CONTRIBUTION OF TOYOTA TO THE ECONOMIES OF FOURTEEN STATES AND THE UNITED STATES IN 2003

PREPARED FOR

TOYOTA MOTOR NORTH AMERICA, INC.

BY

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

Executive Summary

In 1957, Toyota Motor Sales U.S.A., Inc. set up a small dealership in Hollywood, California. By 1975, Toyota became the best selling import brand in the United States. In 1986, Toyota began manufacturing operations in the United States with General Motors at a joint-venture manufacturing facility in Fremont, California. In 2004, Toyota sold just over 2 million vehicles in the United States.

This study has two distinct purposes: (1) to estimate the employment and economic contributions of Toyota's manufacturer-related operations (defined in this analysis as: manufacturing, marketing, distribution, research, development and design, headquarters, and all other operational activities within the company) and dealer-related operations to the nation as a whole and fourteen individual states, and (2) to forecast an estimate of the employment and economic impact of the recently announced vehicle manufacturing facility in San Antonio, Texas to the economy of the State of Texas.

These estimates were derived using the latest version of a state-of-the-art economic model with direct employment and compensation inputs (as of December 31, 2003) supplied by Toyota Motor North America. For manufacturer-related activities in 2003, Toyota directly employed 29,135 people, compensated at $1.9 billion, while an additional 74,060 people were employed selling and servicing new Toyota vehicles and compensated at $2.6 billion (see Table 2.9 on page 26 for further details).

- An estimated 386,300 private sector jobs, and $14.4 billion in annual compensation, are generated by Toyota's total U.S. automotive operations, including new vehicle development and production, along with sales and service of new Toyota vehicles. This total includes direct employment at Toyota and in its dealership network in the United States. The total also includes intermediate, or supplier, employment and spin-off jobs that are created as a result of the spending of Toyota's direct employees and their suppliers in the United States.
- The direct, intermediate, and spin-off employment generated by Toyota's manufacturer-related activities, in the United States is estimated to be approximately 211,000 jobs in the private sector, with an associated compensation of over $8.2 billion.

- Total direct, intermediate, and spin-off employment generated by Toyota's new vehicle sales and service of new vehicles in the United States is estimated to be about 175,300 jobs in the private sector, with an associated compensation of approximately $6.1 billion.
- The estimated forecast direct, intermediate, and spin-off employment in the State of Texas from the San Antonio assembly facility, once it is fully operational, is approximately 9,000 jobs, with an expected annual compensation of $460 million.

Acknowledgements

This study is the result of a group effort. I would like to thank my colleagues at the Center for Automotive Research, Sean McAlinden, Bernard Swiecki and Steven Szakaly, for their assistance with content, analysis, and interpretation. I would also like to acknowledge the significant efforts of Diana Douglass. Diana contributed greatly to the logistic coordination of the project and the production of the document.

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Introduction

The motor vehicle industry is the largest manufacturing industry in the United States. No other single industry is linked so much to the U.S. manufacturing sector or directly generates so much retail business and employment. This study describes the economic contribution of an important company included in the U.S. motor vehicle industry: the U.S. operations of Toyota North America.

The Center for Automotive Research (CAR) has estimated the economic contribution to the U.S. economy associated with the presence of the total U.S. (and the separate international) automotive sector in a number of studies. CAR's most recent estimate of total contribution was completed for the Alliance of Automobile Manufacturers (AAM) in 2004,[1] and was an important update of a, prior study for the AAM and the Association of International Automobile Manufacturers (AIAM) in 2001.[2]

This report, however, is a first estimate by CAR of the economic contribution associated with a single automotive firm in the United States. The importance of this study is directly related to the importance of foreign direct investment and operations in the continuing growth of the overall U.S. automotive industry. The decision by international automakers in the late 1980s to manufacture and operate in the United States is largely responsible for the U.S. motor vehicle industry first recovering, and then maintaining, its traditional position as the largest national automotive industry in the world. Toyota clearly was one of the major international automakers making this decision. This pattern of international investment continues today. A better understanding, then, of the role of Toyota in the U.S. economy leads to a better understanding of the industry as a whole and how it will change in the future and further impact the U.S. economy.

The current study describes the economic contribution of Toyota's total manufacturing and non-manufacturing operations in the United States and is divided into two sections. In the first section of the study, we present a short overview of Toyota's nearly fifty year history in the United States. We also discuss Toyota's achievements in sales, production, and quality

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[1] Institute of Labor and Industrial Relations, University of Michigan and the Center for Automotive Research. *Contribution of the U.S. Motor Vehicle Industry to the Economies of the United States, California, New York, and New Jersey in 2003*. Prepared for the Alliance of Automobile Manufacturers, Inc., Ann Arbor, May, 2004.

[2] Institute of Labor and Industrial Relations and the Office for the Study of Automotive Transportation, University of Michigan and the Center for Automotive Research. *Contribution of the Automotive Industry to the U.S. Economy in 1998: The Nation and Its Fifty States.* A Study Prepared for the Alliance of Automobile Manufacturers, Inc. and the Association of International Automobile Manufacturers, Inc. Ann Arbor, Winter 2001.

performance, as well as the potential impact it has had in these areas in the U.S. automotive industry.

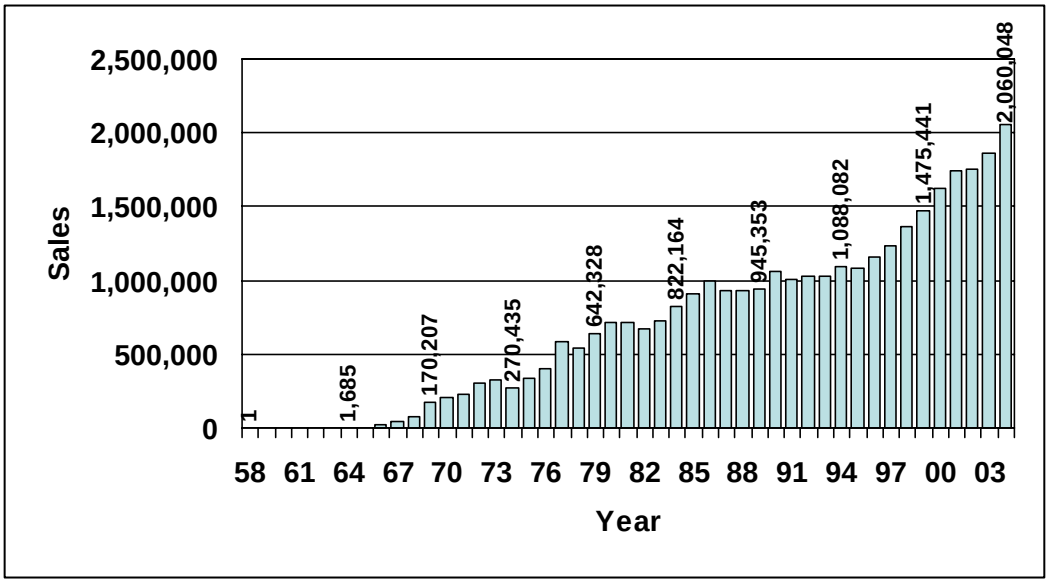
The second section of our study estimates the contribution of Toyota's U.S. operations and dealership partners to employment and income to the economies of fourteen states and the U.S. in 2003. The fourteen states analyzed in detail include Michigan, Texas, Ohio, California, Missouri, Tennessee, North Carolina, Georgia, Alabama, Arkansas, Maryland, West Virginia, Indiana, and Kentucky. Toyota's economic contribution was analyzed using an economic model provided by the Regional Economic Modeling, Inc. (REMI) and used by CAR. Additionally, we use REMI economic model to empirically analyze the additional impact on the Texas economy of Toyota's future assembly facility in San Antonio, Texas. The facility's expected annual contribution to employment and income in Texas is estimated through 2011.

The data used to perform our research was, in the case of Toyota's U.S. operations, provided by Toyota. The remaining data on the U.S. economy and the automotive industry was collected by CAR from a wide variety of publicly available sources.

Section I: Overview

Toyota began selling vehicles in the Unites States in 1958. Its initial offerings were—apart from a small number of Toyopet sedans—Land Cruisers. The introduction of the Toyota Corona sedan in 1965 helped Toyota achieve its first sales success, with total U.S. vehicle sales amounting to 37,890 units in 1966. Figure 1.1 illustrates Toyota's complete U.S. sales history. Toyota's sales recently peaked at just over two million units in 2004 when the company reached an all-time U.S. light vehicle market share of 12.2 percent.

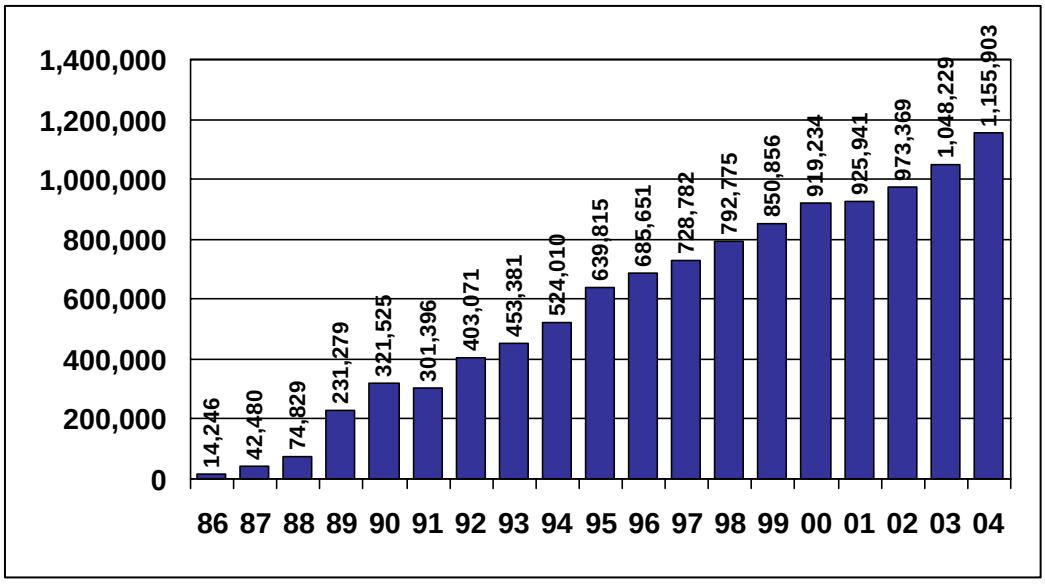
Figure 1.1: Toyota U.S. Sales: 1958 – 2004



Sources: Ward's Automotive Yearbooks 1998 – 2004; Automotive News 100 Year Almanac and the 1996 Market Data Book, Automotive News January 10, 2005 U.S. Light Vehicle Sales by Make p. 49 – 51.

Toyota has been manufacturing vehicles in the United States for nearly twenty years. Toyota's U.S. production began in 1986 with a joint venture with General Motors in the NUMMI (New United Motor Manufacturing, Inc.) operation in Fremont, California. Toyota's first fully owned U.S. assembly facility, located in Georgetown, Kentucky, began producing the Toyota Camry in 1988. Figure 1.2 illustrates Toyota's U.S. vehicle production history. As can be seen, Toyota's U.S. production has risen steadily to a record level of 1,155,903 units in 2004. As table 1.3 shows, this production level will continue to grow when Toyota's San Antonio, Texas assembly facility begins producing the Toyota Tundra in 2007 at a capacity level of 150,000 units.

Figure 1.2: Toyota U.S. Production: 1986 - 2004



Sources: Automotive News January 10, 2005 North America Car and Truck Production p. 54, Automotive News 100 Year Almanac and the 1996 Market Data Book, Ward's Yearbooks 1986 – 1990.

Table 1.2 shows that Toyota also builds engines in the United States. In fact, Toyota built about 300,000 more engines than vehicles in the United States in 2004—exporting many engines to its assembly operations in Canada. Almost 18,000 Toyota employees were reported at its assembly and engine operations in 2004. Not all of these employees, however, were engaged in manufacturing at these sites, and as section 2 of this study shows, total Toyota U.S. employment exceeded 29,000 in 2003. Many employees work in such non-manufacturing operations as research, development and design, marketing, administration, purchasing, port services, warehousing, and other corporate duties. As table 1.3 shows, Toyota has announced that it will add 2,200 U.S. manufacturing jobs by 2007. Most of these jobs will be located at a new assembly plant in Texas—which is a special focus later in this study.

Table 1.1: Toyota U.S. Motor Vehicle Assembly Facilities

	Product	Employment	2004 Production
Fremont, CA (NUMMI)	Vehicles	4,254	311,452
Georgetown, KY (Assembly)	Vehicles	7,000	470,292
Princeton, IN	Vehicles	2,400	184,673
Princeton, IN 2	Vehicles	2,200	189,375
Total		*15,854*	*1,155,792*

Sources: Toyota and The Center for Automotive Research. The Contribution of the International Auto Sector to the U.S. Economy: An Update. A study prepared for the Association of International Automobile Manufacturers, Inc., Ann Arbor, March, 2005.

Table 1.2: Toyota U.S. Motor Vehicle Powertrain Manufacturing Facilities

	Product	Employment	2004 Production
Georgetown, KY (Engine)	Engines	804	505,520
Huntsville, AL	Engines	350	107,031
Buffalo, WV	Engine & Trans.	930	456,231 389,859
Total		*2,084*	*1,458,641*

Sources: Toyota and The Center for Automotive Research. The Contribution of the International Auto Sector to the U.S. Economy: An Update. A study prepared for the Association of International Automobile Manufacturers, Inc., Ann Arbor, March, 2005.

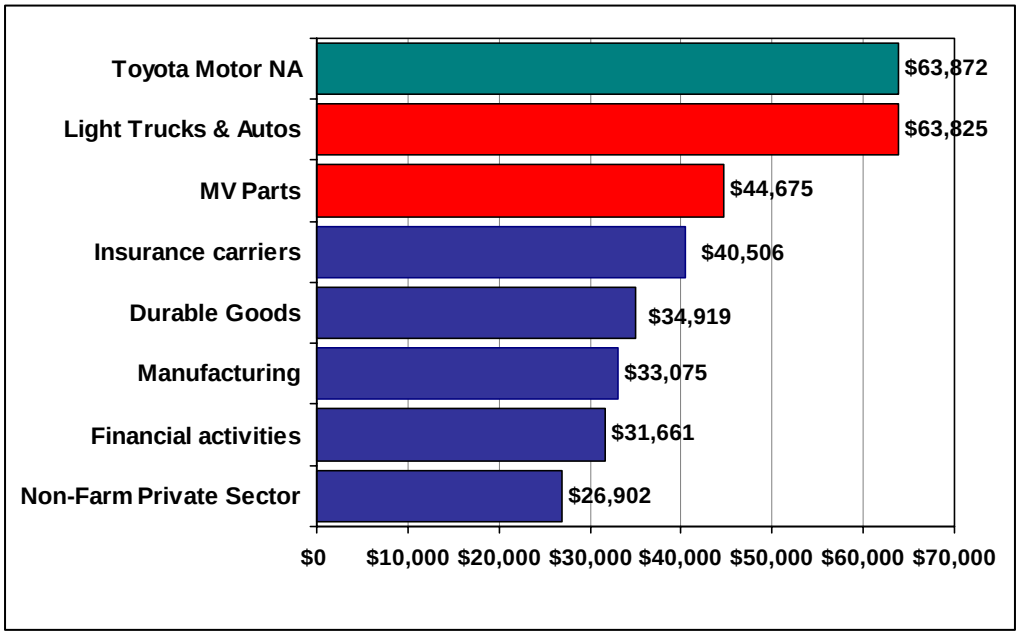
Table 1.3: Toyota Planned Facility Additions and Expansions

	State	Additional Employment	Year Complete
Toyota Motor Manufacturing, Texas, Inc.	TX	2,000	2007
Toyota Motor Manufacturing, Alabama, Inc.	AL	300	2005
Toyota Motor Manufacturing, West Virginia, Inc.	WV	150	2006
Bodine Aluminum, Inc.	TN	220	2007
Toyota Technical Center, U.S.A., Inc.	MI	400	2010
Total		*3,070*	

Sources: Toyota and The Center for Automotive Research. The Contribution of the International Auto Sector to the U.S. Economy: An Update. A study prepared for the Association of International Automobile Manufacturers, Inc., Ann Arbor, March, 2005.

A relative comparison of Toyota per-employee payroll is given in figure 1.3. The Toyota 2003 U.S. average of $63,872 per employee is based on information collected from the company for this study and compares quite favorably to the overall average of $63,825 for all motor vehicle producers surveyed by CAR in 2004. The Toyota and motor vehicle company averages are well above averages in such industries as insurance, durable goods manufacturing, and the financial sector (as reported by the U.S. Department of Labor's Bureau of Labor Statistics). In fact, the average U.S. job in 2003 provided only $26,902, well below 50 percent of Toyota's average compensation level.

Figure 1.3: 2003 Average Annual Salary (U.S.)



Sources: Toyota., and The Center for Automotive Research. The Contribution of the International Auto Sector to the U.S. Economy: An Update. A study prepared for the Association of International Automobile Manufacturers, Inc., Ann Arbor, March, 2005, and the Bureau of Labor Statistics http://www.bls.gov/ces/. Total Private Series CEU0500000004, Manufacturing Series CEU3000000004, Durable Goods Series CEU3100000004, Motor Vehicles Series CEU3133610004, Motor Vehicle Parts Series CEU3133630004

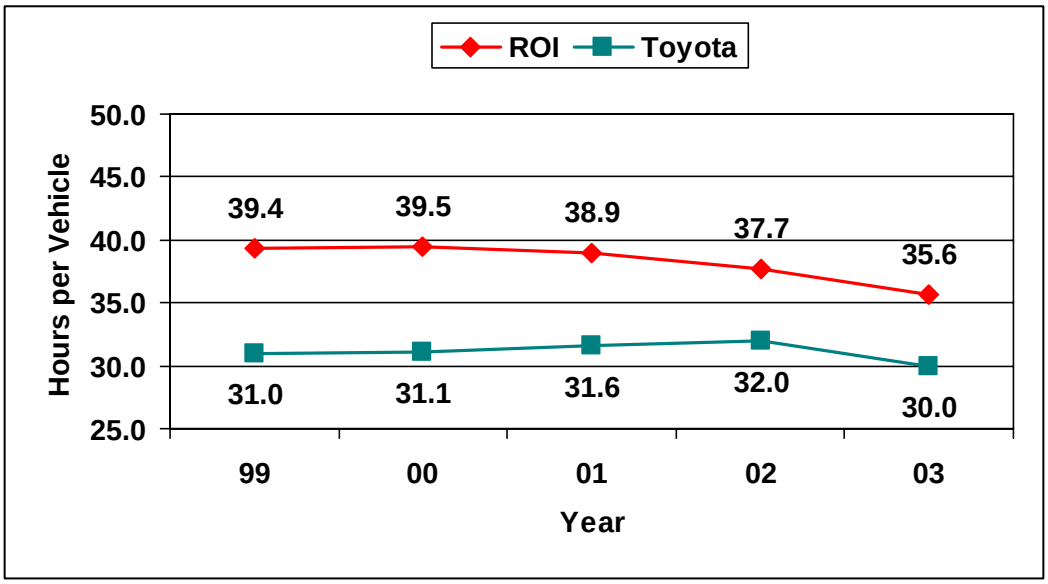
Toyota is well known for its lean manufacturing practices, which almost every other automaker has attempted to adopt. Philosophies that stress the elimination of waste throughout the Toyota system and constant improvement are characteristic of Toyota operations in manufacturing and non-manufacturing. Figure 1.4 illustrates the total Hours Per Vehicle (HPV) of manufacturing labor input (a total of hours used in vehicle assembly, engine and transmission assembly, and stamping of major vehicle body panels), as reported in the well-respected *Harbour Report (*Harbour and Associates, Inc*.)*, over the last five years. Harbour's HPV analysis is the most reliable manufacturing productivity comparison available for the North American auto industry. The HPV for Toyota, as well as a composite figure for the other major automakers producing vehicles in the United States, is shown for the last five years.

Toyota's HPV slightly increased during the four-year period from 1999 to 2002, to a level of 32 HPV, as the company produced more complex and higher content vehicles in North America. In 2003, despite the increasingly higher content and greater complexity of its product mix, Toyota's HPV improved to a level of 30 HPV. During the entire timeframe of the comparison, Toyota has maintained productivity levels that were notably higher than the average level of the rest of the

industry. The importance of Toyota's productivity demonstration in the U.S. economy isn't, of course, restricted to the auto industry which uses Toyota's performance as a standard benchmark for improvement. Many companies throughout U.S. manufacturing and, indeed, in the service and retail sectors, also benchmark Toyota and its practices for productivity improvement. The U.S. economy has recently experienced strong, almost historic, productivity growth in recent years. Although the source of this growth can be partially attributed to the greater use of information technology, some observers also point out the competitive effect of new international competitors such as Toyota on the entire U.S. economy.[3]

[3] Spear, Steven, and Brown, H. Kent "Decoding the DNA of the Toyota Production System." Boston: *Harvard Business Review*. Sept/Oct 1999 Vol. 77, Issue. 5.; Spear, Steven "Learning to Lead at Toyota." *Harvard Business Review.* Boston: May 2004 Vol. 82, Issue. 5.; Furman, Cathie "Implementing a Patient Safety Alert System". *Nursing Economics*. Pitman: Jan/Feb 2005 Vol. 23, Issue 1.; Elsey, Barry "The Training and Development of Kaizen and Technology Transfer Instructors in the Toyota Corporation: A Practical and Conceptual Perspective in Human Resource Development". *Training & Management Development Methods*. Bradford: 2001 Vol. 15, Issue 4.; Kasul, Ruth A., Motwani, Jaideep G. "Successful Implementation of TPS in a Manufacturing Setting: A Case Study". *Industrial Management + Data Systems*. Wembley: 1997 Vol. 97, Issue 7.; Gross, John M., McInnis, Kenneth R. "Kandan Made Simple Simple: Demystifying and Applying Toyota's Legendary Manufacturing Process." New York: ANACOM, 2003.; Besser, Terry L. "Team Toyota: Transplanting the Toyota Culture to the Camry Plant in Kentucky". New York: State University of New York Press, 1996.; Womack, James P., Jones, Daniel T., Roos, Daniel "The Machine That Changed the World: The Story of Lean Production". New York: Harper Collins, 1990.; Liker, Jeffery "The Toyota Way: 14 Management Principles From The World's Greatest Manufacturer" New York: McGraw-Hill, 2004.; Taiichi, Ohno "Toyota Production System: Beyond Large-Scale Production" New York: Productivity Press, 1988.

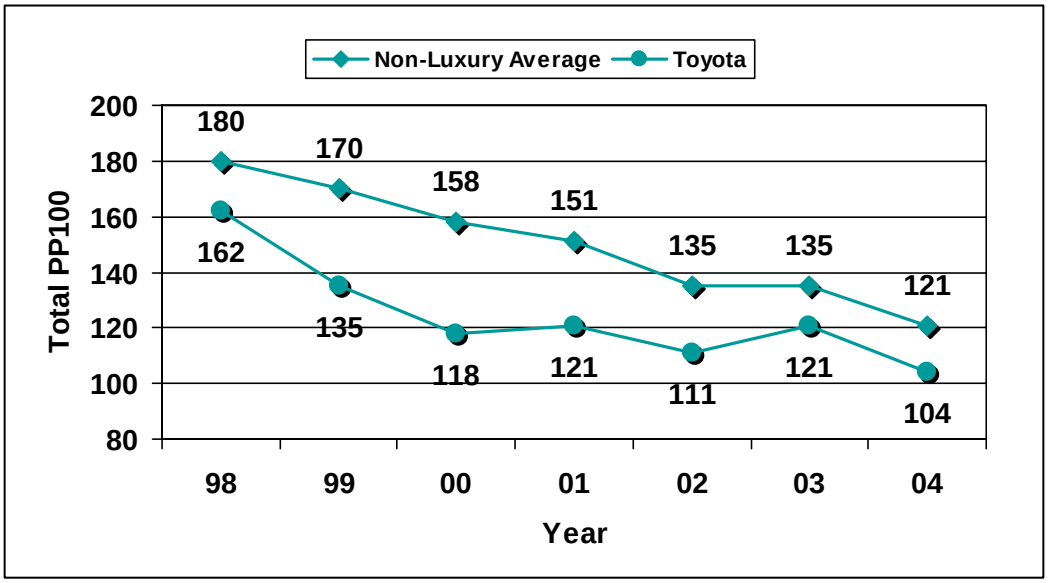
Figure 1.4: Harbour Total Hours per Vehicle Toyota vs. Rest of Industry (ROI) Productivity Estimates: 1999 – 2003



Source: The Harbour Report 2000 – 2004, Harbour Consulting.

The high levels of productivity achieved by Toyota's U.S. manufacturing operations are produced jointly with the high quality of its products. Figure 1.5 illustrates the well known IQS (Initial Quality Study) results from the highly-regarded independent firm, J.D. Power and Associates. The number of problems reported per 100 vehicles in the first 90 days (PP100) is shown for all non-luxury vehicles sold in the United States, as well as Toyota Division vehicles (not including Lexus), during 1998-2004. Although the overall industry has posted impressive improvements in quality during this time period, Toyota has maintained its lead in quality. During the seven-year period analyzed, Toyota's PP100 score has decreased from 162 to 104, an improvement of over 35 percent. While the industry as a whole has improved its quality performance, Toyota has been able to maintain an advantage during the timeframe of our analysis. Once again, the demonstration of such performance has most probably led to greater emphasis on quality throughout the U.S. economy, with benefits for millions of automotive and non-automotive consumers.

Figure 1.5: Non-Luxury Vehicles Problems per 100 Vehicles: 1984 – 2004



Source: J.D. Power and Associates Initial Quality Study (IQS) 2004.

While Toyota has set a moving standard in world class manufacturing productivity and quality, it has also made a corporate commitment to setting another standard in environmental technology in motor vehicles. For example, the Toyota Prius, the best selling hybrid electric vehicle in the world, has now become an international symbol of marketable "green" vehicles and continues to generate high levels of demand. The "Greenest Vehicles" list from the American Council for an Energy Efficient Economy (ACEEE) is reproduced in table 1. 4. The list takes fuel economy and engine emissions into consideration when ranking vehicles using a "Green Score." Toyota placed four vehicles in the top ten; three of the top six "greenest" vehicles are Toyotas.

In addition to reducing fuel consumption and engine emissions, Toyota has dedicated itself to protecting the environment by producing its vehicles in environmentally friendly facilities. For example, in the last six years Toyota has achieved a 50 percent reduction in landfill waste from its manufacturing facilities, and two of its plants, in West Virginia and Alabama, send less than 5 percent of their waste to landfills. In a merging of "green" vehicles and production facilities, Toyota recently announced plans to produce a Camry gas-electric hybrid at its environmental award-winning manufacturing facility in Kentucky.

Table 1.4: American Council for an Energy Efficient Economy Greenest Vehicles for 2005 List

Make & Model	Specifications [a]	Emission Standard [a]	MPG: City	MPG: Hwy	Green Score
Honda Civic GX	1.7L 4, auto CVT [CNG] [b]	PZEV	30	34	57
Honda Insight	1.0L 3, auto CVT	SULEV II	57	56	56
Toyota Prius	1.5L 4, auto CVT	PZEV	60	51	53
Honda Civic Hybrid	1.3L 4, auto CVT	PZEV	47	48	51
Toyota Corolla	1.8L 4, manual	ULEV II	32	41	44
Toyota Echo	1.5L 4, manual	Tier 2 bin 9	35	42	43
Nissan Sentra	1.8L 4, manual	PZEV	28	35	42
Honda Civic HX	1.7L 4, manual	ULEV I	36	44	42
Pontiac Vibe / Toyota Matrix [c]	1.8L 4, manual	ULEV II	30	36	41
Mazda 3	2.0L 4, manual	PZEV	28	35	41
Ford Escape Hybrid	2.3L 4, auto CVT	PZEV	36	31	40
Ford Focus / Focus Wagon	2.0L 4, manual	PZEV	26	35	40

[a] Certain other configurations of these models (with different transmissions or meeting different emission standards) score nearly as well.
[b] Compressed natural gas (CNG) vehicle fuel economy given in gasoline-equivalent miles per gallon.
[c] These vehicles are "twins" -- the same base model carrying different names.

Source: American Council for an Energy Efficient Economy, The Greenest Vehicles of 2005, accessed on March 28, 2005 at http://www.greenercars.com/12green.html.

In summary, a company can contribute to an economy in many ways beyond its level of current employment and income, or the employment and income it might generate at other firms. Economists have recognized innovation, productivity performance, and the inherent value or quality of products as major benefits of a company's contribution—especially when it provides a model to other firms to emulate within an industry or throughout an entire economy (even if forced only by competition). In recent years, the value of environmental performance and example has certainly been more recognized and valued. Our study will seek to correctly estimate the employment and income benefits of Toyota's current contribution to the economy. But it is likely that Toyota's other indirect contributions mentioned above may dwarf even its sizable employment and income effects because of its increasing influence on so many sectors of U.S. economic activity.

Section II: The Economic Impact Analysis

The economic impact analysis is divided into three parts. The first part details the economic contribution of Toyota Motor North America and its direct subsidiaries' U.S. operations to the economy of the United States and also specifically the states of Michigan, Tennessee, Ohio, California, Missouri, North Carolina, Georgia, Texas, Alabama, Arkansas, Maryland, West Virginia, Indiana, and Kentucky. Results in this part include national and regional analyses of the economic contributions attributed to the manufacturing, marketing, distribution, research, development and design, headquarters, and all other operational activities within the company. For simplicity, all of these activities will be referred to in the report as manufacturer-related operations. These activities constitute the complete operations of Toyota Motor North America (Toyota), a vehicle manufacturer and sales firm, in the United States. The second part, referred to as dealer operations, takes a detailed look at Toyota's new vehicle dealers and their economic contributions throughout the same fourteen states and the country as a whole. The third part of the report forecasts expected additional contributions to the Texas state economy resulting from the construction and subsequent assembly operations of the recently announced assembly facility being built in the San Antonio region.

This is the first detailed national and multiregional automotive industry economic impact simulation and analysis based on the North American Industrial Classification System (NAICS) method of categorizing industry jobs—the U.S. government standard first formulated in 1997 and fully implemented in 2001. Previous studies have been based on the Standard Industrial Classification (SIC) system, which classified jobs within industries and industry sectors in very different ways than the NAICS. Therefore, it will be difficult, if not impossible, to compare results in this analysis with previous reports published by the Center for Automotive Research or other research organizations which employed the SIC system in their analysis. The change from SIC to NAICS has enabled researchers to capture a much more accurate and detailed picture of employment within the automobile industry, and to report—with a greater level of confidence and detail—the number of jobs and amount of compensation attributable to the activities related to automobile manufacturing in the United States.

Vehicle Manufacturer Activities

The tables in this section detail the estimated employment and income contributions by Toyota's U.S. manufacturer-related operations to the private sector economies of the fourteen states and country as a whole as of December 31, 2003. The estimates of employment are broken out by direct employment (people employed directly by Toyota), intermediate employment (people employed by suppliers who supply Toyota and the suppliers who supply them), and spin-off employment (expenditure-induced employment resulting from spending by direct and intermediate employees who earn an income as a result of Toyota-related activities).

Employment and income estimates are derived from analyses using a regional economic model, supplied by Regional Economic Models, Inc. (REMI), of Amherst, MA. The model and methodology used will be further discussed in a later section. Direct employment data was provided by Toyota, with the intermediate and spin-off effects generated by the model. Direct employment data included white- and blue-collar job classifications.

Complete U.S. manufacturer-related operations employment and payroll data supplied by Toyota totaled 29,135 employees who were compensated over $1.86 billion annually, as of December 31, 2003. The employment and payroll data was coded according to NAICS into six categories for input into the model—**motor vehicle manufacturing** (category numbers: NAICS 3361-3363), **management of companies** (NAICS 551), **professional, scientific and technical services** (NAICS 541), **securities, commodity contracts and investments** (NAICS 523), **warehousing and storage** (NAICS 493), and **wholesale trade** (NAICS 42). The motor vehicle assembly data is netted for production at the New United Motor Manufacturing, Inc. plant (NUMMI), a joint venture between Toyota and General Motors which builds Pontiac Vibes for GM, along with Toyota's Corolla and Tacoma. GM's share of NUMMI production is slightly less than 19 percent. Subtracting 19 percent off the total employment and payroll at NUMMI provides us the net employment and payroll necessary for production of Toyota vehicles at the plant.

As can be seen in table 2.1, there are 74,660 intermediate jobs resulting from Toyota's direct employment. The sum of employment in the direct and intermediate categories totals 103,795 total jobs. Adding in the spin-off jobs associated with spending (from the people who work in the direct and intermediate jobs) results in another 107,205 jobs, bringing the total jobs associated with Toyota's automotive activities in the United States (direct plus intermediate plus spin-off) to 211,000 jobs. The ratio of total jobs created (direct plus intermediate plus spin-off) to direct employment equals the employment multiplier of 7.2 (211,000 ÷ 29,135). This can

either be interpreted as: (1) there are 7.2 jobs in the U.S. economy for every job at Toyota, or (2) there are 6.2 additional jobs in the U.S. economy for every one job at Toyota (1 direct job + 6.2 additional jobs).

Table 2.1: Total Contribution of Toyota's Manufacturer-related Operations to the Private Sector Economy in the United States, 2003

	Manufacturer-related
Employment	
Direct	29,135
Intermediate	74,660
Total (Direct + Intermediate)	103,795
Spin-off	107,205
Total (Direct + Intermediate + Spin-off)	211,000
Multiplier: (Direct + Intermediate + Spin-off)/Direct	7.2
Compensation ($billions nominal)	8.265
Less: transfer payments	-0.754
Less: social insurance contributions	-0.645
Less: personal income taxes	-1.225
Equals private disposable personal income ($billions nominal)	5.642
Contribution as % of total private economy	
Employment	0.13
Compensation	0.09

Compensation in the private sector associated with the total jobs (direct plus intermediate plus spin-off) amounts to over $8.2 billion. After accounting for transfer payments, social insurance contributions, and personal income taxes, the private disposable personal income (or personal income after taxes, including transfers) is over $5.6 billion in 2003.

To put the compensation and employment numbers in context, the direct, intermediate, and spin-off jobs associated with Toyota's U.S. manufacturer-related operations account for 0.13 percent of employment in the entire U.S. economy and 0.09 percent of total U.S. compensation.

Table 2.2, provides a more detailed look at the intermediate and spin-off employment associated with Toyota's manufacturer-related operations. In the intermediate employment category, there are 74,660 jobs spread across numerous manufacturing and non-manufacturing industries. As discussed earlier, the intermediate category captures the employment necessary to satisfy Toyota's demand for the materials and services it needs to design, produce and sell

motor vehicles. This can be broadly considered Toyota's U.S. supplier network. This supply network consists of the suppliers who supply parts and services directly to Toyota along with the suppliers who supply the basic materials and services to Toyota's suppliers. Some of these companies supply basic commodities and can be 3 - 4 steps or more removed from the vehicle design and manufacturing process; however, they are categorized as suppliers of Toyota.

Table 2.2: Intermediate and Spin-off Employment Contribution of Toyota's Manufacturer-related Operations in the U.S., 2003

	Intermediate	Spin-off
Manufacturing	**14,720**	**22,739**
Primary metal mfg	2,154	2,069
Fabricated metal prod mfg	3,134	2,519
Motor vehicle mfg	2,544	6,185
Plastics, rubber prod mfg	1,365	1,189
Other Manufacturing	5,523	10,776
Non-Manufacturing	**59,940**	**84,466**
Professional and Technical Services	10,530	4,365
Administration and Services	10,250	1,720
Wholesale Trade	6,158	3,808
Retail Trade	5,334	16,566
Transportation, Warehousing	4,048	3,919
Finance, Insurance	5,167	4,333
Management of Companies	2,523	871
Other Services (excluding Government)	4,959	9,281
Other Non-Manufacturing	10,971	39,603
Total	**74,660**	**107,205**

Note: Due to rounding, columns or rows may not sum exactly

As shown in table 2.2, we find 14,270 intermediate jobs in the manufacturing sector, mostly in the obvious industries necessary to produce automobiles—such as 2,154 jobs in primary metal manufacturing, 3,134 in fabricated metal products manufacturing, and 1,365 in plastics and rubber products manufacturing. Additionally, this category contains another 2,544 people who are involved in motor vehicle and parts manufacturing. These people are manufacturing the motor vehicles and parts necessary to produce the parts and services demanded by Toyota and

do not include any of the 29,135 people directly employed by Toyota. There are an additional 5,523 people employed in miscellaneous other manufacturing industries.

The bulk of the employment in the intermediate category is in the non-manufacturing sector, which totals 59,940 jobs. Industries within this category are not normally thought to be associated with automobile manufacturing in such high numbers. However, as a result of the separation of the complete vehicle design and parts manufacturing processes from within the automobile manufacturing company to the supplier sector—an area in which Toyota has been at the forefront since its establishment in the North American market—many more distinct industries have become major suppliers to the automobile industry. Industries of note in the non-manufacturing category are professional and technical services which employ 10,530; administration and services– 10,250 jobs; wholesale trade– 6,158 jobs; and finance and insurance– 5,167 jobs. These large supplier industry totals also reflect Toyota's major sales, administrative and finance activities in the U.S. vehicle market.

In table 2.2 we also show 107,205 total spin-off jobs associated with Toyota's U.S. automobile manufacturing operations. These are expenditure-induced jobs, created as a result of spending by the people employed in the direct and intermediate categories. As could be expected, a large portion of the spin-off jobs are in the non-manufacturing sector of retail trade, which employs 16,566 people. When employees use their paychecks to purchase a wide range of goods including electronics equipment, clothing, food, even new automobiles, employment is created to supply their demands. Table 2.2 shows there are 6,185 jobs related to manufacturing motor vehicles and parts based on the demand of the employees in the direct and intermediate sectors. This employment number does not include any of the 29,135 jobs at Toyota which have been accounted for in the direct employment category.

Tables 2.3 and 2.4 detail the varying shares of intermediate and spin-off employment located in the fourteen states in the study, along with the balance of the United States.

Table 2.3: Intermediate Employment Contribution of Manufacturer-related Operations by State and Nationally, 2003

	U.S.	MI	TN	OH	CA	MO	NC	GA	TX	AL	AR	MD	WV	IN	KY	Balance of U.S.
INTERMEDIATE	**74,660**	**4,758**	**1,378**	**3,935**	**17,610**	**2,325**	**1,036**	**1,221**	**2,204**	**1,051**	**290**	**691**	**690**	**8,519**	**9,297**	**19,656**
Manufacturing	**14,720**	**1,299**	**214**	**874**	**3,334**	**446**	**202**	**153**	**303**	**198**	**44**	**43**	**76**	**2,326**	**1,921**	**3,286**
Primary metal mfg	2,154	137	28	179	386	56	9	15	33	59	9	5	31	483	290	434
Fabricated metal prod	3,134	262	46	204	786	102	26	18	76	46	9	6	17	468	397	672
Motor vehicle mfg	2,544	496	28	124	336	103	6	5	7	15	1	0	4	676	620	123
Plastics, rubber prod	1,365	113	21	90	308	51	17	13	26	16	4	4	8	243	188	261
Other Manufacturing	5,523	290	92	278	1,518	133	145	102	161	62	21	28	16	456	425	1,796
Non-Manufacturing	**59,940**	**3,459**	**1,164**	**3,061**	**14,276**	**1,879**	**834**	**1,068**	**1,901**	**853**	**246**	**648**	**614**	**6,193**	**7,376**	**16,370**
Professional and Technical Services	10,530	649	184	541	2,902	314	134	175	329	136	32	120	92	937	1,165	2,822
Administration and Services	10,250	593	231	578	2,391	275	171	240	376	156	49	157	91	920	1,023	2,998
Wholesale Trade	6,158	405	127	354	1,390	226	93	87	168	108	27	36	72	820	902	1,344
Retail Trade	5,334	398	106	270	889	216	59	63	99	99	22	35	117	946	1,196	819
Transportation, Warehousing	4,048	179	83	184	1,032	105	49	72	140	38	16	28	13	386	396	1,326
Finance, Insurance	5,167	231	89	225	1,121	140	53	77	233	57	15	115	31	381	420	1,981
Management of Companies	2,523	161	46	151	696	111	51	59	30	22	12	10	12	244	243	676
Other Services (excluding Government)	4,959	299	98	242	1,053	210	62	63	93	100	23	25	108	752	1,027	803
Other Non-Manufacturing	10,971	544	199	516	2,802	286	161	233	432	136	50	123	78	807	1,004	3,601

Note: Due to rounding, columns or rows may not sum exactly

Table 2.4: Spin-off Employment Contribution of Manufacturer-related Operations by State and Nationally, 2003

	U.S.	MI	TN	OH	CA	MO	NC	GA	TX	AL	AR	MD	WV	IN	KY	Balance of U.S.
SPIN-OFF	**107,205**	**7,060**	**4,077**	**7,829**	**17,269**	**3,024**	**2,674**	**2,773**	**3,999**	**2,181**	**1,015**	**1,704**	**1,306**	**9,958**	**9,668**	**32,669**
Manufacturing	**22,739**	**2,441**	**1,280**	**2,486**	**1,776**	**647**	**1,054**	**710**	**758**	**712**	**418**	**175**	**197**	**2,109**	**1,071**	**6,909**
Primary metal mfg	2,069	98	114	313	8	51	34	55	70	127	54	23	67	323	103	630
Fabricated metal prod	2,519	170	167	361	54	69	77	53	101	76	55	14	28	218	80	998
Motor vehicle mfg	6,185	1,616	373	935	168	199	131	102	88	107	60	14	19	848	401	1,128
Plastics, rubber prod	1,189	73	96	193	27	30	59	36	31	36	29	8	10	146	49	369
Other Manufacturing	10,776	484	531	685	1,519	299	752	464	469	366	219	116	73	574	439	3,785
Non-Manufacturing	**84,466**	**4,619**	**2,796**	**5,343**	**15,494**	**2,377**	**1,620**	**2,063**	**3,241**	**1,469**	**597**	**1,529**	**1,109**	**7,848**	**8,597**	**25,761**
Professional and Technical Services	4,365	334	127	286	635	60	70	107	85	82	14	261	43	175	180	1,905
Administration and Services	1,720	131	161	198	203	28	40	65	47	30	15	28	20	117	121	517
Wholesale Trade	3,808	155	194	347	418	109	94	217	190	81	39	56	44	251	241	1,374
Retail Trade	16,566	993	506	1,008	3,412	450	249	321	518	280	83	219	252	1,945	2,313	4,016
Transportation, Warehousing	3,919	142	253	255	318	150	145	193	231	93	96	83	43	248	203	1,467
Finance, Insurance	4,333	201	130	276	720	114	90	92	131	69	27	89	44	306	315	1,728
Management of Companies	871	68	14	148	52	92	62	63	0	3	20	4	3	23	14	306
Other Services (excluding Government)	9,281	469	300	516	1,916	249	147	180	408	195	60	134	132	951	1,072	2,550
Other Non-Manufacturing	39,603	2,127	1,111	2,310	7,821	1,124	724	827	1,632	637	244	656	528	3,831	4,138	11,898

Note: Due to rounding, columns or rows may not sum exactly

In table 2.5, (the list of U.S. and state totals for direct, intermediate, and spin-off manufacturer-related employment) California, partially as a result of the large number of people directly employed by Toyota within the state (9,477), has a significant number of jobs in the intermediate (14,277) and spin-off (20,602) categories. While California's employment results should be expected due to the large number of direct jobs within the state, what was not expected were results in other states with relatively few direct jobs. For instance, Texas, with 56 total Toyota employees, has 1,901 intermediate and 4,302 spin-off jobs within the state. Significant total job numbers (though lower than Texas's) occur in Georgia, while North Carolina and Arkansas have no direct Toyota employees in the state, yet have 3,710 and 1,304 jobs, respectively, attributable to Toyota's national manufacturing activities. This should not be too surprising for a mature industry such as automobile manufacturing—which is now established in a large majority of the states east of the Mississippi River. Direct suppliers and their suppliers have located throughout the country for a variety of reasons and have a significant effect on the economies in every state.[4] The states' results primarily reflect the effect of total Toyota employment on individual state employment and income. Even in California, the 44,356 jobs contributed by Toyota arise from not only the California activities of Toyota, but instead from total U.S. Toyota manufacturer-related activities and employment. Therefore, a multiplier is not calculated for any individual state—except where a specific investment has been added to the state, as in the case of the San Antonio assembly plant discussed later in this paper.

[4] The Office for the Study of Automotive Transportation, Transportation Research Institute, and the Institute of Labor and Industrial Relations, University of Michigan. The Contribution of the International Auto Sector to the U.S. Economy. A study prepared for the Association of International Automobile Manufacturers, Inc., Ann Arbor, March, 1998.

Table 2.5: Total Employment Contribution of Manufacturer-related Operations, by State and Nationally, 2003

	U.S.	MI	TN	OH	CA	MO	NC	GA	TX	AL	AR	MD	WV	IN	KY	Rest of U.S.
DIRECT	29,135	497	16	151	9,477	1,031	0	58	56	346	0	662	919	4,848	8,514	2,560
INTERMEDIATE	74,660	4,758	1,378	3,935	17,610	2,325	1,036	1,221	2,204	1,051	290	691	690	8,519	9,297	19,656
TOTAL (Direct + Intermediate)	103,795	5,255	1,394	4,086	27,087	3,356	1,036	1,279	2,260	1,397	290	1,353	1,609	13,367	17,811	22,216
Spin-off	107,205	7,060	4,077	7,829	17,269	3,024	2,674	2,773	3,999	2,181	1,015	1,704	1,306	9,958	9,668	32,669
TOTAL (Direct + Intermediate + Spin-off)	**211,000**	**12,315**	**5,471**	**11,915**	**44,356**	**6,380**	**3,710**	**4,052**	**6,259**	**3,578**	**1,304**	**3,057**	**2,915**	**23,325**	**27,479**	**54,885**
National Multiplier	**7.2**															

Note: Due to rounding, columns or rows may not sum exactly

Automobile Dealers

Automobile dealers associated with selling, financing, and servicing new Toyota cars and trucks also contribute to the United States and states' economies. The tables in this section detail the estimated employment and income contributions by Toyota's U.S. new vehicle dealer operations to the private sector economies of the fourteen states and the country as a whole, as of December 31, 2003. The estimates of employment are broken out by direct employment (people employed directly by Toyota), intermediate employment (people employed by suppliers who supply Toyota dealerships and the suppliers who supply them), and spin-off employment (expenditure-induced employment resulting from spending by direct and intermediate employees who earn an income as a result of Toyota dealer-related activities).

Complete U.S. dealer-related operations employment and payroll data supplied by TMA totaled 105,795 employees, compensated with over $3.7 billion annually as of December 31, 2003. The total Toyota dealer employment and payroll data was reduced by 30 percent to net out activities related to used vehicle sales and servicing (non-warranty). The net new vehicle dealer employees and payroll is 74,060 and $2.6 billion, respectively. The data was coded according to NAICS category for retail trade (NAICS 44-45) for input into the model. Table 2.6 shows that 74,060 people are employed by the new vehicle side of Toyota dealerships, while another 38,990 jobs are associated with suppliers to the dealerships, across many industries. Finally, 62,250 spin-off jobs are a result of the spending of the employees in the direct and intermediate jobs. Altogether, this totals 175,300 jobs, with a multiplier of 2.4 ((74,060 + 38,990 + 62,250) ÷ 74,060) jobs in the U.S. economy for every one job at the dealerships, or 1.4 additional jobs in the U.S. economy for every one job at a Toyota dealership. The multiplier effect for new vehicle dealers is much lower than the multiplier associated with Toyota's manufacturing activities because the dealer supplier network is not as broad as that which supports manufacturing, nor is the compensation for the dealer jobs as high on average as it is for the manufacturing-related jobs.

Table 2.6: Total New Dealer Employment Contribution to the Private Sector Economy, U.S., 2003

	Dealers
Employment	
Direct	74,060
Intermediate	38,990
Total (Direct + Intermediate)	113,050
Spin-off	62,250
Total (Direct + Intermediate + Spin-off)	175,300
Multiplier: (Direct + Intermediate + Spin-off)/Direct	2.4
Compensation ($billions nominal)	6.129
Less: transfer payments	-0.630
Less: social insurance contributions	-0.476
Less: personal income taxes	-0.904
Equals private disposable personal income ($billions nominal.)	4.119
Contribution as % of total private economy	
Employment	0.10
Compensation	0.07

Compensation for the 175,300 total jobs associated with new vehicle dealer activities totals over $6.1 billion. After subtracting transfer payments, social insurance payments, and personal income taxes, the private disposable personal income for all people associated with Toyota new car dealerships in the U.S. totals $4.12 billion.

To put the compensation and employment numbers in context, the direct, intermediate, and spin-off jobs associated with Toyota new vehicle sales, financing, and service account for 0.10 percent of employment in the entire U.S. economy and 0.07 percent of total U.S. compensation.

New vehicle dealer employment figures for the fourteen individual states, the rest of the United States, and national employment results are shown in table 2.7. Direct dealer employment and total employment figures (direct + intermediate + spin-off) in the fourteen states closely correlate to the population of each of the states, as more vehicle dealerships are needed to service larger populations. However, intermediate employment does not mirror the states' populations. Rather, as with the manufacturing operations, supplier location is due to factors other than state population. Therefore, we would not expect to see an even dispersion of supplier jobs across

the states. Table 2.8 shows that intermediate and spin-off employment resulting from the new vehicle dealer activities is distributed across a number of major industry divisions. While the new vehicle dealer activities generate about 12,197 manufacturing jobs, or about 12 percent of the total intermediate and spin-off employment, the bulk of the employment—88 percent, or 89,043 jobs—are located in non-manufacturing industries. In fact, when the 13,250 jobs in the retail trade sector are combined with the 74,060 direct jobs, we find that almost 50 percent of all jobs related to new vehicle dealer activities are in the retail trade sector.

Table 2.7: Total New Dealer Employment Contribution by State and Nationally, 2003

	U.S.	MI	TN	OH	CA	MO	NC	GA	TX	AL	AR	MD	WV	IN	KY	Rest of U.S.
Direct Employment	74,060	1,188	1,730	2,216	12,380	1,097	2,029	2,514	5,576	1,079	485	2,279	700	1,108	1,041	38,640
Intermediate	38,990	1,008	656	1,194	7,415	551	903	1,165	3,055	388	193	630	113	560	339	20,820
Spin-off	62,250	1,739	1,595	2,285	9,895	1,278	2,007	2,125	5,159	1,035	591	1,482	406	1,372	931	30,360
Total Employment	**175,300**	**3,935**	**3,981**	**5,695**	**29,690**	**2,926**	**4,939**	**5,804**	**13,790**	**2,502**	**1,269**	**4,391**	**1,219**	**3,040**	**2,311**	**89,820**
Multiplier (Direct + Intermediate + Spin-off)/Direct	**2.4**															

Note: Due to rounding, columns or rows may not sum exactly

Table 2.8: Intermediate and Spin-off Employment Contribution of New Vehicle Dealers in U.S., 2003

	Intermediate	Spin-off	Total
Manufacturing	**4,739**	**7,458**	**12,197**
Primary metal mfg	262	204	466
Fabricated metal prod mfg	796	454	1,249
Motor vehicle mfg	208	861	1,069
Plastics, rubber prod mfg	453	328	781
Other Manufacturing	3,020	5,612	8,632
Non-Manufacturing	**34,253**	**54,790**	**89,043**
Professional and Technical Services	5,725	1,999	7,724
Administration and Services	7,636	1,018	8,654
Wholesale Trade	1,973	1,647	3,620
Retail Trade	2,007	11,243	13,250
Transportation, Warehousing	2,303	2,027	4,330
Finance, Insurance	2,929	2,751	5,680
Management of Companies	2,135	586	2,721
Other Services (excluding Government)	1,632	6,067	7,699
Other Non-Manufacturing	7,913	27,452	35,365
Total	**38,990**	**62,250**	**101,240**

Note: Due to rounding, columns or rows may not sum exactly

Total U.S. Contribution of Toyota Manufacturer- and Dealer-Related Activities

Table 2.9 sums the combined effects from Toyota's manufacturing operations (shown in table 2.1), and new vehicle dealer activities (shown in table 2.6), to produce the total effect from all of Toyota's U.S. manufacturing- and dealer-related operations. Summing direct employment of 103,195 (29,135 manufacturer-related + 74,060 new vehicle dealer operations), intermediate employment of 113,650 (74,660 manufacturer-related + 38,990 dealer-related), and spin-off employment of 169,455 (107,205 manufacturer-related + 62,250 dealer-related), produces a private sector employment total of 386,300 employees. Comparing total employment to direct employment produces an overall employment multiplier of over 3.7 (386,300 ÷ 103,195), meaning: (1) there are 3.7 jobs in the U.S. economy for every job at Toyota or its dealers, or (2) there are 2.7 additional jobs in the U.S. economy for every one job at Toyota or its dealers (1 direct job + 2.7 intermediate plus spin-off jobs). These manufacturer and dealer-related jobs represent 0.23 percent of all private sector employment in the U.S in 2003.

Table 2.9: Total Manufacturer- and Dealer-related Employment in the U.S., 2003

	Manufacturer -related	New Vehicle Dealer-related	Total
Direct	29,135	74,060	103,195
Intermediate	74,660	38,990	113,650
Total (Direct + Intermediate)	103,795	113,050	216,845
Spin-off	107,205	62,250	169,455
Total (Direct + Intermediate + Spin-off)	211,000	175,300	386,300
Multiplier: (Direct + Intermediate + Spin-off)/Direct	7.2	2.4	3.7
Compensation ($billions nominal)	8.265	6.129	14.394
Less: transfer payments	-0.754	-0.630	-1.384
Less: social insurance contributions	-0.645	-0.476	-1.121
Less: personal income taxes	-1.225	-0.904	-2.129
Equals private disposable personal income ($billions nominal)	5.642	4.119	9.760
Contribution as % of total private economy			
Employment	0.13	0.10	0.23
Compensation	0.09	0.07	0.16

Note: Due to rounding, columns or rows may not sum exactly

Total compensation for all 386,300 private sector workers associated with Toyota's U.S. activities is $14.4 billion, which represents 0.16 percent of the private sector compensation in

the U.S. economy. After netting out transfers, social insurance contributions, and personal income taxes, the private disposable personal income is $9.8 billion.

Table 2.10 sums the combined effects from Toyota's manufacturing operations (shown in table 2.5), and new vehicle dealer activities (shown in table 2.7), to produce the total effect from all of Toyota's U.S. manufacturing- and dealer-related operations across each of the fourteen individual states and nationally.

Table 2.10: Total Manufacturer- and Dealer-related Employment in the U.S. by State and Nationally, 2003

	U.S.	MI	TN	OH	CA	MO	NC	GA	TX	AL	AR	MD	WV	IN	KY	Rest of U.S.
Manufacturer-related																
Direct Employment	29,135	497	16	151	9,477	1,031	0	58	56	346	0	662	919	4,848	8,514	2,560
Intermediate	74,660	4,758	1,378	3,935	17,610	2,325	1,036	1,221	2,204	1,051	290	691	690	8,519	9,297	19,656
Spin-off	107,205	7,060	4,077	7,829	17,269	3,024	2,674	2,773	3,999	2,181	1,015	1,704	1,306	9,958	9,668	32,669
New Vehicle Dealers																
Direct Employment	74,060	1,188	1,730	2,216	12,380	1,097	2,029	2,514	5,576	1,079	485	2,279	700	1,108	1,041	38,640
Intermediate	38,990	1,008	656	1,194	7,415	551	903	1,165	3,055	388	193	630	113	560	339	20,820
Spin-off	62,250	1,739	1,595	2,285	9,895	1,278	2,007	2,125	5,159	1,035	591	1,482	406	1,372	931	30,360
Total Employment	**386,300**	**16,250**	**9,452**	**17,610**	**74,046**	**9,306**	**8,649**	**9,856**	**20,049**	**6,080**	**2,573**	**7,448**	**4,134**	**26,365**	**29,790**	**144,705**

Note: Due to rounding, columns or rows may not sum exactly

Texas Economic Forecast

In 2004, Toyota announced it would build an assembly plant to manufacture pick-up trucks near San Antonio, Texas.[5] It is expected that 2007 will be the first full year of production at the plant. This analysis will evaluate the future potential additional economic impact of the Toyota assembly facility on the Texas state economy through direct, intermediate, and spin-off employment effects. This forecasted employment is in addition to the existing Toyota-related employment—as of December, 2003—estimated in the previous section of this report. The analysis models two basic effects on the state's economy. The first effect is caused by the construction and equipment investment activities from 2004 through 2007 as the company builds and equips the plant. The second effect, beginning in 2007, is the operational phase of the plant. This effect is modeled through 2011. These two effects have been modeled jointly, with construction phasing in during 2004 and winding down in 2007, the same year the assembly operations are fully phased in. Therefore, full construction and partial assembly activities are modeled in 2006, partial construction and full assembly are modeled in 2007, with just full assembly operations commencing in 2008. Toyota provided estimates of the cost of construction and manufacturing equipment purchases, along with the projected employment level and compensation of the fully operational plant. Toyota estimates total investment in the physical structure to be $800 million, spread over 2004-2007. The company also estimates 2,000 workers in the plant when it is fully operational in 2007. In the model, the structural investment costs are allocated between construction and equipment purchases; the number of workers to be employed annually at the plant once assembly operations commence are also entered. The REMI model calculates the number of jobs created by the construction activity and equipment purchases, based on the monetary inputs. For the assembly operations, we assume one-half of the San Antonio facility workforce (1,000 employees) will be in place for training and testing of the new facility in 2006, with a full workforce of 2,000 employees in place in 2007.

The expected employment impacts to the Texas state economy are shown in table 2.11. For 2004, the table shows the initial effects of Toyota's investment, with total employment in the state projected to be 2,054 workers. Very few of the intermediate jobs (less than 100) are in manufacturing, while 22 percent (457) of the total jobs are in non-manufacturing industries. This makes sense, as Toyota is requiring very little in the way of durable goods in the early stages of

[5] For additional information see, for example, Automotive News, February 5, 2003, "Toyota Picks Texas for 6th Plant"

the project. In fact, most of the estimated jobs in 2004 are in the spin-off category. By 2005, it is expected the total employment in Texas, resulting from Toyota's spending, will double to 4,050 employees, with both the intermediate and spin-off employment categories doubling. In 2006, the projection is for another doubling of the total employment, as some of the plant workers are input into the model for the first time. Much of the employment increase comes in the intermediate sector, from both manufacturing and non-manufacturing categories, as Toyota operations require more goods and services from the region. By 2007, the model assumes construction and durable equipment purchases will be winding down, and the plant will be fully staffed. As a result, 2007 will show the highest employment figures for the entire study time period (2004-2011) of 10,639 jobs. By 2008, and on through the end of the forecast period in 2011, the total state employment impact is expected to stabilize at about 9,000 employees, with intermediate employment forecast to level off at approximately 3,500 employees, as part of this total.

In the employment forecasts, state and local government jobs generated as a result of Toyota's San Antonio plant have been purposely left out. While there are over 250 government jobs forecast for 2007, and more than 300 beginning in 2008, other factors may contribute to government employment beyond the demands of the private sector. Even though there is a good deal of literature examining the corresponding staffing levels of governments based on regional population increases,[6] we felt it wise to leave government employment out of the estimated total due to the many uncertainties that affect government staffing. Such factors as state and regional policies and politics play a large role in the size of government in many jurisdictions, and it is impossible for any simulation model to accurately predict government employment levels without a thorough representation of the local political situation.

[6] See for example, by Robert W. Burchell, Distinguished Professor at the Center for Urban Policy Research, Rutgers University, *Development Impact Assessment Handbook, The New Practitioner's Guide to Fiscal Impact Analysis,* and *The Costs of Sprawl Revisited.*

Table 2.11: Texas Projected Employment Scenario A ($400M Construction + $400M Equipment)

	2004	2005	2006	2007	2008	2009	2010	2011
TOTAL EMPLOYMENT (excluding state & local government)	**2,054**	**4,050**	**8,171**	**10,639**	**9,113**	**9,058**	**8,989**	**8,938**
DIRECT PLANT EMPLOYMENT	0	0	1,000	2,000	2,000	2,000	2,000	2,000
Employment Multiplier: Total ÷ Direct				5.3	4.6	4.5	4.5	4.5
CONSTRUCTION AND EQUIPMENT INVESTMENT (millions $nominal)	133	267	267	133				
INTERMEDIATE								
Manufacturing	**94**	**181**	**561**	**866**	**795**	**785**	**776**	**769**
Non-Manufacturing	**457**	**897**	**2,196**	**3,145**	**2,820**	**2,808**	**2,797**	**2,793**
Wholesale Trade	39	77	242	373	342	336	331	326
Retail Trade	48	89	208	290	255	249	243	236
Finance, Insurance	39	75	176	244	210	204	198	195
Professional and Technical Services	93	181	410	571	510	513	515	519
Administration and Services	97	196	407	544	479	481	484	487
Other Non-Manufacturing	142	279	754	1,123	1,024	1,025	1,026	1,029
Total Intermediate Employment	**551**	**1,078**	**2,758**	**4,011**	**3,615**	**3,593**	**3,573**	**3,561**
SPIN-OFF								
Manufacturing	**87**	**169**	**285**	**328**	**259**	**244**	**231**	**221**
Non-Manufacturing	**1,415**	**2,802**	**4,129**	**4,300**	**3,239**	**3,221**	**3,185**	**3,155**
Wholesale Trade	43	85	125	131	102	97	92	88
Retail Trade	190	379	723	911	779	777	774	770
Finance, Insurance	28	54	110	141	114	110	105	102
Professional and Technical Services	64	132	175	167	129	129	128	128
Administration and Services	4	7	21	32	29	29	29	30
Other Non-Manufacturing	1,086	2,144	2,974	2,918	2,087	2,079	2,057	2,039
Total Spin-off	**1,502**	**2,972**	**4,413**	**4,628**	**3,499**	**3,464**	**3,416**	**3,377**
Total Employment (excluding state & local government)	**2,054**	**4,050**	**8,171**	**10,639**	**9,113**	**9,058**	**8,989**	**8,938**
State & Local Government	27	74	161	259	325	383	436	483
Total Employment including State and Local Government	2,080	4,124	8,332	10,898	9,438	9,441	9,425	9,421

Note: Due to rounding, columns or rows may not sum exactly

Table 2.12 shows the expected private sector compensation within Texas resulting from Toyota's San Antonio plant. Total compensation is forecast to start out modestly in 2004 at $67 million, with the expectation it will steadily climb until it reaches a peak of $460 million in 2007 when construction activities are scheduled to be completed and initial plant operations begin. In 2008, total compensation drops to $430 million when construction is finished and the plant is fully staffed, but then is forecast to climb through 2011 due to inflation and other factors. When netting for transfer payments, social insurance contributions, and personal income taxes, the private disposable personal income generated in Texas from the activities related to the Toyota San Antonio facility begins at $48 million in 2004, increases to $337 million by 2007, drops slightly in 2008, then is expected to climb for the remainder of the forecast period.

Table 2.12: Texas Projected Compensation Scenario A ($400M Construction + $400M Equipment)

	2004	2005	2006	2007	2008	2009	2010	2011
Compensation ($billions nominal)	0.067	0.141	0.322	0.461	0.434	0.453	0.470	0.486
Less: transfer payments	0.006	0.010	0.021	0.025	0.016	0.013	0.009	0.005
Less: social insurance contributions	0.005	0.011	0.025	0.036	0.034	0.036	0.037	0.039
Less: personal income taxes	0.009	0.019	0.044	0.063	0.059	0.062	0.064	0.067
Equals private disposable personal income ($billions nominal)	0.048	0.101	0.232	0.337	0.325	0.343	0.359	0.375

Note: Due to rounding, columns or rows may not sum exactly

We have a concern that the automotive sector of the Texas economy is not large enough to provide all of the equipment required by Toyota for the San Antonio assembly plant, and that some equipment may have to be procured from outside of the state. To address these concerns, we ran a second simulation (Scenario B) which reduced the amount of money Toyota spends in the state by $200 million. With Scenario B, the assumption remains that all construction investment will be spent within the state. Thus the input included an equipment figure which is $200 million less than that used in the previous simulation. Therefore, the analysis is modeled on $600 million total Toyota spending within Texas. The results for Scenario B are shown in table 2.13. With the $200 million reduction in spending—which impacts equipment purchases within the state and the jobs associated with manufacturing the equipment—total employment is reduced by 200 to 300 workers annually during the period of construction and equipping the plant, 2004-2007. However, as should be expected, once the plant is up and fully running in 2008, there is virtually no difference between employment levels, or compensation. For compensation during the 2004-2011 forecast period, see table 2.14.

Table 2.13: Texas Projected Employment Scenario B ($400M Construction + $200M Equipment)

	2004	2005	2006	2007	2008	2009	2010	2011
TOTAL EMPLOYMENT (excluding state & local government)	**1,874**	**3,717**	**7,861**	**10,489**	**9,108**	**9,057**	**8,991**	**8,940**
DIRECT PLANT EMPLOYMENT	0	0	1,000	2,000	2,000	2,000	2,000	2,000
Employment Multiplier: Total ÷ Direct				5.2	4.6	4.5	4.5	4.5
CONSTRUCTION AND EQUIPMENT INVESTMENT (millions $nominal)	100	200	200	100				
INTERMEDIATE								
Manufacturing	**78**	**152**	**535**	**853**	**794**	**785**	**777**	**769**
Non-Manufacturing	**385**	**757**	**2,062**	**3,080**	**2,817**	**2,809**	**2,799**	**2,794**
Wholesale Trade	30	61	226	365	342	337	331	326
Retail Trade	45	83	202	287	255	249	243	236
Finance, Insurance	32	63	165	239	210	204	199	195
Professional and Technical Services	79	155	384	559	510	513	516	520
Administration and Services	80	162	374	528	478	481	484	488
Other Non-Manufacturing	119	234	711	1,102	1,023	1,026	1,027	1,029
Total Intermediate Employment	**463**	**909**	**2,597**	**3,933**	**3,611**	**3,594**	**3,576**	**3,563**
SPIN-OFF								
Manufacturing	**56**	**115**	**236**	**306**	**259**	**244**	**231**	**222**
Non-Manufacturing	**1,355**	**2,693**	**4,027**	**4,251**	**3,238**	**3,219**	**3,184**	**3,155**
Wholesale Trade	27	57	100	120	102	97	92	88
Retail Trade	154	311	658	879	776	776	772	770
Finance, Insurance	24	46	103	138	115	110	106	102
Professional and Technical Services	37	82	127	143	128	128	127	127
Administration and Services	4	8	22	33	29	29	29	30
Other Non-Manufacturing	1,109	2,189	3,017	2,939	2,088	2,079	2,056	2,039
Total Spin-off	**1,411**	**2,808**	**4,264**	**4,556**	**3,497**	**3,463**	**3,415**	**3,377**
Total Employment (excluding state & local government)	**1,874**	**3,717**	**7,861**	**10,489**	**9,108**	**9,057**	**8,991**	**8,940**
State & Local Government	23	65	147	245	313	373	427	475
Total Employment including State and Local Government	1,897	3,782	8,008	10,735	9,420	9,430	9,418	9,416

Note: Due to rounding, columns or rows may not sum exactly

Table 2.14.: Texas Projected Compensation Scenario B ($400M Construction and $200M Equipment)

	2004	2005	2006	2007	2008	2009	2010	2011
Compensation ($billions nominal)	0.057	0.121	0.301	0.449	0.431	0.451	0.469	0.486
Less: transfer payments	0.005	0.009	0.020	0.025	0.017	0.013	0.010	0.006
Less: social insurance contributions	0.004	0.009	0.023	0.035	0.034	0.035	0.037	0.039
Less: personal income taxes	0.007	0.017	0.041	0.061	0.058	0.061	0.064	0.067
Equals private disposable personal income ($billions nominal)	0.040	0.086	0.217	0.328	0.322	0.341	0.358	0.375

Note: Due to rounding, columns or rows may not sum exactly

Methods

The basic approach in these analyses has been to use a specially constructed regional economic impact model, input Toyota-specific data, and generate estimates of the economic contribution associated with Toyota's U.S. operations.

The Macroeconomic Model

For the estimation of employment and compensation associated with Toyota's U.S. operations, and to forecast the expected contribution of a new assembly plant to the Texas economy, we use an economic model supplied and constructed specifically for this study by Regional Economic Models, Inc. (REMI) of Amherst, Massachusetts. We then make adjustments to the model to reflect the general characteristics of the automobile industry and Toyota's specific employment and compensation data. The REMI model, which has been fully documented and peer-reviewed, was designed for the type of analyses employed in this current study and has been used by CAR and other organizations for over two decades for these types of analyses.

The version of the model used in this study represents the economies of fourteen states—Michigan, Tennessee, Ohio, California, Missouri, North Carolina, Georgia, Texas, Alabama, Arkansas, Maryland, West Virginia, Indiana, Kentucky—and the rest of the United States. This model allowed for simulating the interaction among all the regional economies and the rest of the nation, providing for an accounting of interregional trade and migration. Therefore, the model can simulate economic impacts that may occur in any one region, resulting from changing Toyota's level of activities in any or all of the regions.

The data provided by Toyota for input into the model included employment and compensation for each region at the end of 2003 and, in the case of the Texas forecast, expected construction and equipment purchase expenses. Before the data was input, it was first coded according to the North American Industry Classification System (NAICS). We then made adjustments in the data to accurately reflect assembly employment by netting out GM-related workers at NUMMI, estimated the used vehicle dealer employees and subtracted them from the total to derive new vehicle dealer employment, and ran two separate Texas construction scenarios to determine a range of job creation estimates.

The general methodology in the analyses is to run baseline simulations for each region's economy, then subtract Toyota's activities in each of the regions and run another set of simulations. The difference between the simulations represents the impact Toyota has on each region. The Texas scenario is similar, except the employment is added to the model and the differences compared.

Changes to the REMI Model: Version 5.5 to Version 6.0

This is the first detailed national and multiregional automotive industry economic impact simulation and analysis performed by CAR based on REMI Model 6.0, which employs the North American Industrial Classification System (NAICS) method of categorizing industry jobs. Previous studies have been based on REMI Model 5.5 and earlier, which used the Standard Industrial Classification (SIC) system to classify jobs within industries and industry sectors in very different ways than the NAICS—now the accepted standard across North America. Therefore, it will be difficult, if not impossible, to compare results in this analysis with previous reports published by CAR or other research organizations which employed the SIC system in their analysis. The change from SIC to NAICS has enabled researchers to capture a much more accurate and detailed picture of employment within the automobile industry, and to report—with a greater level of confidence and detail—the number of jobs and amount of compensation attributable to automobile manufacturing activities in the United States.

Additionally, along with including the NAICS system of coding employment and industries, the latest version of the REMI Model varies substantially from its immediate predecessor, version 5.5. Two major modifications to the model that have a substantial effect on the model's outputs are changes in the equations the model uses to calculate effects from residential and nonresidential investment and producer's durable equipment purchases. In the first case, the equations for calculating residential and nonresidential investment are now based on a two-year moving average of the gap between actual and optimal capital stock, instead of the previous one-year gap. This tends to smooth out the transition between the last historical year and the first forecast year. In other words, all of the impact is not realized in the first year. Rather it takes two years to realize the full impact of a substantial change from the baseline regional model. The second major change to the model is in the producer's durable equipment purchase equations, which now differentiate between replacing and upgrading equipment, and net new purchases of equipment. Because there is less emphasis on new durable equipment purchases each year—which we believe more accurately reflects investment in the auto industry, as it is spread over the 5-6 year life of a vehicle program—we can expect there to be less employment generated each year in simulations run on this present REMI model than in previous REMI versions. As a result, there is a smaller—and more accurate—multiplier associated with investment-intensive industries.

Both of these changes to the model, along with the change to NAICS data, now allow for the most detailed and accurate study to date of the employment and compensation attributable to the automotive industry and individual firms' activities.

References

Adams, F. Gerard, Byron Gangnes, and Gene Huang. "Impact of Japanese Investment in U.S. Automobile Production." *Journal of Policy Modeling* 13, no. 4 (1991):467-87.

American Automobile Manufacturers Association. "Auto and Truck Output." *Economic Indicators* (1st Quarter 1997):15.

Automotive News. *2004 Market Data Book*. Detroit: Automotive News, 1997.

Besser, Terry L. "Team Toyota: Transplanting the Toyota Culture to the Camry Plant in Kentucky". New York: State University of New York Press, 1996.

Campbell, Harrison Jr. "State and Regional Economic Impact of Diamond-Star Motors." *Illinois Business Review,* 45, no 4. (August 1998).

Center for Business and Economic Research. College of Business and Economics, University of Kentucky. "The Economic Significance of Toyota Motor Manufacturing, U.S.A., Inc. in Kentucky." December 1992.

CSM Worldwide. North American Light Vehicle Forecast, October 2004.

DesRosiers Automotive Consultants Inc. *AIAM: A Report Examining Member Company Contributions to the U.S. Economy*. Richmond Hill, Ontario: DesRosiers Automotive Consultants Inc., 1997.

Elsey, Barry "The Training and Development of Kaizen and Technology Transfer Instructors in the Toyota Corporation: A Practical and Conceptual Perspective in Human Resource Development". *Training & Management Development Methods*. Bradford: 2001 Vol. 15, Issue 4.

Furman, Cathie "Implementing a Patient Safety Alert System". *Nursing Economics*. Pitman: Jan/Feb 2005 Vol. 23, Issue 1.

Gross, John M., McInnis, Kenneth R. "Kandan Made Simple Simple: Demystifying and Applying Toyota's Legendary Manufacturing Process." New York: ANACOM, 2003.

Harbour and Associates. *The Harbour Report 2003.* Troy, MI.

Harbour Consulting. *The Harbour Report, North America 2004*, Troy, MI.

Hashimoto, Masanori. "Employment Based Training in Japanese Firms in Japan and in the United States: Experiences of Automobile Manufacturers." In *Training and the Private Sector, International Comparisons.* Edited by Lisa M. Lynch. Chicago: University of Chicago Press, 1994.

Institute of Labor and Industrial Relations and the Office for the Study of Automotive Transportation, University of Michigan and the Center for Automotive Research. "Contribution of the Automotive Industry to the U.S. Economy in 1998: The Nation and Its Fifty States." A Study Prepared for the Alliance of Automobile Manufacturers, Inc. and the Association of International Automobile Manufacturers, Inc. Ann Arbor, Winter 2001.

Institute of Labor and Industrial Relations, University of Michigan; Office for the Study of Automotive Transportation, University of Michigan Transportation Research Institute; and Center for Automotive Research. *Contribution of the Automotive Industry to the U.S. Economy in 1998: the Nation and its Fifty States.* Ann Arbor: University of Michigan, 2001.

Institute of Labor and Industrial Relations, University of Michigan and the Center for Automotive Research. "Contribution of the U.S. Motor Vehicle Industry to the Economies of the United States, California, New York, and New Jersey in 2003." Prepared for the Alliance of Automobile Manufacturers, Inc., Ann Arbor, May, 2004.

Kasul, Ruth A., Motwani, Jaideep G. "Successful Implementation of TPS in a Manufacturing Setting: A Case Study". *Industrial Management + Data Systems*. Wembley: 1997 Vol. 97, Issue 7.

Liker, Jeffery "The Toyota Way: 14 Management Principles From The World's Greatest Manufacturer" New York: McGraw-Hill, 2004.

Office for the Study of Automotive Transportation, Transportation Research Institute, and the Institute of Labor and Industrial Relations, University of Michigan. "The Contribution of the International Auto Sector to the U.S. Economy." A study prepared for the Association of International Automobile Manufacturers, Inc., Ann Arbor, March, 1998.

Pindyck, Robert S. and Rubinfeld, Daniel L. *Econometric Models and Economic Forecasts*. Second Edition. McGraw-Hill Book Company, 1981.

Sims, Richard G. "Economic and Fiscal Effects of the Toyota Auto Facility on the Kentucky Economy." Presented to the Appropriations and Revenue Committee of the Kentucky General Assembly, October 23, 1986.

Spear, Steven "Learning to Lead at Toyota." *Harvard Business Review*. Boston: May 2004 Vol. 82, Issue. 5.

Spear, Steven, and Brown, H. Kent "Decoding the DNA of the Toyota Production System." Boston: *Harvard Business Review*. Sept/Oct 1999 Vol. 77, Issue. 5.

Taiichi, Ohno "Toyota Production System: Beyond Large-Scale Production" New York: Productivity Press, 1988.

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

Treyz, George I. "Policy Analysis Applications of REMI Economic Forecasting and Simulation Models." *International Journal of Public Administration* 18, no. 1 (1995): 13-42.

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

U.S. Department of Commerce, Bureau of Economic Analysis, "Foreign Direct Investment in the U.S.: Financial and Operating Data for U.S. Affiliates of Foreign Multinational Companies," (online). Available: http://www.bea.doc.gov/bea/di/di1fdiop.htm (2004).

U.S. Department of Commerce, Bureau of the Census. *ASM: 2004 Annual Survey of Manufacturers, Statistics for Industry Groups and Industries*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, International Trade Administration 2003, http://ita.doc.gov/td/auto/qfact.html

U.S. Department of Commerce, International Trade Administration, Office of Automotive Affairs, www.ita.doc.gov/td/auto/

U.S. Department of Labor Bureau of Labor Statistics, http://data.bls.gov/

Ward's Automotive Yearbooks 1998-2003.

Womack, James P., Jones, Daniel T., Roos, Daniel "The Machine That Changed the World: The Story of Lean Production". New York: Harper Collins, 1990.