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Occupational Hazard: Why Indiana's Wages Lag the Nation

Employment and Economic Growth in the U.S. Automotive Manufacturing Industry

demographic and economic perspectives, insights, and analysis since 1926

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From the Editor

More and more people are living into their 80s, but not so many magazines. The IBR is one of a relatively few to be in publication for more than 80 years. When it was first published in 1926, its mission was to cover the economy and population of Indiana and to share those insights free to all Hoosiers. That's right, it's been free to anyone wanting to subscribe. But the IBR has been subject to the slings and arrows of economic fortune. This year, we will publish the Indiana Business Review as a web-only publication due to the high cost of printing and the desire for a smaller environmental footprint.

Does this mean less? No, indeed. It means more because we can produce lengthier articles when appropriate and also provide more in the way of resource links and behind-the-scenes information. This issue will be an example of that, with its focus on the "why" behind Indiana's continuous lagging of the national per capita income and the "where" of auto manufacturing and auto parts employment.

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Occupational Hazard: Why Indiana's Wages Lag the Nation

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Last year, Indiana's per capita personal income (PCPI) was $34,605—more than $5,000 below the national average. Since 2001, per capita income has grown at an average annual rate of 3.6 percent for the United States but only 3 percent for Indiana (see **Figure 1**).

In the Fall 2009 issue of the *Indiana Business Review*, Andy Zehner discussed many of the occupational dynamics that contribute to Indiana's lackluster personal income performance. The key to understanding Indiana's low PCPI is dissecting the state's occupational mix and, with it, the compensation associated with those occupations. It is of no surprise that from 2001 to 2008, the state's average annual wage for all occupations, published by the Bureau of Labor Statistics (BLS), has marched in lock-step with changes in per capita income reported by the Bureau of Economic Analysis (see **Figure 2**).

Zehner makes several important points:

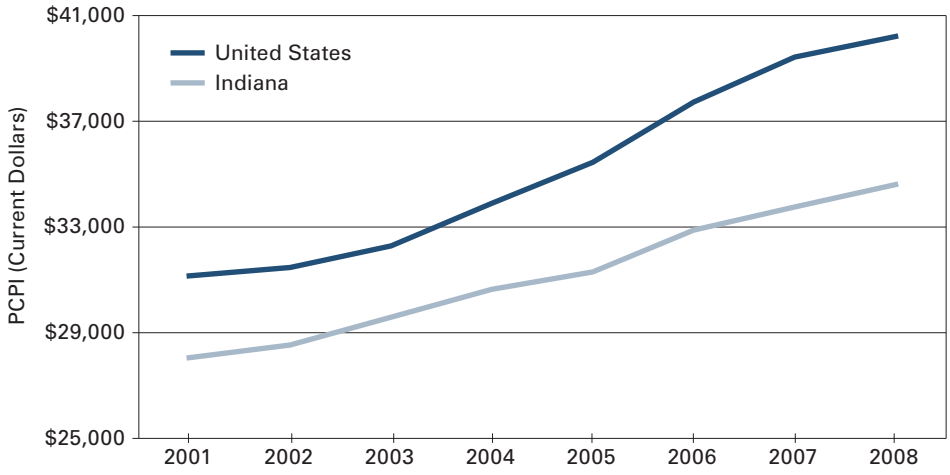
- The decline in manufacturing jobs isn't sufficient to cause sluggish PCPI growth.
- Workers across the board—with a few exceptions—are paid less in Indiana than for comparable jobs in other states.
- The lower Indiana cost of living doesn't make up for the difference.
- Attracting manufacturing plants—"economic development"—won't boost average compensation.

In this article, we will dig deeper to analyze occupational data in greater detail and uncover the shifts in Indiana's workforce that would explain why it is so difficult to move the PCPI needle. Using shift-share analysis that dissects the difference in wages between the state and nation, we present trends in Indiana's occupational mix and compensation using the United States as the benchmark. Then, we compare Indiana's performance within the Midwest.

Shift-Share Analysis

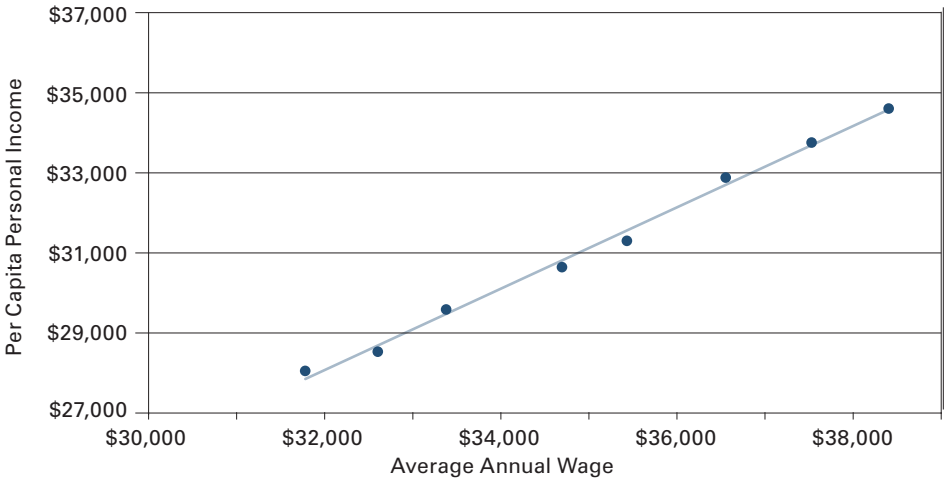
Indiana's occupational mix changes over time. Some occupations wax and others wane. Health care occupations are on the rise, for example. Printing machine operators, on the other hand, are in decline. Over time, one should see the percentage of health care occupations increase and the

Figure 1: Per Capita Personal Income, Indiana Versus United States, 2001–2008



Source: IBRC, using data from the Bureau of Economic Analysis

Figure 2: Indiana Personal Income Versus Average Wage, 2001–2008



Source: IBRC, using data from the Bureau of Economic Analysis and Bureau of Labor Statistics

percentage of printing machine operators decrease.

Few occupations share the same compensation profile. Thus, as one occupation that pays well in Indiana is ascendant and another occupation that pays relatively poorly is in decline, all other things equal, the average wage would increase.

Shift-share analysis enables us to track these types of changes as the economy transforms. Shift-share analysis breaks down wage differentials into three components:

1. **Wages:** This component measures the extent to which the difference between state and national average wage is due to the difference between state and national wages for a given occupation.
2. **Occupation Concentration:** This component measures the extent to which the difference between state and national average wage is due to the difference between state and national share of employment for a given occupation.
3. **Residual:** This component measures the extent to which the difference between state and national average wage is due to factors other than those related to wage and share of employment for a given occupation.

We sorted the twenty-two broad occupation categories defined and reported by the BLS according to their average national wage and then grouped them into three sets—higher, middle and lower wage. **Table 1** presents these three tiers of occupations (broadly defined)

Table 1: Tiers of Occupations by National Average Wage, 2008

Occupation	Indiana Employment	Concentration Relative to the United States	Average Indiana Wage	Average National Wage	Difference
Higher Tier					
Management	108,640	82%	$86,800	$98,230	-$11,430
Legal	13,875	64%	67,735	90,360	-22,625
Computer and Mathematical	43,310	61%	61,800	73,345	-11,545
Architecture and Engineering	46,170	85%	61,315	70,155	-8,840
Health Care Practitioners and Technical	159,905	105%	60,920	66,455	-5,535
Business and Financial Operations	90,630	69%	56,130	63,565	-7,435
Life, Physical, and Social Science	19,400	70%	51,375	63,150	-11,775
Arts, Design, Entertainment, Sports, and Media	31,430	81%	38,910	49,540	-10,630
Middle Tier					
Education, Training, and Library	163,895	90%	$42,805	$47,535	-$4,730
Construction and Extraction	139,275	97%	42,695	41,485	1,210
Installation, Maintenance, and Repair	133,760	114%	40,545	40,580	-35
Community and Social Services	33,190	84%	37,005	41,165	-4,160
Protective Service	55,950	83%	33,715	39,475	-5,760
Production	380,820	175%	33,485	31,815	1,670
Sales and Related	296,350	95%	32,775	35,660	-2,885
Lower Tier					
Transportation and Material Moving	262,530	126%	$30,725	$31,065	-$340
Office and Administrative Support	455,615	90%	29,550	31,710	-2,160
Farming, Fishing, and Forestry	3,105	32%	27,385	23,100	4,285
Health Care Support	73,235	91%	25,465	25,970	-505
Building and Grounds Cleaning and Maintenance	92,015	96%	22,880	23,965	-1,085
Personal Care and Service	62,780	85%	22,340	24,050	-1,710
Food Preparation and Serving Related	262,325	106%	18,050	19,830	-1,780

Source: IBRC, using data from the Bureau of Labor Statistics

showing differences in wages between the United States and Indiana for 2008. These data present a snapshot of Indiana's occupation mix relative to the nation using recent data from the BLS Occupation Employment Survey (OES).[1]

Note that no broad occupation group in the higher tier has a greater wage in Indiana than the national average. With the exception of farming, fishing and forestry, no lower-tier occupation group in Indiana has a greater average wage than the national average. Only in the middle tier does Indiana have two occupation groups—production and construction/extraction—that enjoy wages exceeding the national average.

The shift-share analysis brings a slightly different perspective. In a sense, it balances both the percentage of an occupation as well as the wage of an occupational group. In this way, the transportation occupation group, even though it has an average Indiana wage lower than the national average, contributed to Indiana's average wage positively across all occupations. This is because the percentage difference of those engaged in these occupations in Indiana is much larger than the percentage difference of the average wage in the United States and Indiana. Indiana saw its biggest contribution to wages from production occupations. Installation and maintenance also

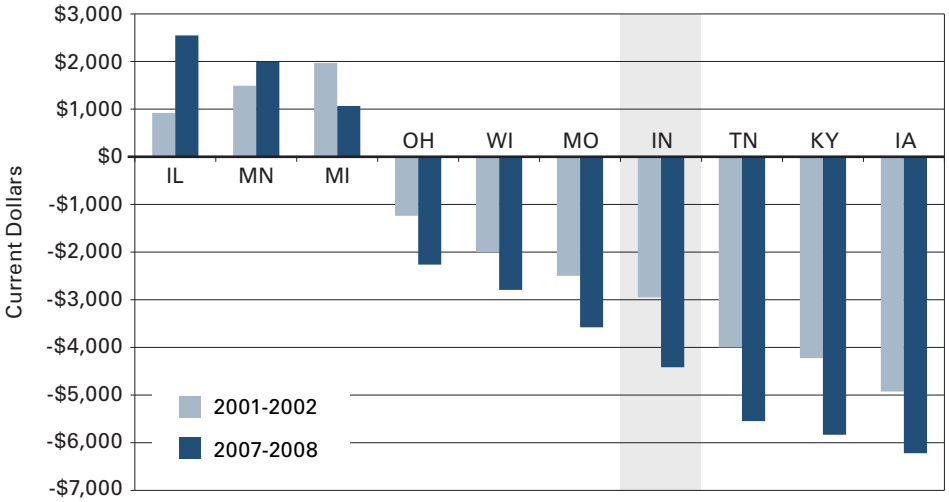
■ **Table 2: Wage and Employment Change among Occupation Tiers, January 2002–July 2008**

Occupation	Change in Employment*			Change in Wages*		
	Indiana**		United States	Indiana**		United States
Higher Tier						
Management	-21,870	-16.8%	-15.0%	$18,860	27.8%	31.3%
Legal	2,210	18.9%	8.5%	14,205	26.5%	23.5%
Computer and Mathematical	7,100	19.6%	16.1%	9,880	19.0%	20.3%
Architecture and Engineering	-5,205	-10.1%	2.2%	10,585	20.9%	22.7%
Health Care Practitioners and Technical	14,730	10.1%	13.4%	12,845	26.7%	27.9%
Business and Financial Operations	7,175	8.6%	28.6%	10,345	22.6%	22.3%
Life, Physical, and Social Science	3,420	21.4%	18.9%	6,965	15.7%	23.7%
Arts, Design, Entertainment, Sports, and Media	7,010	28.7%	18.4%	7,375	23.4%	21.7%
Middle Tier						
Education, Training, and Library	12,450	8.2%	8.7%	5,465	14.6%	19.9%
Construction and Extraction	440	0.3%	7.2%	5,285	14.1%	15.6%
Installation, Maintenance, and Repair	1,370	1.0%	2.1%	4,685	13.1%	14.7%
Community and Social Services	6,085	22.4%	17.9%	6,185	20.1%	19.6%
Protective Service	3,110	5.9%	4.5%	6,060	21.9%	19.9%
Production	-31,210	-7.6%	-8.8%	3,650	12.2%	14.1%
Sales and Related	15,070	5.4%	7.1%	5,525	20.3%	19.8%
Lower Tier						
Transportation and Material Moving	15,815	6.4%	1.8%	3,015	10.9%	15.5%
Office and Administrative Support	790	0.2%	2.1%	4,095	16.1%	15.0%
Farming, Fishing, and Forestry	-1,340	-30.1%	-2.0%	5,455	24.9%	15.9%
Health Care Support	11,305	18.3%	17.6%	3,845	17.8%	17.2%
Building and Grounds Cleaning and Maintenance	1,225	1.3%	3.5%	2,595	12.8%	16.3%
Personal Care and Service	8,910	16.5%	18.5%	2,420	12.1%	13.5%
Food Preparation and Serving Related	14,180	5.7%	13.6%	1,850	11.4%	17.0%

*January 2002 to July 2008
**Left column is jobs lost/gained and right column is percent change
Source: IBRC, using data from the Bureau of Labor Statistics

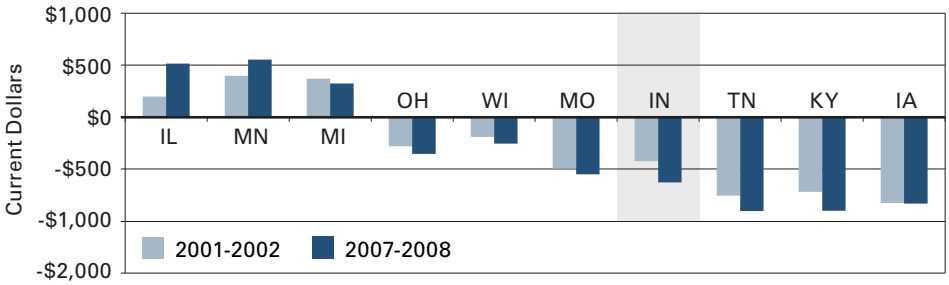
positively contributed. These three occupation groups were the only positive contributors to Indiana's average wage compared to the U.S. average. The other occupation groups pulled down Indiana's average. The biggest drags on wages were from management, business and finance, office and administrative support, and computer and mathematical occupations.

FIGURE 3: Total Wage Differential for All Occupations



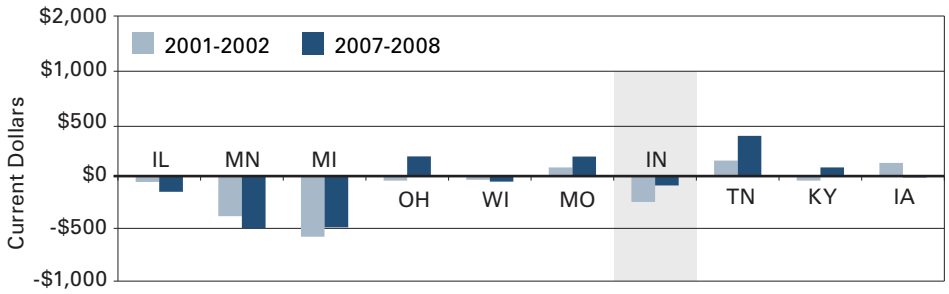
Source: IBRC, using data from the Bureau of Labor Statistics

FIGURE 4: Lower Tier Wage Component



Source: IBRC, using data from the Bureau of Labor Statistics

FIGURE 5: Lower Tier Occupation Concentration Component



Source: IBRC, using data from the Bureau of Labor Statistics

Next, we investigate trends in these occupations. **Table 2** compares Indiana's occupational trends with the United States between 2001-2002 and 2007-2008 for the three wage tiers.

The higher tier of **Table 2** shows that the state has lost jobs in both management and the architecture and engineering occupation group. However, it has been gaining jobs in two occupations that have historically weighed down the state-nation wage differential. Since early in the decade, Indiana has added 7,100 computer and mathematical jobs—a 19.6 percent increase that tops the national increase of 16.1 percent. Indiana also gained 7,175 business and finance jobs, but the rate of increase of 8.6 percent fell significantly below the national increase of 28.6 percent.

Production jobs have been on a downward trend, as the middle tier of **Table 2** shows. Since 2001-2002, the state has lost 31,200 jobs in production. This is especially bad news since production occupations have been exerting positive pressure on the state-nation wage differential primarily through the disproportionately large share of employment in these occupations, but also due to the higher average wage in Indiana relative to the nation (refer back to the middle tier of **Table 1**). Employment in transportation occupations has grown by 15,800, as shown in the lower tier of **Table 2**, but because the average wage for this occupation group is below the state average of $37,090, growth in this employment exerts negative pressure on Indiana's average wage and income.

Comparing Indiana with the Midwest

Having documented that Indiana's per capita personal income and average wage for most occupations lag behind the U.S. averages, we turn our attention to understanding

possible sources of this discrepancy. The preliminary shift-share analysis revealed that some typically higher-paid occupations, such as management or finance, paid less on average in Indiana than in the United States as a whole. In addition, these higher-paying occupations constituted smaller percentages of total employment than the nation as a whole. Indiana has a heavy concentration of production occupations, and accordingly, that occupational category has the greatest effect on Indiana's average wage.

The following analysis compares the occupational dynamics of ten Midwestern states using the same three tier occupation sets. **Figure 3** plots the overall wage difference for the Midwest. Only three states had a wage component which had a positive impact on the overall wage differential relative to the U.S. average. Illinois and Minnesota improved their overall standing between 2001-2002 and 2007-2008. Michigan, while still having a positive wage component, lost ground during the time period.

The Lower Tier

Figures 4 and **5** highlight the change in the lower tier for Midwestern states in 2001-2002 and 2007-2008. Not surprisingly, wages for low-paying jobs in states with positive overall differentials are higher than the national average, and those in states with negative differentials are lower than the national average (see **Figure 4**).

Figure 5 plots the occupational mix component. The takeaway point for this graph is that the Midwest does not appear to deviate much from the average national proportion of jobs in the lower tier. This suggests that these occupations, such as health care support, maintenance jobs, and personal care and support, do not have a material effect on Indiana's (or the Midwest's) overall wage differential one way or the other.

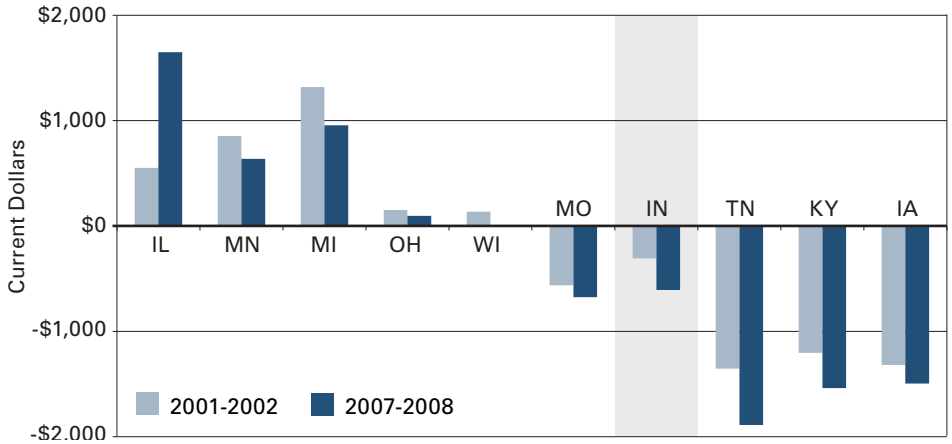
The Middle Tier

Figure 6 plots the wage component and **Figure 7** the occupational component for the middle wage tier. Here, important dynamics begin to appear.

The wage components in the middle tier mimic the trend in total wage for all occupations differentials (with the exception of Minnesota). The occupational components, on the other hand, reveal the drivers of much of the Midwest's wage differential. Midwestern states, and Indiana in particular, tend to have higher percentages of workers in this category than the national

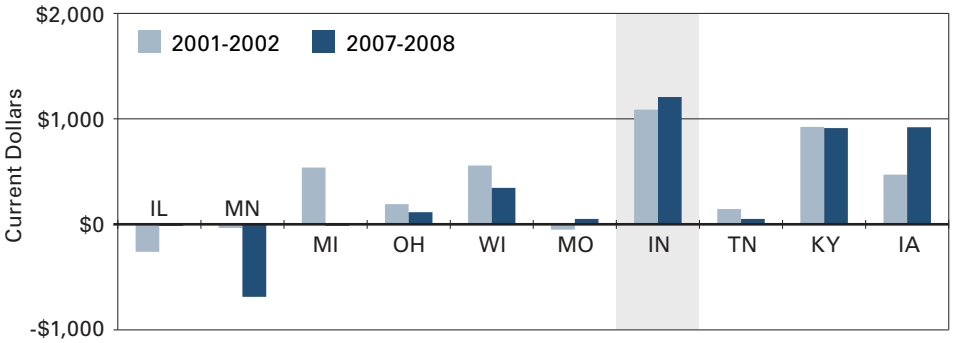
> *"The loss of manufacturing jobs doesn't explain Indiana's lackluster PCPI performance ...the higher wage tier accounts for a vast majority of the PCPI performance of Indiana and the Midwest."*

Figure 6: Middle Tier Wage Component



Source: IBRC, using data from the Bureau of Labor Statistics

Figure 7: Middle Tier Occupation Concentration Component



Source: IBRC, using data from the Bureau of Labor Statistics

average. Unfortunately, this positive differential is mostly canceled out by the negative wage components for these same occupations.

Indiana is the poster child for this dynamic. Relatively speaking, Indiana has experienced a rise in the number of workers in the middle tier from 2001-2002 to 2007-2008, as **Figure 7** shows. But, as **Figure 6** shows, the wage component has been deteriorating. This dynamic leads one to conclude that the loss of manufacturing jobs doesn't explain Indiana's lackluster PCPI performance, and that economic development—to the degree that economic development means capturing more manufacturing plants—won't improve Indiana's average incomes.

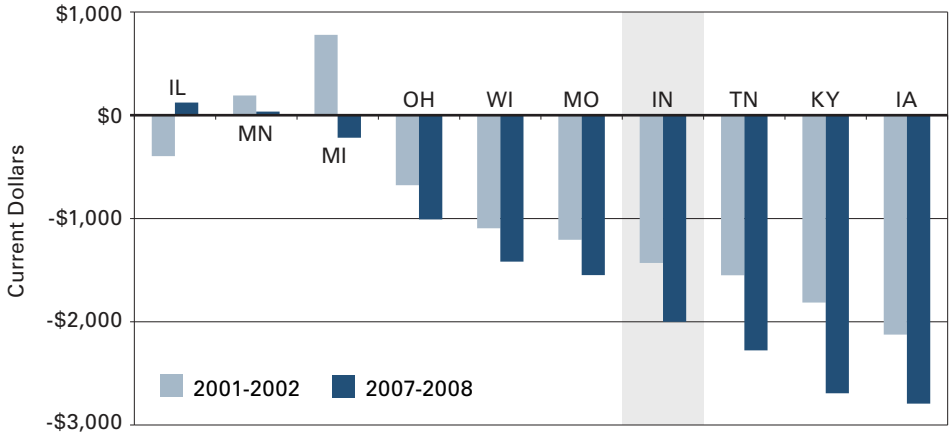
The Higher Tier

As disheartening as the conclusions drawn from the dynamics of the middle wage tier may be, the higher wage tier accounts for a vast majority of the PCPI performance of Indiana and the Midwest. **Figures 8** and **9** highlight the difference in the higher wage tier.

This tier drives the negative wage differential observed in most Midwestern states relative to the nation as a whole, as shown in **Figure 8**. Average wages for the occupations in this tier are generally below the national average. Even Illinois and Minnesota, the states that are doing relatively well in the Midwest, do not have average wages that are materially different than the national average. That said, the movement of the wage component in Illinois in the higher tier from negative to positive from 2001-2002 to 2007-2008 explains the boost in overall wage differential. Conversely, the opposite shift in Michigan in the higher tier explains the less favorable shift in the overall wage difference over the period.

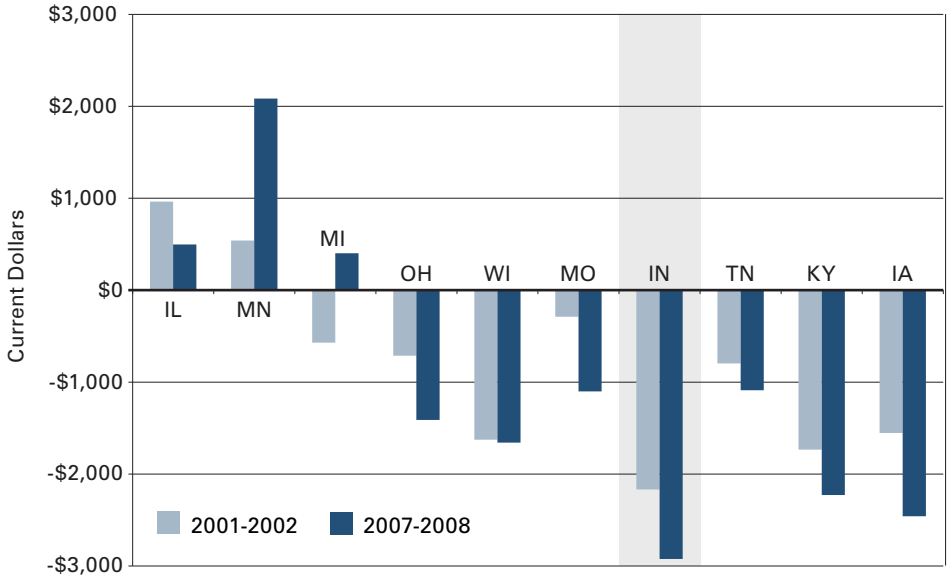
Figure 9 presents the occupation concentration component. The percentage of total employment devoted to the higher-paying occupations relative to the United States helps to identify whether a state has a positive or negative overall wage differential. An interesting comparison is between Minnesota and Indiana. Relative to the nation, Minnesota's portion of employment in the higher-paying tier shot up between 2001-2002 and 2007-2008. Conversely, Indiana's fell. Relative to its Midwestern neighbors in 2001-2002, Indiana had the lowest proportion of its workforce in the higher-earning occupation tier. In 2007-2008, the concentration in this occupation tier further deteriorated. This negative dynamic is the primary explanation for Indiana's poor average earnings performance.

FIGURE 8: Higher Tier Wage Component



Source: IBRC, using data from the Bureau of Labor Statistics

FIGURE 9: Higher Tier Occupation Concentration Component



Source: IBRC, using data from the Bureau of Labor Statistics

Drilling Deeper: The Forward/Reverse Index

Stratifying aggregate occupation categories into three tiers provides some perspective on Indiana's relative weaknesses in terms of the state's occupational mix. But it doesn't tell

the whole story. Even within underperforming occupation categories, there are some winners. Below, we present more detail on some selected occupations as well as introducing a "forward/reverse index." This index indicates whether a specific occupation trend over time for, say, industrial production managers, is having an increasing or decreasing effect on Indiana's wage or income averages. There are two components to the "forward/reverse index" (FRI).

1. **The ratio of the rate of increase in Indiana's average wage for an occupation divided by the rate of increase in the U.S. average wage.** In other words, this component looks at whether Indiana is gaining ground or losing ground on the wage front. For instance, if Indiana's average wage for team assemblers grew by 5 percent over the study period—from 2001-2002 to 2007-2008 in this case—and the national average wage for team assemblers grew by 5 percent as well, this component would be 1. If Indiana's average wage for team assemblers outpaces the U.S. average wage, the ratio will be greater than 1.
2. **The ratio of the change in the occupation's concentration over time.** It addresses the question of whether the relative concentration of a given occupation is rising or falling relative to the nation. For instance, if the percentage of Indiana's employment consisting of team assemblers increased while the percentage of the nation's workforce in this occupation decreased, this component would be greater than 1. The concentration component ratio would be less than 1 if the U.S. percentage of team assemblers grew more quickly than the percentage of that occupation in Indiana.

"Industrial production managers and sales managers have been on a relative tear, with index values of 1.34 and 1.25, respectively. They have exerted positive pressure on Indiana's overall wage and income averages by gaining in concentration."

The FRI itself is derived by simply multiplying these two components. Thus, an index over 1 for a given occupation signifies that either one of the two components was large enough to offset a low value in the other, or that both components were greater than 1. In either case, a number above 1 shows a specific occupation is increasing in its effect upon Indiana's average wage (and income). Conversely, a number below 1 indicates that an occupation's effect on wages with the state is waning.

By looking at the two components that make up the FRI, one can also note whether an occupation is rapidly raising Indiana's averages. For example, both the wages and concentration of medical and health service managers have been growing faster than the nation. Thus, this occupation might be viewed as accelerating the pace by which Indiana would close the gap between state and the U.S. averages.

The FRI isn't perfect and should be handled with care. For example, an occupation that is increasing in concentration will lower the state average wage if that occupation's wage is less than the state average. Thus, an increasing concentration in food preparation and serving occupations would pull the state average wage down. For those occupations that are in the middle and lower tiers, one must be aware of the average wage for a particular occupation.

To demonstrate how the FRI can be used, **Table 3** presents the results of prominent occupations within four major occupational categories: management occupations, business and financial occupations, production occupations, and transportation occupations. As it relates to the three tiers discussed earlier, the management and business and financial categories represent the higher tier, while the production category lands in the middle tier and the transportation occupations are in the lower tier.

First we'll look at selected occupations within the management category in **Table 3**.[2] Industrial production managers and sales managers have been on a relative tear, with index values of 1.34 and 1.25, respectively. They have exerted positive pressure on Indiana's overall wage and income averages by gaining in concentration. Industrial production managers are especially interesting in that, while their average wage has kept pace with the U.S. average for the occupation, their concentration in Indiana relative to their concentration nationwide has increased by a third. Trends in occupations that have not exerted positive pressure on Indiana averages include general and operations managers as well as education administrators because of decreasing concentration relative to the nation.

While many management occupations are helping to increase Indiana's averages, business and

■ **TABLE 3: The Forward/Reverse Index of Prominent Occupations Comparing Indiana to the United States**

	Occupation Category	Ratio of Wage Change	Ratio of Concentration Change	FRI
Higher Tier	***Management***			
	Industrial Production Managers	1.00	1.33	1.34
	Sales Managers	0.95	1.31	1.25
	Medical and Health Services Managers	1.08	1.07	1.15
	Chief Executives	0.94	1.11	1.05
	Construction Managers	1.00	1.03	1.03
	Education Administrators, Elementary and Secondary School	0.95	0.90	0.86
	General and Operations Managers	1.01	0.81	0.82
	Business and Financial			
	Training and Development Specialists	1.03	1.18	1.22
	Management Analysts	0.98	1.17	1.15
	Cost Estimators	1.02	1.05	1.07
	Purchasing Agents, Except Wholesale, Retail, and Farm Products	1.03	0.94	0.96
	Financial Managers	1.01	0.94	0.94
	Accountants and Auditors	0.99	0.87	0.86
	Loan Officers	1.01	0.82	0.82
Middle Tier	***Production***			
	Team Assemblers	1.07	1.12	1.20
	Helpers–Production Workers	0.97	1.22	1.18
	Inspectors, Testers, Sorters, Samplers, and Weighers	0.95	1.17	1.11
	Cutting, Punching, and Press Machine Setters and Operators	0.99	1.05	1.04
	Machinists	1.04	0.99	1.02
	First-line Supervisors/Managers of Production and Operations	1.01	1.00	1.00
	Welders, Cutters, Solderers, and Brazers	0.93	0.88	0.82
Lower Tier	***Transportation***			
	Laborers and Freight, Stock, and Material Movers	0.92	1.27	1.17
	Bus Drivers, School	1.05	1.00	1.06
	Truck Drivers, Heavy and Tractor-trailer	0.96	1.09	1.04
	Industrial Truck and Tractor Operators	1.02	0.99	1.01
	Driver/Sales Workers	0.86	1.15	0.99
	Truck Drivers, Light or Delivery Services	0.92	1.05	0.96
	Packers and Packagers, Hand	0.97	0.87	0.85

Note: A shaded cell indicates that the occupation unambiguously helps to lift Indiana's average wage.
Source: IBRC, using data from the Bureau of Labor Statistics

financial occupations have had less positive effect (see the business and financial category of **Table 3**). Accountants and auditors, together with loan officers, have FRI values below 0.9, thus showing negative trends. On the other hand, the trends for training and development specialists, as well as management analysts, have put positive pressure on Hoosier state averages.

While the production occupation category has, on average, a higher wage than the nation, most of the prominent Indiana occupations in the production category of **Table 3** do not necessarily have a positive effect on Indiana's mean wage. It is noteworthy that Indiana team assemblers' wage growth outpaced U.S. team assembler wage growth, and they constitute a growing share of Indiana's workforce relative to the nation. That said, their average wage, because it is less than the Indiana average, pulls down the state average for all occupations. Only two of the prominent occupations in the production category unambiguously help to lift Indiana's average wage:

1. Machinists
2. First-line supervisors/managers of production and operations

Leading transportation occupations shown last in **Table 3** give a less rosy picture than those for production occupations. Only the wages of school bus drivers and industrial truck and tractor operators increased at a faster clip than the national average. Overall, the aggregated transportation category trails the U.S. average on the wage side, while greatly exceeding the average U.S. concentration. The wage and employment dynamics of this transportation occupation group and the evidence of several selected occupations point to the fact that this occupation group exerts downward pressure on Indiana's average wage.

Access Full Data Set Online

Occupational wage, concentration and FRI data for all occupations—not just aggregate occupation groups or selected occupations—are available online at www.ibrc.indiana.edu/analysis. Readers can conduct their own investigation at a more granular level as to what a particular occupation pays on average, whether Indiana has a relatively high or low concentration and whether the occupation is helping to pull up Indiana's average wage relative to the United States.

Cost of Living—A Brief Excursus

As noted in the introduction, the Indiana cost of living, while lower than the national average, doesn't make up for the lower average wage and personal income. But upon a closer look in average wages, several occupation groups swing from lower than the national average to even with or slightly higher than the national average after adjusting for the cost of living. These occupations are mostly in the lower wage tier. In fact, with the exception of food preparation and serving, all the occupation groups in the lower tier match or beat the national averages after adjusting for the cost of living. This is certainly good news for those on the lower end of the income spectrum.

Conclusion

Piggybacking on a previous article that investigated the occupational considerations that contribute to the state's sub-par performance for personal income, we presented data and analysis on the wage and concentration trends of occupations in Indiana, the Midwest and the nation. We found that for the middle tier set of occupations that Indiana tends to concentrate in—jobs in production, for example—Indiana does not lag the nation or neighbors. The higher-earning tier, however, is where Indiana is at a comparable disadvantage. The lower concentration and lower wages of the occupations in the higher-earning tier contribute mightily to the gap between Indiana and U.S. average wages (and per capita personal income). While the relatively poor performance in the lower-earning tier also contributes to the income gap, this gap disappears when adjusting wages for the cost of living. We also examined some selected occupations to determine whether, and the degree to which, specific occupations help to narrow the wage gap.

This article was not originally conceived as a policy piece, but the nagging question as to how the state can narrow the wage and income gap persists. The first conclusion is that the better economic development initiatives would focus on cultivating business activities that employ people in the higher wage tier occupations. The Indiana Economic Development Corporation has been aggressive, and successful, in attracting investment, but if that investment results in expanding (or maintaining) employment in the middle wage tier, that will not narrow the wage and PCPI gap. Investment in manufacturing should be seen as akin to a medical trauma center—stopping the hemorrhaging, stabilizing the patient, but not returning the patient to full health. The long and hard work—physical therapy and athletic conditioning if you will—will require augmenting Indiana's human capital. It will require brainpower and the business activities that emphasize brainpower, like company headquarters and high-tech companies. The higher wage tier occupations are the high brainpower jobs.

Indiana has the potential for those high brainpower jobs. The Hoosier state does quite well in terms of science and engineering graduates, well above the national average in terms of graduates per thousand of the state's population. The state also has some top-shelf business schools. Employing those graduates in the state, however, remains the challenge.

Indiana may not be taking full advantage of its intellectual assets. For example, the Crane Naval Weapons Support Center filed over sixty patents in 2009 and hopes to file a hundred patents in 2010. Many of those patents can be commercialized. Will it be Indiana firms that bring those potential products or services to the market? Will those potential Indiana firms, once they become well-established, remain in Indiana (rather than being bought out by a larger firm on one of the coasts)?

These would be the high-impact business activities that could improve Indiana's economic vitality as well as close the wage and income gap.

Other economic analysts and policy makers, no doubt, have other ideas and policy proposals to improve Indiana's prosperity, but if those proposals do not expand the ranks of the higher-earning occupational tier, the PCPI and wage needle will barely budge.

Also contributing to this article was Alex Cohen, Research Assistant at the Indiana Business Research Center, Kelley School of Business, Indiana University.

Notes

1. The data are averaged from the 2007 and 2008 OES. Because the survey results for specific, less numerous, occupations frequently have large margins of error and can be erratic, we averaged two years of data for more stable results.
2. The FRI components are location quotients (LQs). Recall that an LQ, or location quotient, measures the relative concentration of an occupation compared to the United States. An LQ of 1.0 shows the state as having the same proportion of workers in a particular occupation. Greater than 1.0 indicates that the state is more concentrated in an occupation; less than 1.0 indicates less concentrated.

Employment and Economic Growth in the U.S. Automotive Manufacturing Industry: Considering the Impact of American and Japanese Automakers

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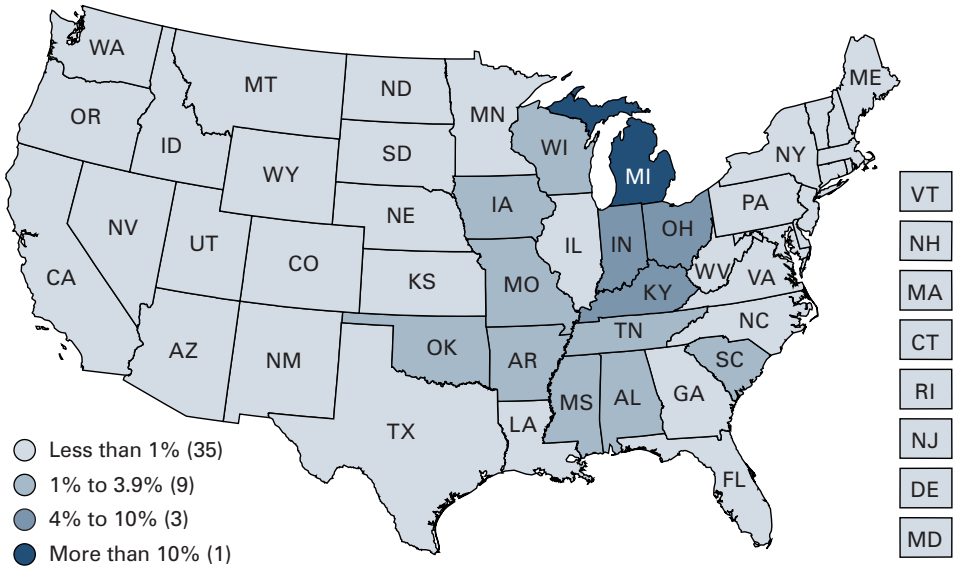
What can we learn about recent trends in the automotive manufacturing industry that may help us understand factors behind the current downturn, as well as potential for future growth? This article looks at states across the contiguous United States to understand employment and gross domestic product (GDP) growth within this declining industry and its automotive parts manufacturing subsector between 1998 and 2008. This research also assesses the influential impact of the annual revenues earned by the top six automotive companies in the United States—the Detroit Three (General Motors, Ford, and Chrysler) and the top three Japanese companies (Toyota, Honda, and Nissan). Controlling for several influential factors, we find that employment and GDP growth among states is generally linked to the improved revenues of U.S. companies relative to Japanese companies. The one notable exception is Toyota whose revenues were not significantly associated with increases or decreases in state employment or GDP.

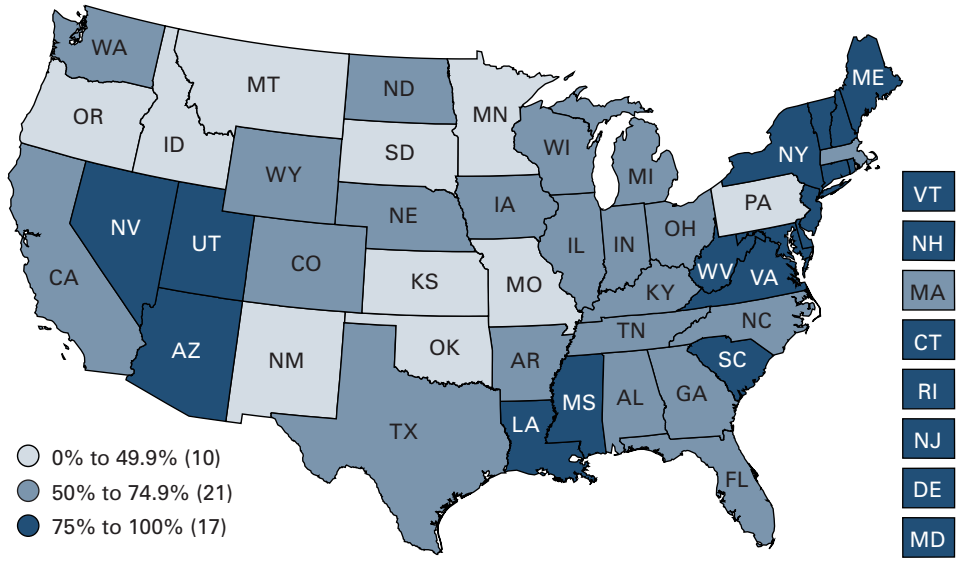
Companies in the automotive manufacturing industry are classified by the North American Industrial Classification System (NAICS) as part of the larger transportation equipment manufacturing industry (NAICS 336).[1] Specifically, this research will focus on the employment and GDP associated with the production of cars, as well as light and heavy-duty trucks, by analyzing manufacturers in

FIGURE 1: Average Percentage of State GDP in Automotive Manufacturing, 1998 to 2008



Source: IBRC, using data from the U.S. Bureau of Economic Analysis and Moody's Economy.com

FIGURE 2: Percentage of Automotive Employment Manufacturing in Automotive Parts Manufacturing, 2008



Source: IBRC, using data from the U.S. Bureau of Labor Statistics

the following three 4-digit NAICS categories:

- **3361: Motor Vehicle Manufacturing:** Establishments (often called original equipment manufacturers or "OEMs") that primarily assemble entire motor vehicles including cars, mini-vans, light trucks, sport utility vehicles (SUVs), electric automobiles for highway use, fire-trucks, tractors, and buses.
- **3362: Motor Vehicle Body and Trailer Manufacturing:** Firms that manufacture motor vehicles bodies as well as cabs and trailers. Often these include assembling cars in kit form, special purpose vehicle bodies, stretch limo assemblies, dump truck lifting mechanisms, flatbed trailers, and self-contained Recreational Vehicles (RVs).
- **3363: Motor Vehicle Parts Manufacturing:** Firms that do not assemble complete motor vehicles or bodies but focus on manufacturing motor vehicle parts, engines or rebuild motor parts. Such components include hoses and belts, springs, diesel engine parts, brake and electric system components, steering and suspension, and seats and trimming for automobiles.

The automotive manufacturing industry is an important component of the U.S. economy and is particularly important in several Midwestern and Southern states. **Figure 1** shows the average proportion of each state's GDP that can be attributed to the automotive manufacturing industry over the past decade.

As expected, the Midwestern states of Michigan (10.3 percent), Indiana (6.3 percent), and Ohio (4.7 percent) are among the four states with over 4 percent of state GDP dependant on automotive manufacturing, with Kentucky the only other state with such a high percentage of GDP directly linked to this industry. **Figure 1** also shows the concentration of the automotive manufacturing industry along the corridor of states stretching from the Great Lakes to the Gulf Coast—often referred to as "Auto Alley."[2]

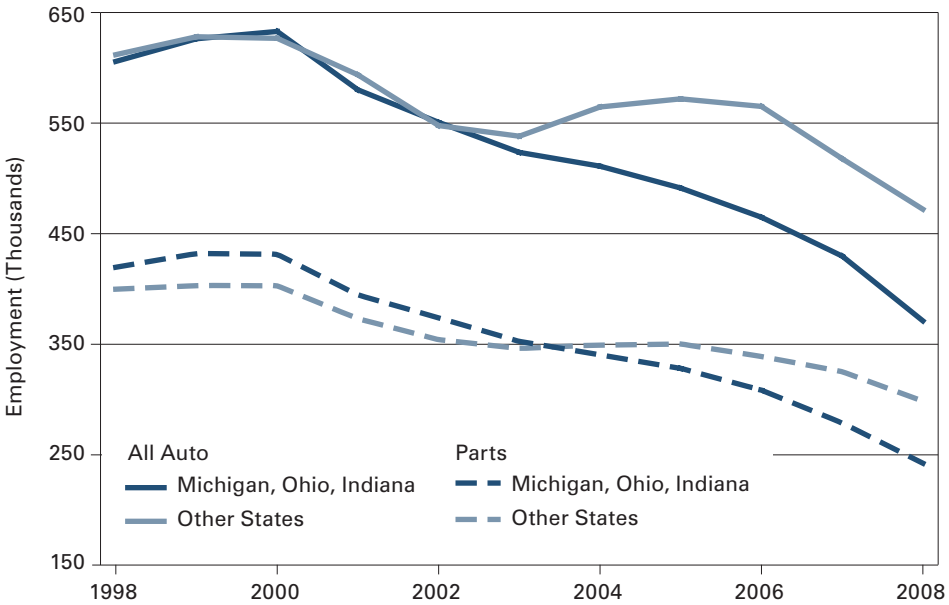
Interestingly, most employment in this industry is upstream of the original equipment manufacturers (OEMs) since Klier and Rubenstein emphasize that carmakers increasingly focus on final assembly having largely passed on the responsibility of manufacturing the bulk of their auto parts to independent suppliers.[3] **Figure 2** summarizes the percentage of each state's automotive employment that works for automotive parts manufacturers (NAICS 3363) and we see they are the largest sub-sector of employment in all but ten of the contiguous states.

Job and GDP Growth in the Automotive Manufacturing Industry

Within this industry, the overall trends are declining employment and GDP growth volatility between 1998 and 2008. However, these trends gain complexity when we pay particular attention to parts suppliers and when we consider differences between Midwestern states and the rest of the country. **Figure 3** shows a fairly constant decline in the automotive manufacturing industry and for the parts manufacturing sub-sector over this ten-year period. However, the employment pattern was noticeably different for other states between 2002 and 2006 where automotive manufacturing employment held constant and even increased slightly before declining between 2006 and 2008.

One of the primary drivers for the job loss was a disproportionately high growth in automotive parts

FIGURE 3: Automotive Manufacturing in the Midwest and Other States, 1998-2008



Note: "Other States" does not include Alaska and Hawaii and some employment is suppressed due to non-disclosure requirements. Auto refers to the sum of NAICS 3361, 3362, and 3363. Parts refers only to NAICS 3363.
Source: IBRC, using data from the U.S. Bureau of Labor Statistics

imports. Collins, McDonald and Mousa explain that, between 2000 and 2006, the trade gap (imports over exports) had grown from 7 percent to about 51 percent and, coupled with the declining sales of the Detroit Three, this trade deficit led to a downward employment trend in parts manufacturing nationwide. This drop in employment was particularly severe in the Midwest, which experienced increased domestic competition for jobs from southeastern states where wages were 23 percent lower than corresponding automotive parts jobs in 2006. Additionally, as output per worker grew 28.6 percent, fewer employees were needed in the Midwest.[4]

Figure 4 shows that GDP growth is noticeably more volatile among the three Midwestern states compared to other states; however, real GDP levels (in chained 2000 dollars) are roughly the same today as they were ten years ago. While GDP trends for the Midwest were largely similar to other states through 2002, they differed markedly between 2002 and 2006 where other states experienced steady growth. This is hardly a surprise keeping in mind that nominal sales revenues for the Detroit Three were lower in 2008 as compared to ten years ago.[5]

Performance of American and Japanese Automakers

The automobile industry as a whole continues to be depressed as a result of the global economic recession, but foreign automakers Toyota and Honda continued to achieve record high revenue levels through 2008 as they increased their market share in the United States. This article examines the top-line revenue numbers from the U.S. Securities and Exchange Commission (SEC) filings of the six major automakers to track their performance for the period of 1998 to 2008. While many of these data were available through the SEC's official EDGAR database, some data were only available via alternative databases and foreign corporate websites and required additional calculation.[6] The companies under review are as follows:

General Motors (GM)

Founded in 1908, GM manufactures, sells and services a range of light and heavy automotive vehicles under the Buick, GMC, Chevrolet, Cadillac, and Opel umbrellas. Major models include LaCrosse, CTS, Cobalt, Malibu, Escalade, Tahoe, Suburban, Yukon, Yukon Denali, Hummer, Silverado, Sierra, Corvette, and Camaro.

Ford

Founded in 1903, Ford Motor Company manufactures, sells and finances cars and trucks under the Ford, Lincoln, Mercury, and Volvo umbrellas. Major models include the Focus, Fusion, Taurus, Mustang, Escape, Explorer, Ranger, F-150, MKS, Navigator, Town Car, Milan, Mountaineer, V70, S80, C70, and XC90.

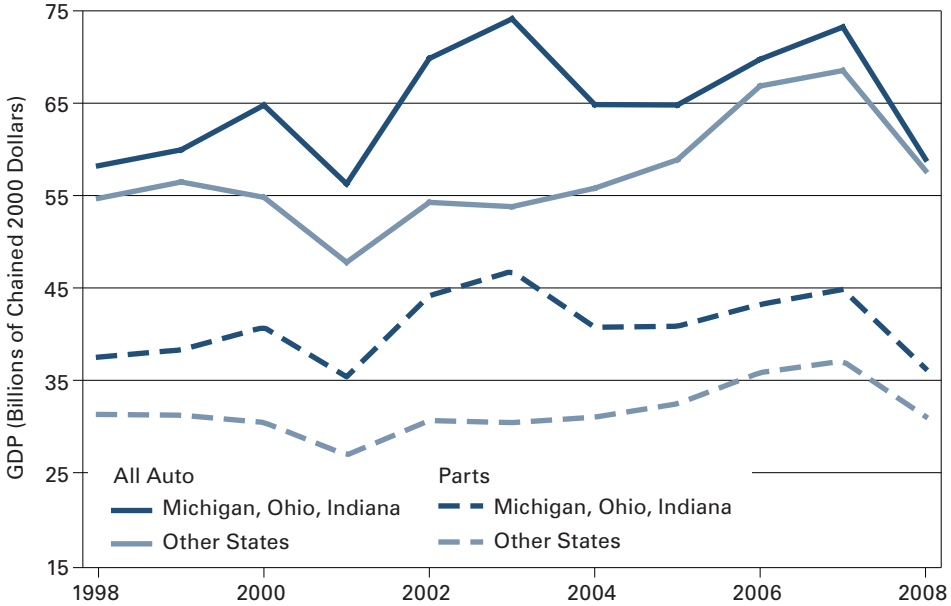
Chrysler[7]

Founded in 1925, Chrysler currently manufactures and sells automobiles under the Dodge, Chrysler, Jeep, RAM, and Global Electric Motorcar brands. Popular models include the PT Cruiser, Sebring, Chrysler 300, Wrangler, Grand Cherokee, Avenger, Charger, Grand Caravan, Viper, Dakota, and Ram.

Toyota

Founded in 1933, Toyota Motor Corporation designs, manufactures and sells sedans, mini-vans, compact cars, SUVs, trucks, and related parts and accessories worldwide. Major models under the Toyota umbrella include the Corolla, Camry, Lexus, 4Runner, Rav4, Sienna, and Prius.

■ FIGURE 4: **Automotive Manufacturing GDP in the Midwest and Other States, 1998-2008**



Note: "Other States" does not include Alaska and Hawaii and some employment is suppressed due to non-disclosure requirements. Auto refers to the sum of NAICS 3361, 3362, and 3363. Parts refers only to NAICS 3363.
Source: IBRC, using data from the U.S. Bureau of Economic Analysis and Moody's Economy.com

Honda

Founded in 1946, Honda Motor Corporation produces and sells motorcycles, automobiles, and power products (generators, engines, marine motors, etc.). Major models include the Accord, Civic, Acura, Pilot, CR-V, and Element.

Nissan

Founded in 1933, Nissan produces cars, trucks, buses, forklifts, and manufacturing parts for overseas production. Major models include the Versa, Sentra, Altima, Maxima, Xterra, Pathfinder, Quest, and the Z series.

Figure 5 shows a distinct downward trend in the top-line revenues for the Detroit Three between 2005 and 2008, especially when compared to the performance of major Japanese automobile manufacturers. As a result, revenues for the Detroit Three are all substantially lower in value (in chained 2000 dollars) in 2008 as they were ten years ago. Noticeably, GM moved from being the highest revenue earner at $167 billion in 1998 and a high of $184 billion in 2000 to drop down to $122 billion in revenue in 2008—a distant second among automakers. In contrast, all three major Japanese automakers saw their revenues soar over this period with Toyota increasing its revenues from under $100 billion in 1998—a distant third in ranking—to an astounding record $214 billion in 2008 (chained 2000 dollars). Toyota is now the largest automaker in the world[8] and their constant annual growth of 8 percent in this period seems to indicate that they were the biggest beneficiary of the decline of the American carmakers.

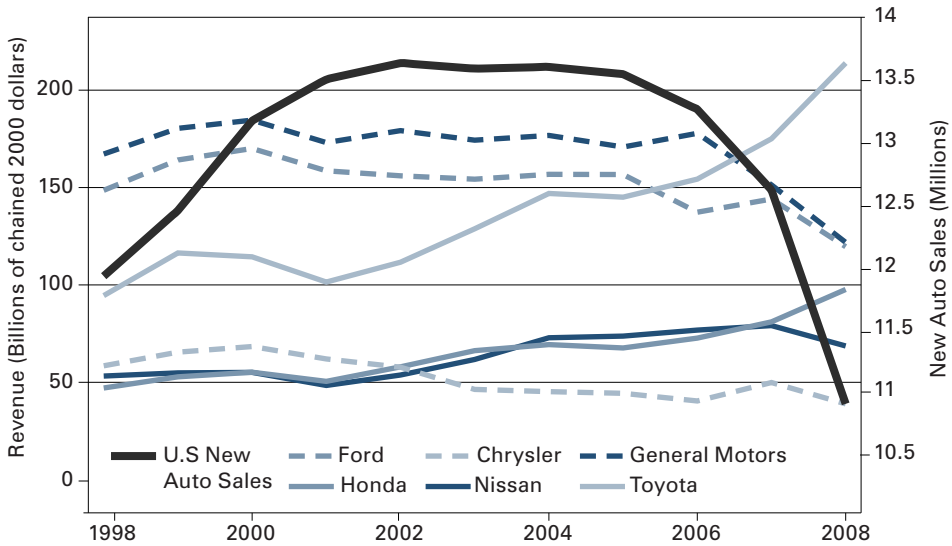
"Toyota is now the largest automaker in the world and their constant annual growth of 8 percent in this period seems to indicate that they were the biggest beneficiary of the decline of the American carmakers."

Assessing the Impact of Automaker Revenues on State Employment and GDP Growth

This study attempts to understand the relative effects that the performance of leading automakers can have on employment and GDP growth in the automotive manufacturing industry once we control for other important factors. We can recognize that economic growth and GDP are not themselves independent of each other with GDP growth known to be a major predictor of employment growth since it can "generate an increased derived demand for workers."[9] In particular, GDP growth in the automotive manufacturing industry should play a major role in this sector's employment growth. This research measures this impact using data from the U.S. Bureau of Economic Analysis and Moody's Economy.com. The major demographic factor of population growth, reflected by U.S. Census data is also an important consideration since shifts in population size due to births, deaths and migration are often associated with the size of the workforce.[10]

The link between automaker revenues and automotive sales to state employment and GDP growth is a more complex relationship. Increasing sales and revenues of a

■ FIGURE 5: **Revenue of the Top Six Automakers Compared to U.S. New Auto Sales**



Source: IBRC, using data from the U.S. Securities and Exchange Commission (SEC) EDGAR database and SEC filings data obtained from LexisNexis Academic, Hoovers, Forbes, and automaker corporate websites. New auto sales data are from the U.S. Department of Transportation, Bureau of Transportation Statistics.

particular automaker would lead to states achieving higher employment and GDP levels only if the vehicles and components of that automaker are likely to have come from that state—a key premise for this article. Of course, the manufacture of each vehicle—even one "made in the USA"—is likely to involve a large network of body makers and parts suppliers located across the United States and even other countries. Ideally, this research would benefit from detailed information on the many manufacturer-supplier relationships, sales data between each of the major carmakers, and establishments located within each state. However, such data are typically only available through confidential company records and fee-based proprietary data sources such as the Auto Industry Portal offered by ELM International, Inc.

This research sheds light on which carmakers' revenues have significant positive or negative impacts on state employment and GDP growth through longitudinal regression models of the full automotive sector and the automotive parts sub-sector. Specifically, fixed-effects models are used that control for unique characteristics in each of the 48 contiguous states over this ten-year period, while also controlling for other important factors mentioned above.[11] While the results share interesting insights, these models should not be interpreted as predictive causal relationships and individual factors (such as the revenue of a particular carmaker) can only be interpreted in relation to other factors contained within each model.

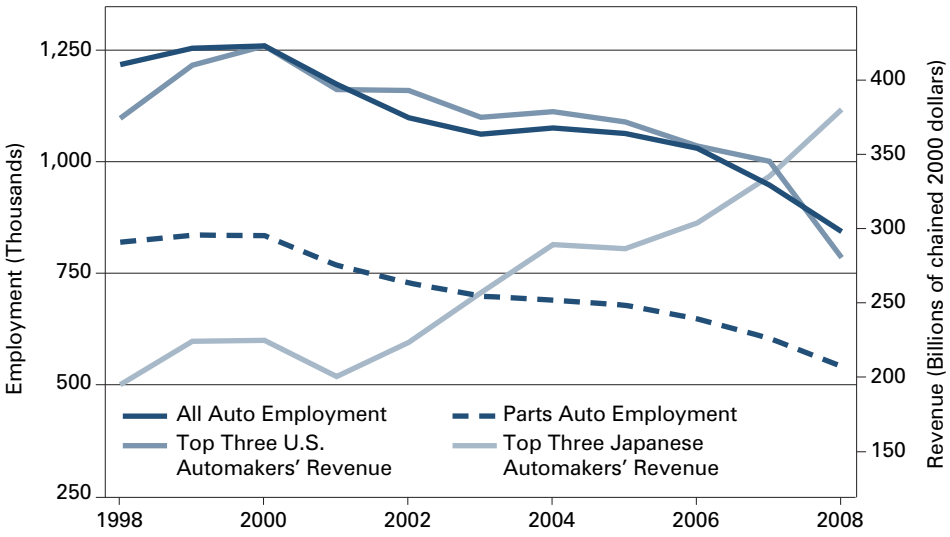
Which Automakers Impact Employment Growth?

Figure 6 reveals that, over the 1998-2008 period, state automotive employment trends appear to closely mirror changes in the revenue patterns of the top three U.S. automakers—General Motors, Ford, and Chrysler. The revenues of these U.S. automakers increased to a high of $423 billion in 2000, dropped to $394 billion in 2001 and then slowly decreased through 2007 before a large drop to $280 billion in 2008 (all figures are chained 2000 dollars). Meanwhile, employment in the automotive manufacturing sector followed a nearly identical trend to the revenues of the Detroit Three by rising to 1.25 million workers in 2000, dropping noticeably in 2001 then more slowly through 2006 before a large drop down to 843,000 workers respectively in 2008. Less dramatic yet similar, parts manufacturing employees peaked at 834,000 workers in 2000, dropped gradually through 2006 before a final dip to 541,000 workers by 2008. Remarkably, the total number of automotive manufacturing workers in 2008 was barely higher than the number of workers in the automotive parts manufacturing sub-sector alone a decade earlier.

Meanwhile, the performance of the top three Japanese automakers only appears positively associated with employment through 2001 when the revenues of these increased to $225 billion and then dropped to $200 billion. However, from 2001 onward, while employment levels dropped, the revenues of the Japanese companies grew rapidly through 2004 to $289 billion and then again between 2005 and 2008 to $380 billion.

The regression coefficients in **Table 1** help to confirm whether there are in fact significant relationships between the growth in American and Japanese carmakers' revenues and employment growth. Before we assess the influence of carmaker revenue growth, we see that in the simple model on automotive employment (column 1), other factors like automotive manufacturing GDP and the annual growth in auto sales have a significant impact on employment. Each percentage increase in automotive manufacturing GDP is associated with a 0.1 percent increase in employment in this sector ($p < 0.05$) and each percentage increase

■ **Figure 6: Automotive Manufacturing Employment Compared to the Revenue of the Top Three U.S. and Top Three Japanese Automakers**



Notes: Employment data are for the 48 contiguous states and some employment is suppressed due to non-disclosure requirements. Auto refers to the sum of NAICS 3361, 3362, and 3363. Parts refers only to NAICS 3363.
Source: IBRC, using data from the U.S. Bureau of Labor Statistics, the U.S. Securities and Exchange Commission (SEC) EDGAR database, and SEC filings data obtained from LexisNexis Academic, Hoovers, Forbes, and automaker corporate websites.

in new car sales is associated with a 0.7 percent increase in employment ($p < 0.01$), controlling for population growth and the previous year's employment levels.

However, when we take into account carmaker revenues (column 2), only GDP growth, as well as the revenues for Honda and Nissan, have statistically significant impacts on automotive manufacturing employment. Each percentage increase in revenue for Honda and Nissan are associated with decreases in automotive employment of 0.5 percent and 0.2 percent, respectively, ($p < 0.05$) holding all other factors constant.

The observed impacts on employment for the automotive parts manufacturing sub-sector is noticeably different from the automotive manufacturing sector as a whole. While the simple automotive parts model (column 3) is quite similar to the "all automotive" model (column 1), there are striking differences when we examine the full model (column 4) when we account for revenues of the top six carmakers. Here, not only do both annual growth in automotive parts manufacturing GDP and new car sales have significant impacts on employment but each percentage increase in annual growth in new car sales is actually associated with a surprisingly negative impact of 1.1 percent ($p < 0.05$).[12] We also observe that there are significant impacts on automotive parts manufacturing employment associated with the revenue growth for all three U.S. carmakers and for Honda. Each percentage increase in revenues for General Motors and Ford led to increases in parts employment of 0.5 percent and 0.6 percent, respectively. A 1 percent increase in revenues for Chrysler and Honda lead to decreases in parts employment of 0.2 percent and 0.5 percent, respectively ($p < 0.01$).

Overall, the results suggest that state employment in the automotive employment sector—and the parts sub-sector in particular—largely increase in relation to the performance of U.S. carmakers and decrease in relation to the performance of Japanese carmakers with some notable exceptions. For example, Toyota's tremendous growth over the 1998-2008 time period is not significantly linked to increases or decreases in U.S. automotive employment in relation to other carmakers. U.S. carmaker revenues—which mostly declined during this period—had no significant impact on automotive manufacturing employment as a whole but did correspond positively

■ Table 1: Impact of Automotive and Demographic Characteristics on Percentage Annual Employment Growth in the Contiguous U.S. States, 1998-2008

	All Automotive		Automotive Parts	
Variables	**Column 1**	**Column 2**	**Column 3**	**Column 4**
Automotive Manufacturing GDP, Annual Growth (%)	0.094*	0.094*		
	(2.35)	(2.35)		
Automotive Parts Manufacturing GDP, Annual Growth (%)			0.202**	0.202**
			(4.44)	(4.44)
New Car Sales, Annual Growth (%)	0.781**	0.004	0.435**	-1.091*
	(5.47)	(0.00)	(3.30)	(2.51)
Population, Annual Growth (%)	2.422	2.422	-1.234	-1.234
	(1.12)	(1.12)	(1.22)	(1.22)
All Automotive Manufacturing Employment in Previous Year	-0.000	-0.000		
	(1.25)	(1.25)		
Automotive Parts Manufacturing Employment in Previous Year			0.000	0.000
			(0.55)	(0.55)
General Motors Revenue, Annual Growth (%)		0.263		0.493**
		(0.90)		(3.11)
Ford Revenue, Annual Growth (%)		0.379		0.639**
		(1.04)		(3.35)
Chrysler Revenue, Annual Growth (%)		-0.152		-0.191**
		(1.66)		(3.07)
Toyota Revenue, Annual Growth (%)		0.362		0.276
		(1.35)		(1.64)
Honda Revenue, Annual Growth (%)		-0.520*		-0.518**
		(2.17)		(2.70)
Nissan Revenue, Annual Growth (%)		-0.201*		-0.121
		(2.28)		(1.62)
Constant	1.587	-0.678	1.449	0.118
	(0.58)	(0.29)	(0.85)	(0.07)
R-Squared	0.30	0.30	0.33	0.33

+ Significant at 10 percent; * Significant at 5 percent; ** Significant at 1 percent

Notes: Coefficients are for fixed effects regression models with robust t statistics in parentheses. All models control for each year of data. Each observation represents one record per state per one-year time period in which employment data were not suppressed by the U.S. Bureau of Labor Statistics: 259 records for the "All Automotive" models and 464 for the "Parts" models. Vermont was excluded due to suppression of data or zero employment in all time periods.
Source: IBRC, using data from the U.S. Bureau of Labor Statistics, U.S. Bureau of Economic Analysis, Moody's Economy.com, U.S. Census Bureau, U.S. Bureau of Transportation Statistics, and Securities and Exchange Commission (SEC) filings.

> *Results suggest that, despite global manufacturer-supplier relationships, the performance of U.S. automakers—particularly General Motors and Ford—does result in higher levels of employment in the U.S. automotive parts manufacturing sub-sector.*

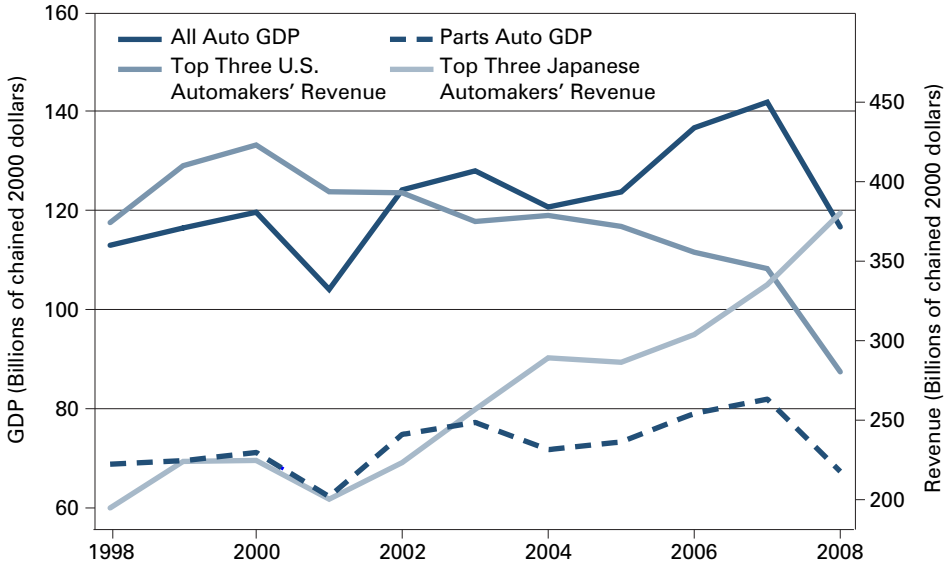
with parts employment. The only U.S. carmaker for which there was a negative relationship between revenues and employment relative to other carmakers, was the impact of Chrysler's annual growth on automotive parts employment.[13]

Which Automakers Impact GDP Growth?

Due to the volatile nature of automotive manufacturing GDP, **Figure 7** reveals no obvious trends that we can attribute to the revenues of major U.S. or Japanese automakers. Only through 2001 do we see some similarity in the patterns of GDP and the Detroit Three's revenue, but then GDP seems to increase as these carmakers' revenue declines through 2007 before matching the precipitous drop between 2007 and 2008. Japanese carmakers' revenues also seem to mirror GDP for the first four years of this period but then largely increase through 2008 regardless of changes of GDP in the following six years.

The regression models in **Table 2** confirm that there is little evidence of a direct relationship between most top six carmakers' revenue growth and GDP growth in the automotive manufacturing industry—with General Motors being the major exception. Beyond the expected though small negative impact of the previous year's GDP on current GDP growth,[14] the only other significant impact observed was that a 1 percent increase in General Motors' revenue was associated with a 1.6 percent increase in GDP, holding all other factors constant.[15] This substantial and positive relationship was observed not only for the automotive manufacturing industry as a whole but also for the automotive parts sub-sector.

■ **Figure 7: Revenue of the Top 6 Automakers, Compared to U.S. New Auto Sales**



Notes: Employment data is for the 48 contiguious states and some employment is suppressed due to non-disclosure requirements. Auto refers to the sum of NAICS 3361, 3362, and 3363. Parts refers only to NAICS 3363.
Source: IBRC, using data from the U.S. Bureau of Economic Analysis, Moody's Economy.com, the U.S. Securities and Exchange Commission (SEC) EDGAR database, and SEC filings data obtained from LexisNexis Academic, Hoovers, Forbes, and automaker corporate websites.

Understanding Carmaker Performance and State Employment and GDP Growth Trends

This article sheds light on the relationship between carmaker performance and employment and economic trends within the contiguous United States for the highly discussed automotive manufacturing industry. Results suggest that, despite global manufacturer-supplier relationships, the performance of U.S. automakers—particularly General Motors and Ford—does result in higher levels of employment in the U.S. automotive parts manufacturing sub-sector. Additionally, the financial performance of General Motors—long the largest of American carmakers—has a strong effect on state automotive manufacturing GDP growth indicating that the company maintains strong ties within the U.S. economy.

Despite the relatively short time period of this study, these findings do provide some insight into understanding the consequences of carmakers' performance on key factors of economic health in this industry. For starters, it would appear that government efforts to assist the major U.S. automakers—all of which

have recently experienced economic turmoil—could lead to desired effects of increasing state automotive manufacturing employment. In particular, if General Motors were to improve their revenues, there could also be increases in state automotive manufacturing GDP. We can also posit that, as Japanese automakers' revenues continue to improve relative to U.S. automakers, this would lead to lower levels of employment within this industry for the United States. However, it is important to stress that this is not the case for Toyota—despite tremendous growth in sales between 1998 and 2008, the company was not significantly likely to increase or decrease state employment or GDP.

Notes

1. The larger transportation equipment manufacturing classification includes the manufacture of rail, marine and air transport as well as motorcycles and military vehicles. See the official 2007 NAICS documentation at www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007.
2. Thomas Klier and James Rubenstein, *Who Really Made Your Car? Restructuring and Geographic Change in the Auto Industry* (Kalamazoo, Michigan: Upjohn Institute for Employment Research, 2008).
3. Ibid.

4 For more information, please see: Benjamin Collins, Thomas McDonald, and Jay A. Mousa, "The Rise and Decline of Auto Parts Manufacturing in the Midwest," *Monthly Labor Review* 130, no. 10 (2007): 14-20.

5. Ibid.
6. Japanese manufacturing firms report revenue in the Japanese Yen but use different conversion rates for evaluating dollar values. Therefore, an average annual spot rate for the fiscal year was used to compute dollar amounts. The ownership changes at GM and Chrysler may lead to some inconsistency in accounting methods.
7. Chrysler Group, LLC has recently conducted business under several names including Chrysler Corporation, Daimler Chrysler, and Daimler AG.
8. Kendra Marr, "Toyota Passes General Motors as World's Largest Carmaker," *Washington Post*, January 22, 2009.
9. This relationship is believed to be a lagged positive relationship with employment growth following GDP growth by an estimated one to three months. However, recent research by Sawtelle suggests that this relationship may not be significant (or even positive) for some industries once we control for other economic factors beyond the scope of this article (such as the employment cost index). For more information, please see Barbara Sawtelle, "Analyzing the Link between Real GDP and Employment: An Industry Sector Approach," *Business Economics* 42, no. 4 (2007): 46-54.
10. For more information, please see: Matt Kinghorn, "Population and Employment Change in Indiana" *InContext*, July-August 2009, www.incontext.indiana.edu/2009/jul-aug/article1.asp.
11. Tests proved that there was serial correlation within the panel data. A fixed-effects model was selected due to the larger number of observations (48 states) relative to time periods (t=10).
12. This puzzling result may indicate that other factors may be at play beyond the performance of the top six carmakers, such as revenues associated with other carmakers that are beyond the scope of this article.
13. While the reason behind this result is beyond the scope of this article, this finding suggests that where Chrysler may have had larger revenue growth relative to the other carmakers (this was generally not the case), any related increases in parts employment may have occurred outside of the United States.
14. We can interpret this to mean that a high level of GDP in the previous year slightly reduces the likelihood of achieving high levels of GDP growth the following year, holding all other factors constant.
15. The negative impact associated with Toyota revenues is only significant at the $p < 0.1$ level and may be largely influenced by the spike in Toyota revenues during the final 2007-2008 period.

TABLE 2: Impact of Automotive Characteristics on Percentage Annual Automotive Manufacturing GDP Growth in the Contiguous U.S. States, 1998-2008

Variables	All Automotive		Automotive Parts	
	Column 1	Column 2	Column 3	Column 4
New Car Sales, Annual Growth (%)	0.897**	-2.985+	0.926**	-2.961+
	(5.64)	(1.96)	(5.77)	(1.94)
All Automotive Manufacturing GDP in Previous Year	-0.004**	-0.004**		
	(3.87)	(3.87)		
Automotive Parts Manufacturing GDP in Previous Year			-0.007**	-0.007**
			(3.68)	(3.68)
General Motors Revenue, Annual Growth (%)		1.636**		1.639**
		(2.70)		(2.70)
Ford Revenue, Annual Growth (%)		0.606		0.609
		(0.70)		(0.71)
Chrysler Revenue, Annual Growth (%)		0.297		0.290
		(1.61)		(1.58)
Toyota Revenue, Annual Growth (%)		-1.225+		-1.212+
		(1.79)		(1.77)
Honda Revenue, Annual Growth (%)		0.728		0.715
		(1.08)		(1.05)
Nissan Revenue, Annual Growth (%)		0.299		0.301
		(1.51)		(1.51)
Constant	8.251*	20.998**	8.704*	21.343**
	(2.34)	(4.73)	(2.39)	(4.71)
R-Squared	0.18	0.18	0.18	0.18

+ Significant at 10 percent; * Significant at 5 percent; ** Significant at 1 percent

Notes: Coefficients are for fixed effects regression models with robust t statistics in parentheses. All models control for each year of data. Data represent 480 records: one per state per one-year time period.
Sources: IBRC, using data from the U.S. Bureau of Economic Analysis, Moody's Economy.com, U.S. Bureau of Transportation Statistics, and Securities and Exchange Commission (SEC) filings.