilities ($1.5 billion). The second-largest category of spending is "Other purchases," not including spending on advertising or transportation. "Other purchases" includes expenses for goods and services used in engineering and design activities, automotive parts purchased by dealerships, and other goods and services bought by operations in sales, distribution, finance, and port services.

Figure 1.10 includes total spending in 1996 on employee compensation in both manufacturing and nonmanufacturing. Compensation includes amounts paid to employees in the form of wages and salaries, as well as the cost of total benefits. The final two categories in figure 1.10 are 1996 investment spending on all types of plant and equipment ($2.5 billion) and expenses for advertising and transportation ($4.1 billion).

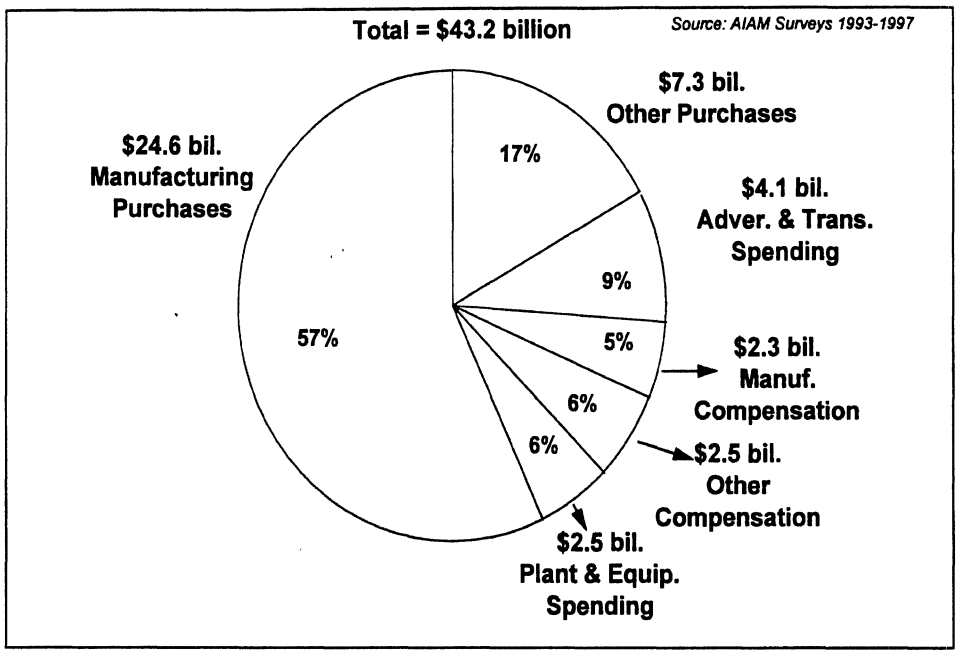

Figure 1.10
USIAS 1996 Spending (U.S. Dollars)

Previous AIAM membership surveys provide evidence of the increasing contribution of the USIAS to the U.S. economy. As shown in figure 1.11, total spending by the USIAS increased by 47 percent during 1992-1996. The largest percentage increase was in total purchases, which rose by 54 percent over the period, to almost $36 billion in 1996.

The fastest-growing component of purchasing is manufacturing purchases of U.S.-made parts, components, and services, which increased by 90 percent during 1992-1996. In fact, the AIAM survey for 1996 reported that there were 2,441 U.S. suppliers of parts and components, and 21,054 U.S. suppliers of other goods and services for USIAS manufacturing facilities. These are large numbers indeed, even though it is very likely that some of these companies are counted more than once across the responding automakers.

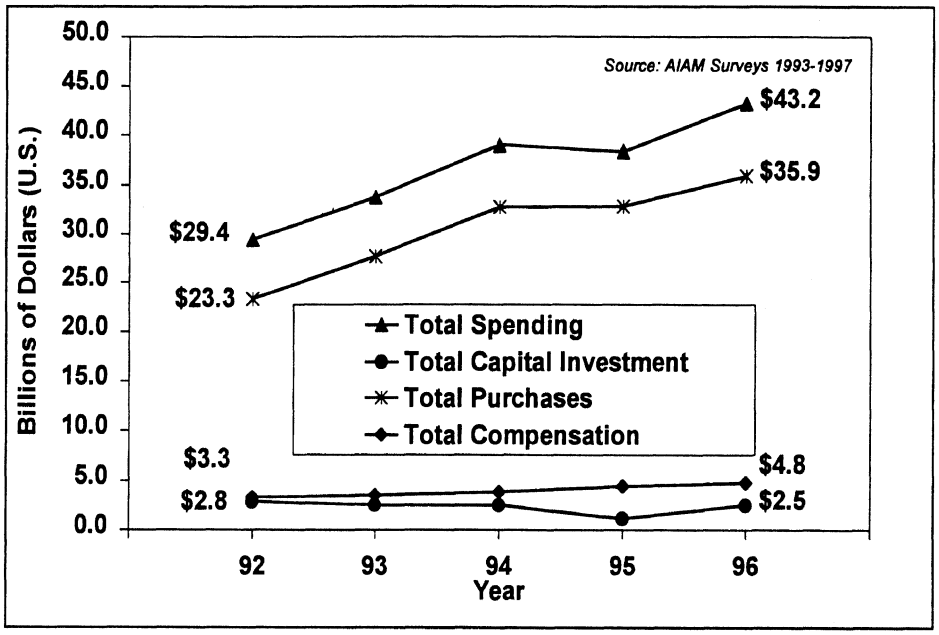

Figure 1.11
USIAS Expenditures in the U.S. 1992 - 1996

A breakout of capital spending on plant and equipment for 1992-1996 is shown in figure 1.12. Total spending in this category naturally rises and falls with the construction of new capacity, although annual spending on special tooling is a steady $0.5 billion during 1992-1996.

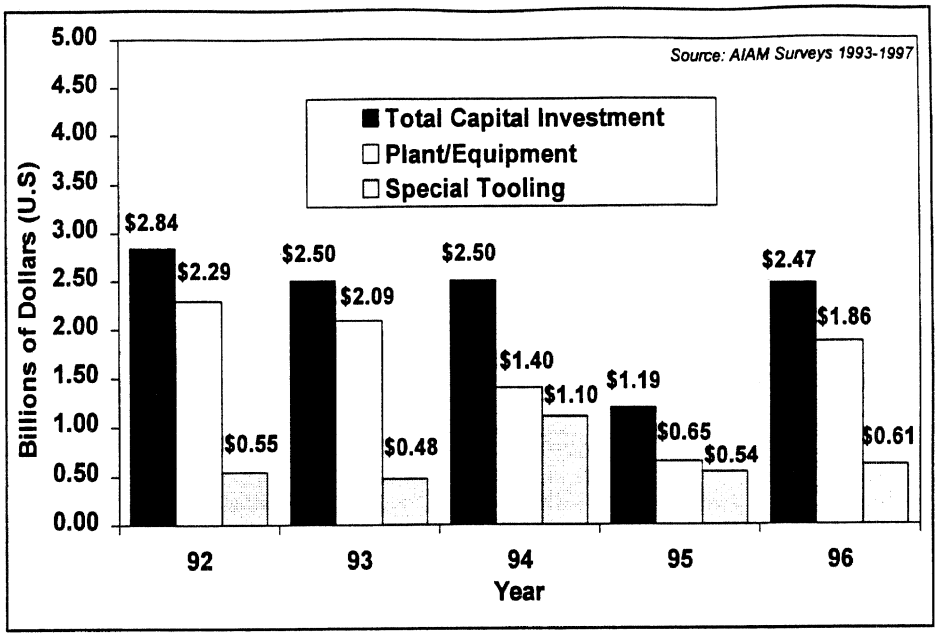

Figure 1.12

Total New Capital Investment: USIAS: 1992 - 1996

The second-fastest growing category of U.S. spending is employee compensation, which increased by 45 percent during 1992-1996. Figure 1.13 provides survey information on USIAS employment totals for 1992-1996. Total USIAS employment grew by 18 percent during the period, and manufacturing employment grew by 23 percent. Employment growth tells only part of the story, however, of the increase in employee compensation.

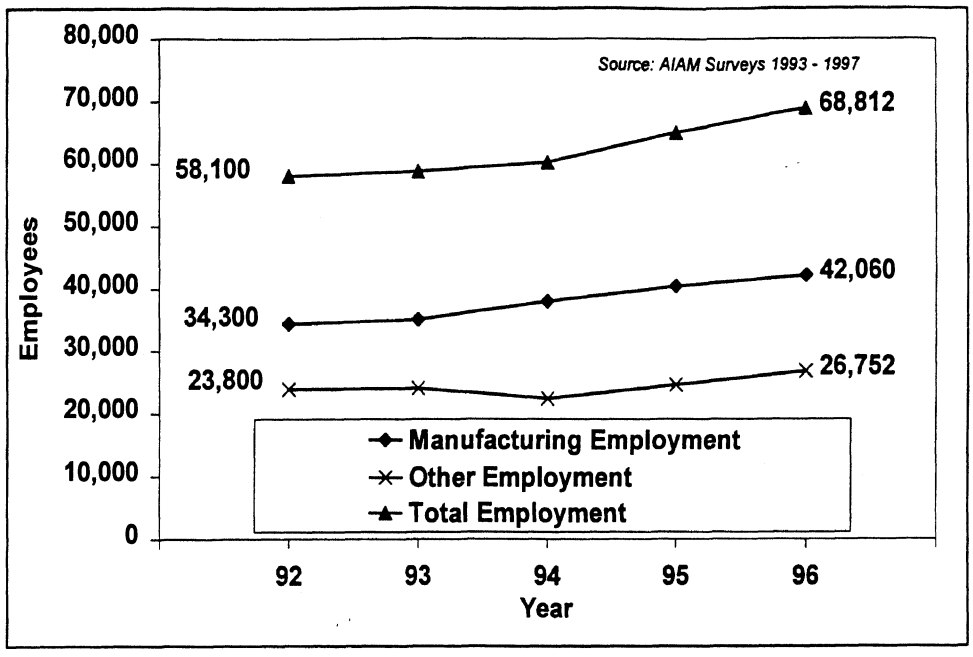

Figure 1.13
USIAS Employment 1992 - 1996

Figure 1.14 combines reported employment totals with information from the AIAM surveys on employee compensation, both manufacturing and nonmanufacturing, yielding employee compensation averages for 1992-1996. As can be seen, average compensation for all employees rose 23 percent over the period—from about $56,000 in 1992 to almost $70,000 in 1996. Nonmanufacturing compensation rose from an average of about $76,000 to an impressive $93,000 per employee. Manufacturing employee compensation rose by an even greater percentage (29 percent), from $43,000 to $55,000; this category reflects compensation for about 60 percent of USIAS employment.

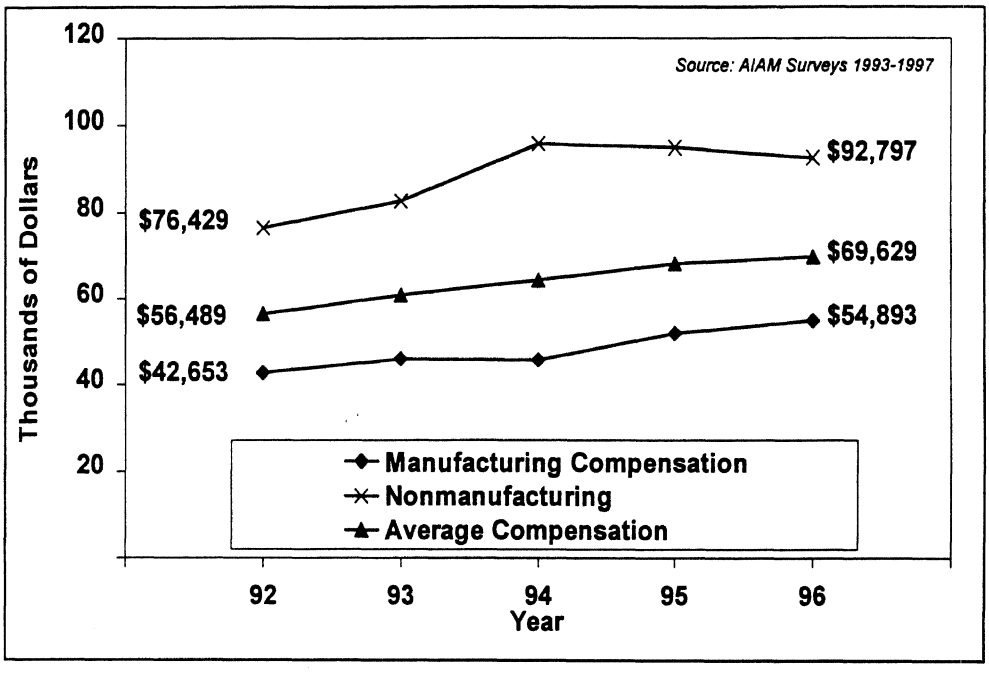

Figure 1.14
Average USIAS Employee Compensation 1992 - 1996

The employment and employee compensation data shown in figures 1.13 and 1.14 are important parameters for the economic contribution section of this study. Also important are U.S. purchasing averages per vehicle sold and per vehicle manufactured in the United States. Figure 1.15 shows two series of estimates for these averages. The average of total spending per vehicle sold is computed by dividing the total spending levels shown in figure 1.11 by corresponding total USIAS vehicle sales. As figure 1.15 shows, total U.S. spending by USIAS firms rose from about $7,696 per vehicle in 1992 to $10,371 in 1996—an increase of 35 percent.

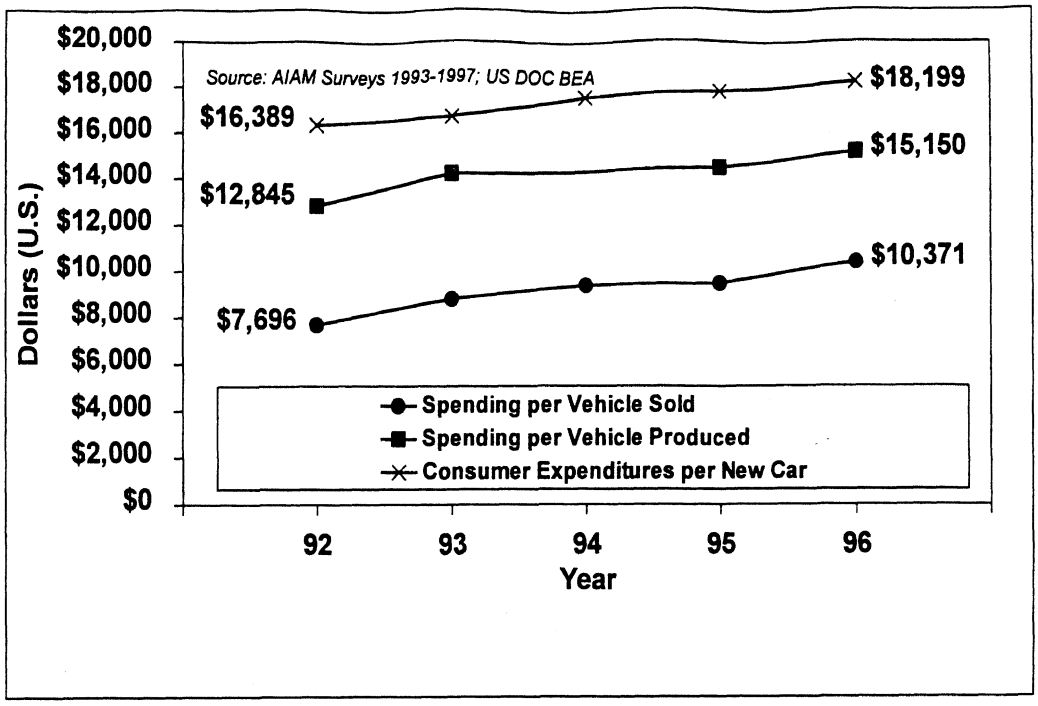

Figure 1.15
USIAS Spending per Vehicle Sold and per Vehicle Produced
1992 - 1996

Spending increases are also observed for U.S.-assembled USIAS vehicles. In this case, manufacturing purchases and capital spending on manufacturing plant and equipment are combined with a proportional share of other spending categories, such as advertising or transportation, to yield an estimate of total spending related to sales of U.S.-built vehicles. Our results indicate that the USIAS spent about $12,845 per domestic vehicle in 1992 and about $15,150 per domestic vehicle in 1996, or an increase of about 18 percent.

Figure 1.15 also contains a series of estimates of the average consumer expenditure for a new, domestic-built, passenger car. The average expenditure for 1996 was $18,199 (American Automobile Manufacturers Association 1997). Our estimate, then, of USIAS U.S. spending per domestically-produced vehicle is about 83 percent of the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) 1996 expenditure average. This percentage is higher to the weighted domestic content (EPA/CAFE calculation) percentage of 76.1 percent reported in the AIAM survey for 1996.

The survey results provide valuable information for this study's estimate of the contribution of the USIAS to the U.S. economy. The AIAM survey, however, covers only employment, compensation,

and purchasing activity of the international vehicle firms. Many observers would claim that our definition of the USIAS in this section—basically the AIAM membership—is limited. In part 2, we provide an expanded estimate of the USIAS's total contribution, using an economic model of the United States.

Other Economic and Noneconomic Contributions

Contributions to the performance of a nation's economy can be made in other areas apart from direct employment, income, or investment. Other positive changes often introduced by international industries include new technologies, product innovations, and the development of new economic activities not present before the appearance of international firms. The USIAS can certainly claim that it has provided a host of such improvements, even if only through the harsh process of competition. In particular, this section discusses the well known differences in productivity that still exist between USIAS manufacturing operations and the traditional U.S. motor vehicle industry. Other differences in vehicle technology in the areas of fuel economy, vehicle emissions, and performance are also examined. Finally, the issue of "vehicle domestic content" is subjected to a corrected analysis, providing an update of final "U.S. domestic content" that is meant to improve this study's final estimation of USIAS contributions to U.S. economic activity.

Productivity Differences

The superior manufacturing productivity performance of the major Japanese vehicle assemblers is acknowledged by almost all industry observers. It is also recognized that management and system technologies have been exported successfully from Japan to the U.S. operations of the USIAS. The effect of these now "in-country" techniques on the current restructuring of the U.S. domestic industry cannot be underestimated. A host of private consulting firms, and even some academic programs, now exist for the purpose of spreading these techniques. The efforts of the Japanese firms themselves—working with U.S. domestic auto suppliers and other service providers to transfer these systems through special programs—are well known.

How much of the rapid pace of current productivity improvements in the total U.S. auto industry is due to the powerful competitive example of USIAS firms? Perhaps the answer is that the current

influence of Japanese management technology is similar to that exerted by Ford's mass production system on the European auto industry in the 1920s. Also similar to Ford in the 1920s, the example of Japanese manufacturing technology has spread to many areas of the economy outside of the motor vehicle industry.

Our estimation of the USIAS's contribution to the U.S. economy must take into account productivity differences between USIAS manufacturing operations and those for the U.S. motor vehicle industry as a whole. We use employment, output, and productivity data taken from the widely respected Harbour & Associates, Inc., annual report, *The Harbour Report, 1997*, to create a series of comparative ratios for three major areas of manufacturing productivity. The three areas are (1) vehicle assembly (SIC 3711, motor vehicle and motor vehicle body manufacturing), (2) engine assembly (SIC 3714, motor vehicle parts and accessories), and (3) major automotive stampings (SIC 3465, automotive stampings).

Both total U.S. industry and USIAS ratios for 1996 are calculated for each of the major operations. Similar ratios are also computed for 1994 and earlier years using information from previous reports by Harbour and Associates (1994, 1995). Brief descriptions of the formulas we use in this analysis follow.

Vehicle assembly: The productivity measure for assembly is workers, per vehicle produced, per day. The total U.S. industry and USIAS assembly ratios are calculated by aggregating assembly employment and daily output of each assembly facility, then dividing total employment by total daily output. Unfortunately, there is no correction for vehicle content or type.

Engine assembly: The productivity measure for engine manufacturing is hours per engine; Harbour provides a content-adjusted figure they refer to as "strategic content hours." Separate U.S. total industry and USIAS aggregates of "strategic content hours" are divided by aggregate 1996 engine production for total U.S. and USIAS motor vehicle engine plants. The productivity measure is "hours per engine."[9]

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[9]Harbour's 1994 results are not reported in terms of "strategic content hours." Therefore, the number of engine plant employees was multiplied by eight hours to produce a ratio similar to that reported in the 1997 report.

Major stampings: The construct "equivalent stamped vehicles" (a Harbour sourcing adjustment) is divided by actual hours worked by stamping employees to calculate a productivity ratio, hours per vehicle. Once again, this calculation was performed for both the total U.S. industry and the USIAS stamping plants.[10]

The differences in 1996 productivity revealed in this simple comparison of major operations are impressive. Compared with the U.S. auto industry as a whole, USIAS manufacturing plants enjoy a 26 percent labor productivity advantage in assembly of vehicles, a 44 percent productivity advantage in the assembly of engines, and an 80 percent labor productivity advantage in the production of major stampings. These percentage differences are calculated using the results shown in table 1.5. The differences are even more significant when it is considered that USIAS plant performance is used in the calculation of overall U.S. industry numbers.

OSAT Productivity Calculations: USIAS vs. U.S. Motor Vehicle Industry Comparison

	(1) Overall U.S.	(2) USIAS	Output per Worker (1 ÷ 2)
Vehicle Assembly			
1996 WPV*	3.23	2.57	26%
1993 WPV*	3.49	2.86	22%
Engine Assembly			
1996 Hours per Engine	5.01	3.49	44%
1994 Hours per Engine	4.99	2.47	102%
Vehicle Stamping			
1996 Hours per Vehicle	4.40	2.45	80%
1994 Hours per Vehicle	5.05	2.45	106%

* Workers Per Vehicle per day

Source: Harbour & Associates, Inc., The Harbour Report 1997, 1995, 1994.

Table 1.5

[10]Canadian and Mexican stamping facilities were included in stamping calculations since they supply multiple assembly facilities, many of which are in the United States. The inclusion of these facilities did not skew the results substantially: the U.S. hours-per-vehicle ratio, which was 4.40, would have been 4.42 had Canadian and Mexican operations not been included. Similarly, the USIAS calculation, which was 2.45, would have been 2.48 had Canadian and Mexican operations not been included. In 1994, Harbour adjusted employment

It is ironic that the superior level of productivity enjoyed by USIAS's U.S. manufacturing plants would appear to reduce their apparent economic contribution to the economy in terms of gross employment. Consumers benefit, however, from receiving the same level of value at reduced cost due to such productivity, and the economy benefits from increased resources—and thus output—due to the reduction in required input in auto manufacturing. The productivity ratios in table 1.5 were used in part 2 of this report to estimate the economic contribution of the USIAS.

Vehicle Domestic Content

Critics of USIAS manufacturing investment have frequently charged that USIAS produced vehicles contain less "U.S. content" than traditional domestic vehicles. U.S. content typically refers to the percentage of U.S.-produced parts and components assembled into the vehicle (measured in dollars or other units). It takes some time, however, to increase the level of domestic content of vehicles produced by international firms, especially when there are separate manufacturing systems involved. USIAS firms have tended to increase their content with increases in their scale of production in the United States. Local suppliers have to be trained in new systems and adjust their methods and capacities accordingly. Finally, significant changes in domestic content would probably occur only with the introduction of new models on a cyclical basis. There is solid evidence that the USIAS's domestic content has risen steadily in recent years.

The U.S. Environmental Protection Agency (EPA) mandates domestic content calculations for each model sold in the United States as part of the overall Corporate Average Fuel Economy (CAFE) reporting program. The AIAM survey asks each member firm to report its U.S.-produced vehicle EPA/CAFE content percentages. These percentages are then used by the AIAM to create a weighted USIAS overall domestic content percentage for USIAS vehicles built in the United States. The AIAM survey results for the 1993-1997 model years are shown in figure 1.16. This chart shows a steadily increasing domestic content percentage of USIAS vehicles produced in the United States, except for 1996, when average domestic content jumped by 4.3 percentage points over the 1995 level.

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rather than vehicles for content purposes. Consequently, in order to create a comparable ratio, the number of workers was multiplied by 8 hours to enable the calculation of hours per vehicle.

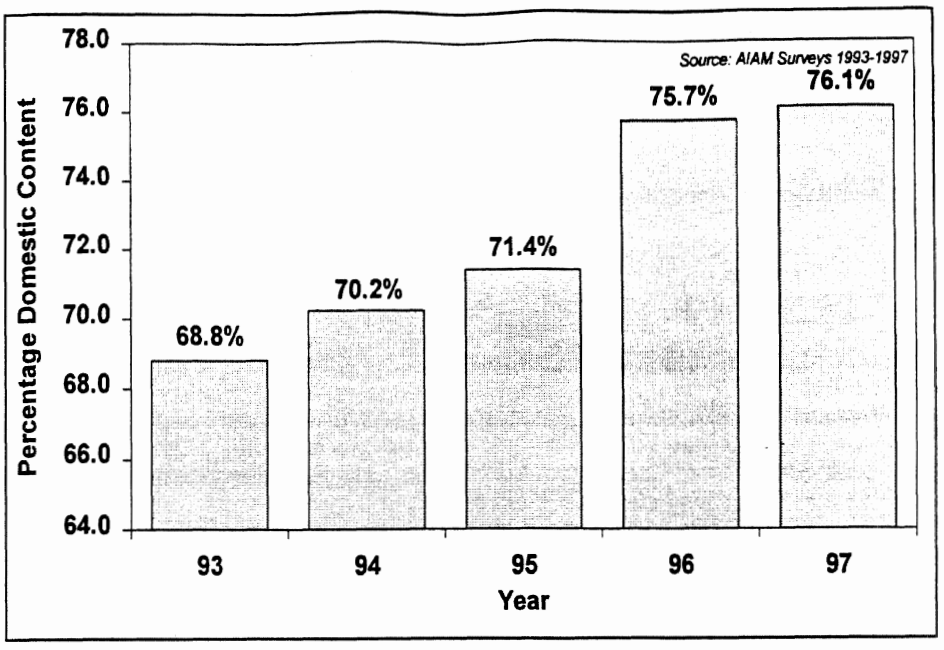

Figure 1.16
USIAS Domestic Content 1993 - 1997 Model Years (U.S. -produced model vehicles)

The Office for the Study of Automotive Transportation (OSAT) at the University of Michigan obtained 1996 model domestic content ratios from the EPA for each U.S.-produced traditional domestic vehicle. The 1996 model content percentages are weighted by actual 1996 calendar-year U.S. production. This gives a measure of *equivalent* U.S. vehicle production units for each vehicle.[11] The aggregate of the *equivalent* U.S. vehicle production of all vehicles was divided by the aggregate of the actual output of the same U.S. vehicles, providing a weighted average domestic content of 89.2 percent for traditional domestic vehicles. Similarly, the aggregate of USIAS *equivalent* U.S. vehicle production was divided by the aggregate of USIAS actual output of U.S. vehicles, to arrive at a weighted average domestic content of 76.1 percent for USIAS-produced U.S. vehicles.

These initial ratios are then adjusted to remove Canadian parts content, included in the CAFE content measure.[12] The final adjusted estimate of U.S. content is 77.6 percent, while the USIAS

[11]Non-AIAM EPA/CAFE content percentages provided by companies, April, 1997, through July, 1997, at OSAT's request.

[12]OSAT's Technology Delphi IX, Question 27 (1997) round one results estimates of Canadian parts content were used. An assembly value-added ratio of 20 percent was subtracted from the initial content ratios. The resulting parts value-added figures were multiplied by the ratio of U.S. components to U.S.-Canadian

adjusted ratio is 69.3 percent. These two adjusted content percentages were used in part 2 of this report to estimate the economic contribution of the USIAS.

Noneconomic Contributions

The USIAS has also made significant noneconomic contributions to the U.S. automotive industry, automotive consumers, and the many communities that are home to USIAS facilities. These improvements include overall vehicle quality, automotive supplier performance, increased fuel economy, and local social contributions. A short review of these additional contributions of the international motor vehicle industry makes it apparent that the many USIAS companies bring unique strengths that contribute to the increased competitiveness of the U.S. automotive industry and the well-being of U.S. automotive consumers.

Initial Quality

The Initial Quality Survey, released annually by J. D. Power and Associates, a U.S.-based consulting and market research organization, has become an accepted industry standard for measuring vehicle quality. The Initial Quality Survey began in 1987. The data comprise customer-reported new vehicle defects during the first 100 days of ownership. J. D. Power reports these survey results on a defect-per-100-vehicles basis. Figure 1.17 shows the sales-weighted industry average and the USIAS average for the Initial Quality Survey from 1987 to 1996.[13] Over the past nine years, the USIAS average has been lower than the industry average. Reported defects for USIAS vehicles were, on average, approximately 50 percent lower in 1997 than 1987. The USIAS has set a high standard for quality, and the IQS data suggest that the rest of the industry has followed its lead.

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components sourcing indicated in the Delphi Forecast. Then the assembly value-added ratio of 20 percent was added back.

[13]Special data provided to OSAT by J. D. Power in a letter dated November 13, 1997.

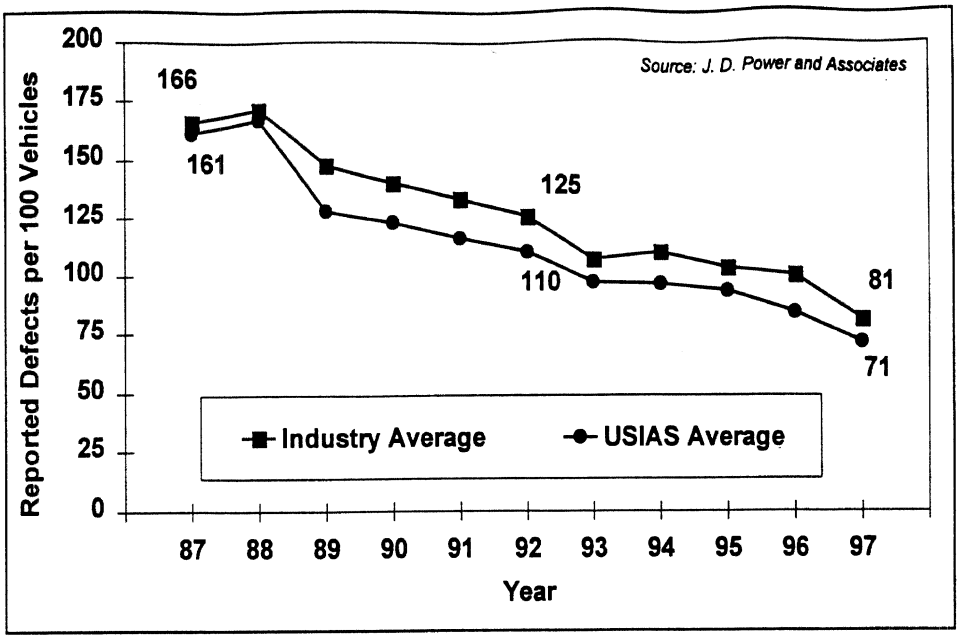


Figure 1.17
J. D. Power Initial Quality Survey: 1987 - 1997

Supplier Development

Another area in which the USIAS has contributed value to the U.S. automotive industry is in the development of the automotive supply base.

For example, Toyota has been manufacturing vehicles in the U.S. since 1984, first at NUMMI, its joint venture with General Motors, and later at its own facility in Georgetown, Kentucky. In the past thirteen years, Toyota has expended considerable effort working with its U.S. suppliers to assist them in becoming more competitive. To this end, the Toyota Supplier Support Center (TSSC) in Georgetown, Kentucky, has been established to assist local suppliers in developing lean manufacturing practices. While many manufacturers have exerted similar effort to develop their own supply bases, the TSSC has taken supplier development a step further and is open to any supplier, not just those that supply Toyota. The premise is that opening the TSSC to all interested suppliers will increase the overall competitiveness of the supply base.

The newest of the USIAS manufacturers also presents an interesting illustration of supplier development. The Mercedes-Benz facility in Vance, Alabama, has incorporated a level of modular assembly unprecedented in the U.S. automotive industry. Modular assemblies, such as completed

instrument panels, are delivered by suppliers to the production floor on a just-in-time basis. For example, Delphi Packard Electric is responsible for supplying the cockpit assembly on the new Mercedes M-Class sport utility vehicle. As a module supplier, they are responsible for coordination of second-tier suppliers, the integration of components in assembly, and delivery of the completed modules to the Vance facility. Suppliers such as Delphi Packard Electric have gained valuable insight into manufacturing systems integration and are well positioned to apply these skills to serve other manufacturers.

Fuel Economy, Emissions, and Other Environmental Contributions

Many USIAS companies gained a foothold in the highly competitive U.S. market by providing smaller, fuel-efficient cars during the energy crises of the 1970s. Twenty-five years later, the USIAS maintains a combined CAFE higher than the U.S. industry average. Figure 1.18 compares USIAS sales-weighted passenger car fuel economy performance with the overall U.S. industry average for three years: 1986, 1991, and 1996. The USIAS maintains its leadership in this area while shifting its product mix to include larger, more powerful vehicles.

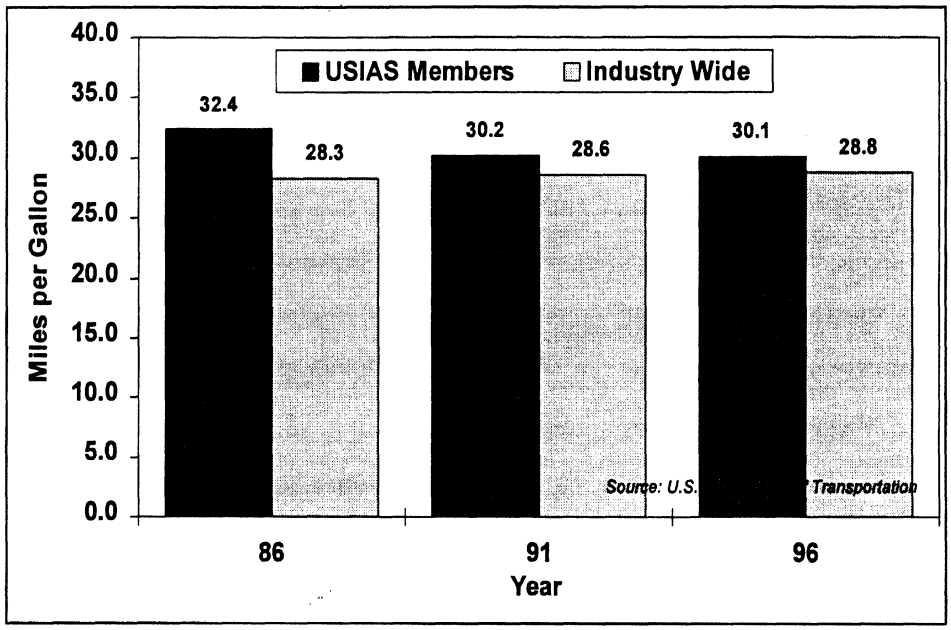


Figure 1.18
Corporate Average Fuel Economy: Passenger Car

Figure 1.19 shows the 1996 car models with the highest fuel economy performance ratings in the U.S. market. The thirteen most fuel-efficient cars are all offered by USIAS firms.

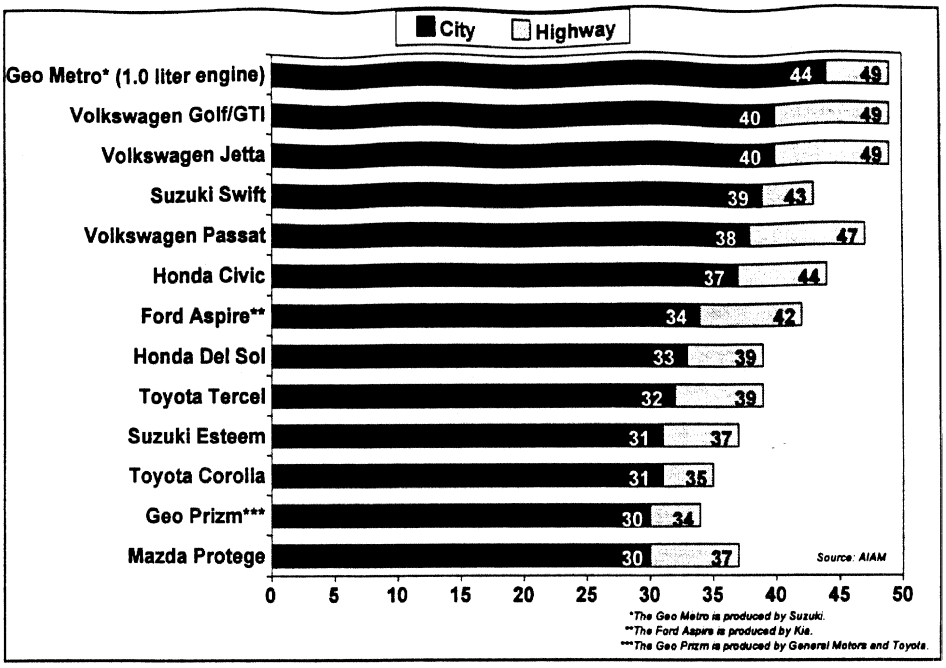


Figure 1.19
1996 Fuel Economy Leaders

As concern regarding the potential of global warming continues to increase, USIAS companies provide leadership on fuel economy and improved vehicle emissions performance. In 1973, Honda introduced the CVCC Civic engine and became one of the first manufacturers to meet the standards set forth in the Clean Air Act of 1975, and it did so without the use of a catalyst. Twenty-five years later, Honda continues the strategy of emphasis on "engine out" emissions reduction with its U.S.-produced 1998 ULEV 3.0 V6 (Fukui 1997). The Honda ULEV engine, supplemented by a catalyst, is the first engine to meet the strict California Air Resource Ultra Low Emission Vehicle standard—two years before the law goes into effect. Finally, Honda engineers recently announced a working prototype of a Zero Level Emission Vehicle (ZLEV) engine based on the current 2.3-liter four-cylinder engine found in the 1998 Accord.

The global perspective and background of the USIAS contribute a special source of experience and expertise to meet the twin policy challenges of fuel conservation and the reduction of emissions. Many of the home markets for USIAS producers tax fuel at far higher rates and set harsher restrictions on the use of large engines than does the United States. Because of this, the USIAS members have been very proactive in development of alternative energy powertrains. In recent years, Volkswagen has developed breakthroughs in diesel technology. The Turbo Direct Injection (TDI) diesel engine delivers quicker starts and acceleration, and decreased noise and

emissions levels, all while achieving 45 miles to the gallon. Turbo Direct Injection represents a viable alternative to traditional gasoline engines.

The USIAS has made significant efforts in the development of more advanced alternate fuel technologies. In December, 1997, Toyota launched the world's first mass-produced gasoline engine, electric engine hybrid vehicle. The Prius, a compact car, uses an electric engine for start-up and low speeds, but uses a 1.5 liter gasoline engine for higher speeds. Audi will be the second manufacturer to mass-produce a hybrid vehicle, but the Audi will be unique because it will use a diesel electric hybrid powertrain.

USIAS members are also contributing to the development of even longer-range technology. Daimler-Benz is recognized as one of the leaders in the development of fuel cell technology. The company recently introduced the NECAR III evaluation vehicle. Daimler-Benz has developed a joint venture with a technology supplier and is planning to market a fuel-cell-powered A-Class vehicle by 2004. It is apparent that the USIAS members will continue to proactively develop environmentally friendly technologies for future generations.

Local Social Impact

USIAS companies with U.S. assembly facilities have shown an exceptionally high commitment to the training of their employees. Evidence of this commitment to training is found in a 1994 essay on training differences in the automotive industry. The essay noted that new employees in Japanese-owned U.S. assembly facilities received an average of 370 hours of training compared with 46 hours of training at U.S. owned facilities (Hashimoto 1994). The USIAS companies' need for higher-skilled manufacturing workers has contributed to an increased skill level within the regions where the facilities are located, and may also have influenced training practices through U.S. industry.

Currently, there are ten USIAS companies producing vehicles in the U.S. All of these companies are of either German or Japanese origin. For these companies, the U.S. training system is far different from what they have in their countries. Both Japan and Germany have strong enterprise-based training systems—companies are largely responsible for training. Conversely, in the U.S.,

the public sector—usually vocational education and community colleges—is responsible for most of vocational training.[14]

The high level of training at USIAS assembly facilities may also be attributable to the use of a production system that is vastly different than has been used by the U.S. industry (Womack et al. 1990). It is possible that through their emphasis on increased training, the USIAS manufacturers have had a positive effect on the U.S. educational system. By increasing the importance of problem-solving skills, basic academic skills, and team building, USIAS manufacturers have been an important catalyst in the current reexamination of the role of public education.

USIAS member companies have developed a strong commitment to the communities where they have located. Given their strong commitment to training, it is not surprising that many USIAS companies have established local, regional, and national education foundations. Table 1.6 shows selected charitable activities directed toward education.

International Auto Sector Education Foundations and Charities	
BMW North America	Community Impact Award
Daimler-Benz AG	The Award of Excellence a Program for German Language
Honda	Honda Prize for Science and Academia
Hyundai	Hyundai Academy of Automotive Technology
Mazda	The Mazda Foundation
Mitsubishi	The Mitsubishi Young Entrepreneurs Program
Nissan	The Nissan Foundation
Porsche	The Porsche Foundation
Subaru	Subaru of America Foundation
Toyota	The Toyota Foundation.

Source: Various company reports.

Table 1.6

[14]For a more complete discussion about the differences among the three countries' training systems, see Hashimoto 1994 and Berg 1994.

PART 2

Estimates of the Economic Contribution of the International Auto Sector in the United States

Introduction

The fastest-growing segment of the motor vehicle and equipment industry in the 1980s and 1990s has been the United States international auto sector (USIAS). The economic contributions of the USIAS in many dimensions are apparent from the statistics presented in part 1 of this report, which are also dramatic confirmation of the USIAS's growing importance as a player in the domestic economy.

Impressive as they are, however, these statistics still understate the contributions of the USIAS, since they exclude motor vehicle dealer activities altogether, and they account for only its direct activity in manufacturing, ignoring spin-off activities. Spin-off activities are those that come from two sources: indirect effects, or purchases from domestic suppliers (for example, steel); and induced effects, or spending by people who receive income attributable to USIAS activity (for example, in restaurants). It is the sum of these direct and spin-off activities that determines the total contribution of the USIAS to the domestic economy. Indeed, in its 1997 annual report, the Association of International Automobile Manufacturers uses the total contributions concept, but understates its magnitude (Association of International Automobile Manufacturers, Inc. 1997, pp. 20-21).

The purpose of this part of the report is to provide the most thorough estimates to date of the economic contribution currently associated with the presence of the international auto sector in the United States. As such, the report is in the spirit of a study assessing the contribution of Toyota in Kentucky, published six years ago (Center for Business and Economic Research 1992). Although similar in genre to the Kentucky study, the current study had available to it considerably more powerful economic modeling capabilities, and a richer data set. As a result, a more complete set of factors could be incorporated into the analysis.

It is also important to indicate what this study does *not* attempt to analyze. The study should not be interpreted as representing the economic activity that would be lost if the USIAS did not assemble vehicles in the United States. There would be some replacement activity, and the economy would make other compensating adjustments over time. Other studies have made some attempt to estimate the so-called net effects (Adams et al. 1991, Howes 1993, Lawrence 1990,

U.S. General Accounting Office 1988), but we do not. Also, we do not consider the long-run general equilibrium solutions that are important in macroeconomic analysis when compensating adjustments are made following a perturbation of the economic system. These are different issues, and they are not the focus of this study, which specifically is on the current economic contribution of the USIAS to the domestic economy (the so-called gross effect).

Results

The series of tables in this section show our estimates of the economic contribution associated with the presence of the international auto sector in the United States. This contribution includes both direct employment and the spin-off jobs in the domestic economy that result from its direct employment. The employment estimates are based on the total number of private sector jobs, using the Bureau of Economic Analysis (BEA) definition of employment. We use the BEA definition in order to be consistent with personal income estimates that we also use. This definition of employment includes the self-employed. Data on direct employment are from the survey of AIAM member companies by DesRosiers Automotive Consultants Inc. (1997), discussed in part 1.

The employment contribution of the USIAS in 1996, for private sector manufacturing and support activities, including white-collar workers but excluding dealers, is shown in table 2.1. (Within the industry, the term "manufacturing and support" is often used to describe the activities that we term "manufacturing and distribution." The following section, Methods, has more detail on the composition of these activities. The direct employment of 68,800 jobs is consistent with the survey. Spin-off employment from these activities is estimated to be 381,200 jobs. Recall that these spin-off jobs are those that come from two sources: purchases from domestic suppliers, and spending by people who receive income attributable to USIAS activity. The sum of direct jobs and spin-off jobs equals the total contribution of USIAS manufacturing and support activities, amounting to 450,000 private sector jobs. The total number of jobs created (direct plus spin-off) for every direct job introduced constitutes the "employment multiplier." In this case, the employment multiplier equals 6.5. The employment multiplier can be interpreted in two ways: (1) there are 6.5 times as many total jobs generated as there are direct jobs, or (2) there are 5.5 spin-off jobs generated for every direct job (1 direct job + 5.5 spin-off jobs = 6.5 total jobs). The contribution to compensation is estimated to be about $20 billion in the private sector. Compensation, measured in 1996 dollars, consists of wage and salary disbursements,

supplementary earnings (mostly fringe benefits), and net incomes of owners of unincorporated businesses.

Private Sector Manufacturing and Support Activities	
Direct employment	68,800
+ Spin-off employment	381,200
= Total contribution to employment	450,000
Employment multiplier (total ÷ direct)	6.5
Total contribution to compensation (wages, salaries, fringe benefits)	$20 billion

Table 2.1

Little analysis exists to date on the economic contributions of dealer activity. The results shown in table 2.2 are for USIAS dealer activity in the United States for 1996. The direct employment of 333,900 jobs is consistent with the data provided (Association of International Automobile Dealers, Inc. 1997). Spin-off employment from these activities is estimated to be 488,400 jobs. The total contribution to private sector employment amounts to 822,300 jobs. The resulting employment multiplier equals 2.5. 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 private sector contribution to compensation is estimated to be about $29 billion.

Private Sector Motor Vehicle Dealer Activities	
Direct employment	333,900
+ Spin-off employment	488,400
= Total contribution to employment	822,300
Employment multiplier (total ÷ direct)	2.5
Total contribution to compensation (wages, salaries, fringe benefits)	$29 billion

Table 2.2

The "bottom line" can be derived by combining the estimates for manufacturing and support with the estimates for dealers presented in tables 2.1 and 2.2. This results in the estimates of total private sector contributions from USIAS activities shown in table 2.3. Direct employment of 402,700 jobs combined with spin-off employment of 869,600 produces a total contribution to

private sector employment of 1,272,300. In summary, *the employment contribution currently associated with the presence of the international auto sector in the United States is estimated to be about 1.3 million jobs in the private sector.* The corresponding employment multiplier is 3.2. *The compensation contribution is estimated to be about $50 billion in the private sector.*

Further detail on income is shown in the addendum to table 2.3, with all measures in 1996 dollars. Compensation (equivalent to labor and proprietors' income in the personal income data issued by BEA) of $49 billion is prior to deductions for personal income taxes and contributions to social insurance programs, and does not include transfer payments. As shown in the addendum, a reduction of transfer payments of about $4 billion is associated with the presence of the USIAS in 1996, and personal income tax revenues are increased by about $7 billion. The implication for disposable personal income, or personal income after taxes and including transfers, is an increase of $34 billion in the domestic economy for 1996.

Total Private Sector USIAS Activities	
Direct employment	402,700
+ Spin-off employment	869,600
= Total contribution to employment	1,272,300
Employment multiplier (total ÷ direct)	3.2
Total contribution to compensation (wages, salaries, fringe benefits)	$49 billion
Addendum: Detail on income	
Compensation	$49 billion
plus: Transfer payments	-$4 billion
less: Social insurance contributions	$4 billion
less: Personal income taxes	$7 billion
equals: Disposable personal income	$34 billion

Table 2.3

Regional Distribution of the Contributions

The estimates were generated for two subregions of the United States: a region containing the eleven states where the USIAS has a significant presence in manufacturing and distribution, and a region consisting of the rest of the country, where the only USIAS activity is associated with manufacturing support and dealers. (Detail is provided in the Methods section.) Of the 1,272,300

job contributions for the country, 701,500 are in the region with a significant presence in manufacturing and distribution, and 570,800 are in the rest of the United States. Of the $49 billion in compensation contributions, $29 billion can be attributed to the region with a significant presence in manufacturing and distribution, and $20 billion to the balance of the country. Thus, as shown in table 2.4, the USIAS accounts for a greater share of economic activity in the region of the country where it has a presence in manufacturing and distribution. Nevertheless, the table shows that USIAS activity makes an important contribution to the rest of the economy, outside of its regional manufacturing base.

Private Sector Contributions by Geographic Region (As a Percentage of the Total Regional Economy)		
Contributions to:	Significant Presence in Manufacturing & Distribution for USIAS	Balance of United States
Employment	701,500	570,800
	(1.5%)	(0.7%)
Compensation (wages, salaries, fringe benefits)	$29 billion	$20 billion
	(2.0%)	(0.8%)

Table 2.4

Industry Distribution of the Contributions

The USIAS contributions to employment are distributed across the industry divisions of the domestic economy. A summary of this industry distribution is shown for total USIAS activities in the left column of table 2.5. The same summary for USIAS manufacturing and distribution activities, excluding dealers, is shown in the right column of table 2.5.

With dealer activities included, the vast majority of the 1,272,300 job contributions are in the private nonmanufacturing sector. About 83 percent of the jobs are in this sector; 17 percent are in manufacturing, with three-quarters of the manufacturing jobs in durable goods. For total USIAS activities, 32 percent of the job contributions (402,700) are direct jobs, and the rest are spin-off jobs, roughly divided equally between indirect (429,700) and induced (439,900) sources. (Recall that indirect jobs are generated from purchases by domestic suppliers, and induced jobs are generated from spending by people who receive income attributable to USIAS activity.)

When dealer activities are excluded, 31 percent of the 450,000 job contributions are in manufacturing, again dominated by durable goods. Only 15 percent of these job contributions (68,800) are direct jobs. These jobs are leveraged into a much higher proportion of spin-off jobs, amounting to 85 percent of total job contributions. This is reflected in the relatively large employment multiplier shown in table 2.1. About 47 percent of the total job contributions (210,200) are indirect, and 38 percent (171,000) are induced.

The lower panels of each column in table 2.5 show, in order, the five industry divisions that provide the greatest job contributions within each of the durable manufacturing, nondurable manufacturing, and private nonmanufacturing sectors. For USIAS activities, both including and excluding dealers, the industry divisions listed comprise over 80 percent of the job contributions in durable and nondurable manufacturing, and over 90 percent of the jobs in private nonmanufacturing.

Most of the same industries are listed whether dealers are included or not, although the rank order changes somewhat because of the effect of dealer activities. Within manufacturing, major auto suppliers are prominent, such as fabricated metals (e.g., automotive stampings), machinery and computers (e.g., pistons, valves), electrical equipment (e.g., semiconductors, batteries, equipment for internal combustion engines), primary metals (e.g., steel mills, foundries), plastics (e.g., exterior and interior trim), and apparel (e.g., automotive fabric).

For total USIAS activities, much of the employment contribution in the private nonmanufacturing sector is direct activity from the motor vehicle dealers included in retail trade. There is also much more induced activity in the private nonmanufacturing sector than in manufacturing, particularly in industries such as retail trade, due to household purchasing activity. What is less well known, but important, is the level of indirect activity in the private nonmanufacturing sector that is linked to the auto business. *Activities such as business, professional, and repair services, finance, wholesale trade, and trucking are more linked to the supplier network for autos than is often recognized. The industrial sector, in this sense, extends well beyond the official designations for manufacturing activity.*

Employment Contributions of the International Auto Sector (USIAS) to the U.S. Economy, by Industry Division, 1996	
Contributions of Total USIAS Activities	Contributions of USIAS Manufacturing And Distribution Activities
Distribution by Major Sector (%)	Distribution by Major Sector (%)
Total private 100.0	Total private 100.0
Manufacturing 17.1	Manufacturing 31.3
Durables 12.6	Durables 24.6
Nondurables 4.5	Nondurables 6.7
Private nonmanufacturing 82.9	Private nonmanufacturing 68.7
Rank by Industry Division (1987 SIC code)	Rank by Industry Division (1987 SIC code)
Durables	Durables
1. Motor vehicles (371)	1. Motor vehicles (371)
2. Fabricated metals (34)	2. Fabricated metals (34)
3. Machinery and computers (35)	3. Electrical equipment (36)
4. Electrical equipment (36)	4. Machinery and computers (35)
5. Primary metals (33)	5. Primary metals (33)
Nondurables	Nondurables
1. Printing (27)	1. Rubber & plastics (30)
2. Rubber & plastics (30)	2. Printing (27)
3. Food (20)	3. Apparel (23)
4. Apparel (23)	4. Food (20)
5. Textiles (22)	5. Chemicals (28)
Private nonmanufacturing	Private nonmanufacturing
1. Retail trade (52-59)	1. Services (70-89, 07-09)
2. Services (70-89, 07-09)	a. Business (73)
a. Business (73)	b. Professional (81, 87, 89)
b. Professional (81,87,89)	c. Personal & repair (72, 75, 76)
c. Personal & repair (72, 75, 76)	2. Retail trade (52-59)
3. Construction (15-17)	3. Construction (15-17)
4. Finance (60-67)	4. Wholesale trade (50-51)
5. Wholesale trade (50-51)	5. Finance (60-67)

Table 2.5

USIAS Contributions in Context

To put the employment and compensation contributions of the USIAS in some context, these contributions are represented in table 2.6 as a share of the total private sector economy for the United States. For 1996, the USIAS was associated with 1.0 percent of the private sector jobs and 1.3 percent of the private sector compensation in the U.S. economy. The compensation share is

greater than the employment share because the jobs associated with USIAS activity are higher paid on average than the average job economywide.

Private Sector Employment and Income Contributions As a Percentage of the Total U.S. Economy	
Contributions to:	
Employment	1.0%
Compensation (wages, salaries, fringe benefits)	1.3%

Table 2.6

The contribution of the manufacturing and distribution (or manufacturing and support) activities of the USIAS to the domestic economy for 1996 is shown in table 2.7. Three other manufacturing industries are included as well, for purposes of comparison: electronic computing equipment, household audio and video equipment, and telephone and telegraph apparatus. These three were chosen because they are important contributors to the new technology-based economy, all with a favorable outlook for the future. The estimates of the total contributions of these three industries have been generated by the same model and procedures as used for the USIAS estimates. Data on direct employment, direct compensation, and white-collar to blue-collar ratios were provided by the Bureau of Labor Statistics.

USIAS manufacturing and distribution has a smaller number of jobs than do the other industries, albeit only slightly smaller than household audio and video equipment. On the other hand, the USIAS has the highest employment multiplier among these industries, reflecting the strong leverage these jobs have in the U.S. economy. The average compensation per job associated with USIAS activity—which includes compensation for both direct and spin-off jobs—is also highest, chiefly reflecting the comparatively high pay for the direct jobs. (These average compensation figures are different from the compensation data in part 1, which refers only to direct jobs.) In fact, auto manufacturing's multiplier and its compensation level are among the highest of all manufacturing industries in the U.S. economy.

Private Sector Contributions of Selected Manufacturing Industries to the U.S. Economy, 1996				
	Electronic computing equipment (SIC 3571-77)	Household audio & video equipment (SIC 365)	Telephone & telegraph apparatus (SIC 3661)	U.S. international auto sector: manufacturing & distribution
Employment				
Direct	313,100	82,700	112,800	68,800
Spin-off	1,203,600	389,000	509,100	381,200
Total	**1,516,700**	**471,700**	**621,900**	**450,000**
Multiplier (Total ÷ direct)	**4.8**	**5.7**	**5.5**	**6.5**
Compensation	**$65 billion**	**$19 billion**	**$26 billion**	**$20 billion**
Annual compensation per job	$42,900	$39,600	$41,600	$44,200
Contributions as % of total U.S. economy				
Employment	1.20%	0.37%	0.49%	0.36%
Compensation	1.68%	0.48%	0.67%	0.51%

Table 2.7

Methods

The general approach is to use a state-of-the-art economic model, where the USIAS data is embedded in more aggregate data, in conjunction with detailed survey data on the USIAS and the data from OSAT on productivity and domestic content discussed in part 1. The model and data are combined in the research design so that the USIAS can be isolated as a well articulated sector in the model. This enables the use of the model to generate estimates of the contribution associated with the USIAS's presence in the domestic economy. A summary of the model, data, and procedures follows.

Macroeconomic model

To simulate the contribution of the USIAS, we use a macroeconomic model of the U.S. economy constructed by Regional Economic Models, Inc. (REMI, Amherst, MA) 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 fifteen years.

As with models, or tools, used in other studies, 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. There are at least three implications of using such a design. First, because of this innovative design, events and changes at the regional level sum to total results at the national level. This is in contrast to most multiregional models, where total results are determined at the national level and then simply allocated among constituent regions. Second, the regions interact with each other so that interregional migration and trade flows stimulated by a change in any given region are identified, including the feedback effects among regions. And third, of course, the United States needs to be divided into certain regions prior to carrying out the study.

In this study, we divided the United States into two regions: a region consisting of the eleven states where the USIAS has a significant presence in manufacturing and distribution; and a region consisting of the rest of the country (including Washington, DC), where the only direct USIAS activity is associated with manufacturing support and dealerships. The composition of the regions is shown both in table 2.8 and in figure 2.1.

Dividing the country into regions also demonstrates the presence of the USIAS outside of the region with a significant presence in manufacturing and distribution. Regional analysis can be important when assessing policy and public relations initiatives. 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 initial study, though, we judged the two-region breakout to be sufficient.

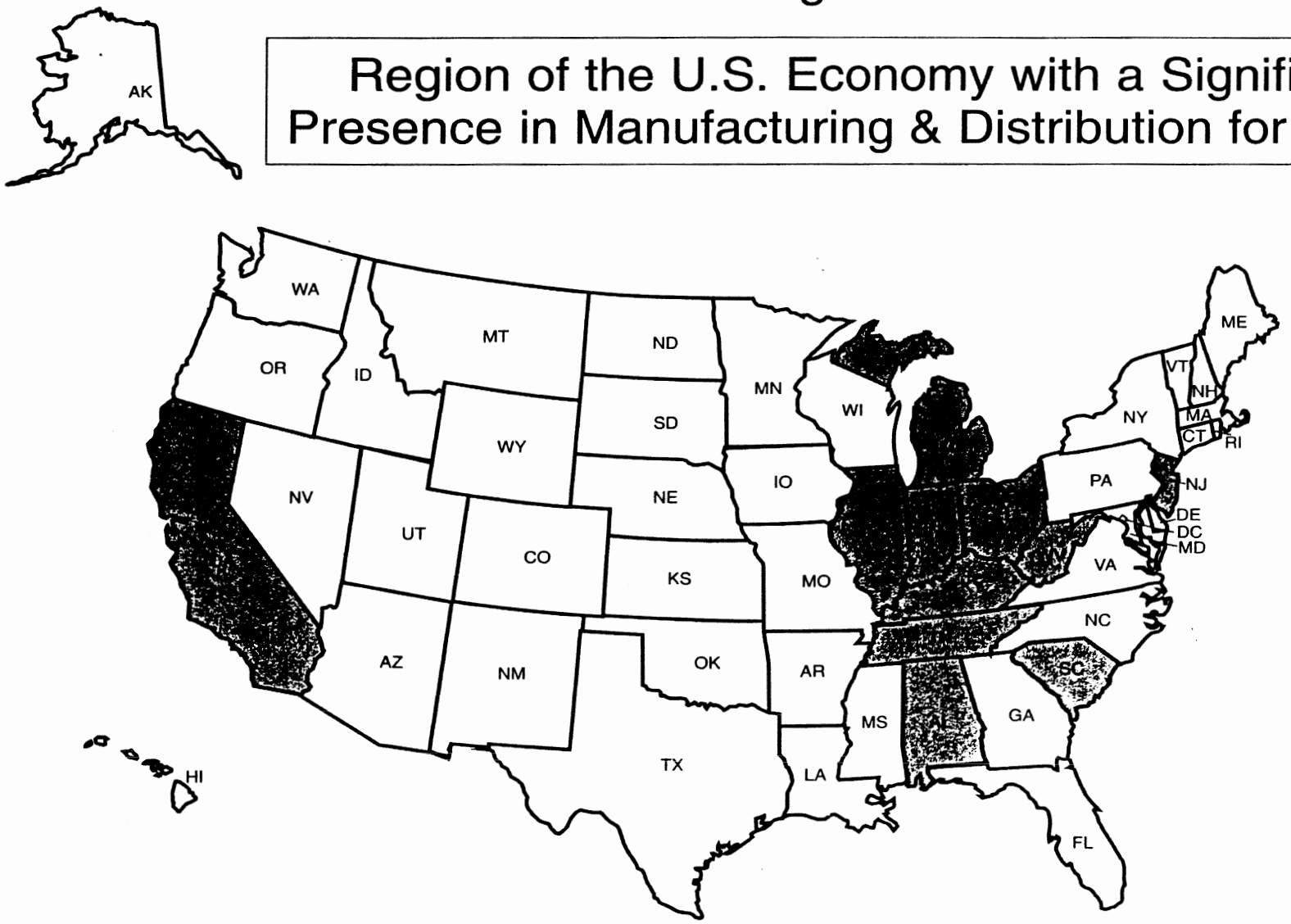
For this study, the greatest advantage of the structure of the REMI model is that it is so detailed and flexible that it can generally be tailored to the specific question being asked, rather than giving only generic representations of the question. One of the points of this study is that the USIAS is different from the industry at large, and the model must recognize the distinctions.

Regions of the U.S. Economy	
Significant Presence in Manufacturing & Distribution for USIAS	Balance of United States
Alabama	Remaining 39 states
California	plus Washington, DC
Illinois	
Indiana	
Kentucky	
Michigan	
New Jersey	
Ohio	
South Carolina	
Tennessee	
West Virginia	

Table 2.8

Figure 2.1

Region of the U.S. Economy with a Significant Presence in Manufacturing & Distribution for USIAS



Data

Besides the detail and flexibility of the model, we are able to isolate the USIAS from the industry because of a unique data set. Primary data were collected in the independent survey of USIAS member companies by DesRosiers Automotive Consultants Inc. (1997). Additional detail was collected in this year's survey to accommodate the needs of this study. (More information on the results of the survey is provided in part 1, "AIAM Survey Information.") Data on productivity and domestic content were calculated by OSAT (see part 1, "Other Economic and Noneconomic Contributions"). Secondary data were collected by REMI and the University of Michigan.

Procedures

The general approach to estimating the economic contribution of the USIAS is to remove USIAS member companies from the two regions of the domestic economy and then have the model generate the economywide losses, including loss of spin-off activities, from this action. We begin by generating a baseline simulation for the economies of each region in 1996, before any changes are made. We selected 1996 because it was the most recent year for which we had survey data on the USIAS. (Although we have the capability to generate reasonable forecasts of USIAS contributions to the domestic economy, we have chosen to analyze only the most recent year for which we have hard data. The main objective here is to obtain the most accurate estimate possible of these contributions, and this is best done using observed, rather than projected, data.) To evaluate the contribution of the USIAS to the regional economies, we then generate an alternative simulation in which we remove from the baseline simulation the USIAS member companies, to determine hypothetically how much smaller the economies would be. Specifically, we compare economic outcomes from the alternative simulation with those from the baseline simulation which includes USIAS activity. The decrease in total activity associated with removing USIAS activity constitutes the gross contribution of the USIAS to the economies of the two regions. The contribution to the national economy in total is calculated by summing the regional contributions.

As indicated previously, what makes this general procedure more complicated is that the particular sector of interest, international autos, is embedded in the aggregate data of the model. Much of

the process underlying our general procedure is to introduce our primary data on this sector into the model so that the model generates properly calibrated results.

The data on employment directly associated with the USIAS, used as inputs to the model, are provided by the survey. This employment can be thought of as falling into four general categories of activity: (1) manufacturing production (blue-collar vehicle assembly and parts); (2) manufacturing nonproduction (white-collar vehicle assembly and parts); (3) support for manufacturing and sales (engineering and design, sales and distribution, port service, finance, and other); and (4) dealers. The direct employment for the first three categories, which are termed "manufacturing and support," was 68,800 in 1996. Dealer employment in 1996 was 333,900 (Association of International Automobile Dealers, Inc. 1997).

Since the survey data are 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. One of these assignments in particular is worth noting. Our analysis suggests that manufacturing nonproduction workers (or white-collar workers) are functionally most like workers in professional services. Consequently, we input these workers in this 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. (Coincidentally, the federal government is planning a reassignment of white-collar autoworkers to the service industry for the next revision of the SIC codes.)

The data on direct employment were assigned to one of the two regions. By definition, the manufacturing production and nonproduction workers were assigned to the manufacturing region. All direct jobs for engineering and design were also assigned to this region. We had sufficient information to determine the split between regions for the total number of support jobs; we assumed that the support jobs in each category (sales and distribution, port service, finance, and other) were split in the same proportion as the total. For dealers, we had data on employment by state, so we were able to make precise assignments to the regions. Some adjustments were made to the manufacturing support jobs to avoid double-counting jobs already accounted for by the model. Also, the model was adjusted so that the correct payroll values were used for all of the direct employees.

The model was tested to ensure that it was generating a level of direct investment for the USIAS consistent with the survey results. This test indicated that the model and survey results were the same (within round-off).

With the calibrations we made to the model, a number of important distinctions were made between the USIAS and the U.S. industry as a whole:

(1) Differences in worker productivity were accounted for in motor vehicle assembly (0.796 workers required in USIAS assembly for every worker required in U.S. assembly overall; calculations summarized in part 1, "Productivity Differences").
(2) Differences in domestic content were accounted for (69.3 percent for the USIAS, 77.6 percent for the total U.S. industry; calculations summarized in part 1, "Vehicle Domestic Content").
(3) Differences in the ratio of white-collar workers to blue-collar workers were accounted for.
(4) Pay differentials, although modest, were accounted for.
(5) The different geographic distribution of activity was accounted for.

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

Summary

This study is intended to improve our understanding of the economic contribution associated with the presence of the USIAS in the United States. To this end, we have combined a state-of-the-art macroeconomic model with a rich data set of primary survey information on the USIAS, and a research design that incorporates the best estimates to date of such key economic factors as labor productivity and domestic content. With these tools, we were able to generate quantitative estimates of the contribution of the USIAS to the domestic economy. Specifically, we estimate that the economic contribution currently associated with the presence of USIAS activity in the United States is about 1.3 million jobs and about $50 billion in compensation in the private sector, when spin-off activity is accounted for. This represents 1.0 percent of the total private sector jobs in the U.S. economy, and accounts for 1.3 percent of private sector compensation in the economy. In addition, auto manufacturing's multiplier and its compensation level are among the highest of all

manufacturing industries in the U.S. economy. Although the contributions of the USIAS are smaller in the parts of the country where they do not have a manufacturing presence, their contributions are nevertheless important there as well.

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 and management technique transfers associated with the presence of the USIAS.

Thus, the international auto sector is associated with greater economic activity in the United States than has been estimated to date. This is undoubtedly the case as well for the traditional auto industry.

A number of possible future research directions are suggested by the study. These would include a greater number of regional breakouts, and comparisons with other industries of total contributions. They also include an analysis of the "net" effect of the USIAS on the domestic economy, or an estimate of the economic activity that would be lost if the USIAS did not assemble vehicles in the United States. Such studies, including the current one, demonstrate the importance of using research-based public policy in formulating economic strategy.

Appendix to Part 2

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.

Policy makers 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.

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