The Changing Structure of the U.S. Automotive Parts Industry

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UMTRI 93-6

The Office for the Study
of Automotive Transportation
University of Michigan
Transportation Research Institute

February 1993

U.S. Department of Commerce
Economic Development Administration
Technical Assistance and Research Division

This report was prepared by Sean P. McAlinden and Brett C. Smith. The statements, findings, conclusions, and recommendations are those of the authors and do not necessarily reflect the views of the Economic Development Administration.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTRI-93-6		

4. Title and Subtitle	5. Report Date
The Changing Structure of the U.S. Automotive Parts Industry	February, 1993
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
McAlinden, Sean P., and Smith, Brett C.	
9. Performing Organizations Name and Address	10. Work Unit No. (TRAIS)
University of Michigan Transportation Research Institute Office for the Study of Automotive Transportation 2901 Baxter Road Ann Arbor, MI 48109-2150	11. Contract or Grant No.
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
U.S. Department of Commerce Economic Development Administration Herbert C. Hoover Bldg., Room 7319 14th Street & Constitution Ave., NW Washington, D.C. 20230	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

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17. Key Works	18. Distribution Statement
Automotive parts industry	Available through EDA or OSAT

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
		53	$25.00

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Acknowledgments

The authors of this report would like to thank Wendy Barhydt, Lisa Hart, and Jennifer D'Arcy for their editorial advice, and document preparation assistance. Without their patience, and skill, the completion of this report would not have been possible. We would also like to thank Wesley R. Brown for his assistance, and persistance in gathering plant closing data.

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1. Introduction

The U.S. automotive parts industry underwent a significant structural change in the 1980s. Perhaps not since World War II have U.S. automotive suppliers experienced, in the space of a decade, such fundamental shifts in sales and product design, required materials and technologies, and location and scale of operations. Neither have they experienced such changes in quality, pricing, and labor costs, or such increases in import competition and foreign-owned domestic competition. Yet the domestic auto parts industry, by any definition, remains one of the largest and most important categories of U.S. manufacturing in the early 1990s.

It is ironic that the reasons for structural change in the auto parts industry, briefly discussed below, are better understood and more widely known than is the actual extent of this change in recent years. Traditionally, the very size and complexity of auto parts manufacturing leads to difficulties in defining the industry, and in tracking it on a consistent basis. This report's modest goal is to contribute to the knowledge of what has happened and perhaps what might happen.

We find that the auto parts industry is undergoing a process of simultaneous re-concentration and diffusion in its geographic location in the United States. Major component production, especially that carried out by domestic vehicle producers (captive supply), remains concentrated in the Midwest region of the country. However, production of smaller parts is diffusing to new regions in the United States and other countries. The recent appearance of new, foreign-owned parts production facilities, especially those that supply Japanese-owned transplant vehicle assembly plants, tends to reinforce the concentration of component parts production. The auto parts market connected to foreign-owned U.S. assembly plants is now a large (potentially very large), rapidly growing, and permanent segment of the market for auto parts in the United States. In fact, the development of foreign-owned operations on such a large scale, in a period of

less than a decade, may be the most significant structural change experienced by the industry in recent years.

A second major change in the auto parts industry involves scale of production. The average size of an auto parts manufacturing facility, at least in terms of employment, may have fallen by almost 40 percent. Changes include the use of new materials and production technologies, the "fragmentation" of vehicle markets, and the erosion of traditional producer market share. These changes are allowing, and even perhaps requiring, parts producers to alter not only their location, but also their scale of production. There is also evidence that the pattern of sourcing or integration within the traditional motor vehicle industry is changing to the direct benefit of "independent" auto parts suppliers. This may be because independent suppliers can adapt to change with a higher degree of flexibility. For example, the use of smaller, more flexible, auto parts facilities allows relocation to regions in the United States with generally lower labor costs, or to countries with even lower costs. Unlike captive supplier operations, independent suppliers can hedge the risks and costs of this new investment across a variety of customer markets.

Change in any industry brings opportunities. These opportunities are thought to be largely open to new companies or regions and communities not previously connected to the industry. Yet traditional automotive suppliers and communities can, and perhaps should, recognize and adapt to these opportunities. This report first defines in very general terms the auto parts industry and several recent, broad trends in its performance. Next, it discusses major influences on the structure of the industry; finally, it presents an investigation of structural change at three levels: captive production of components, regional shifts in a sample of auto parts industry establishments, and employment and geographical location of the new transplant parts sector of the U.S. automotive industry.

1.1 Definitions

The typical passenger car contains anywhere from 6,000 to 15,000 discrete parts and components using over 100 different elements, alloys, compounds, and other materials. The technical sophistication and scope of automotive parts covers a vast range--from simple metal stampings or plastic parts to complex powertrains containing precision machined aluminum parts and systems of electronic controls and modern microprocessors.

Automotive studies traditionally open their investigations through the use of charts that explain the structure of automotive manufacturing in terms of the value stream, or "build," or in terms of "sourcing," or who produces automotive value. Figure 1 is a simple illustration of the automotive manufacturing value chain. The chain starts with materials, moves through casting and foundry products, simple parts, forming and shaping, production of major components or systems, and ends with, assembly of the vehicle. Since this is a report on auto parts manufacturing, final assembly of vehicles is only briefly considered in the analysis. Materials production for automotive parts, and casting and foundry production of parts used in automotive components, are excluded. These products are not insignificant in terms of the automotive value chain. They are excluded because materials and foundry manufacturing for the automotive industry is carried out in industries that produce intermediate products for many industries and are so measured by the government. This study concentrates exclusively on industries that specialize in the manufacture of products for automotive use, or specifically, automotive parts and components.

Another common conceptual model of sourcing splits the production of parts and components between (a) "captive" facilities owned and operated by vehicle producers and (b) "independent" suppliers that sell and supply to vehicle producers--either directly or indirectly. The independent suppliers are themselves typically separated into at least two tiers of sourcing to the eventual customer or vehicle producer. "First-tier" suppliers supply products directly to vehicle producers for installation into vehicles in assembly. "Second-tier" suppliers supply parts to either first tier suppliers or to captive parts facilities engaged in component production.

Another model of sourcing further divides automotive parts into those produced outside of the United States--imported auto parts--and parts produced in U.S. facilities (domestic auto parts.) However, this study does not directly investigate trade patterns or trade issues in the automotive parts sector. Although patterns in auto parts trade have undeniably influenced the structure of the domestic auto parts industry in recent years, foreign trade in automotive parts is a complex subject best treated in a separate investigation.[1]

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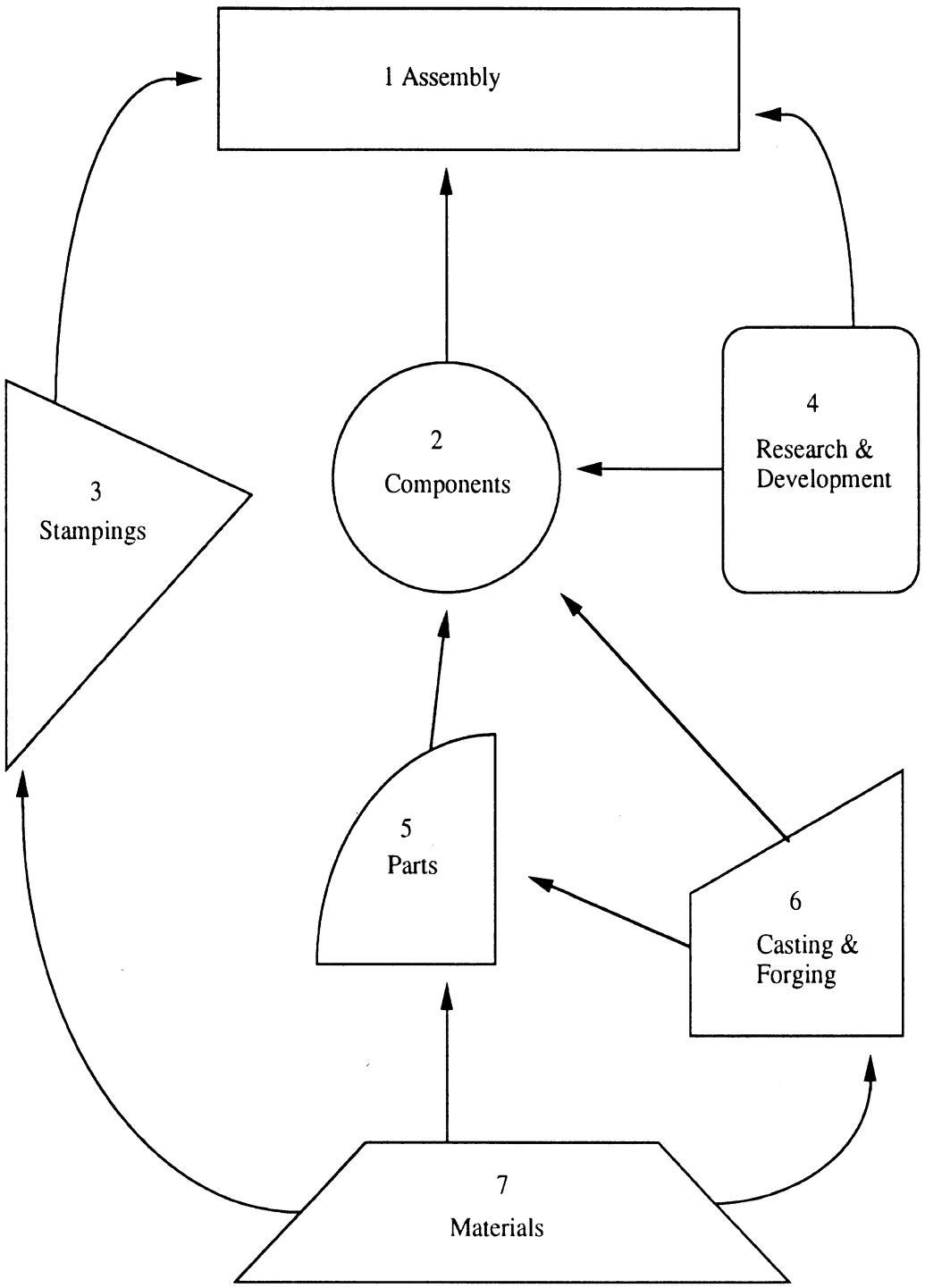
[1] See, for example: McAlinden, S., Andrea D., Flynn, M., and Smith, B., **The U.S.-Japan Automotive Bilateral 1994 Trade Deficit**, Office for the Study of Automotive Transportation, The Transportation Research Institute, University of Michigan, Ann Arbor, MI May 1991.

Figure 1:
Stages of Automotive Value



1.2 Recent Trends in Shipments, Employment, and Productivity

It is possible to track a consistent portion of the U.S. auto parts industry through information contained in the Census of Manufactures and Annual Survey of Manufactures (USCOM and ASM), published by the Bureau of the Census of the U.S. Department of Commerce.[2] The Census information includes annual series on shipments, value added, and employment for nine major four-digit Standard Industrial Classification (SIC) industries that produce significant output for automotive use. Table 1 below briefly describes the nine industries.

Table 1:
Major Supplier Industries

SIC Code/Title	Product Description
SIC 2396/Automotive and apparel trimmings	Textile trim for automotive use, men's and boy's apparel and printed garments
SIC 3011/Tires and inner tubes	Pneumatic tires and inner tubes for all uses.
SIC 3465/Automotive stampings	Job stampings for automotive use
SIC 3519/Internal combustion engines, nec	Non-automotive gasoline engines, automotive diesel engines, engine parts
SIC 3592/Carburetors, pistons, rings and valves	Carburetors new and used, piston rings and pins, and valves
SIC 3691/Storage batteries	Lead and nonlead acid storage batteries
SIC 3694/Vehicular lighting equipment	Headlamps and taillamps
SIC 3694/Engine electrical equipment	Ignition harness and cable sets, alternators, generators, regulators, starters, spark plugs, and other engine electronic equipment.
SIC 3714/Motor vehicle parts and accessories	Gasoline engines and engine parts for motor vehicles, engine filters, exhaust systems, drivetrain components, wheels, brake parts and assemblies, other new and rebuilt parts for motor vehicles not included in shipments of other industries.

The nine automotive supplier industries also manufacture nonautomotive products. For example, only a third of SIC 3519 and about half of SIC 2396 output is destined for automotive use. Although most tires and inner tubes produced by manufacturers in SIC 3011 are for use in new motor vehicles, many go to the automotive replacement market ("aftermarket"). A wide variety of other industries not listed above, of course, also produce for the automotive parts

[2]U.S. Department of Commerce, Bureau of the Census, **Annual Survey of Manufactures Statistics for Industry Groups and Industries**, (AS)-1. 1979-1990 volumes, Washington D.C., U.S. Government Printing Office.

market. Yet these nine major industries constitute a large share of total automotive parts manufacturing. This is especially true of shipments from facilities coded in SIC 3714, or the motor vehicle parts and accessories industry. Table 2 gives selected Census information for the overall group of nine supplier industries for 1979-1990. [3]

Table 2:
Nine Supplier Industries:
Shipments, Employment and Productivity 1979-1990

Year	(1) Shipments in Current $ (millions $)	(2) Shipments in Constant $ (millions CPI 83-84$ $)	(3) Value Added for SIC 371 (millions PPI 82$)	(4) Total Employment (thousands)	(5): (3)/(4) Value Added/ Employee (thousands $)
1979	$81856.4	$112749.9	$53087.5	962.7	$55.1
1980	71286.0	86512.1	36411.2	796.9	45.7
1981	79505.6	87464.9	37871.9	774.3	48.9
1982	75037.9	77759.5	30489.4	697.9	43.7
1983	87988.0	88341.4	42300.1	712.6	59.4
1984	105824.9	101852.7	47194.2	797.7	59.2
1985	111113.1	103265.0	47321.0	796.7	59.4
1986	109864.2	100241.1	44568.7	773.9	57.6
1987	118483.9	104299.2	47346.3	800.9	59.1
1988	129595.3	109548.0	50871.4	826.7	61.5
1989	126874.6	102318.2	48567.2	806.7	60.1
1990	122210.1	93504.3	47962.5	779.4	61.5

Source: Bureau of the Census, U.S. Dept. of Commerce, **Census of Manufactures, 1987, Annual Survey of Manufactures, 1979-1990,** Bureau of Labor Statistics, U.S. Dept. of Labor

Column one shows a decline of about seven percent in current dollar parts shipments during 1979-1982. Shipments then recovered during 1983-1988 to peak at $130 billion. Shipments declined in 1988-1990 by about $7 billion, or a little over five percent.

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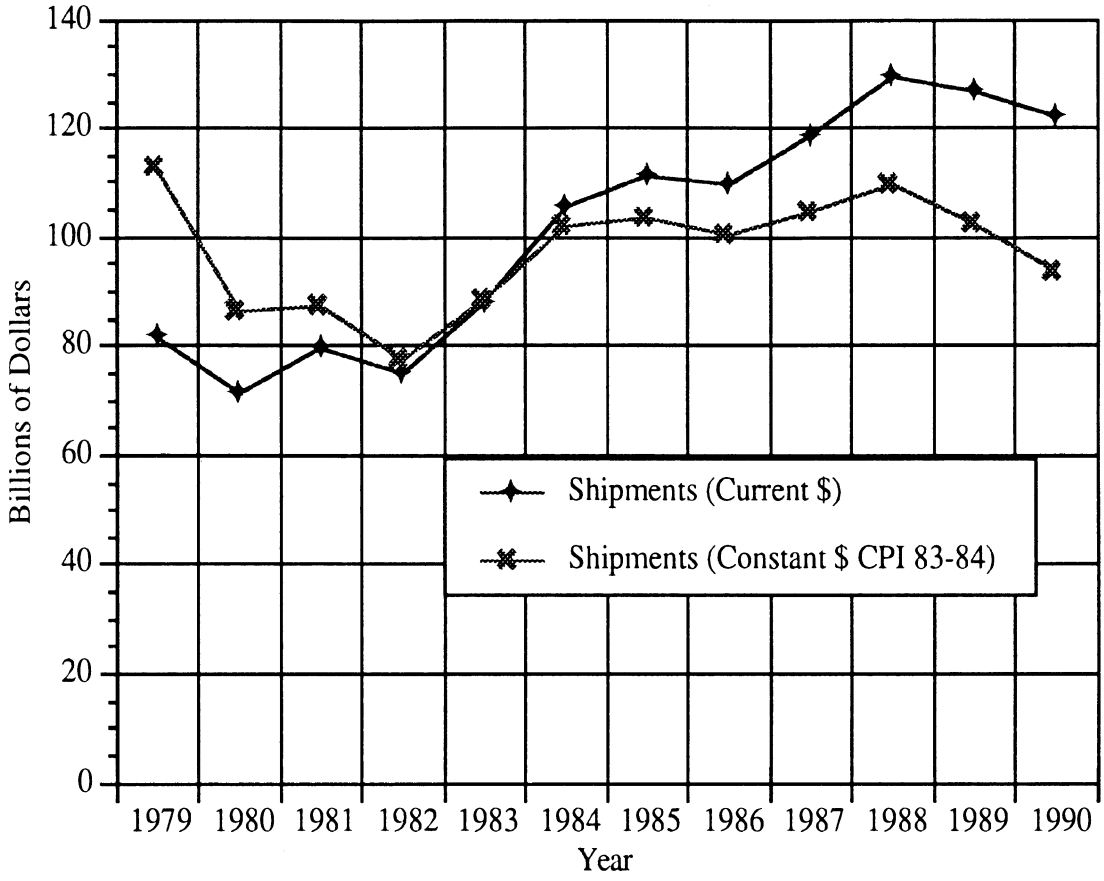
[3]For a somewhat similar summary of shipments and productivity performance of the U.S. auto parts industry during 1972-1983, see **A Competitive Assessment of the U.S. Automotive Parts Industry and the U.S. Aftermarket for Japanese Cars and Light Trucks,** Automotive Affairs and Consumer Goods, International Trade Administration, U.S. Department of Commerce (March 1985), Washington D.C., U.S. Government Printing Office,

Column two in table 2 shows shipments in current dollars deflated by the Consumer Price Index (CPI). This series of constant dollar shipments reveals a different pattern during 1979-1990 from that of current dollar shipments shown in column one. The 1979-1982 decline in constant dollars amounts to 31 percent. Constant dollar shipments recovered in the mid-1980s and reached a high in 1988 at a level 40 percent above the 1982 trough, but still 4 percent below the 1979 level. The 1988-1990 decline in constant dollars amounted to 10 percent. Figure 2 shows that constant-dollar shipments did not quite return to their 1979 level during the 1980s but did start to fall again in 1988. Figure 2 shows the relationship of shipments in current and constant dollars.

Figure 2:
Nine Supplier Industries: Shipments;
Constant and Current Billions of Dollars



Value added by manufacture is a measure of industry activity derived by subtracting the cost of materials, supplies, containers, energy, and contract work from industry shipments. When also adjusted for inventory changes and marketing activity, it measures the value of industry contributions to total industry shipments. Value added is an important indicator of industry activity, since it nets contributions from other industries or imports as a share of shipments. Column three of table 2 contains a series on total value added for the nine supplier industries that

has been deflated by the producer price index (PPI) for products in the product group SIC 371 (motor vehicles and equipment manufacturing). Constant dollar value added fell by over 40 percent during 1979-1982, and never fully recovered during the 1980s. After a high in 1988, value added fell by roughly 6 percent through 1990.

Employment for the nine supplier industries was 963,000 in 1979. This total declined by 266,000 through 1982, and then recovered to an average of about 800,000 during 1984-1989. The highest employment, almost 827,000, occurred in 1988 (as was the case for shipments and value added). Employment declined during 1989-1990 to 779,000, or 184,000 fewer workers than in 1979. A crude but meaningful measure of industry productivity is produced by dividing constant dollar (PPI) industry value added by employment to produce the ratio value added per employee. The series for this ratio is displayed in the final column of table 2. Constant dollar (1982 $ PPI) value added per employee was $55,100 in 1979 and reached $61,500 in 1988 and 1990; the increase for the period was about 11.5 percent. Although productivity grew slowly in auto parts manufacturing through 1990, auto parts shipments, employment, and value added by manufacture never recovered to 1979 levels during the 1980s and clearly began to decline in 1989.

The Census provides a second measure of auto parts manufacturing activity. This measure is based on purchases made by vehicle manufacturers, or materials costs reported by establishments in SIC 3711 (light duty motor vehicle manufacturing). Although these materials costs include purchases of energy and contract work performed by manufacturing establishments in other industries, an overwhelming proportion of vehicle producer materials costs is for raw materials and intermediate goods (including imported parts) needed to assemble new light duty cars, trucks, and vans.

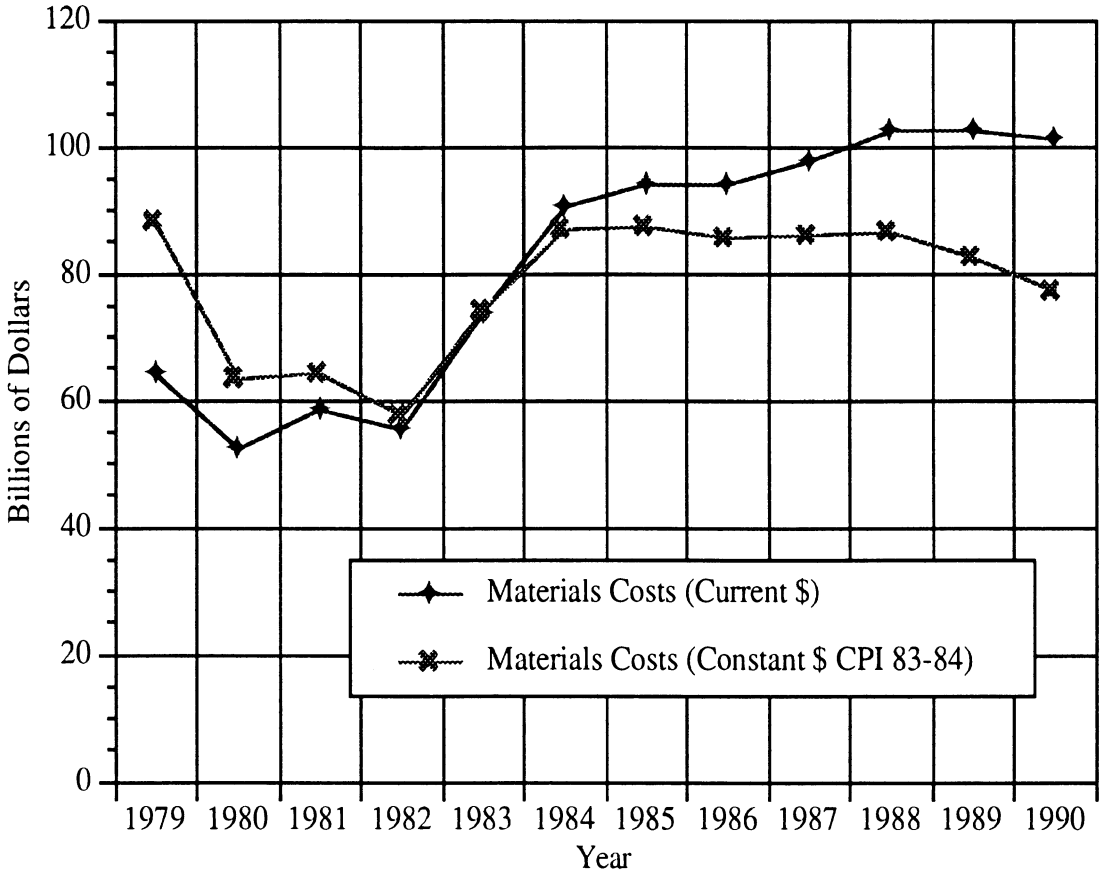
Table 3:
Materials Cost (MC) in U.S. Light Vehicle Manufacturing
1979-1990

Year	(1) SIC 3711 MC (Current millions $)	(2) SIC 3711 MC (Constant millions CPI 83-84$)	(3) SIC 3711 MC (millions PPI 82$)	(4) Per Vehicle MC or (2)/US veh. prod. (Thousands $)	(5) Per Vehicle MC or (3)/US veh. prod. Thousands	(6) PCE Repair + Rental (Constant billions $)
1979	$64226.7	$88466.5	$82766.4	$7.998	$7.483	$44.1
1980	52297.2	63467.5	59159.7	8.170	7.616	40.9
1981	58326.4	64165.5	60316.9	8.334	7.834	40.4
1982	55520.0	57533.7	55520.0	8.467	8.171	39.3
1983	73818.2	74114.7	72655.7	8.215	8.053	42.7
1984	90435.0	87040.4	85801.7	8.175	8.059	47.8
1985	94220.6	87565.6	86759.3	7.710	7.639	53.6
1986	93965.0	85734.5	85422.7	7.748	7.720	55.4
1987	97520.4	85845.4	88654.9	8.078	8.342	57.8
1988	102364.8	86529.8	92054.7	7.923	8.429	62.1
1989	102345.2	82536.5	90892.7	7.778	8.566	63.8
1990	101130.8	77376.3	90724.7	8.101	9.498	63.1

Source: Bureau of the Census, U.S. Dept. of Commerce, **Census of Manufactures, 1987, Annual Survey of Manufactures, 1979-1990,** and U.S. Dept. of Commerce, Bureau of Economic Analysis.

Table 3 contains three Census series on costs of materials declared by motor vehicle manufacturers (SIC 3711) during 1979-1990. Materials costs in current dollars, shown in column one, declined slightly during 1979-1982 and grew impressively during the rest of the decade to peak in 1988-1989 at a level of $101 billion, or 37% above the level of industry purchases in 1979. When we measure in constant dollars, however, a different pattern once again emerges. Constant dollar purchases, deflated by the CPI in column two, fell dramatically during 1979-1982, but recovered to 99 percent of the 1979 total by 1985. Thereafter, purchases gradually declined through 1989 and fell severely in 1990 with the onset of the automotive recession. Current and constant materials costs are illustrated in figure 3. Constant dollar materials costs per vehicle assembled is shown in column four. This figure peaked in 1982 at $8,400 but slowly declined through the rest of the decade.

Figure 3:
Materials Costs in U.S. Light Vehicle Manufacturing (SIC 3711)
Constant and Current Billions of Dollars



Materials costs deflated by an auto industry producer price index (SIC 371 PPI) follow a somewhat different pattern. This version of constant dollar materials costs is shown in column 3 of table 3. Materials costs actually exceeded 1979 levels by 1985, and reached a level of $91 billion (82$) in 1990. The per-vehicle figure, shown in column 4, increased from roughly $7,500 in 1979 to $9,500 in 1990, a rise of 27 percent in materials purchases per vehicle. On this basis, 1990 cars and trucks contained more in the way of materials and components than 1979 cars. The information in columns 4 and 5 underscores a major problem for the domestic auto industry. Producer prices received by manufacturers of vehicles and parts generally lagged well behind the overall rate of increase in consumer prices. Although this may be seen as a laudable restraint on the general rate of price inflation, the adverse effect on the financial performance of the industry can well be imagined.

The last column of table 3 shows levels of consumer expenditures on repair, maintenance, and rental of vehicles during 1979-1990. These figures are deflated by the CPI and demonstrate a remarkable rate of growth during the 1980s increasing 43% between 1979-1990. This may

indicate a rapidly growing market for aftermarket service and parts, but the breakout between repair service and rental expenditures is not available. Thus, little can be said with confidence about this segment of demand for automotive parts.

In conclusion, combined industry totals for shipments, employment, and value added during the 1980s never again reached 1979 levels. In fact, materials purchased by U.S. vehicle producers, if measured in CPI-deflated dollars, have never reached the 1979 total or that of any previous years. Of course, the major reasons for slow or even absent market growth for the domestic supplier industry are to be found in the related structural changes of the market for new vehicles in the United States.

1.3 Trends in New Vehicle Sales and Production

The most important influences on auto parts manufacturing are trends in the sales and production of traditional cars and trucks in the United States by U.S.-owned motor vehicle firms.[4] Table 4 contains a series of sales and market share figures for three types of vehicle sales during 1982-1990. Total U.S. motor vehicle sales rebounded from a recession trough of 10.5 million units in 1982 to an all-time U.S. record sales level of 16.3 million units in 1986. Sales remained relatively robust in 1987-1988 but began to decline in 1989 and reached a second recession trough of 12.5 million in 1991. Sales of imported cars and trucks also peaked in 1986 at over 4 million and slowly declined in later years to a level of 2.5 million. Offsetting this decline for foreign-owned vehicle producers was the rapid rise in the sale of "transplant" vehicles, or vehicles assembled in North America by foreign owned facilities during 1982-1991. U.S. sales of these vehicles exceeded 1.3 million in 1991. The market share for sales of imports from outside of North America reached almost 27 percent in 1987, but declined to less than 21 percent (in units, although not revenue) by 1991. However, the market share of transplant vehicles steadily increased throughout the period to a high of 10.6 percent in 1991.

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[4]"Traditional vehicle sales," or sales of traditional cars and trucks, will refer to U.S. sales of vehicles by U.S. owned vehicle producers (GM, Ford, and Chrysler) of cars and trucks assembled in their North American assembly plants. "Traditional vehicle production" will refer to production of cars and trucks by U.S.-owned vehicle producers in their U.S. assembly plants. "Domestic" vehicle sales will refer to sales of cars and trucks assembled in the United States, regardless of national status of plant ownership. These sourcing definitions are used because there are undeniable differences in the pattern of parts content, and because ownership certainly matters in terms of the national accounts, as defined by the Bureau of Economic Analysis, U.S. Department of Commerce.

Table 4:
U.S. Motor Vehicle Sales and Market Share by Source
1982-1991

Year	(1) Total Sales (mil. of units)	(2) Total Import Sales (mil. of units)	(3) Total Transplant Sales (mil. of units)	(4) Traditional Sales* (mil. of units)	(5) Import Share	(6) Transplant Share	(7) Traditional Share
1982	10.54	2.64	0.10	7.81	0.250	0.009	0.741
1983	12.31	2.86	0.15	9.30	0.232	0.012	0.756
1984	14.48	3.06	0.30	11.12	0.211	0.021	0.768
1985	15.72	3.62	0.37	11.73	0.230	0.024	0.746
1986	16.32	4.19	1.34	10.80	0.256	0.082	0.662
1987	15.19	4.05	0.62	10.51	0.267	0.041	0.692
1988	15.68	3.65	0.73	11.30	0.232	0.047	0.721
1989	14.71	3.24	0.91	10.57	0.220	0.062	0.718
1990	14.15	3.03	1.24	9.87	0.214	0.088	0.698
1991	12.54	2.59	1.33	8.62	0.206	0.106	0.687

Source: Motor Vehicle Manufacturers Association, **Economic Indicators**, Nov. 3, 1992

Sales of, and market share for, traditional vehicles (assembled by U.S.-owned firms in North America) peaked in 1985 and 1984 respectively and thereafter slowly declined through 1991. Sales of traditional vehicles fell below 10 million in 1990 and below 9 million in 1991. The market share hovered near 69 percent of the U.S. total vehicle market for both years.

Table 5 shows U.S. vehicle production levels in units and market share by source during 1982-1991. The most interesting development is the production of traditional vehicles. In 1977 and 1978, this production reached historical peaks of over 12.5 million units (not shown), but it declined to a 1982 level of less than 7 million. It then only partially recovered to a 1980s peak of 11.2 million in 1985. Traditional vehicle production gradually slowed and fell below 10 million in 1989. In the recession sales year of 1991, traditional production was less than 400 thousand above the previous recession trough experienced in 1982, although the total market was some 2 million vehicles larger. A significant anomaly occurred in 1986: for the first time a record year in U.S. vehicle sales was not also a record year in U.S. vehicle production.

Since imports actually declined in sales share by 1990, two other developments underlie the major decline in the production of traditional U.S. vehicles. First, U.S.-owned vehicle producers shifted a larger share of vehicle assembly to Canada during the 1980s (not shown here). Second, the share of transplant vehicle production of total U.S. vehicle production rose in the 1980s to remarkable heights. The production share of transplants grew steadily from 1 percent in 1982 to 18 percent in 1991 without a single annual reversal. This development, combined with the increased importation of Canadian-assembled vehicles, explains the steady drop in traditional production share throughout 1982-1991. Note that 1988 is the last year that traditional production of vehicles exceeded ten million. Constant dollar product shipments and value added, and employment for the nine supplier industries, also reached decade highs in 1988 and declined with traditional vehicle production in 1989-1990.

Table 5:
U.S. Vehicle Production and Production Share by Source
1982-1991

Year	(1) US Total Production (mil. of units)	(2) Total Transplant Production (mil. of units)	(3) Traditional Production (mil. of units)	(4) Transplant Production Share %	(5) Traditional Production Share %
1982	6.95	0.09	6.86	1	99
1983	9.19	0.18	9.01	2	98
1984	10.92	0.31	10.60	3	97
1985	11.62	0.46	11.16	4	96
1986	11.29	0.70	10.59	5	94
1987	10.88	0.80	10.08	7	93
1988	11.20	0.90	10.30	8	92
1989	10.85	1.25	9.60	12	88
1990	9.76	1.49	8.27	15	85
1991	8.79	1.55	7.24	18	82

Source: Motor Vehicle Manufacturers Association, **Economic Indicators**, Nov. 3, 1992

1.4 Trends in Auto Parts Trade, Vehicle Segment Share, Materials Use, and the Fragmentation of the Market

A number of other important factors influenced the restructuring of the domestic auto parts industry in the 1980s. Increased trade in automotive parts with other countries occurred in recent years. Table 6 summarizes total imports, exports, and net exports (levels of deficit or surplus) in automotive parts trade during 1982-1991. Imports and exports of parts between the

United States and Canada had been responsible for most parts trade through 1983. This was still largely the case in 1982-1983 when the U.S. deficit in parts trade amounted to about $1 billion. However, both imports and exports of parts grew rapidly in subsequent years. The balance clearly favored imports through 1989. The auto parts deficit peaked in 1989 at over $20 billion, an increase of over 1800 percent in only seven years. With the onset of the declining U.S. motor vehicle sales in 1990, and perhaps the influence of a weaker dollar, import sales declined during 1990-1991. The parts deficit has correspondingly fallen as exports continued to grow. Yet it remains to be seen whether this positive trend will continue and whether the enormous level of $30 billion in annual parts imports will continue to fall or grow once again.

Table 6:
U.S. Automotive Parts Trade
1982-1991
Current bil. $

Year	Imports	Exports	Deficit
1982	$6.90	$5.80	$1.10
1983	8.20	7.10	1.10
1984	18.16	13.79	4.37
1985	21.05	14.23	6.82
1986	23.81	13.02	10.79
1987	27.93	14.83	13.10
1988	32.08	17.43	14.65
1989	33.78	13.59	20.19
1990	33.34	17.66	15.68
1991	30.93	22.35	8.58

Source: U.S. International Trade Commission

U.S. vehicle producers largely accomplished the major downsizing of their passenger car models by 1980. The downsizing resulted in a weight reduction of roughly 800 lbs., on average. As shown in table 7, the typical domestic passenger car weighed about 3,360 lbs. in 1980. In 1990, the average weight figure reached a decade low of about 2,900 lbs., or about 14 percent less than in 1980. In some cases, lighter weight materials were substituted for heavier alternatives. For example, aluminum was substituted for steel in transmission and engine components; plastic replaced steel in dashboards, bumpers, and even panels. However, lighter and even smaller vehicles did not result in fewer or less value-intensive parts in automotive production. Many of the new, lightweight materials were actually more expensive. Also, many vehicle options

increased in popularity during the 1980s. Such options as air conditioning and FM stereo radios became almost standard.

Table 7:
Materials Usage and Share in New Domestic Passenger Cars

Material	1980	Shr. %	1990	Shr.%
Steel	1993.5	59.3	1564.0	54.0
Iron	484.0	14.4	398.0	13.7
Aluminum	130.0	3.9	158.5	5.5
Rubber	131.0	3.9	128.0	4.4
Plastics/ Composites	195.0	5.8	222.0	7.7
Glass	83.5	2.5	82.5	2.8
Copper	35.0	1.0	46.0	1.6
Zinc Die Castings	20.0	0.6	19.0	0.7
Powder Metal Parts	17.0	0.5	23.0	0.8
Fluids & Lubricants	178.0	5.3	167.0	5.8
Other	96.0	2.9	88.0	3.0
Total	**3363.0**		**2896.0**	

Source: Automotive News, **1992 Market Data Book**, Crain Communications, Detroit, MI, May 27, 1992.

In fact, domestic vehicles did not decrease in average value during the 1980s, but actually increased in content, and perhaps even size. Table 8 shows market class share of U.S. passenger car sales for small cars (subcompact/compact), intermediate sized cars, and large and luxury cars during 1982-1991. Large/luxury cars roughly maintained their share of sales throughout the period, but the small car share fell from over 46 percent to less than 31 percent. Many U.S. buyers of domestic cars presumably switched their preferences to larger intermediates in the late 1980s as the average age of a new car buyer increased and as the price of gasoline, in constant value terms, fell.

But market class share of the car market only tells part of the story of the switch in vehicle preference. Column four in table 8 shows the share of trucks and vans as a percentage of total vehicle sales during 1982-1991. The sales share of trucks and vans rose steadily throughout the period from about 24 percent in 1982 to peak just under 35 percent in 1991. Option content in

trucks and vans, it must be noted, rose steadily throughout the decade to a level rivaling that of passenger cars. The average weight and content of vehicles may very well have risen significantly during the past decade when overall truck share of sales is taken into account.

Table 8:
Domestic Passenger Car Sales by Market Class and Truck Share of U.S. Vehicle Market
1982-1991

Year	(1) Small Car %	(2) Middle Car %	(3) Large/ Luxury %	(4) Truck Share % of Total Vehicle Sls.
1982	46.2	31.3	22.5	24.3
1983	35.2	39.8	25.0	25.4
1984	36.2	39.0	22.9	28.3
1985	34.6	42.5	23.0	29.8
1986	32.6	44.4	22.1	29.8
1987	32.1	45.8	22.8	32.3
1988	30.7	46.5	23.5	32.8
1989	30.9	45.6	23.1	33.6
1990	30.1	46.8	21.9	34.3
1991	30.9	47.2	20.9	34.8

Source: Motor Vehicle Manufacturers Association, **Economic Indicators**, Nov. 3, 1992.

Many analysts believe that the most significant structural change in the automotive market of the past two decades has been the fragmentation of vehicle markets. Table 9 contains just one illustration of this phenomenon in terms of the average sales level of five best selling passenger car models in the United States. Average sales of the five most popular models reached almost one million units in 1955 and still averaged over 750,000 units in 1965. This average fell below 600,000 by 1970 and in recent years fell to nearly 300,000 units.

Only 74 separate nameplate/bodystyle (model) combinations were offered by traditional vehicle producers in 1955 when U.S. domestic car sales totaled over 7,400,000.[5] An average of 100,000 units of each model were sold in 1955. In 1991, traditional producers offered 143 models. Traditional car sales totaled 4,994,000 units in 1991 or about 35,000 per model.

[5]Model count (nameplate X bodystyle basis) based on OSAT calculation using Langworth, R.M., **Encyclopedia of American Cars 1930-1980**, Beekman House, New York, 1984.

Foreign-owned automakers offered 235 passenger car models in 1991.[6] Sales of these foreign models in the U.S. market totaled 3,181,000 or about 13,500 per model. Given the extent to which common components are shared across models, scale economies in the production of many parts for passenger cars certainly changed by the 1980s. Despite the presence of several large sales volume models, the same change also occurred in the light truck and van segment. There were 478 nameplate/bodystyle combinations of trucks and vans for sale in 1991 compared to 378 such combinations for passenger cars. The past ten years saw the introduction of entirely new segments in the truck market which now included minivans, "sports utilities" (SUs), and compact pickup trucks.

Table 9:
Five Best Selling Domestic Car Nameplates
1955-1992

Model	Sales	Model	Sales
1955		**1965**	
Chevrolet (regular)	1,639,500	Chevrolet (regular)	1,698,471
Ford (regular)	1,559,593	Ford (regular)	981,531
Plymouth	647,352	Mustang	518,252
Buick	544,400	Chevelle	349,555
Pontiac	530,007	Pontiac	324,366
Avg. Sales: 984,170		**Avg. Sales: 774,435**	
1970		**1992**	
Ford	838,366	Taurus	409,751
Chevrolet	732,004	Accord	393,477
Chevelle	381,054	Camry	286,602
Torino	351,304	Escort	236,622
Maverick	342,198	Civic	219,228
Avg. Sales: 528,985		**Avg. Sales: 309,000**	

Source: **Ward's Automotive Reports**, Various issues of **Ward's Automotive Yearbook**

The development of lower average sales levels for vehicle *models* has been matched overall by lower average sales levels for vehicle *firms* producing in the United States. The traditional "Big Three" lose market and production share to foreign-owned competition, which now includes six new assembly competitors within the United States. Many facilities, and perhaps even entire company production systems that were designed and built in preceding periods, characterized by mass-volume production of identical models may have been rendered inappropriate by the fragmentation of automotive markets. At first glance, independent suppliers should be potential beneficiaries of the new regime of low volume production. Independents can more easily operate smaller, more flexible facilities or operations that specialize in the production

[6]Model count (nameplate X bodystyle basis) based on OSAT calculation using **1992 Market Data Book**, Automotive News, Crain Communications, May 27, 1992.

of one type of component for several customers. But changes in captive production of automotive parts should be investigated before we examine the wider subject of structural change in the automotive supplier industry as a whole.

2. Regional Shifts in Captive Production

Captive production of automotive parts refers to the production of automotive parts and components by the motor vehicle firms themselves for use in new vehicles and the replacement market. Assembly firms such as General Motors (GM), Ford, Chrysler—the Big Three—and Honda all produce parts for their own needs, but the scope and extent of integrated parts manufacturing varies widely across vehicle producers. For example, an overwhelming share of gasoline engines, and, to a somewhat lesser extent, transmissions and body panels, are manufactured by the vehicle producers themselves. On the other hand, General Motors manufactures brake systems for installation in their vehicles, whereas Ford and Chrysler do not. Ford and Chrysler manufacture some automotive glass for their own and others' vehicles, but General Motors purchases glass from those two and independent suppliers. Finally, all companies, except Ford--which made its own until after World War II--have purchased automotive tires from independent tire firms.

The volume of captive parts production can appear to be significant in terms of total parts shipments. The 1987 Census of Manufactures reports total shipments for SIC 3714 (motor vehicle parts and accessories), the largest of the nine supplier industries, at a level of $62 billion. Over half this total, almost $33 billion, comprised shipments in two parts categories, gasoline engines/engine parts and drivetrain components (transmissions). These parts are produced largely in captive facilities by vehicle producers.[7] Similar 1987 census information for the automotive stampings industry, SIC 3465, shows that 23 establishments with employment exceeding 1,000 employees accounted for 57 percent of industry shipments and over 50 percent of total industry employment.[8] These 23 stamping facilities are almost entirely operated by vehicle producers.

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[7]U.S. Department of Commerce, Bureau of the Census,**1987 Census of Manufactures, Industry Series**, "Motor Vehicles and Equipment," MC87-I-37A, U.S. Government Printing Office, Washington D.C., April, 1990.

[8]U.S. Department of Commerce, Bureau of the Census,**1987 Census of Manufactures, Industry Series**, "Screw Machine Products, Fasteners and Washers; Metal Forgings and Stampings; and Metal Services," MC87-I-34D, U.S. Government Printing Office, Washington D.C., April, 1990.

Yet shipments do not tell the entire story of integration in the auto industry. The 1987 USCOM also reported that engine and drivetrain producing facilities purchased $17.5 billion in materials in 1987, or almost 53 percent of the value of engine and drivetrain shipments. Large automotive stamping facilities purchased 44 percent of the value of their shipments from other facilities within and outside of the automotive stampings industry.

Parts integration, or the portion of vehicle parts and components built "in house" for vehicle producers, has been the subject of some debate and contention in recent years. Perhaps the best, and probably the only, external study of vehicle producer integration yielded the results shown in table 10. The results are based on a partial sample of parts and components supplied for a number of vehicle platforms produced by the Big Three.

Table 10:
1988 Big Three Vertical Integration

Firm	(1) Parts Integration %	(2) Parts Cost Integration %	(3) Total Vehicle Cost Integration %
General Motors	72%	31%	53%
Ford	54%	25%	39%
Chrysler	39%	19%	34%

Source: D. Luria, **Calculating Big Three Vertical Integration**, Industrial Technology Institute, Ann Arbor, MI, August 1990

A 1990 Industrial Technology Institute (ITI) study measured three types of Big Three integration. First, the study measured the percentage of parts received at assembly plants from assembly company parts facilities or "parts integration" (final assembly of components). For example, this study reported that, in 1988, GM assembly plants received 72 percent of their components from GM parts facilities (For example, 100% of GM engines were shipped from GM engine plants). Second, the study also measured the percentage of parts cost actually incurred within GM or parts cost integration. (For example, only 70% of the cost of producing a GM engine is incurred within GM, since 30% of the cost can be traced to non GM parts used in engine production). About 31 percent of the cost of GM parts was actually incurred within GM captive parts operations. The third type of integration was total percentage of vehicle cost, including cost of assembly, incurred within the vehicle firm. GM was estimated to have the highest level of integration in all three types of integration in 1988.

The ITI study reported that imports and independent parts producers' share of 1988 new vehicle parts production value ranged from 69 percent to as high 81 percent, depending on the

vehicle producer in question. Similar estimates for Japanese vehicle producers are hard to find, yet it is generally believed that Japanese auto makers final-assemble about 25 percent to 40 percent of their vehicle components, or less than the average for the Big Three. The percentage of parts value sourced to independent suppliers, then, is even higher for Japanese vehicle firms. However, present static estimates, for the Big Three or the Japanese, say little about changing levels of integration for vehicle firms in recent years.

Table 11 shows striking evidence of declining Big Three U.S. employment in recent years. The Big Three reduced their U.S. employment by 164,000 during 1979-1989, a job loss figure that increased during the 1990-1991 recession. The decline in automotive employment for these firms is higher than that shown in table 11, since the Big Three added nonautomotive subsidiaries during this period. Unfortunately, it is hard to determine precisely the sources of the 1979-1991 decline in employment.

Table 11:
Big Three U.S. Employment: 1979, 1989 & 1991

Year	U.S. Employment
1979	960,525
1989	796,642
1991	717,078
Total change	
1979-1989	-163,883
1979-1991	-243,447
Percent change	
1979-1989	-17.1%
1979-1991	-25.3
Source: Company public relations departments	

Tables 4 and 5 document the decline in Big Three U.S. sales and production. It must be assumed that some improved productivity in operations was achieved as well. Employment decline due to lower integration, then, is not separated from employment decline attributable to loss of vehicle production or higher productivity.

2.1 Change in Big Three Facilities: 1979-1991

A special count of Big Three U.S. automotive facilities was performed for this study for 1979 and 1991.[9] The final results of this investigation are shown in table 12. Big Three operations are sorted into two types of assembly plants (car and truck/van), three types of component plants (engine, transmissions, and stamping), and an all-other parts category. A total of 257 operating Big Three manufacturing facilities (including American Motors Corporation plants) are identified for 1979. This total is reduced to 215 in 1991; there were 42 net closures.

[9]The primary source of information for the facility count was the **Information Handbook: U.S. Motor Vehicle Manufacturers' North American Plant Facilities**, Editions for 1979-1991, Motor Vehicle Manufacturers Association of the United States, Detroit, MI.

Actually, 80 facilities have closed across the categories, and 38 new or reconverted facilities have opened (see Appendix 1). The number of Big Three assembly plants has fallen by 17, of which 15 are in car assembly operations and only 2 in the production of trucks and vans. The disproportionate number of net closings for car assembly plants reflects the increasing share of trucks and vans in the total vehicle market, as well as an even greater increase in the share of Big Three sales.

The largest number of net closures of any category is that for stamping plants. To a certain extent, this probably reflects the substitution in car production of so-called "unibody" models for older "body-on-frame" cars. This shifted a considerable portion of body work from stand-alone body/stamping plants to the body shops of car assembly plants.[10] The increase in engine plants can be attributed to a larger number of engine families or types in production (and lower production volumes per engine type) to meet the needs of the fragmented market for vehicles.

Table 12:
Big Three U.S. Facilities: 1979 & 1991

Facility Classification	(1) 1991 Facilities	(2) 1991 Assembly ratio	(3) 1979 Facilities	(4) 1979 Assembly Ratio	(5) Net Change 1979-1991
Assembly Plants	54		71		-17
Car	29		44		-15
Truck	25		27		-2
Engine Plants	18	3.0	14	5.1	+4
Stamping Plants	24	2.3	39	1.8	-15
Transmission Plants	9	6.0	11	6.5	-2
Other Component Plants	110	0.5	122	0.6	-12
Totals	215		257		-42

Source: OSAT analysis of Motor Vehicle Manufacturing Association information

The small number of net closures for "other component plants" is somewhat surprising. Two reasons for the low count of net closures of captive parts facilities are (1) that two of the

[10]This study coded separate 1979 truck and car "body" plants as stamping facilities. The usual practice of the U.S. Census was, and is, to code such facilities as motor vehicle body plants and include them with assembly plants in the classification SIC 3711, separate from automotive stamping facilities (SIC 3465). Of course, body shop operations, the welding and painting of "body-on-frame" passenger cars, were largely integrated into final assembly plants in the early-to mid-1980s, We coded these 1979 facilities as separate from assembly, largely to reflect the intermediate status of their output and to provide a clearer picture of capacity change in final assembly.

domestic vehicle makers (Ford and Chrysler) did not maintain a large number of such facilities in 1979 and (2) that GM actually built or reconverted a number of these parts facilities in the mid-to late-1980s. GM is apparently reconsidering this pattern in 1992.[11] Table 12 also shows assembly ratios for component and parts plants for both 1979 and 1991. An assembly ratio is the count of assembly plants divided by the count of a given parts category. A lower ratio in 1991 vis-a-vis 1979 could mean declining scale economies in the production of a particular component. But this holds only if assembly capacity as well as the level of integration in parts production remains constant. Assembly capacity did not remain constant; assembly plant production generally rose from about 200,000 to 240,000 units of vehicle capacity. It appears that the scale of captive automotive stamping increased between 1979 and 1991. But work that had been performed in separate body and stamping plants in 1979 had been transferred to the body shops of many assembly plants by 1991. The average size and output of a typical stamping plant may not have changed at all.

The Big Three closed 80 facilities and reconverted or built 38 plants during 1979-1991. The total of 108 amounts to 42 percent of the original facility count of 257 and could have provided the Big Three with ample opportunity to change the regional distribution of their operations. James Rubenstein, an industrial geographer at Miami University in Ohio, promulgates an appealing theory on the recent relocation of the U.S. auto industry. According to Rubenstein, the branch assembly plant system, constructed by GM and Ford over the previous 60 years to produce identical vehicle models nationwide at minimum "freight-out" cost, began to break up in the 1970s with the fragmentation of the U.S. passenger car market. Multiple regional assembly plants building identical cars at optimal distances from consumer markets were gradually replaced by segment-specific, single-source plants producing for the national (even continental) market. These plants generally relocated, for optimal freight-cost purposes, from coastal regions (such as Los Angeles and New Jersey) to Midwest and Midsouth locations (between the I-75 and I-65 inter-state highway corridors, bounded by I-20 in the south) or the "automotive box". Yet large urban-industrial areas within the Midwest did not necessarily benefit from this reconcentration in the Midwest because of their high costs relative to rural locations.

Finally, Rubenstein asserts that, with the exception of stamping, body, and aftermarket parts plants, component facilities have always been, and remain, concentrated in the upper

[11]During 1990-1992, General Motors announced the eventual closing of six U.S. assembly plants and 16 U.S. component and parts-making facilities. The closings are expected to take place through 1995. The Van Nuys California Assembly plant is the first of these closings (1992), and reduces the assembly plant count in table 12 to 53.

Midwest. Rubenstein and others expect this pattern to continue, mildly reinforced, perhaps, by the adoption of just-in-time (JIT) inventory systems.[12] JIT has been recognized as more than an efficient method to minimize inventory. Low inventory levels of components and parts in assembly plants provide an essential incentive to maintain and improve the quality of the entire automotive production system. In a JIT system, defective parts cannot easily be replaced from inventory since only a few hours of needed stock are on hand. Also, this low inventory system requires not only frequent deliveries of needed parts and components (every four to five hours), but also close communication and cooperation from both suppliers and their assembly customers. This would require suppliers to locate in close proximity to their assembly customers. This is especially the case for large, complex, and high-value components such as engines and transmissions.

2.2 Change in Big Three Facilities by Regions: 1979-1991

The Big Three facilities counts are coded by region for the purpose of detecting patterns in regional relocation during 1979-1991. The number of states with at least one facility in either 1979 or 1991 is twenty-six. The twenty-six states are grouped into the following six regions:

Big Three Regions	
Region	**States**
Southeast	Alabama, Georgia, Mississippi, Virginia
Southwest	Kansas, Louisiana, Oklahoma, Texas
Northeast	Connecticut, Delaware, Massachusetts, Maryland, New Jersey, New York, Pennsylvania
Midwest	Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, Wisconsin
Midsouth	Kentucky, Missouri, Tennessee
West	California

Regional facility counts, by type, are shown in table 13 for 1979 and 1991. The information in table 13 is used to calculate regional share of facilities—shown in table 14 once

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[12] Rubenstein, J.M., **The Changing U.S. Auto Industry, A Geographical Analysis,** Routledge, London, 1992. See also the discussion in GlassMeier, A.K., and R.E. MCluskey, "U.S. Auto Parts Production: An Analysis of the Organization and Location of a Changing Industry," **Economic Geography,** Vol. 63, (April 1987), pp.142-159.

again by type, for 1979 and 1991. Rubenstein's theory about industry relocation is supported in tables 13 and 14, at least for the category of assembly plants. Ten of the seventeen net closures of assembly plants during 1979-1991 occurred in the Northeast and the West (California). This pattern is reinforced through a recent closing and announced closings by General Motors in 1992. Tables 13 and 14 also show the continued concentration of Big Three engine, transmission, and stamping plants in the Midwest. The Midwest share of these major component facilities hardly changed during 1979-1991. The Midwest share of *major* component plants in 1991 ranged from 89 to 100 percent. All in all, assembly plants appeared to return to the general environs of component plants during 1979-1991.

But the Midwest suffered a six percentage point decline in its share of *other* component plants. The Southeast, Southwest, and Midsouth all achieved larger shares of these parts facilities. Once again, recent plant closing announcements by GM in 1992 appear to further support a southward drift in parts production.[13] The recent GM consolidation makes it hard to detect any final trend, especially since the company's downsizing may not be complete.

[13]None of the GM parts or component facilities in the Midsouth or Southeast are scheduled to close. The GM assembly plant in Doraville, Georgia will apparently lose the production of its present car model, but the plant is expected to gain a minivan model as a replacment product.

Table 13:
Regional Percent Change of Big Three Facilities:
1979 - 1991

	Southeast			Southwest			Northeast			Midwest			Midsouth			West		
	1991	1979	Change (%)	1991	1979	Change (%)	1991	1979	Change (%)	1991	1979	Change (%)	1991	1979	Change (%)	1991	1979	Change (%)
Assembly Plants	3	5	-40.0	4	2.0	100.0	6.0	10.0	-40.0	30.0	34.0	-11.8	10.0	13	-23.1	1	7	-85.7
Car	2	3	-33.3	3	2	50.0	3	8	-62.5	15	19	-21.1	5	7	-28.6	1	5	-80.0
Truck	1	2	-50.0	1	0	0.0	3	2	0.0	15	15	0.0	5	6	0.0	0	2	0.0
Engine Plants	0	0	0.0	0	0	0.0	1	1	0.0	16	13	23.1	1	0	NA	0	0	0.0
Transmission Plants	0	0	0.0	0	0	0.0	0	0	0.0	9	11	18.1	0	0	0.0	0	0	0.0
Stamping Plants	0	0	0.0	0	0	0.0	2	2	0.0	22	37	40.5	0	0	0.0	0	0	0.0
Component Plants	10	7	42.9	8	5	60.0	13	16	-18.8	75	91	-17.6	2	1	100.0	2	2	0.0
Total	13	12	8.3	12	7	71.4	22	29	-24.1	152	186	-18.3	13	14	-7.1	3	9	-66.7

Source: OSAT analysis of Motor Vehicle Manufacturing Association data

Table 14:
Regional Percent Share of Big Three Facilities:
1979 & 1991

	Southeast		Southwest		Northeast		Midwest		Midsouth		West	
	1991	1979	1991	1979	1991	1979	1991	1979	1991	1979	1991	1979
Assembly Plants	5.6	7.0	7.4	2.8	11.1	14.1	55.6	47.9	18.5	18.3	1.9	9.9
Car	6.9	6.8	10.3	4.5	10.3	18.2	51.7	43.2	17.2	15.9	3.4	11.4
Truck	4.0	7.4	4.0	0.0	12.0	7.4	60.0	55.6	20.0	22.2	0.0	7.4
Engine Plants	0.0	0.0	0.0	0.0	5.6	7.1	88.9	92.9	5.6	0.0	0.0	0.0
Transmission Plants	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0
Stamping Plants	0.0	0.0	0.0	0.0	8.3	5.1	91.7	94.9	0.0	0.0	0.0	0.0
Component Plants	9.1	5.7	7.3	4.1	11.8	13.1	68.2	74.6	1.8	0.8	1.8	1.6
Total	6.0	4.7	5.6	2.7	10.2	11.3	70.7	72.4	6.0	5.4	1.4	3.5

Source: OSAT analysis of Motor Vehicle Manufacturing Association data

Figures 4 and 5 show an alternative presentation of the eight 1979-1991 plant closings. These figures portray two regions and two facilies categories. Figure 4 locates assembly and component (all types) plant shutdowns in the United States except for a tri-state (Michigan, Ohio, Indiana) "home region." The non-tri-state region suffered 21 of the 30 assembly and 7 of the 50 component closings for 1979-1991. Figure 5 shows closings for the tri-state region, with a special breakout for Wayne County, Michigan. The tri-state area suffered 9 of the 30 assembly plant shutdowns and 43 of the component and parts plant closings.

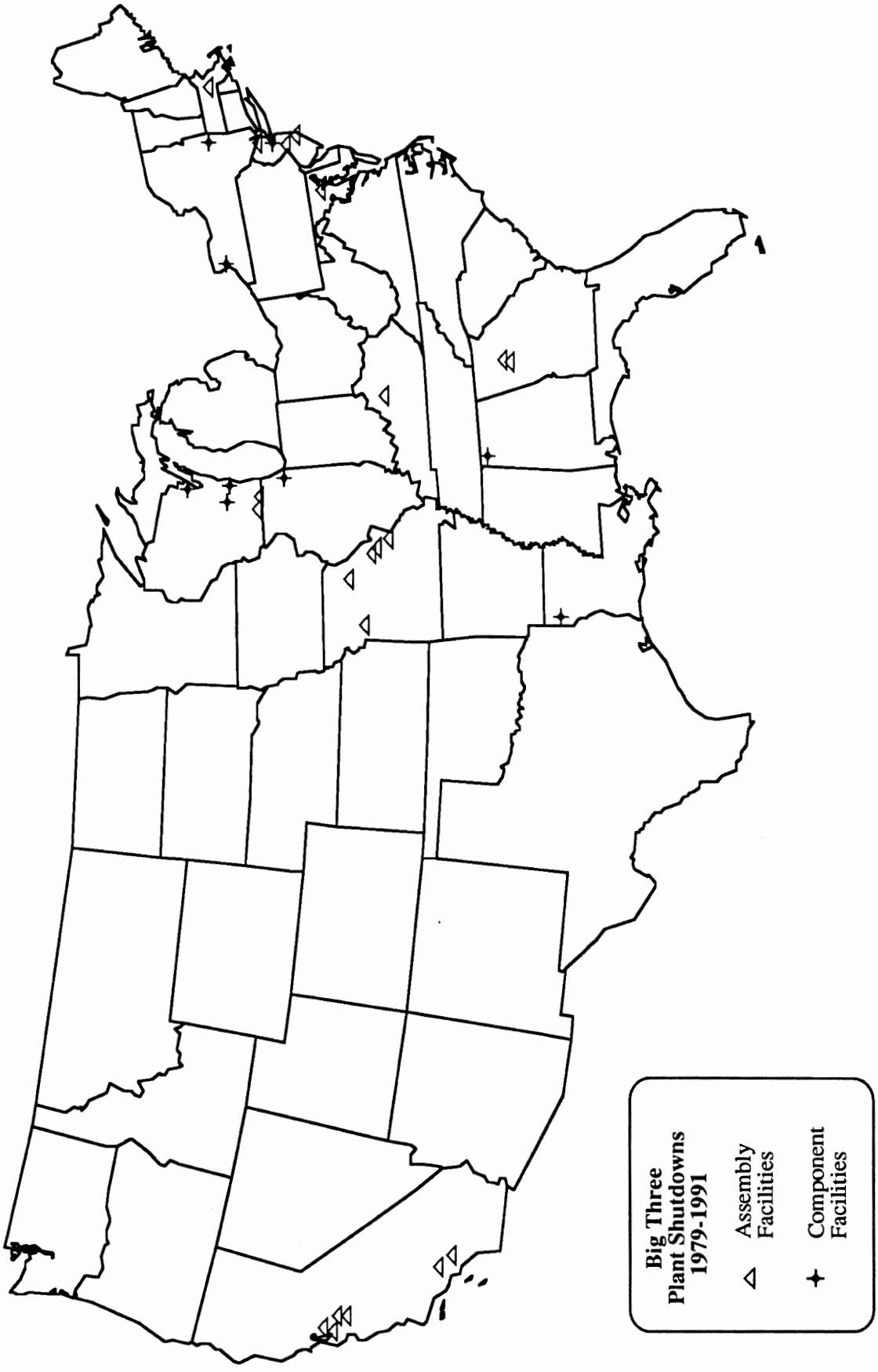
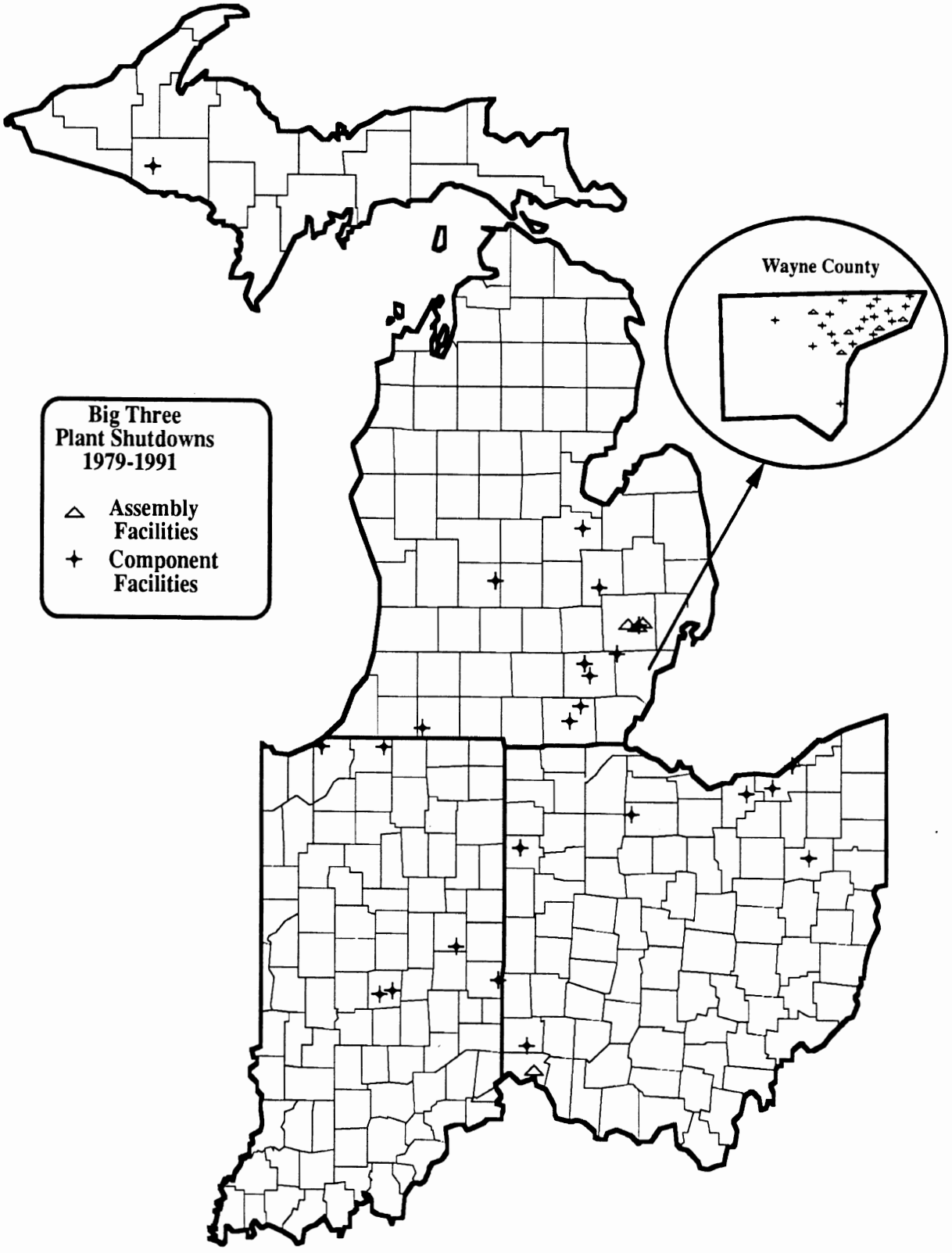


Figure 4:
Distribution of U.S
Plant Shutdowns

Figure 5:
Distribution of Tri-state Plant Shutdowns



3. Change in Location and Scale for Automotive Parts Facilities

The U.S. Bureau of the Census produces an annual publication titled County Business Patterns (CBP). CBP reports establishment counts and employment by industry for the 50 individual states and for the United States as a whole.[14] The Census derives information for CBP from a variety of sources including the USCOM and the ASM. The CBP has its critics as a source of information on establishments. Many researchers prefer alternate government sources on the grounds of consistency. But a major attraction of the CBP is its accessibility. This study uses the 1979 and 1989 (the most recent) CBP volumes to measure the location of automotive parts manufacturing establishments for eight of the nine major supplier industries listed in table 1.

Twenty-five states had significant automotive parts manufacturing activity in 1979. The 25 states below had 98 percent of U.S. employment in the eight major supplier industries in 1979. The 25 states and their regions are as follows:

County Business Patterns	
Region	**States**
Southeast	Alabama, Georgia, North Carolina, South Carolina, Virginia
Southwest	Kansas, Louisiana, Oklahoma, Texas
Northeast	Delaware, Massachusetts, Maryland, New Jersey, New York, Pennsylvania
Midwest	Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin
Midsouth	Kentucky, Missouri, Tennessee
West	California

3.1 County Business Patterns Change in Employment and Facilities

Table 15 shows the results from the CBP data. Establishment counts and employment for the eight major supplier industries are shown for 1979 and 1989. Also shown are establishment and employment counts for two vehicle production industries, SIC 3711 and SIC 3713 (large trucks and buses). Information is shown for the United States as a whole and for the regions described above. Table 15 shows that the number of supplier establishments increased by about 1,300 in the United States as a whole between 1979 and 1991, but employment fell by 196,000. Establishment counts rose in six of the eight industries. But only one industry experienced an

[14]Fifty-two volumes of U.S Bureau of the Census, County Business Patterns, U.S. Government Printing Office, Washington D.C. were used in tabulations for this section of the study. The volumes include those for twenty-five states in each of two years, 1979 and 1989, for example **Michigan** (CBP-89-24) and two **United States** (CBP-89-1) volumes for 1979 and 1989.

Table 15:
The Relocation of Automotive Parts Production: 1979-1989

	United States		Southeast		Southwest		Northeast		Midwest		Midsouth		California	
SIC	1979	1989	1979	1989	1979	1989	1979	1989	1979	1989	1979	1989	1979	1989
2396 Auto and Apparel Trim														
Establishments	705	1375	34	141	25	77	356	399	81	210	28	65	75	220
Employment	35675	47150	1269	3823	375	702	9044	11397	20847	18122	535	2292	1145	5841
3010 Tires and Inner Tubes														
Establishments	167	147	34	36	21	20	21	15	33	30	17	17	13	7
Employment	112634	68025	26692	26221	13462	9622	12457	3510	31632	12585	12883	8225	3354	750
3465 Automotive Stampings														
Establishments	594	688	20	25	2	8	32	41	470	530	16	26	22	24
Employment	137766	122318	4657	5339	175	385	14439	9372	130810	101865	1743	2186	1328	1736
3519 Int. Combustion Engines														
Establishments	200	260	4	20	22	25	27	28	74	90	5	13	29	34
Employment	101037	68627	1750	5635	3367	2560	7951	4370	88849	52531	1125	2990	3750	7500
3592 Carb., Rings, Pistons														
Establishments	149	147	2	10	10	15	22	18	45	48	14	13	34	24
Employment	37000	23165	750	1275	384	1005	11318	1561	14685	11687	9572	4143	1312	1265
3647 Vehicle Lighting Equipment														
Establishments	72	70	0	1	3	1	15	15	23	29	3	6	11	7
Employment	17670	16164	0	750	1125	750	2712	1782	12341	13411	375	1125	224	353
3694 Engine Electrical Equip.														
Establishments	392	450	29	43	34	51	82	73	116	128	31	25	40	47
Employment	71762	64273	2336	7123	2753	4795	10265	9732	52576	29964	2953	768	1750	3750
3714 Motor Vehicle Parts														
Establishments	2259	2689	124	211	194	189	265	303	823	979	128	193	390	402
Employment	499913	407770	21611	34668	12144	9156	43206	37506	343405	248284	28098	29525	18225	18151
Parts Total														
Establishments	4538	5826	247	487	311	386	820	892	1665	2044	242	358	614	765
Employment	1013457	817492	59065	84834	33785	28975	111392	79230	695145	488449	57284	51254	31088	39346
3711 Motor Vehicles & Bodies														
Establishments	296	393	22	32	20	27	42	46	101	137	18	30	35	49
Employment	393117	246643	21572	13664	11250	22500	46798	25257	184635	141763	41482	33570	17390	8333
3713 Truck and Bus Bodies														
Establishments	691	680	70	92	62	66	124	112	154	130	53	43	89	104
Employment	45658	41738	4785	7140	2627	3391	5597	6886	17165	12808	3307	2087	3090	3526
Vehicles Total														
Establishments	987	1073	92	124	82	93	166	158	255	267	71	73	124	153
Employment	438775	288381	26357	20804	13877	25891	52395	32143	201800	154571	44789	35657	20480	11859
Total Vehicle and Parts														
Establishments	5525	6899	339	611	393	479	986	1050	1920	2311	313	431	738	918
Employment	1452232	1105873	85422	105638	47662	54866	163787	111373	896945	643020	102073	86911	51568	51205

increase in employment. The increase was in SIC 2396, auto and apparel trim, an industry that produces only one-third of its shipments for the auto industry.

Table 16 presents the 1979-1989 regional percentage changes in establishments and employment. Overall, parts establishments in the United States increased by 28 percent at the same time employment fell by 19 percent. Every region experienced a positive increase in the number of parts establishments; the Southeast showed the largest increase, 97 percent, followed by California, with 25 percent. These two regions had the only positive changes in parts employment, 44 percent in the Southeast and 27 percent in California. The Midwest suffered the largest percentage decline in employment, -30 percent. The Northeast, at -29 percent, followed closely. Table 15 gives evidence of the massive employment decline in parts production. The Midwest lost almost 207,000 and the Northeast 32,000 parts jobs between 1979 and 1989. The combined job loss–239,000–amounted to 122 percent of the total U.S. decline in auto parts employment.

Table 15 shows an increase in auto parts employment of about 26,000 for the Southeast, and an increase of 8,000 for California (West). The two increases yield a total gain for these two regions of 34,000. The employment gains in the Southeast and West, of course, are smaller than the national decline of 196,000 or the job loss total of 216,000 for the other four regions. Table 17 presents regional share percentages of total U.S. automotive establishments and employment. The share of parts employment in the 25 states included in the six regions fell from 98 percent in 1979 to about 94 percent in 1989. Parts employment declined by 216,000 in the 25 states. This decline implies that the excluded 25 states did gain almost 20,000 parts production jobs between 1979 and 1989 (216,000 minus 196,000). The Midwest experienced the largest decline in employment share, a decline from almost 69 percent of parts employment in 1979 to just under 60 percent in 1989. About half the Midwest loss in share (primarily in Michigan) is captured by the Southeast (primarily in North and South Carolina), which rose from just under 6 percent to over 10 percent of parts employment.

Only one parts industry, auto and apparel trim, showed an increase in national employment. Auto and apparel trim, it should be remembered, produces largely nonautomotive output. The Midwest suffered an employment decline in seven of the eight parts industries during 1979-1989. The exception is an increase in vehicular lighting industry employment. In contrast, the Southeast gained employment in seven of the eight parts industries; the exception is the tires and inner tubes industry.

Table 16:
1979-1989 Percentage Change in
Auto Parts Facilities and Employment by Region

SIC Code	United States	South-east	South-west	North-east	Mid-west	Mid-south	Calif.
2396 Auto and Apparel Trim							
Establishments	95.0	314.7	208.0	12.1	159.3	132.1	193.3
Employment	32.2	201.3	87.2	26.0	-13.1	328.4	410.1
3010 Tires and Inner Tubes							
Establishments	-12.0	5.9	-4.8	-28.6	-9.1	0.0	-46.2
Employment	-39.6	-1.8	-28.5	-71.8	-60.2	-36.2	-77.6
3465 Automotive Stampings							
Establishments	15.8	25.0	300.0	28.1	12.8	62.5	9.1
Employment	-11.2	14.6	120.0	-35.1	-22.1	25.4	30.7
3519 Int. Combustion Engines							
Establishments	30.0	400.0	13.6	3.7	21.6	160.0	17.2
Employment	-32.1	222.0	-24.0	-45.0	-40.9	165.8	100.0
3592 Carb., Rings, Pistons							
Establishments	-1.3	400.0	50.0	-18.2	6.7	-7.1	-29.4
Employment	-37.4	70.0	161.7	-86.2	-20.4	-56.7	-3.6
3647 Vehicle Lighting Equip.							
Establishments	-2.8	NA	-66.7	0.0	26.1	100.0	-36.4
Employment	-8.5	NA	-33.3	-34.3	8.7	200.0	57.6
3694 Engine Electrical Equip.							
Establishments	14.8	48.3	50.0	-11.0	10.3	-19.4	17.5
Employment	-10.4	204.9	74.2	-5.2	-43.0	-74.0	114.3
3714 Motor Vehicle Parts							
Establishments	19.0	70.2	-2.6	14.3	19.0	50.8	3.1
Employment	-18.4	60.4	-24.6	-13.2	-27.7	5.1	-0.4
Parts Total							
Establishments	28.4	97.2	24.1	8.8	22.8	47.9	24.6
Employment	-19.3	43.6	-14.2	-28.9	-29.7	-10.5	26.6
3711 Motor Vehicles & Bodies							
Establishments	32.8	45.5	35.0	9.5	35.6	66.7	40.0
Employment	-37.3	-36.7	100.0	-46.0	-23.2	-19.1	-52.1
3713 Truck and Bus Bodies							
Establishments	-1.6	31.4	6.5	-9.7	-15.6	-18.9	16.9
Employment	-8.6	49.2	29.1	23.0	-25.4	-36.9	14.1
Vehicles Total							
Establishments	8.7	34.8	13.4	-4.8	4.7	2.8	23.4
Employment	-34.3	-21.1	86.6	-38.7	-23.4	-20.4	-42.1
Total Vehicle and Parts							
Establishments	24.9	80.2	21.9	6.5	20.4	37.7	24.4
Employment	-23.9	23.7	15.1	-32.0	-28.3	-14.9	-0.7

Source: CBP, various states and the United States, 1979, 1989.

Table 17:
1979 & 1989 Regional Percentage Share of U.S. Auto Parts Establishments and Employment

SIC	Southeast		Southwest		Northeast		Midwest		Midsouth		California	
	1979	1989	1979	1989	1979	1989	1979	1989	1979	1989	1979	1989
2396 Auto and Apparel Trim												
Establishments	4.8	10.3	3.5	5.6	50.5	29.0	11.5	15.3	4.0	4.7	10.6	16.0
Employment	3.6	8.1	1.1	1.5	25.4	24.2	58.4	38.4	1.5	4.9	3.2	12.4
3010 Tires and Inner Tubes												
Establishments	20.4	24.5	12.6	13.6	12.6	10.2	19.8	20.4	10.2	11.6	7.8	4.8
Employment	23.7	38.5	12.0	14.1	11.1	5.2	28.1	18.5	11.4	12.1	3.0	1.1
3465 Automotive Stampings												
Establishments	3.4	3.6	0.3	1.2	5.4	6.0	79.1	77.0	2.7	3.8	3.7	3.5
Employment	3.4	4.4	0.1	0.3	10.5	7.7	95.0	83.3	1.3	1.8	1.0	1.4
3519 Int. Combustion Engines												
Establishments	2.0	7.7	11.0	9.6	13.5	10.8	37.0	34.6	2.5	5.0	14.5	13.1
Employment	1.7	8.2	3.3	3.7	7.9	6.4	87.9	76.5	1.1	4.4	3.7	10.9
3592 Carb., Rings, Pistons												
Establishments	1.3	6.8	6.7	10.2	14.8	12.2	30.2	32.7	9.4	8.8	22.8	16.3
Employment	2.0	5.5	1.0	4.3	30.6	6.7	39.7	50.5	25.9	17.9	3.5	5.5
3647 Vehicle Lighting Equip.												
Establishments	0.0	1.4	4.2	1.4	20.8	21.4	31.9	41.4	4.2	8.6	15.3	10.0
Employment	0.0	4.6	6.4	4.6	15.3	11.0	69.8	83.0	2.1	7.0	1.3	2.2
3694 Engine Electrical Equip.												
Establishments	7.4	9.6	8.7	11.3	20.9	16.2	29.6	28.4	7.9	5.6	10.2	10.4
Employment	3.3	11.1	3.8	7.5	14.3	15.1	73.3	46.6	4.1	1.2	2.4	5.8
3714 Motor Vehicle Parts												
Establishments	5.5	7.8	8.6	7.0	11.7	11.3	36.4	36.4	5.7	7.2	17.3	14.9
Employment	4.3	8.5	2.4	2.2	8.6	9.2	68.7	60.9	5.6	7.2	3.6	4.5
Parts Total												
Establishments	5.4	8.4	6.9	6.6	18.1	15.3	36.7	35.1	5.3	6.1	13.5	13.1
Employment	5.8	10.4	3.3	3.5	11.0	9.7	68.6	59.7	5.7	6.3	3.1	4.8
3711 Motor Vehicles & Bodies												
Establishments	7.4	8.1	6.8	6.9	14.2	11.7	34.1	34.9	6.1	7.6	11.8	12.5
Employment	5.5	5.5	2.9	9.1	11.9	10.2	47.0	57.5	10.6	13.6	4.4	3.4
3713 Truck and Bus Bodies												
Establishments	10.1	13.5	9.0	9.7	17.9	16.5	22.3	19.1	7.7	6.3	12.9	15.3
Employment	10.5	17.1	5.8	8.1	12.3	16.5	37.6	30.7	7.2	5.0	6.8	8.4
Vehicles Total												
Establishments	9.3	11.6	8.3	8.7	16.8	14.7	25.8	24.9	7.2	6.8	12.6	14.3
Employment	6.0	7.2	3.2	9.0	11.9	11.1	46.0	53.6	10.2	12.4	4.7	4.1
Total Vehicle and Parts												
Establishments	6.1	11.1	7.1	6.9	17.8	15.2	34.8	33.5	5.7	6.2	13.4	13.3
Employment	5.9	7.3	3.3	5.0	11.3	10.1	61.8	58.1	7.0	7.9	3.6	4.6
Source:												

3.2 *Employment Change in States*

A popular theory concerning the recent diffusion of parts employment centers on differences in state or regional manufacturing wages and rates of unionization. It is thought that a number of automotive parts producing companies moved their facilities during the 1980s from high manufacturing wage states to low manufacturing wage states. This study undertakes a simple test of this hypothesis by attempting to measure the effects of differences in state manufacturing wages and unionization rates on percentage change in 1979-1989 parts employment measured by the CPB data.

Table 18 summarizes a simple investigation relating parts employment change, hourly earnings in manufacturing, and the rate of unionization. Results for three regressions are shown. The number of cases in each estimation is 25—the number of states listed in the six study regions. The dependent variable for each regression is percentage change in total state parts employment between 1979 and 1989, measured by CBP.

A single explanatory variable is used in each regression. Since employment change was measured by comparing 1979 with 1989 employment in parts industries, we used two wage variables, one for the beginning of the period (1980) and one for roughly in the middle (1986) of the 1979-1989 period.[15]

Explanatory Variables	
Ln(Earn 80)	The natural log of 1980 state average hourly earnings for production workers in manufacturing.
Ln(Earn 86)	The natural log of 1980 state average hourly earnings for production workers in manufacturing.
1984 Union %	The rate of unionization in state manufacturing employment in 1984.

The three explanatory variables prove to be significantly negative at the 95 percent confidence level when regressed separately on percentage change in parts employment. The earnings variables are specified as the natural log of state values. When these variables are regressed on percentage change in parts employment, the resulting coefficients can be roughly

[15]U.S. Bureau of Labor Statistics, U.S. Department of Labor, **Employment and Earnings**, monthly, U.S. Government Printing Office, Washington D.C., 1981, 1991.

interpreted as measures of "elasticity," or percentage change in parts employment given a percentage change in the explanatory variable. For **Ln(Earn 86)**, each 1 percent difference in 1986 state earnings (above the 25 state average) predicts a -1.7 percent decline in parts employment.

Table 18:
Twenty-Five States:
The Possible Effect of Production Worker Average Earnings and Unionization Rates on Parts Employment Change

(1) Y= % Change in Total Parts Employ.: 1979-1989	(2) X = Ln Earn 80	(3) X = Ln Earn 86	(4) X= 1986 Union %
Intercept coeff.	2.804	3.976	.306
t-statistic	3.467	3.633	2.452
X coeff.	-1.445	-1.768	-1.375
t-statistic	-3.535	-3.682	-3.190
r^2	0.324	0.371	0.307
n	25	25	25

The simple regressions above should not be interpreted as models of parts employment change across states. The simple predictors only partially explain variance in parts employment change (anywhere from 32 percent to 37 percent). The standard errors of the estimation equations are quite large. Further, a number of other potential causes of parts employment change could be linked to average earnings for production workers. For example, low earnings for production workers may be characteristic of states with low business taxes, utility rates, or other influences, such as real estate or construction costs.

On the other hand, the dependent variable partially reflects parts employment at the Big Three, or employment subject to many institutional labor restrictions on relocation.[16] Change in state parts employment, excluding Big Three employment in parts facilities, might prove even more elastic with respect to relative wage cost than total employment that includes Big Three parts and component plants. Low earnings levels are also clearly correlated with low rates of unionization in manufacturing. The simple regression results in table 18 merely indicate a significant, negative relationship between change in automotive parts employment and both average hourly earnings and the extent of unionization.

[16]General Motors built a number of parts facilities in the late 1970s along the I-20 interstate in the deep South. This "southern strategy" was interpreted by many auto analysts as an attempt by the company to escape the pervasive influence of the United Auto Workers (UAW). If so, the attempt failed. All of the new southern plants were organized by the UAW or allied unions. All "Big Three" manufacturing facilities in the United States employ represented workers.

3.3 Changes in Scale

Another important change in the structure of auto parts manufacturing is apparent in the CBP comparisons (tables 15 and 16). Although U.S. employment in eight supplier industries declined by over 19 percent during 1979-1989, the number of industry establishments rose by over 28 percent. Average 1979 employment per establishment was 223 in 1979, or 1.01 million employees located in 4,538 establishments. The establishment employment average fell to 140 in 1989, or 817,000 employees located in 5,826 establishments. These figures reflect a gain of almost 1,300 facilities and a decline in average facility employment of 37 percent. Average facility employment for the largest parts industry, motor vehicle parts and accessories (SIC 3714), also declined, because industry employment fell by about 92,000 while the number of facilities rose by 430.

The contribution of small business to employment and economic growth has been a popular subject in recent years. An examination of the CBP information on establishment sizes in table 19 appears to support a growing role for small facilities in auto parts production during 1979-1989. CBP listed 61 fewer parts making facilities with 1,000 or more in employment in its 1989 U.S. totals than in 1979. Facilities employing 500 to 999 declined by six during 1979-1989. But facilities employing between 50 to 499 increased by 291 and those with fewer than 50 employees increased by 1,064. Still the largest increase in numbers of smaller facilities (under 500 in employment) is that for SIC 2396 (auto and apparel trim), an industry with largely non-automotive output. Several supplier industries did not experience significant growth or even any growth in smaller facilities. These industries include tires and inner tubes (SIC 3010), vehicle lighting equipment (SIC 3647), and carburetors, pistons and rings (SIC 3592). Yet for other large supplier industries, such as motor vehicle parts and accessories (SIC 3711) or automotive stampings (SIC 3465), counts of facilities did rise, especially for smaller establishments.

The reduction in average facility employment is attributable to several factors. First, smaller production runs for lower sales volume car and truck models permitted smaller operations. Better technologies, such as computer numerical control equipment, reduced the employment of many facilities without affecting output. Finally, many new facilities were built to serve as local warehouses needed to meet the just-in-time (JIT) delivery requirements of transplant assembly plant customers or even the traditional U.S. producers. These small facilities often served the purpose of satisfying one major customer and engaged in very little actual manufacturing at all. In effect, they functioned as trans-shipment locations with major manufacturing taking place elsewhere in the United States or overseas in larger facilities. The

subjects of the scale and actual operation of small parts facilities deserve further investigation, because it is critically important to economic developers to know what kinds of automotive facilities are being built and why.

Table 19:
Automotive SIC Establishment Sizes 1979 & 1989

	1 to 49		50 to 499		500 to 999		1000 +	
SIC Code	1979	1989	1979	1989	1979	1989	1979	1989
2396 Auto and Apparel Trim	624	1195	72	169	3	5	6	6
3010 Tires and Inner Tubes	60	66	51	45	11	8	45	28
3465 Automotive Stampings	273	332	278	322	15	11	28	23
3519 Int. Combustion Engines	90	146	69	79	16	20	25	15
3592 Carb., Rings, Pistons	83	88	48	47	9	9	9	3
3647 Vehicle Light. Equip.	36	36	29	27	4	4	3	3
3694 Engine Elect. Equip.	259	289	107	139	16	12	10	10
3714 Motor Vehicle Parts	1414	1751	668	785	88	87	89	66
Parts Total	2839	3903	1322	1613	162	156	215	154
3711 Motor Vehicles and Bodies	183	258	34	65	8	5	71	65
3713 Truck and Bus Bodies	510	492	196	174	7	10	5	4
Total	3532	4653	1525	1852	177	171	291	223

Source: CPB, various states and United States volumes, 1979, 1989.

4. The New Transplant Suppliers

The start-up of seven Japanese-affiliated vehicle assembly plants between 1982 and 1989 is a remarkable development in the history of the U.S. auto industry. These transplant assembly plants possessed the ability to assemble 2.14 million units in 1992; recent announcements place the 1994 capacity of these plants at over 2.5 million.[17] Just as remarkable as the appearance of the new foreign-owned assembly plants is the start-up of 259 automotive parts manufacturing facilities with Japanese investment interest in the United States since 1981.

[17] A total U.S. transplant build of 1.69 million in 1992 means that as a group the transplant assemblers operated at 79% utilization of capacity.

Table 20:
U.S.-Based Japanese Assembly Plants

Company	Location	Start Up Date	Models	Announced Assembly Capacity
Honda	Marysville, OH	November 1982	Accord	360,000
Nissan	Smyrna, TN	June 1983	Altima, truck	450,000
NUMMI	Fremont, CA	December 1984	Prizm, Corolla, Compact Truck	300,000
Mazda	Flat Rock, MI	September 1987	MX-6, 626, Probe	240,000
Toyota	Georgetown, KY	May 1988	Camry	240,000
Mitsubishi	Normal, IL	September 1988	Eclipse, Mirage, Talon, Summit, Laser	240,000
Fuji/Isuzu	Lafayette, IN	September 1989	Legacy, Rodeo	160,000
Honda	East Liberty, OH	December 1989	Accord, Civic	150,000
			Total	2,140,000

Source: JAMA, 1992 The Motor Industry of Japan

Information describing Japanese transplant suppliers is taken from the Office for the Study of Automotive Transportation's (OSAT's) fourth annual survey of Japanese automotive manufacturing facilities in the United States. The results of the survey appear in OSAT's Japanese Automotive Supplier Investment Directory (JASID). The information is collected through mail surveys and telephone interviews covering many facility characteristics.

A comparative analysis of the transplant suppliers presented a difficult challenge for this study. First, although there are now 259 transplant supplier facilities operating in the United States, the transplant supplier population is still relatively small and highly diverse. The size of this group makes it hard to directly compare industrial classifications with those of the overall U.S. auto parts industry. Second, only 109 of the 259 transplant parts facilities fall into the eight SIC codes used in the CBP analysis in the previous section (see Appendix 2). This fact reduces the value of any direct comparison of transplant results with the overall CBP results.

A major difference between the overall U.S. auto parts industry and the Japanese transplant system is the virtual absence of captive supplier facilities associated with the Japanese assembly plants. There is only one separate transplant powertrain/drivetrain facility; there are no separate stamping facilities. The small number of powertrain facilities may be due to economies of scale. The apparent lack of stamping facilities introduces a significantly different issue.

Traditionally the Big Three have operated satellite stamping facilities, with each stamping plant producing parts for several vehicle models produced at several assembly plants. In contrast, transplants have a contiguous stamping facility located within, or adjacent to, their assembly buildings. These contiguous stamping facilities are considered effective, because they specialize in the production of parts for very few, sometimes just one, vehicle platform or model assembled in the host facility.

Although the transplant assemblers have few captive suppliers in the United States, they do maintain equity interest in U.S. transplant suppliers. Honda has an investment position in at least eight Japanese transplant supplier facilities. A recent report by the Mid-America Project found that Toyota, Honda, and Nissan have transferred important elements of their keiretsu system from Japan to the United States.[18] Table 21 shows the number of group members that have followed their assembler to the United States. Although not all these facilities are engaged in manufacturing, this is evidence of the extensive use of partial ownership control, a pattern almost unheard of in the traditional U.S. supplier industry.

A potential advantage of joint equity ownership, compared to fully integrated (captive) or fully independent suppliers, is the opportunity to spread facility output across one primary, and a number of secondary, non-keiretsu customers. A transplant supplier such as Nippondenso–a Toyota group member–may have a greater ability to sell to outside assemblers than a captive supplier such as AC/Rochester Division of General Motors. Such a transplant supplier is more likely to sell to several customers and achieve high capacity utilization levels. High utilization is helpful to both the supplier and the group assembler. The relationship gives the assembler a local production source, yet allows the supplier to take advantage of larger economies of scale based on having many sources of demand for output.

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18 **Keiretsu, U.S.A.; a Tale of Japanese Power.** Mid-America Project, July 1991.

Table 21:
Transplant Assemblers
and Their Keiretsu Grouping

Relationship	Nissan	Toyota	Honda
Group members	24 (51 locations)	23 (54 locations)	19 (27 locations)
Non-group suppliers (with ownership*)	6 (17 locations)	7 (16 locations)	0
Total	30 (68 locations)	30 (70 locations)	19 (27 locations)

* Non-group suppliers include only those companies in which the New Entrant assembler holds equity, but are not a part of the assemblers' keiretsu.
Source: Keiretsu, U.S.A.; A tale of Japanese Power, Mid-America Project.

There are two basic types of ownership styles common among transplant suppliers. The first type, is a subsidiary, or single ownership—a facility that is solely owned by a single Japanese company. The second type is a joint venture. Joint ventures can be split into two distinct groups, Japan-Japan and U.S.-Japan. Another type of transplant supplier joint venture is that of Japan-Other Country. Until recently, there have been relatively few of these last ownership arrangements.

Transplant suppliers are primarily located in two regions of the United States, the Midwest and the Midsouth. In 1991, 79 percent of the transplant facilities and 73 percent of transplant employment were located in these two regions. This compares to 41 percent and 66 percent respectively for the 1989 CBP listing of facilities. Table 22 shows, however, that the Midsouth has captured a relatively high share of transplant parts plants.

Table 22:
Overall and Transplant Parts Facilities
Location Comparison of Selected Regions
Percent of group

	(1) Midwest		(2) Midsouth		(1) + (2) Combined	
	All Suppliers: 1989	Transplant 1991	All Suppliers 1989	Transplant 1989	All Suppliers 1989	Transplant 1991
Establishment	35.1%	56.4%	6.1%	22.8%	41.2%	79.2%
Employment	59.7	50.7	6.3	22.4	66.0	73.1

Source: JASID and CBP, 1989

The Midwest has 56 percent of transplant supplier facilities, compared to 35 percent of the 1989 CBP parts facilities. The Midsouth has 23 percent of the transplant facilities but only 6 percent of the overall 1989 CBP count. Since the transplants are included in the CBP figures, they are responsible for a portion of the change in parts facility location during 1979-1989, especially in the Midsouth. As table 15 shows, the Midsouth gained 116 auto parts facilities during 1979-1989. Since at least 52 new Japanese supplier facilities were built in the Midsouth during 1982-1991, much of the total gain of 116 can be attributed to transplant activity and location.

Table 23:
Regional Shifts of Japanese Transplant Parts Suppliers

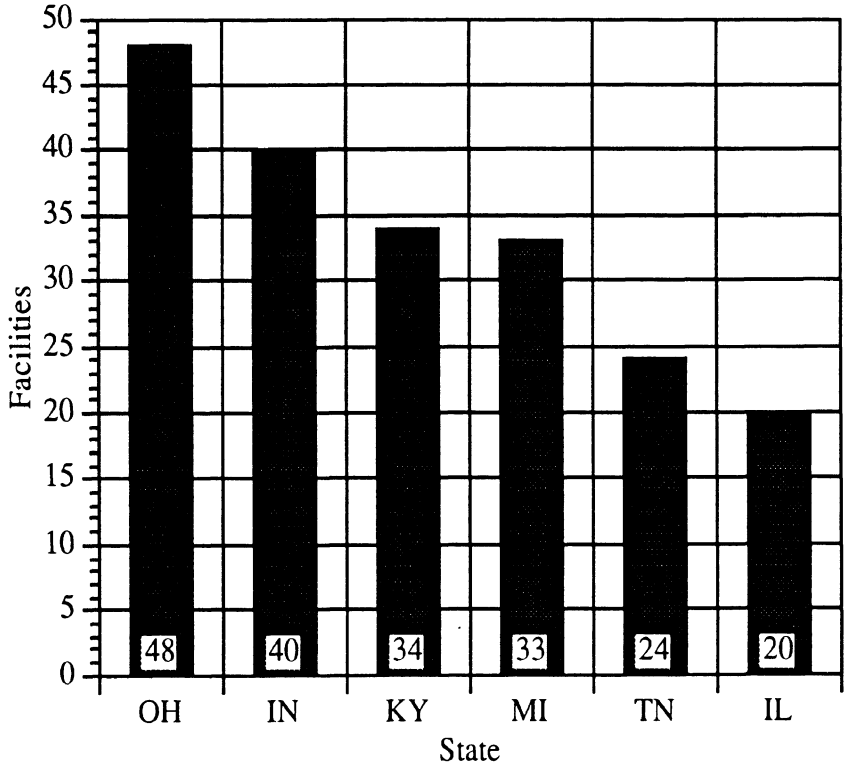
	United States	Southeast	Southwest	Northeast	Midwest	Midsouth	West
1985							
Establishments	55	2	6	1	28	7	11
Employment	17,576	469	1482	320	9,349	4,384	1,572
1991							
Establishments	259	16	20	5	146	59	13
Employment	63,093	4,308	6,455	2,820	31,984	15,360	1,866
Source: JASID							

In fact, the transplant suppliers are increasingly concentrated in the Midsouth. This Midsouth preference contrasts with an earlier preference for locations in California. The JASID contains information on the startup year, or the year that a transplant plant first began production. Comparative distributions of transplant supplier facilities for two years, 1985 and 1991, are shown in table 23. In 1985, the Midsouth had only 7 transplant parts facilities; the West had 11 plants. But between 1985 and 1991, the West gained only two additional supplier facilities, whereas the Midsouth gained 52.

Six states had 81 percent of the transplant supplier facilities in 1991. The six states include the traditional automotive manufacturing states of Illinois, Indiana, Michigan, and Ohio but also the Midsouth states of Kentucky and Tennessee (see figure 6). Ohio has the largest number of facilities, 48. Ohio's lead can be attributed to Ohio's early recruitment of Japanese firms and Honda's large assembly capacity position in south-central Ohio.[19]

19 When transplant materials, capital tools, and transplant assemblers are included along with transplant suppliers, Ohio has nearly 30,000 employees working for automotive-related manufacturing and assembly facilities with Japanese investment.

Figure 6:
Transplant Facilities - Top Six States



The average facility employment of a transplant parts plant (235 in 1991) is significantly higher than the 1989 CBP (140 in 1989). A distribution on facility employment size is shown in table 24. Transplant suppliers are overwhelmingly concentrated in medium-sized (50-499 employees) facilities, almost the reverse of the pattern for facilities contained in the CBP sample. This concentration in medium-sized facilities may be attributable to the fact that very small Japanese parts suppliers cannot locate in the United States, and because large captive facilities remain concentrated in Japan.

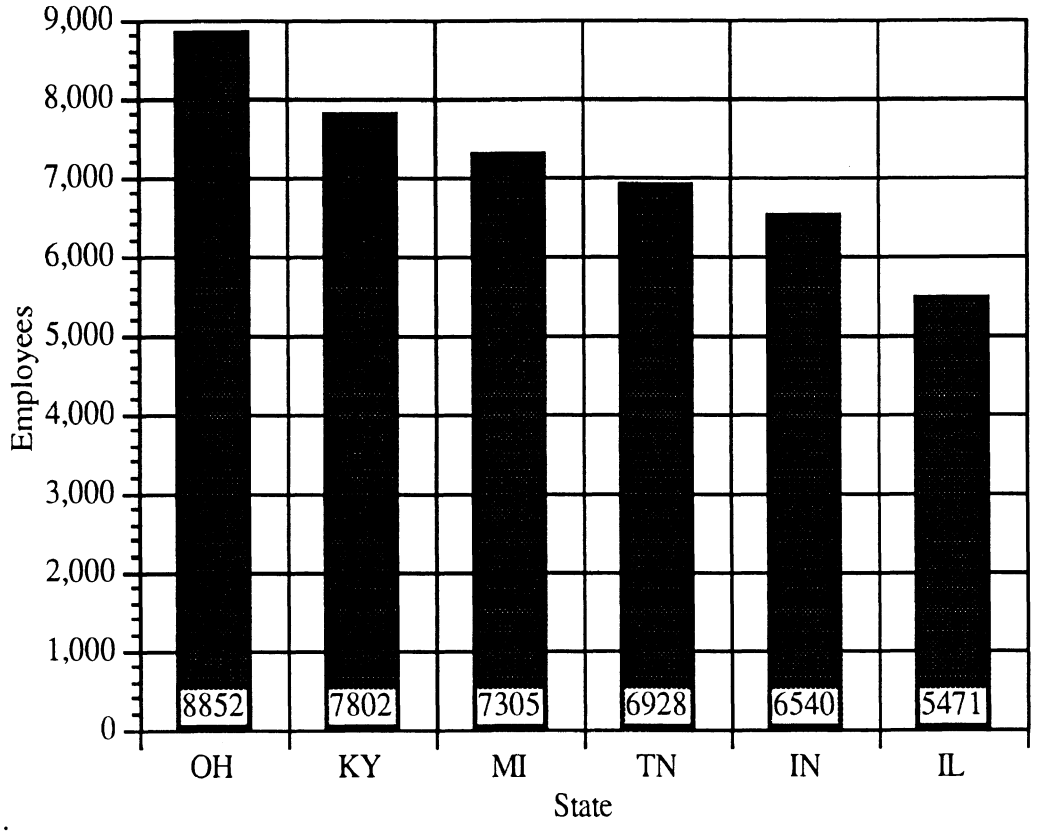
Table 24:
Japanese Transplant Supplier
Employment by Facility Size

	(Employees)				
	1-49	50-499	500-999	1000+	Total
Establishments	40	192	16	8	256
Employment	1092	39,480	9921	11,929	62,422

Source: Japanese Automotive Supplier Investment Directory

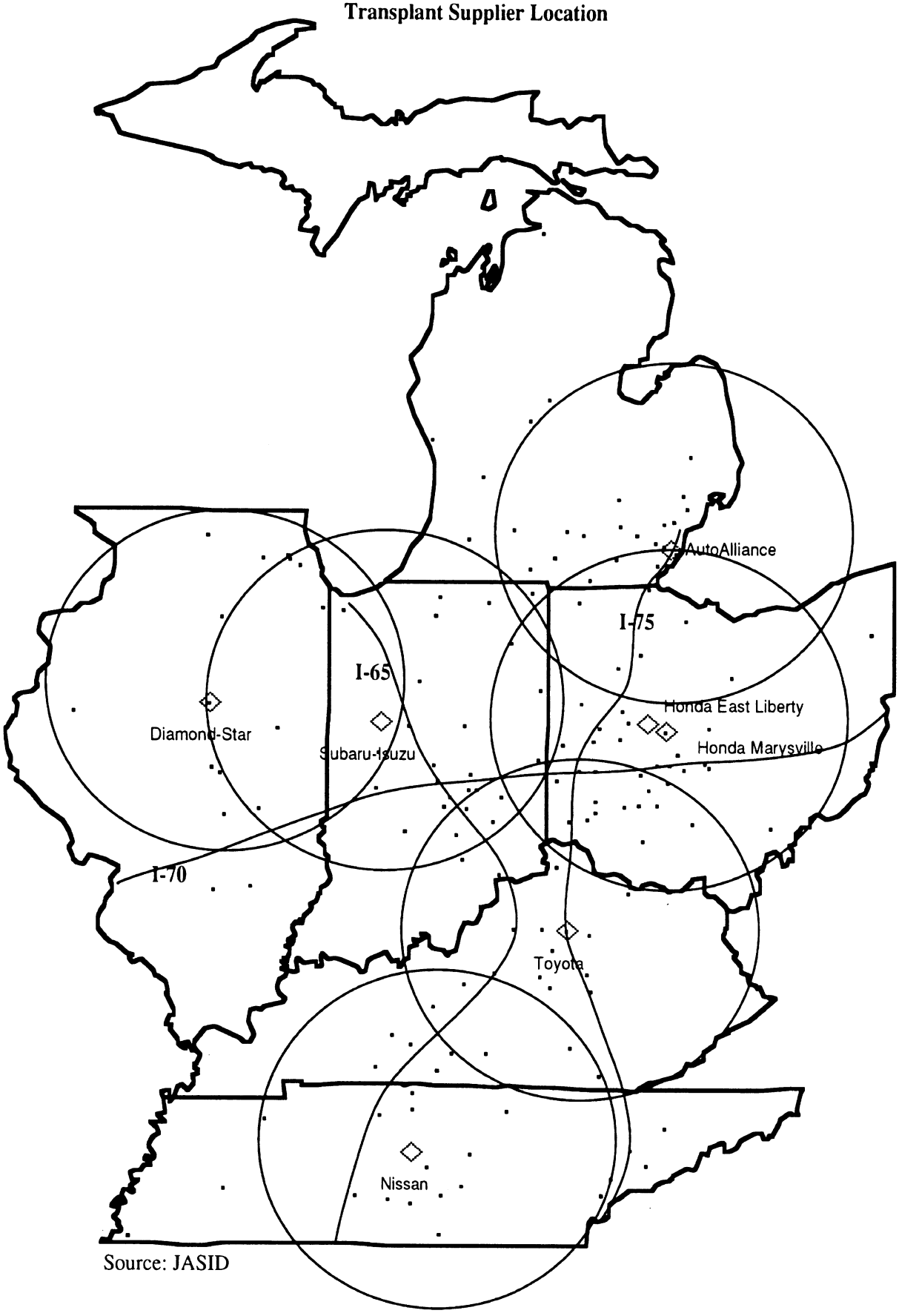
Ohio (8,852) and Kentucky (7,802) have the highest levels of transplant supplier employment. Transplant supplier employment is also high in Michigan (7,305) and Tennessee (6,928) (see figure 7).

Figure 7:
Transplant Supplier Employment - Top Six States



The influence of JIT production techniques, a vital factor in Japanese assembler-supplier operations, plays a significant part in the location of transplant suppliers. Although the suppliers probably benefit from lower wages and nonunion work forces in the greenfield locations chosen by the transplant assemblers, to some extent they had little input in the location decision. Typically, transplant suppliers are located within five hours driving time, or 200 miles, of their

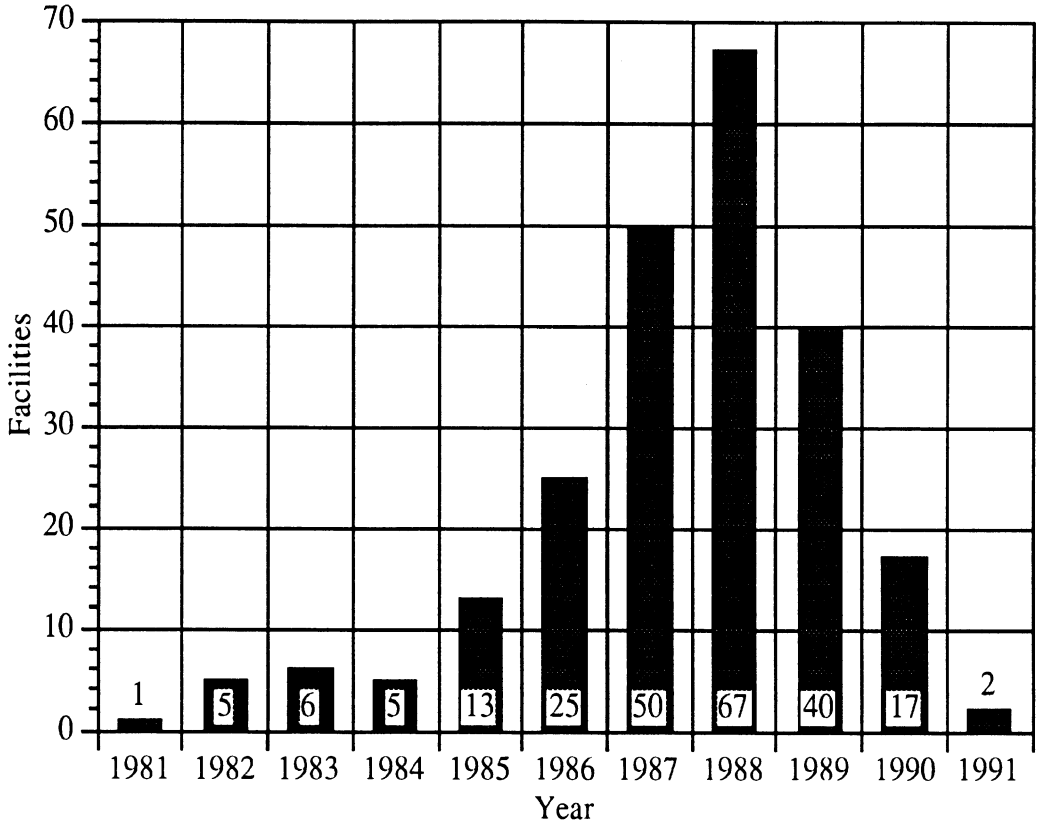
Figure 8
Transplant Supplier Location



Source: JASID

major transplant assembly customer. Figure 8 shows the locations of transplant suppliers in a six state area. Transplant suppliers in the Midsouth are still well-positioned for access to opportunities with the traditional Big Three assembly facilities, especially if the Big Three are indeed re-concentrating their assembly production in the Midwest and Midsouth.

Figure 9:
Transplant Suppliers -Reported Startups
1981-1991



Transplant supplier investment has leveled off in recent years. Figure 9 shows that 1987 and 1988 are the years with the largest number of transplant startups. Since then, there has been a major decline in startups. This decline is at least partly because transplant assemblers already have reached full (or near full) production. As a result, their sourcing patterns have already been set, and there is significant transplant supplier capacity in place to serve those assemblers.

5. Conclusions and Executive Summary

This study's purpose is to describe change, especially structural and geographic change, in the U.S. auto parts industry during the 1980s and early 1990s. After giving a brief description of the overall economic performance of a sample of auto supplier industries, we introduce a number of causal factors that influenced the evolution of the U.S. auto parts industry in recent years. Our results and conclusions are as follows:

- Constant dollar shipments from U.S. auto parts facilities never recovered to 1979 or pre-1979 levels during the 1980s. A second decline in constant dollar shipments began in 1989.

- Constant dollar value added and employment never recovered to 1979 or pre-1979 levels during the 1980s. Productivity in the auto parts industry, measured by constant dollar value added per employee, grew slowly in the 1980s; 1990 industry productivity was only 11.5% higher than 1979 productivity.

- Constant dollar materials purchases by vehicle assemblers in the United States never recovered to 1979 or pre-1979 levels during the 1980s. Dollar purchases per vehicle deflated by a consumer price index were no higher in 1990 than in 1979, but were 27 percent higher between 1979 and 1990 if deflated by an industry price index.

- Exports of automotive parts are now a significant share of total industry output but were offset by even larger levels of imported auto parts during 1982-1990.

- Significant structural change occurred in the U.S. market for new motor vehicles in terms of both (a) the market share for trucks and vans, and (b) the fragmentation of markets—or a rapid fall in the average sales volume per model.

The study describes change in the "captive supplier" parts production system operated by Ford, General Motors, and Chrysler during 1979-1991, both in terms of numbers of facilities by type and by region. The results and conclusions of this investigation are as follows:

- The "Big Three" closed 80 manufacturing facilities and opened or converted 38 plants, for a U.S. net closing total of 42 during 1979-1991. This total is made up of 17 assembly plants, 15

stamping or body plants, 2 transmission plants, and 12 other component plants. The number of engine plants increased by four.

- The James Rubenstein hypothesis regarding a re-concentration of assembly, engine, transmission, and stamping operations in the Midwest is supported by the facilities analysis of the pattern of site selection during 1979-1991 by the Big Three. Large integrated component manufacturing remained concentrated in the Midwest, but the region did suffer a loss in its share of "other component" Big Three facilities.

We perform a national and 25 state analysis of County Business Patterns information that identifies the regional distribution of eight major auto parts industries in 1979 and 1989. Some of the results and conclusions from the analysis are as follows:

- The number of parts establishments increased 28 percent between these two years, but employment declined by 19 percent.

- All study regions gained parts facilities. The Southeast (97 percent increase) and the West (25 percent increase) showed the largest gains. The only gains in parts employment were in the Southeast (44 percent increase) and the West (27 percent increase). The Midwest experienced a 30 percent employment decline and the Northeast a 29 percent decline between 1979 and 1989.

- The Midwest share of auto parts employment fell from 69 percent to just under 60 percent during 1979-1989. The Southeast share of auto parts employment increased from 6 percent to 10 percent.

- A simple regression analysis found evidence of a negative relationship between 1979-1989 percentage change in parts employment and average hourly earnings of production workers and the degree of unionization. The model exluded othere important determinants of employment change, such as markets.

- Average auto parts facility employment fell 37 percent (from 223 to 140) during 1979-1989. This decline may reflect changes in economies of scale in parts production or other business factors, such as new inventory methods, during this period. Growth in facilities was concentrated in those employing less than 50 (increase of 1,064) or 50 to 499 (increase of 291). Large facilities employing 500 or more declined in number during 1979-1989 (decrease of 66).

This study concludes with a special comparative analysis of the new transplant supplier facilities. The analysis relies on information collected for a special transplant investment directory published annually by the Office for the Study of Automotive Transportation. Some of the results and conclusions from this analysis are as follows:

- Eight large transplant assembly operations started in the United States between 1982 and 1989. The vehicle assembly capacity of these facilities is over 2.1 million units. At least 259 Japanese-affiliated auto parts facilities began operations during 1981-1991. They employed 62,422 in 1991.

- The Japanese automotive transplant system differs sharply from that of the overall U.S. auto industry. The Japanese system shows a virtual absence of integrated drivetrain and powertrain plants in the United States.

- Transplant suppliers are concentrated in the Midwest (56 percent of facilities) to an even greater extent than is the overall parts industry (50 percent of establishments). The Midsouth increased between 1985 and 1991 at the expense of the West.

- The average facility employment of a transplant supplier was 256 employees in 1991. Most transplant suppliers employed between 50 and 499 employees.

- Transplant supplier startups and investment in the United States have leveled off in recent years. The period with the largest number of start-ups is 1987-1989, when an average of 57 new transplant suppliers began operations each year. In 1991, only two new transplant suppliers began operations.

The U.S. automotive parts industry experienced a rough decade in the 1980s. Many structural changes occurred. The industry declined in overall size, as measured by employment and levels of constant dollar shipments and manufacturing value added. These macro changes in the overall U.S. parts industry are largely the result of a decline in the production of traditional U.S. vehicles and of a rise in the use of imported automotive parts.

Of greater relevance to economic developers is the 1980s shift of a significant portion of automotive parts industry employment and establishments to states and regions with historically low levels of automotive activity. States with low manufacturing wages and rates of unionization evidently benefited at the expense of states with higher wages and unionization. Yet the

movement of parts manufacturing to low wage states appears to have excluded large component production (engines, transmissions, and large stampings). The production of large components remains concentrated in the Midwest. The concentration of large component production is reinforced by the fragmentation of vehicle markets and the breakup of coastal, branch plant assembly operations. There is clearly a strong need for further research into the determinants of facility site decisions by both large automotive assembly firms and smaller suppliers.

The drop in average employment of auto parts manufacturing establishments and the large increase in the number of small facilities presents economic developers with a new trade-off. There are significantly more facilities in operation than in previous years. This should increase the likelihood of attracting new automotive parts operations to any viable locality. On the other hand, the typical parts facility brings fewer jobs, and thus less income and fewer other economic gains. Fewer development resources can now be justified for each potential establishment.

The creation of a new transplant supplier industry is indeed a major structural change for the U.S. auto parts industry. It is true that the total count of 259 facilities is not large, but the average facility employment of transplant parts makers is twice the level of the overall auto parts industry. Although most transplant supplier facilities have been located in the traditional (for the automotive industry) Midwest, a significant number have located in the Midsouth. This development is contrary to past industry structure. Despite the impressive development of the transplant parts system (in less than a decade), its future development is in doubt. The number of startups in recent years has declined to a trickle. Transplant vehicle production in the United States leveled off in 1991-1992.

Appendix Table 1
Total Regional Openings and Closings

	Southeast		Southwest		Northeast		Midwest		Midsouth		West		Totals	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
Assembly														
Car	0	1	1	0	0	4	4	8	3	5	0	4	8	22
Truck	0	1	1	0	1	1	2	3	0	1	0	2	5	8
Engine	0	0	0	0	0	0	4	1	1	0	0	0	5	1
Stamping	0	0	0	0	0	0	0	13	0	0	0	0	0	13
Transmission	0	1	0	0	0	0	0	2	0	0	0	0	0	2
Components	4	1	4	1	0	3	11	29	1	0	0	0	20	24
Totals	4	3	6	1	1	8	22	56	5	6	0	6	38	80

Appendix Table 2
General Motors Regional Openings and Closings

	Southeast		Southwest		Northeast		Midwest		Midsouth		West		Totals	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
Assembly														
Car	0	1	1	0	0	2	3	5	3	3	0	2	7	13
Truck	0	1	1	0	0	0	2	2	0	1	0	1	3	5
Engine	0	0	0	0	0	0	3	0	1	0	0	0	4	0
Stamping	0	0	0	0	0	0	0	8	0	0	0	0	0	8
Transmission	0	0	0	0	0	0	0	2	0	0	0	0	0	2
Components	0	0	3	1	0	2	7	7	1	0	0	0	14	10
Totals	0	2	5	1	0	4	15	24	5	4	0	3	28	38

Appendix Table 3
Ford Openings and Closings

	Southeast		Southwest		Northeast		Midwest		Midsouth		West		Totals	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
Assembly														
Car	0	0	0	0	0	2	0	0	0	2	0	2	0	6
Truck	0	0	1	0	1	1	0	0	0	0	0	1	1	2
Engine	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Stamping	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transmission	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Components	0	1	0	1	0	1	0	5	0	0	0	0	0	7
Totals	0	1	0	1	1	4	1	5	0	2	0	3	2	15

Appendix Table 4
Chrysler Regional Openings and Closings

	Southeast		Southwest		Northeast		Midwest		Midsouth		West		Totals	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
Assembly														
Car	0	0	0	0	0	0	1	3	0	0	0	0	1	3
Truck	0	0	0	0	0	0	1	1	0	0	0	0	1	1
Engine	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Stamping	0	0	0	0	0	0	0	5	0	0	0	0	0	5
Transmission	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Components	1	0	1	0	0	0	4	17	0	0	0	0	6	17
Totals	1	0	1	0	0	0	6	27	0	0	0	0	8	27

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