REGIONAL ECONOMIC ISSUES

The Midwest Economy: Quantifying Growth
and Diversification in the 1980's

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The decade of the 1980s has been a period of dynamic regional change within the U.S. economy. Early in the decade, the eastern and western coasts were thriving, while the Midwest was in sever recession.[1] By the end of the decade, the situation had virtually been reversed, with the Midwest emerging as one of the most stable and prosperous regional economies. In the process of rebuilding itself, the Midwest economy has undergone extensive structural change that has altered its historical relationship with the national economy. Over the decade, the region has become less sensitive to the growth trends of the nation, as well as less vulnerable to business cycle fluctuations. Part of the reason could be attributed to greater competitiveness among Midwest industries and to less dependence on mature, cyclically sensitive industries. Yet, the extent to which diversification of the Midwest economy has occur is limited and depends on which economic variable is being analyzed-- employment has shown much more erosion than output.

The purpose of this **Working Paper** is to examine the decade of the 1980s in the context of past employment, income, and output trends, in order to determine to what extent the economic trends have changed and how these changes may be affecting the structure of the Midwest economy.[2] While the underlying causes for the changing pattern are largely left to speculation, the document is intended to serve as a general reference to economic change in the Midwest. While emphasis is on comparative growth rates and elasticities before and after 1980 at a fairly detailed industry level, aggregate measures of economic change are calculated to provide a comprehensive view of economic change In all four major factors of change are covered in the sections below--interregional linkages, growth and cycle trends, structural change, and diversification.

Interregional Linkages

Regional economic growth rarely occurs in a vacuum. Either the impetus to growth must come from an expansion of the national economy (in which all

regions are able to share in some degree) or growth must come from the region's competitive strength that allows it to increase its share of the national economy at the expense of other regions. While it is beyond the scope of this paper to build a multi-equation structural model of the region's economy that would identify specific causes of the Midwest's growth, it is possible to gain useful insights into the growth process by analyzing the regions responsiveness to national growth.

How closely is the Midwest tied to the nation? How do national fluctuations effect the Midwest? We can answer these questions by comparing Midwest fluctuations in employment with national employment fluctuations. Our employment data is taken from the Bureau of Labor Statistics. As opposed to survey of the business establishments, this data is based upon household surveys. The employment data runs from 1956 through 1989. A clear picture develops by looking at total employment and the manufacturing and services sectors. Total employment is all non-agricultural employment. We define the service sector to include finance and real estate, transportation and public utilities, wholesale and retail trade, and services. Government is not included.

One method of making this comparison is to regress changes in the log of quarterly Midwest employment on changes in the log of national employment. When examining the data, it is apparent that there is a change in trends in 1974. For this reason we divide the data into two groups 1956-1973 and 1974-1989. (For equations, see Appendix B). This division is achieved by use of a dummy variable. This variable is set equal to 0 prior to 1974 and to 1 during and after 1974. The dummy is then multiplied by the change in national employment to create a second independent variable. Adding the regression model coefficient from this variable to the coefficient of the change in national employment yields a coefficient for the period from 1974 through 1989. While the coefficient on the change in national employment now yields the relationship for only the pre 1974 period. Thus, by this method we are able to differentiate the pre 1974 relationship from the later period.

Table 1 shows the results of this exercise. As one would expect, Midwest manufacturing is more closely tied to the nation than is services. This relationship holds for both periods. However, for both sectors, the relationship between national and regional fluctuations is weaker in the second period.

The relationship may differ from expansions to contractions. To test this hypothesis we separate the quarters of national growth in total employment

from those were employment decreased. However, now there are two variables to represent change in the national employment level. The first is for expansions. This variable is set equal to 0 when the change in the total U.S. employment level is negative and equal to the change in the log of U.S. employment when the change is positive. The second variable, for contractions, works in a similar manner. When the change is positive, this variable is set equal to 0 otherwise it is equal to the change. To accommodate the structural break two additional variables are needed. The dummy variable is multiplied by each of the two variables representing change.

The results from this experiment are in Table 2. Over the entire 1956-1989 period we find that fluctuations in Midwest manufacturing employment is slightly more correlated with national fluctuations during contractions. Services show a different relationship. Not only is the Midwest service sector employment more closely correlated with the nation during expansions but there is no clear correlation during contractions. For both the early and later time periods these results hold true.

Trends and Cycles

Because of business cycles, growth rates can be misleading. If the dates from which the growth rates are calculated are at different points of the business cycle, the growth rate can over or under estimate the actual trend. So being able to compensate for business cycles is important to understanding long term growth. What is the source of the Midwest's cyclical volatility? As one might expect, much of the nation's volatility comes from its manufacturing sector. With a higher concentration in manufacturing than the nation on average, one would expect that the Midwest would be at least as sensitive to the business cycle as the nation. In fact, the Midwest's industrial structure has given it a greater sensitivity to business cycles, but not simply because of its manufacturing base.

To compensate for the business cycles we separately regress employment and output for an industry not only on time but also on the GNP gap. The GNP gap is the difference in the log of GNP and the log of potential GNP. When the economy is strong the GNP gap is positive. When the economy is weak, in a state of decline, the GNP gap is negative. The coefficient on time can then be interpreted as the trend growth rate, while the coefficient of the GNP gap tells us the percent change in employment or output that can be expected

given a one percentage point change in the GNP gap. We use industry data at both the one and two digit SIC level. (For list of SIC codes, see Appendix A.)

From 1956 through 1989 employment has been growing more slowly in the Midwest than the nation (Table 3). While no Midwest industry had an absolute loss of employment during this period, the manufacturing sector had no growth. Deindustrialization is a decrease in manufacturing share of total employment. Since 1974 both the Midwest and the nation have been deindustrializing . During this deindustrialization Midwest manufacturing had an absolute loss in employment. For the periods 1956-1974 and 1974-1989 no other industry either in the Midwest or nation had an absolute loss in employment.

Given manufacturing dominance of the Midwest economy and the deindustrialization of the nation, it is not surprising that Midwest manufacturing performed so poorly. What is surprising is that, in terms of employment, between 1956 and 1989 every sector, at the one digit level of the economy grew faster at the national level than in the Midwest (Table 4). During the 1956-1974 period only Midwest mining and services were growing more quickly than their national counterparts. But since 1974, every sector has underperformed the national standard. Across both periods, the services, FIRE, and trade have been the fastest growing sectors while the goods producing sectors have lagged.

In terms of economic cycles, for the pre 1974 period, manufacturing reacted the most to fluctuations in the economy. While the services either were not effected by fluctuations or were counter cyclical. During the post 1974 period, in both the Midwest and the nation, construction became the most cyclical sector, although manufacturing was not far behind. And no sector was counter cyclical.

However, employment may not be the best method for examining industrial competitiveness and growth. As labor productivity increases, through technological change or substitution of capital for labor, employment may decrease while income or output actually increase. Therefore, examining output may give a clearer picture of the economy. BEA gross state product (GSP) data is used as a measure of output. GSP data are similar to value added. These two measurement differ in that central administrative offices, i.e. headquarters, research and development laboratories, data processing facilities, are allocated to the state where they are located, rather than the state were production takes place. Also, purchased services are removed.[3] GSP

data are only available from 1963 through 1986. The change in time periods should not have a qualitative effect on the results. When we examine the trends of the cyclically adjusted model we find essentially the same results as with employment (Table 5). For both the 1963-74 and 1974-1986 periods, every industry's cyclically adjusted growth in output is lower than the nation's. For both the nation and the region, manufacturing and construction are by far the most cyclically sensitive sectors.

Does the aggregation of industries hide trends in smaller industries that are different than the larger pattern? At the two digit SIC level some of the Midwest industries fair better. Although when looking at the employment model, we find that no sectors in the Midwest grew more quickly then in the nation (Table 6), when looking at output we find that between 1963 and 1974, six of the 21 manufacturing sectors in the Midwest outperform the national industry (Table 7). Three of these sectors are durable goods and three are nondurables. Other Midwest industries that did well in the early period were non-bank financial institutions, health services and the small sectors of motion pictures and miscellaneous repairs. However, these successful industries are few and far between. The one highlight is that three of the Midwest's large manufacturing industries, food processing, chemicals, and primary metals all grew faster than the industry at the national level. During the more recent 1974-1986 period, the Midwest industries do not perform any better. The non-bank financial institutions still remain strong and air transportation and coal mining are now growing more quickly than the nation. However, there are now only three manufacturing sectors that are outperforming the nation and they each represent only a small share of Midwest manufacturing output. These industries are textile mills, apparel and lumber products. Only two of the over fifty industrial sectors grew more quickly in the Midwest than in the nation during both time periods; lumber and wood products and non-bank credit agencies. Not a great showing.

Not only are the highly cyclical industries concentrated in the Midwest but those in the Midwest are significantly more cyclical than the same industry in the U.S. For almost all durable goods sectors, a one percentage point change in the GNP gap will cause over a 1.5% change in the employment level for the Midwest in that sector. What is even more striking is the difference between the Midwest and the nation. For example, SIC 34, metal fabricating, has a GNP gap coefficient in the Midwest model of 1.86, while the national model has a coefficient of only 1.27, a difference of over half a percentage point. Or in other words, the Midwest has fifty percent more change in employment levels, for the fabricated metals industry, due to fluctuations in the national

economy, than does the same industry at the national level. The output version of the cyclical model yields many of the same results. Of the 53 GSP sector models, thirty have coefficients for the GNP gap variable for both the Midwest and nation that are significantly different from zero. Of these thirty, the Midwest has larger coefficients in twenty seven of the sector. Across the board, in nondurable goods, durable goods, transportation and utilities, and business services, the Midwest shows significantly more responsiveness to the GNP gap than does the U.S.

Structural Change

As some industries grow quickly, their share of the economy increases. This shifting of industrial importance is known as structural change. One quantative method describes this change by looking at the change in each industry's share of the economy. Our structural change index is the sum of the absolute changes of each industry's share of the total economy (see Appendix B for the forumla used to construct this index).

On comparing the Midwest with the nation, it is apparent that both areas have similar rates and patterns of structural change (Chart 1). However, when the states are examined, a different view emerges (Chart 2 and Table 8). At points, Iowa shows a cumulative change almost twice that of some other Midwest states. Also, Iowa and Michigan show a tremendous amount of fluctuation. Often moving away from and then returning to early structures. What sectors of the economy are causing these changes?

Structural change in the national economy was due to the shrinking, relative to total output, in the oil and gas extraction, primary metals, and railroad sectors and expanding machinery, real estate services, business services, and health care service sectors (Table 9). The Midwest was similar in that it was also driven by a shrinking primary metals and railroad sectors and an expanding non-electrical machinery, real estate services, business services, and health service sectors. The differences lie in that the oil and gas extraction and electric and electronic machinery sectors showed almost no change relative to the Midwest economy. Also, unlike the national chemical industry, the expanding Midwest chemical industry changed the industrial structure of the region.

Except for oil and gas extraction, Illinois' structural change was driven by the same industries as the Midwest. Iowa was also similar to the Midwest except

Chart 1

Index of structural change

index
0.25

0.20

0.15

0.10

0.05

0.00

U.S.

Midwest

1964 '66   '68   '70   '72   '74   '76   '78   '80   '82   '84   '86
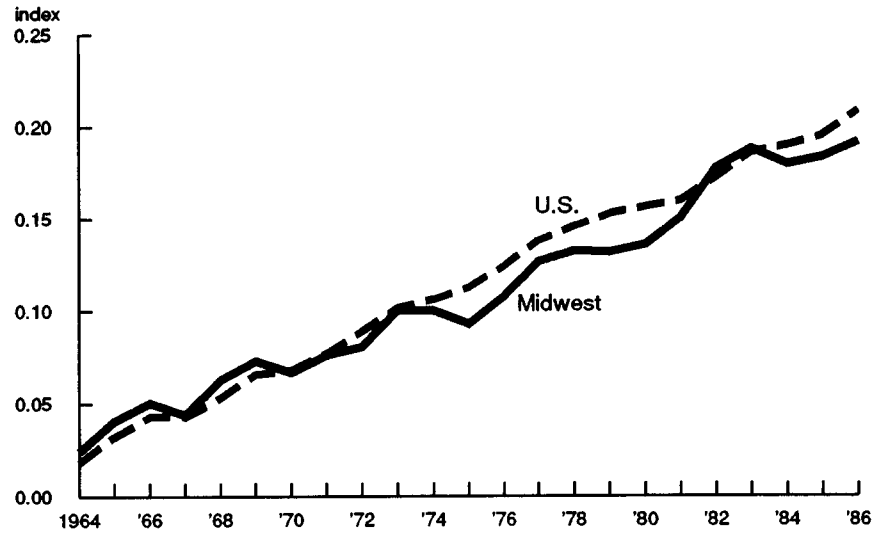
Chart 2

Index of structural change by state

index
0.30

0.25

0.20

0.15

0.10

0.05

0.00

IA

IL

OH

IN

MI

WI

1964 '66   '68   '70   '72   '74   '76   '78   '80   '82   '84   '86
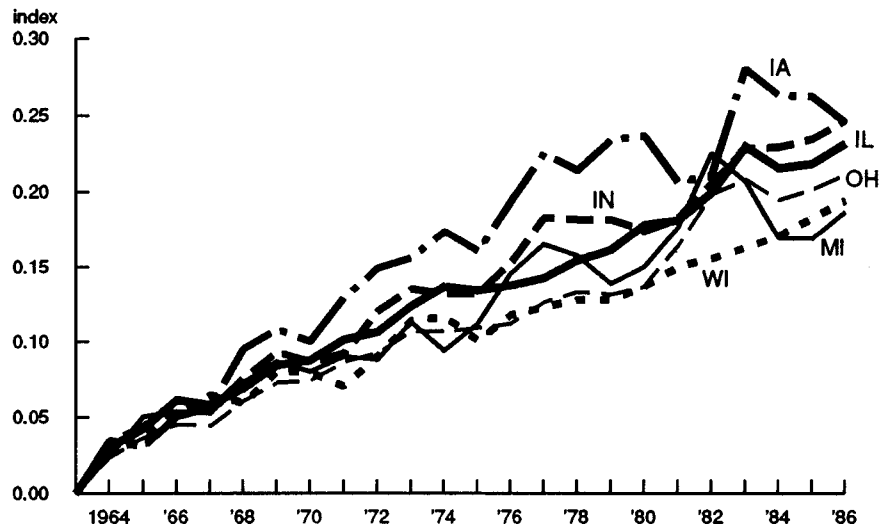
that a shrinking agriculture sector and expanding banking sector drove much of its structural change and the primary metals sector had little effect. Also, like the entire economy, the nonelectrical machinery sector expanded but at a much faster rate, accounting for over 20% of the structural change. Wisconsin was also like the Midwest, except that the chemical industry and primary metals played little role and paper products grew substantially while transportation equipment declined relative to the economy. Except for the expansion of the transportation sector, Ohio had the same change as the Midwest. Except for the declining auto and associated fabricated metals sectors, Michigan also followed the Midwest pattern of structural change. Finally, there is Indiana. The real estate sector was the cause of little structural change. More like the nation than pothe Midwest, agriculture decreased its share of output and the associated food processing industry declined even more rapidly. Also more like the nation than the Midwest, was the expansion of electric machinery in Indiana.

Diversification

All of these patterns of structural change have at least one major characteristic in common. Both the Midwest and each state in the Midwest are becoming more like the nation as a whole. The only exception is Wisconsin which has remained relatively unchanged compared to the nation. The process of the industrial structure becoming more like the nation is known as diversification. Assuming the national economy is in perfect balance, a perfectly diversified regional economy should have the same structure as the nation. Of course, because of local competitive advantages, stage of development of the local economy, and other factors that are unique to a sub-national economy, no regional economy is likely to have the same exact structure as the nation. Nevertheless, the industrial structure of the nation represents a standard of diversity and, therefore, is used here to derive a quantitative measure of a region's diversification.

To that end, an index of diversification is constructed by summing up the absolute difference between output share of each industry in the region and the nation (see Appendix B). A tool that is often used in conjunction with diversification measures is the location quotient. The location quotient is a measure of industrial concentration. It is derived by dividing the industry's share of the regional economy by the industry's share of the national economy (see Appendix B). If the location quotient is one, then the region has the same industry intensity as the nation. If the location quotient is greater than one

then the industry is concentrated in the region, its share of the regional economy is greater than the industry's share of the national economy (location quotients and industry shares of the national economy are reported in Appendix C). The Midwest showed no tendency to become more like the national economy until the recession of the early eighties (Chart 3). At this time rapid loss of the manufacturing sector caused the Midwest's economy to take on a structure more like the nation. This same pattern holds for the heavily industrialized states of Michigan, Indiana, and Ohio (Chart 4). Illinois and Iowa have had slow but steady diversification and Wisconsin contrasts the pattern, showing dediversification during the eighties (Chart 5).

Which industries are driving the diversification?. As a share of output, all of the Midwest states have small oil and gas extraction industries. As the oil and gas extraction industry's share of the nation's output declined, the Midwest states became more like the nation. Thus except for Illinois, the oil and gas sector contributed a large share of the Midwest states' move towards an economy more like the nation's. This change is unusual in that it was due more to changes in the national economic structure than to reallocation of resources within the region. Another unusual industry is SIC 33, primary metals. Between 1969 and 1986, relative to the nation, every state in the Midwest became more concentrated in primary metals. However, because this industry more than halved its share of total output, this industry actually caused the diversification index of each state to decrease. As would be expected, due to the historically high concentration of the machinery industry in the Midwest, the electrical and nonelectrical machinery sectors, overall, were major contributors towards the diversification of the Midwest (Table 10).

No one sector dominated Illinois's diversification. The two most important sectors were SIC 35, non electrical machinery, and SIC 36, electrical and electronic machinery. Two industries that countered the diversification were SIC 28, the chemical industry and SIC 62, security and commodity services.

In Michigan the diversification can be attributed to the dominant auto industry and its suppliers. As the auto industry's share of Michigan's economic output decreased it brought down its suppliers; metal fabricating, and non electrical machinery. Unfortunately, Michigan was unable to jump on the silicon band wagon. As SIC 36 doubled its share of the national economy, Michigan's electronic machinery sector grew, but not as fast. So this sector pushed the Michigan economy away from the national norm.

Chart 3

Diversification index for the the Midwest
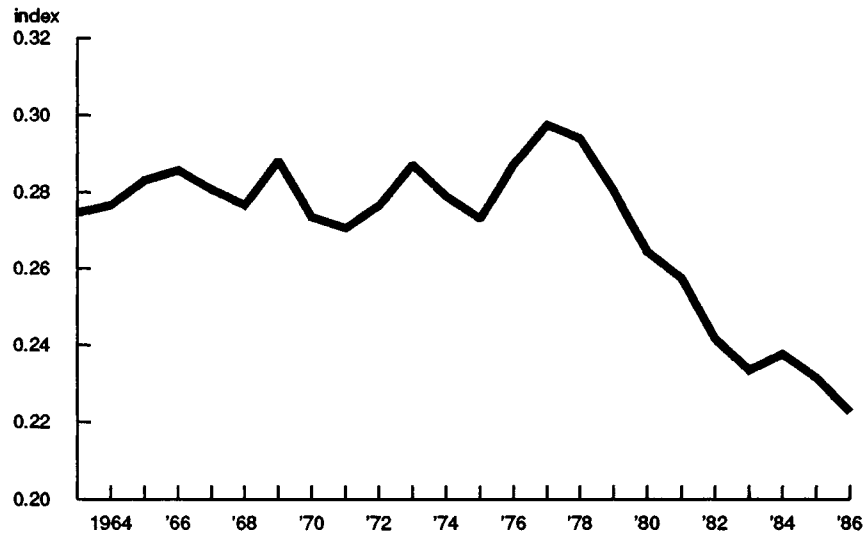
index

Chart 4

Diversification indexes by state
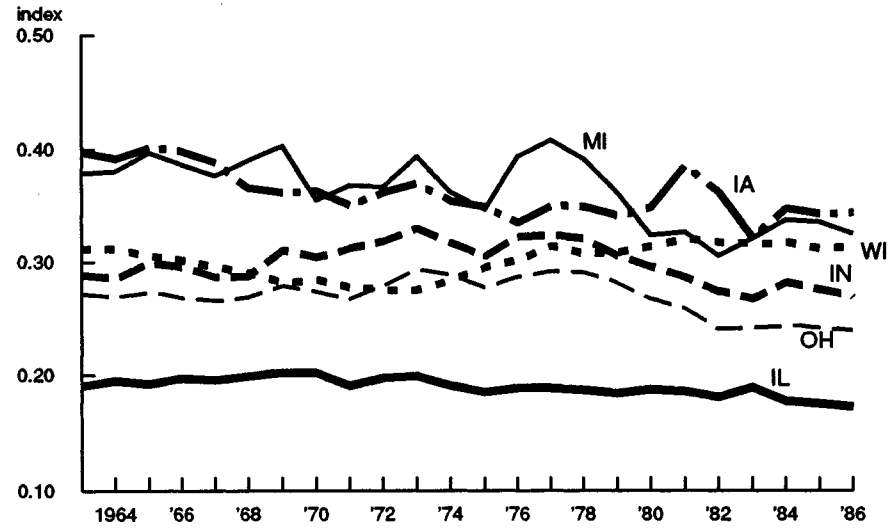
index

Chart 5

Change in diversification indexes by state

change, 1963-1986
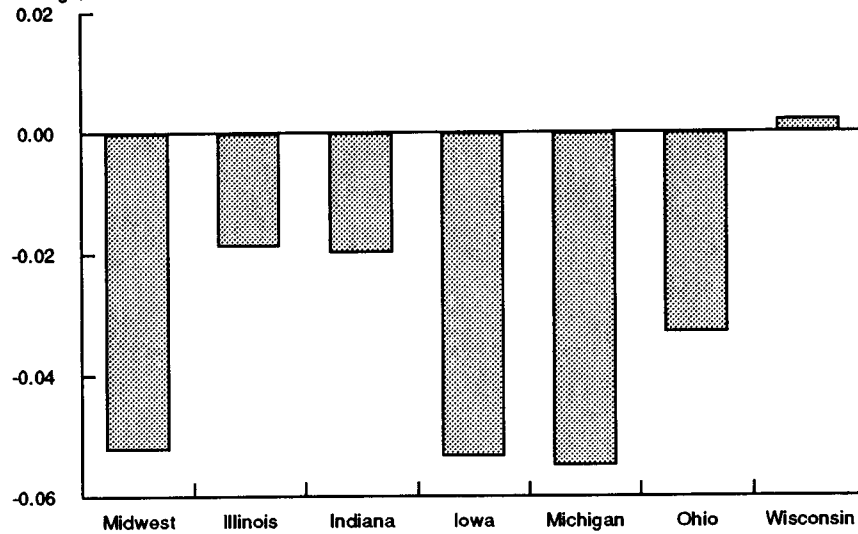
Indiana's economy, following the Midwest pattern, moved towards the national norm in oil and gas extraction and primary metals. No other industry dominated the picture. Food processing, SIC 20, had a large shift from a location quotient of 1.46, a concentration almost fifty percent higher than the nation to a location quotient of 1.09, or a concentration nine percent higher than the nation. But this shift was countered by the chemical industry, SIC 28, whose location quotient went from 1.26 to 1.60, and trucking and warehousing, SIC 42, which increased its location quotient from 1.30 to 1.75. Also, countering the diversification was real estate services. However, this change was due to the industry growing in the nation, while its share of the Indiana economy remained almost unchanged.

Like Indiana, much of the diversification of the Ohio economy was due to fuel extraction and primary metals. Leading the move away from the national economy was the auto industry. While the auto industry maintained a constant share of the national economy, it grew in Ohio. Transportation equipment, SIC 37, had its location quotient in Ohio grow from 1.88 to 2.66.

Along with oil and gas extraction, non electrical machinery and real estate services dominated Iowa's diversification. In 1963, real estate services accounted for 3.4 percent more of Iowa's economy than that of the nation's. By 1986 the difference was only 0.3 percent and in the other direction. This move towards the national economy was countered by the nonelectrical machinery sector. As the sectors share of the nation's economy doubled, the already concentrated industry's share of the Iowa economy increased by over 120 percent. Further concentrating the sector in Iowa.

With a slightly increasing diversification index, Wisconsin is the state that goes against the Midwest trend. A large shift towards the national norm in transportation equipment was overwhelmed by the rapidly expanding paper and products sector, SIC 26. In 1963, with a location quotient of 3.57, Wisconsin was highly concentrated in paper products. As paper products increased its share of the national economy, it grew even faster in Wisconsin, slowing the diversification process. Nonelectrical machinery is an industry that is concentrated in Wisconsin. Between 1963 and 1986 Wisconsin's machinery sector grew more slowly then the nation's. So the industry became less concentrated. Normally this change would be considered diversification. But because this was a rapidly growing industry, the diversification index, which looks at differences in the share of the economy, actually increased due to this change. It is situations like this that show the importance of using these indicators in combination, rather than individually.

Concluding Remarks

Economic change in a region is a complex process that often defies conventional wisdom. The Midwest has undergone dramatic change over the last twenty years, but remains a predominantly manufacturing-based economy. Diversification, when measured by output, is far less extensive than suggested by the employment changes that have occurred in the region. Yet the impact of that diversification on growth and cyclical sensitivity has been significant. Policy makers and analysts must be aware of the nature of economic changes in the Midwest if their analysis and decisions are to reflect the real impact of regional change on the growth potential of the region. To that end, we hope that the charts and tables contained in this document will serve as a reference for those who want to have a better understanding of the direction that Midwestern states have been taking in recent years.

Footnotes

[1]The Midwest is defined as the Great Lakes states (Illinois, Indiana, Michigan, Ohio, and Wisconsin), and Iowa.

[2]For more discussion of these issues see "Interregional Competitiveness and Diversification", by Schnorbus and Weiss, in *The Great Lakes Economy: Looking north and South*, Federal Reserve Bank of Chicago and the Great Lakes Commission.

[3]For more information, see Testa and Weiss, "Calibrating Manufacturing Decline in the Midwest: Value Added, Gross State Product, and All Points Between."

Table 1

Interregional model with structural break--employment

Sector	Intercept	Change 1956-73	Dummy	Change 1974-89	R^2
Total	-0.0042	1.456	-0.181	1.275	.85
Manufacturing	-0.0024	1.398	-0.109*	1.289	.89
Services	-0.0014*	1.166	-0.219*	0.947	.29

Services defined as: fire + tpu + trade + services.

*Not significant at 5% confidence level.

Table 2

Interregional model with expansion and contraction--employment

Sector	Intercept	Expansion	Contraction	R^2
Total	-0.0036	1.281	1.456	0.84
Manufacturing	-0.0020	1.276	1.349	0.89
Services	-0.0010*	0.995	0.388*	0.26

Services defined as: fire + trade + service + tpu.

*Not significant at 5% confidence level.

Interregional model with expansion and contraction--employment with structural break

Sector	Intercept	Expansion 1956-73	Contraction 1956-73	Expansion 1974-89	Contraction 1974-89	R^2
Total	-0.0032	1.34	2.32	1.16	1.44	0.85
Manufacturing	-0.0019	1.34	1.55	1.22	1.33	0.88
Services	-0.0012*	1.15	0.50*	0.94	0.48*	0.28

Services defined as: fire + trade + service + tpu.

*Not significant at 5% confidence level.

Table 3

Trend and cycle model by sector--employment

<u>Midwest</u>

Sector	Intercept	Time	GNP Gap	R^2
Mining	3.51	0.0094*	0.94*	.04
Construction	5.54	0.0117	1.09	.22
Manufacturing	8.75	-0.0040*	1.28	.50
FIRE	4.56	0.0276	0.04*	.89
Services	4.73	0.0389	0.12	.92
TPU	6.40	0.0049	0.48	.29
Trade	6.38	0.0233	0.39	.72
Total	8.42	0.0163	0.57	.63

<u>United States</u>

Sector	Intercept	Time	GNP Gap	R^2
Mining	6.05	0.0068*	0.83	.05
Consturction	6.73	0.0200	1.01	.56
Manufacturing	9.51	0.0041*	0.88	.46
FIRE	5.78	0.0341	0.09	.95
Services	6.17	0.0448	0.14	.98
TPU	7.43	0.0134	0.35	.64
Trade	7.50	0.0296	0.31	.91
Total	9.41	0.0243	0.39	.85

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*Not significant at 5% confidence level.

Table 4

Trend and cycle model with structural break--employment

<u>Midwest</u>

Sector	Intercept 1956-73	Time 1956-73	GNP Gap 1956-73	Intercept 1974-89	Time 1974-89	GNP Gap 1974-89	R^2
Mining	2.20	0.029	-0.98*	5.25	-0.011*	0.91	.28
Construction	4.55	0.027	0.57*	6.66	-0.002*	1.42	.29
Manufacturing	7.61	0.013	1.29	9.92	-0.018	1.39	.67
FIRE	4.38	0.030	-0.11*	4.72	0.026	0.12	.93
Service	2.99	0.066	-1.41	5.41	0.033	0.43	.99
TPU	6.02	0.011	0.30*	6.81	-0.000*	0.64	.44
Trade	5.86	0.031	0.23	6.89	0.017	0.47	.86
Total	7.80	0.026	0.51	9.11	0.008	0.66	.79

<u>United States</u>

Sector	Intercept 1956-73	Time 1956-73	GNP Gap 1956-73	Intercept 1974-89	Time 1974-89	GNP Gap 1974-89	R^2
Mining	5.88	0.009*	0.65*	6.40*	0.003*	0.99	.63
Construction	6.26	0.027	0.14*	7.25	0.014	1.51	.68
Manufacturing	8.75	0.016	0.74	10.24	-0.004*	0.98	.55
FIRE	5.71	0.035	-0.09*	5.85	0.033	0.18	.96
Service	6.23	0.044	0.04*	6.13	0.045	0.19	.98
TPU	7.19	0.017	0.17*	7.67	0.011	0.47	.76
Trade	7.21	0.034	0.16	7.74	0.027	0.39	.98
Total	9.06	0.030	0.27	9.78	0.020	0.47	.94

*Not significant at the 5% level

Table 5

Trend and cycle model with structural break--output

<u>Midwest</u>

Sector	Intercept 1963-73	Time 1963-73	GNP Gap	Intercept 1974-86	Time 1974-86	R^2
Total	10.95	0.031	1.57	12.42	0.011	.98
Mining	9.79	-0.016	0.30*	8.32	0.004*	.65
Construction	11.60	-0.017*	2.96	13.01	-0.035*	.88
Manufacturing	9.34	0.037	3.07	11.60	0.007	.94
FIRE	9.01	0.030	0.46	9.47	0.023	.98
Service	8.26	0.038	0.85	9.01	0.028	.99
TPU	7.41	0.047	1.29	10.47	0.006	.99
Trade	8.57	0.039	1.16	10.14	0.017	.95

<u>United States</u>

Sector	Intercept 1963-73	Time 1963-73	GNP Gap	Intercept 1974-86	Time 1974-86	R^2
Total	12.20	0.035	0.99	12.97	0.025	.99
Mining	9.79	0.028	0.32*	12.24	-0.006*	.58
Construction	12.66	-0.009	2.16	12.09	-0.001*	.91
Manufacturing	10.42	0.039	2.19	11.40	0.026	.99
FIRE	9.55	0.045	0.41	10.69	0.029	.99
Service	9.57	0.043	0.52	9.75	0.041	.99
TPU	8.63	0.051	0.90	10.69	0.024	.99
Trade	9.71	0.045	0.91	10.54	0.033	.98

*Not significant at the 5% level of confidence

Table 6

Trend and cycle model by industry--employment

<u>Midwest</u>

Industry*	Intercept	Time	GNP Gap	R^2
20	6.94	-0.013	0.27	.50
22	4.38	-0.025	1.18	.23
23	6.16	-0.023	1.52	.76
24	4.12	0.004*	2.19	.62
25	4.62	-0.001*	1.59	.50
26	5.57	-0.006	0.91	.54
27	4.97	0.008	0.23	.15
28	5.31	0.001*	0.29	.16
29	5.84	-0.038	0.22*	.27
30	5.05	0.005	1.98	.56
31	7.09	-0.051	0.62	.93
32	6.80	-0.022	1.37	.62
33	8.51	-0.032	1.75	.47
34	7.67	-0.017	1.86	.65
35	7.69	-0.014*	1.27	.25
36	8.09	-0.024	1.53	.69
37	7.56	-0.013	1.95	.46
38	4.22	0.006*	1.01	.38
39	5.36	-0.016	0.86	.23
40	8.74	-0.054	0.57	.52
48	5.47	-0.003*	-0.02*	.02
49	4.46	0.007	0.04*	.14
50	5.65	0.015	0.41	.56
52	6.35	0.020	0.49	.73
53	6.04	-0.003*	0.54	.22
60	3.55	0.021	0.00*	.35
80	3.59	0.038	-0.08*	.79

Table 6 (cont'd)

<u>United States</u>

Industry*	Intercept	Time	GNP Gap	R^2
20	7.81	-0.005	0.26	.32
21	5.75	-0.019	-0.16*	.41
22	8.59	-0.023	1.23	.78
23	8.47	-0.017	1.07	.62
24	6.64	-0.001*	2.17	.65
25	5.95	0.003*	1.71	.62
26	6.64	-0.001*	0.72	.43
27	5.42	0.022	0.30	.72
28	6.74	0.003*	0.34	.21
29	6.08	-0.010	-0.30*	.08
30	5.46	0.014	1.57	.65
31	9.11	-0.047	0.87	.50
32	7.33	-0.011	1.22	.59
33	9.13	-0.028	1.33	.34
34	7.88	-0.007*	1.27	.50
35	7.15	0.006*	0.83	.19
36	7.03	0.007*	1.06	.39
37	7.16	0.005	1.57	.63
38	4.58	0.023	0.50	.41
39	6.90	-0.011	1.09	.50
40	9.44	-0.042	0.67	.44
48	6.44	0.009	-0.17*	.11
49	5.22	0.018	0.03*	.67
50	5.88	0.026	0.45	.70
52	4.52	0.024	0.89	.86
53	7.23	0.006	0.66	.60
60	4.92	0.029	-0.01*	.63
80	4.72	0.047	-0.08*	.94

NOTE: SIC 22 does not include IA, IN. SIC 23: IN, SIC 24: IA. SIC 25: IA. SIC 29: IA, OH, WI.SIC 31: IA, IN. SIC 38: IA. SIC 39: IA, OH.
*For industry list see appendix.

Table 7

Trend and cycle model with structural breaks by industry--output

Midwest

Industry	Intercept 1963-73	Time 1963-73	GNP Gap	Intercept 1974-86	Time 1974-86	R^2
01	9.19	0.006*	0.72*	9.32	0.005*	.28
07	6.30	0.014	-0.39*	3.99	0.042	.96
10	4.95	0.009*	5.67	14.36	-0.114	.84
12	5.78	0.025	0.43*	4.86	0.035	.92
13	11.16	-0.046	0.26*	7.51	0.004*	.47
14	4.62	0.031	2.81	10.44	-0.048	.92
20	7.04	0.034	-0.13*	8.47	0.013	.79
21	2.46*	0.024*	-1.56*	15.86	-0.153	.26
22	4.70	0.017*	0.83*	3.42	0.033	.61
23	4.82	0.034	2.49	6.08	0.017	.83
24	4.11	0.050	2.13	6.62	0.014	.82
25	5.62	0.028	2.91	6.61	0.015	.91
26	5.46	0.042	1.65	6.91	0.022	.90
27	7.24	0.025	1.11	9.03	0.000*	.94
28	3.80	0.074	1.12	6.78	0.032	.97
29	5.73	0.037	1.25*	9.71	-0.016*	.48
30	5.08	0.049	2.78	7.08	0.021	.91
31	7.49	-0.012	0.53*	8.97	-0.032	.90
32	6.83	0.024	2.20	9.70	-0.015	.72
33	8.15	0.025	4.25	13.53	-0.047	.89
34	7.71	0.030	3.32	9.45	0.005*	.90
35	7.90	0.030	3.89	8.23	0.027	.81
36	5.56	0.053	3.35	7.79	0.022	.94
371	6.11	0.056	4.96	10.80	-0.007*	.66
379	6.83	0.022	3.12	8.19	0.004	.60
38	5.19	0.034	2.64	6.14	0.022	.78
39	5.43	0.032	1.93	7.71	0.002*	.55
40	8.13	0.010*	3.13	13.94	-0.066	.79
41	9.33	-0.031	1.39	8.93	-0.026	.94
42	5.15	0.057	2.62	9.46	-0.000*	.93
44	5.21	0.012*	1.47	6.66	-0.007*	.29
45	1.68	0.082	3.29	6.31	0.019	.91
46	1.45*	0.070	0.86*	9.44	-0.040	.68

Table 7 (cont'd)

Industry	Intercept 1963-73	Time 1963-73	GNP Gap	Intercept 1974-86	Time 1974-86	R^2
47	5.76	0.010*	1.41	2.28	0.059	.98
60	5.59	0.048	-0.12*	8.95	0.002*	.80
61	3.75	0.041	-1.10*	1.03	0.075	.96
62	3.78	0.049	0.22*	2.01	0.072	.89
63	5.62	0.039	0.45*	7.04	0.020	.93
64	6.34	0.023	0.64	7.65	0.006*	.85
65	9.00	0.025	0.58	9.07	0.025	.96
70	6.07	0.025	1.53	9.89	-0.026	.87
72	8.00	0.007*	1.26	8.94	-0.007*	.66
73	5.64	0.047	1.41	4.76	0.060	.96
75	3.92	0.058	1.76	6.79	0.020	.97
76	5.52	0.022	0.86	6.20	0.014	.99
78	3.38	0.039	0.81*	7.41	-0.015*	.47
79	6.36	0.015	0.51*	6.17	0.019*	.89
80	5.43	0.061	0.05*	7.46	0.034	.97
81	6.98	0.020	0.93	7.59	0.012	.96
82	4.97	0.040	0.02*	6.85	0.014	.87
83	6.53	0.027	0.42*	7.21	0.018*	.93
84	4.27	0.058	2.00	5.96	0.036	.95
88	11.21	-0.056	0.79	7.82	-0.011*	.87

Table 7 (cont'd)

<u>United States</u>

Industry	Intercept 1963-73	Time 1963-73	GNP Gap	Intercept 1974-86	Time 1974-86	R^2
01	10.65	0.005*	-0.70*	9.35	0.022	.70
07	7.68	0.019	0.74	5.38	0.050	.96
10	6.79	0.019*	2.09*	11.50	-0.043	.61
12	7.92	0.019	0.22*	7.10	0.030	.96
13	9.58	0.029	0.22*	12.41	-0.010*	.51
14	5.91	0.035	1.91	7.73	0.010	.96
20	8.46	0.032	-0.13*	8.81	0.026	.96
21	7.40	0.024	-0.12*	10.98	-0.024	.36
22	6.17	0.045	1.37	7.22	0.030	.84
23	6.91	0.039	1.47	8.78	0.013	.84
24	6.48	0.045	2.39	8.91	0.012	.94
25	5.84	0.044	2.70	7.36	0.024	.94
26	6.33	0.051	1.47	8.10	0.026	.94
27	8.42	0.027	0.89	8.66	0.023	.99
28	5.61	0.069	0.99*	8.25	0.033	.96
29	7.81	0.032	0.61*	10.30	-0.002*	.67
30	4.98	0.065	2.06	6.73	0.040	.98
31	8.66	-0.003*	1.21*	10.79	-0.031	.74
32	7.71	0.030	2.22	9.50	0.006*	.80
33	9.40	0.019	3.95	14.05	-0.042	.84
34	7.71	0.042	2.67	9.76	0.014	.97
35	7.91	0.042	3.02	6.58	0.061	.89
36	6.02	0.063	2.80	5.88	0.064	.99
371	6.13	0.061	4.87	10.04	0.008*	.66
379	10.76	-0.005*	2.14	8.77	0.022	.47
38	5.08	0.062	2.16	6.11	0.049	.99
39	6.01	0.046	1.94	8.26	0.015*	.74
40	9.93	0.004*	2.65	12.91	-0.035	.87
41	10.70	-0.024	0.96	10.05	-0.015	.83
42	6.23	0.062	2.11	10.32	0.007*	.96
44	7.14	0.023	1.06	8.37	0.007*	.70
45	2.94	0.094	2.45	8.52	0.018	.94
46	3.28	0.070	0.75	7.73	0.010	.96
47	6.61	0.024	1.10	3.61	0.066	.99

Table 7 (cont'd)

Industry	Intercept 1963-73	Time 1963-73	GNP Gap	Intercept 1974-86	Time 1974-86	R^2
60	7.10	0.049	-0.13*	8.66	0.028	.98
61	6.26	0.027	0.89	4.22	0.055	.98
62	5.55	0.053	0.46*	4.52	0.066	.90
63	7.30	0.038	0.32*	7.73	0.032	.98
64	7.48	0.029	0.63	8.00	0.023	.88
65	9.20	0.045	0.49	10.54	0.027	.99
70	6.99	0.039	1.00	8.84	0.014	.98
72	9.29	0.010*	0.79	9.34	0.009*	.46
73	6.42	0.061	1.02	6.06	0.066	.98
75	5.27	0.062	1.40	7.23	0.036	.98
76	7.28	0.020	0.27*	6.57	0.031	.98
78	5.79	0.038	1.09*	7.21	0.019	.90
79	7.82	0.019	0.34*	6.17	0.042	.98
80	7.08	0.060	-0.05*	8.28	0.044	.99
81	7.88	0.031	0.40	7.79	0.031	.99
82	6.71	0.041	-0.056*	8.14	0.021	.95
83	7.82	0.031	0.34*	8.14	0.027	.97
84	5.68	0.063	1.10	7.15	0.044	.96
88	12.15	-0.041	0.74*	8.98	0.001*	.80

*Not significant at the 5% level of confidence.

Table 8

Structural change index by state

Year	U.S.	Midwest	Illinois	Indiana	Iowa	Michigan	Ohio	Wisconsin
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.019	0.025	0.030	0.035	0.035	0.024	0.023	0.027
65	0.033	0.041	0.043	0.044	0.031	0.051	0.037	0.037
66	0.044	0.051	0.062	0.062	0.051	0.054	0.045	0.055
67	0.043	0.044	0.058	0.055	0.057	0.053	0.044	0.064
68	0.054	0.063	0.070	0.076	0.095	0.073	0.061	0.060
69	0.066	0.073	0.085	0.093	0.108	0.087	0.073	0.080
70	0.069	0.067	0.088	0.086	0.100	0.080	0.075	0.079
71	0.077	0.077	0.102	0.092	0.130	0.090	0.087	0.071
72	0.090	0.081	0.107	0.120	0.150	0.088	0.093	0.090
73	0.102	0.101	0.124	0.135	0.157	0.113	0.106	0.114
74	0.106	0.100	0.137	0.132	0.174	0.094	0.107	0.117
75	0.113	0.093	0.135	0.133	0.161	0.112	0.109	0.101
76	0.124	0.108	0.138	0.153	0.194	0.146	0.112	0.118
77	0.138	0.127	0.143	0.183	0.225	0.165	0.127	0.123
78	0.146	0.133	0.155	0.182	0.214	0.158	0.133	0.129
79	0.153	0.132	0.162	0.182	0.234	0.139	0.132	0.128
80	0.157	0.136	0.179	0.174	0.236	0.151	0.137	0.137
81	0.160	0.151	0.181	0.183	0.206	0.177	0.164	0.150
82	0.172	0.178	0.200	0.206	0.210	0.225	0.199	0.156
83	0.186	0.188	0.230	0.228	0.281	0.207	0.208	0.164
84	0.190	0.180	0.216	0.229	0.263	0.170	0.195	0.171
85	0.196	0.184	0.218	0.235	0.262	0.169	0.202	0.183
86	0.208	0.192	0.231	0.247	0.245	0.187	0.211	0.195

Table 9

Structural change among states--1963 to 1986

Industry	U.S.	Midwest	Illinois	Indiana	Iowa	Michigan	Ohio	Wisconsin
Total	0.2084	0.1921	0.2313	0.2474	0.2451	0.1874	0.2111	0.1946
01	0.0091	0.0070	0.0081	0.0128	0.0274	0.0043	0.0041	0.0036
07	0.0003	0.0002	0.0001	0.0001	0.0025	0.0002	0.0004	0.0000
10	0.0010	0.0004	.	.	.	0.0017	.	0.0003
12	0.0005	0.0002	0.0001	0.0009	0.0006	.	0.0008	.
13	0.0210	0.0067	0.0217	0.0049	0.0001	0.0008	0.0002	0.0001
14	0.0003	0.0009	0.0010	0.0007	0.0012	0.0009	0.0007	0.0006
20	0.0029	0.0027	0.0055	0.0106	0.0016	0.0001	0.0005	0.0025
21	0.0023	0.0002	.	0.0002	.	.	0.0003	.
22	0.0001	0.0001	0.0001	0.0001	0.0004	0.0001	0.0004	0.0004
23	0.0011	0.0002	0.0018	0.0002	0.0005	0.0036	0.0000	0.0000
24	0.0003	0.0010	0.0002	0.0017	0.0023	0.0006	0.0017	0.0032
25	0.0000	0.0001	0.0016	0.0007	0.0007	0.0031	0.0013	0.0007
26	0.0009	0.0017	0.0002	0.0003	0.0019	0.0015	0.0003	0.0136
27	0.0015	0.0034	0.0061	0.0009	0.0001	0.0017	0.0040	0.0017
28	0.0043	0.0079	0.0093	0.0109	0.0106	0.0025	0.0116	0.0030
29	0.0031	0.0016	0.0038	0.0153	0.0006	0.0004	0.0061	0.0001
30	0.0023	0.0026	0.0042	0.0076	0.0025	0.0033	0.0035	0.0062
31	0.0016	0.0013	0.0019	0.0002	0.0000	0.0004	0.0009	0.0047
32	0.0023	0.0040	0.0046	0.0031	0.0038	0.0023	0.0067	0.0009
33	0.0128	0.0204	0.0130	0.0371	0.0058	0.0199	0.0297	0.0063
34	0.0026	0.0066	0.0075	0.0017	0.0056	0.0130	0.0083	0.0018
35	0.0197	0.0200	0.0123	0.0161	0.0512	0.0139	0.0172	0.0417
36	0.0112	0.0054	0.0036	0.0158	0.0084	0.0043	0.0042	0.0025
371	0.0003	0.0005	0.0013	0.0046	0.0053	0.0096	0.0088	0.0120
379	0.0041	0.0005	0.0001	0.0046	0.0018	0.0017	0.0005	0.0014
38	0.0037	0.0011	0.0010	0.0038	0.0019	0.0014	0.0017	0.0015
39	0.0002	0.0005	0.0011	0.0011	0.0011	0.0019	0.0003	0.0003
40	0.0084	0.0100	0.0125	0.0099	0.0119	0.0061	0.0108	0.0074
41	0.0038	0.0030	0.0033	0.0038	0.0019	0.0020	0.0035	0.0028
42	0.0008	0.0025	0.0025	0.0077	0.0004	0.0021	0.0023	0.0005
44	0.0010	0.0004	0.0002	0.0004	0.0003	0.0013	0.0003	
45	0.0033	0.0026	0.0058	0.0014	0.0006	0.0023	0.0013	0.0009
46	0.0002	0.0002	0.0002	0.0000	0.0004	0.0001	0.0005	0.0001
47	0.0009	0.0009	0.0018	0.0002	0.0002	0.0011	0.0005	0.0005

Table 9 (cont'd)

Industry

	U.S.	Midwest	Illinois	Indiana	Iowa	Michigan	Ohio	Wisconsin
60	0.0028	0.0004	0.0046	0.0068	0.0144	0.0004	0.0005	0.0010
61	0.0006	0.0014	0.0033	0.0009	0.0013	0.0004	0.0021	0.0006
62	0.0037	0.0036	0.0080	0.0011	0.0011	0.0010	0.0032	0.0020
63	0.0015	0.0022	0.0020	0.0018	0.0033	0.0017	0.0026	0.0033
64	0.0003	0.0006	0.0001	0.0011	0.0006	0.0004	0.0009	0.0014
65	0.0148	0.0095	0.0123	0.0043	0.0224	0.0172	0.0087	0.0104
70	0.0006	0.0019	0.0022	0.0012	0.0024	0.0016	0.0015	0.0031
72	0.0037	0.0038	0.0048	0.0023	0.0037	0.0037	0.0033	0.0040
73	0.0197	0.0173	0.0255	0.0110	0.0165	0.0172	0.0121	0.0160
75	0.0027	0.0024	0.0030	0.0036	0.0014	0.0022	0.0020	0.0016
76	0.0001	0.0001	0.0000	0.0009	0.0007	0.0004	0.0001	0.0006
78	0.0000	0.0002	0.0001	0.0004	0.0007	0.0000	0.0004	0.0005
79	0.0004	0.0001	0.0001	0.0000	0.0005	0.0005	0.0001	0.0001
80	0.0179	0.0203	0.0168	0.0242	0.0141	0.0209	0.0247	0.0173
81	0.0000	0.0009	0.0004	0.0011	0.0012	0.0003	0.0013	0.0033
82	0.0001	0.0007	0.0015	0.0002	0.0002	0.0001	0.0008	0.0006
83	0.0001	0.0003	0.0005	0.0001	0.0009	0.0007	0.0000	0.0011
84	0.0057	0.0058	0.0060	0.0029	0.0023	0.0073	0.0082	0.0022
88	0.0054	0.0038	0.0034	0.0038	0.0043	0.0040	0.0041	0.0036

Table 10

Midwest diverisfication index

Industry	1963	1986	Change
01	0.0035	0.0059	0.0024
07	0.0011	0.0015	0.0005
10	0.0013	0.0006	-0.0008
12	0.0012	0.0008	-0.0004
13	0.0464	0.0269	-0.0196
14	0.0000	0.0007	0.0006
20	0.0064	0.0064	-0.0000
21	0.0052	0.0023	-0.0029
22	0.0046	0.0047	0.0000
23	0.0047	0.0029	-0.0018
24	0.0029	0.0019	-0.0010
25	0.0013	0.0011	-0.0001
26	0.0013	0.0023	0.0010
27	0.0037	0.0012	-0.0025
28	0.0005	0.0040	0.0034
29	0.0026	0.0006	-0.0019
30	0.0054	0.0055	0.0001
31	0.0006	0.0001	-0.0005
32	0.0031	0.0010	-0.0021
33	0.0248	0.0144	-0.0104
34	0.0250	0.0189	-0.0060
35	0.0311	0.0300	-0.0011
36	0.0085	0.0010	-0.0075
371	0.0362	0.0354	-0.0007
379	0.0110	0.0060	-0.0050
38	0.0007	0.0039	0.0032
39	0.0007	0.0003	-0.0004

Table 10 (cont'd)

Industry	1963	1986	Change
40	0.0027	0.0006	-0.0021
41	0.0017	0.0006	-0.0011
42	0.0033	0.0053	0.0019
44	0.0026	0.0018	-0.0008
45	0.0019	0.0027	0.0008
46	0.0004	0.0009	0.0004
47	0.0004	0.0004	-0.0000
60	0.0008	0.0037	0.0028
61	0.0002	0.0008	0.0006
62	0.0020	0.0021	0.0001
63	0.0006	0.0004	-0.0003
64	0.0000	0.0005	0.0004
65	0.0065	0.0003	-0.0062
70	0.0022	0.0037	0.0015
72	0.0001	0.0000	-0.0001
73	0.0025	0.0054	0.0029
75	0.0007	0.0010	0.0003
76	0.0006	0.0004	-0.0002
78	0.0013	0.0014	0.0001
79	0.0010	0.0016	0.0006
80	0.0007	0.0023	0.0016
81	0.0008	0.0019	0.0011
82	0.0018	0.0010	-0.0008
83	0.0003	0.0003	-0.0000
84	0.0023	0.0021	-0.0002
88	0.0032	0.0012	-0.0021
Total	0.2748	0.2228	-0.0520

Appendix A

Titles and Descriptions of Industries

Division A. Agriculture, forestry, and fishing
        Major Group 01. Agricultural production--crops
        Major Group 02. Agricultural production livestock and animal specialties
        Major Group 07. Agricultural services
        Major Group 08. Forestry
        Major Group 09. Fishing, hunting and trapping

Division B. Mining
        Major Group 10. Metal mining
        Major Group 12. Coal mining
        Major Group 13. Oil and gas extraction
        Major Group 14. Mining and quarrying of nonmetallic minerals, except fuels

Division C. Construction
        Major Group 15. Building construction-general contractors and operative builders
        Major Group 16. Heavy construction other than building construction-contractors
        Major Group 17. Construction-special trade contractors

Division D. Manufacturing
        Major Group 20. Food and kindred products
        Major Group 21. Tobacco products
        Major Group 22. Textile mill products
        Major Group 23. Apparel and other textile products made from fabrics
        Major Group 24. Lumber and wood products, except furniture
        Major Group 25. Furniture and fixtures
        Major Group 26. Paper and allied products
        Major Group 27. Printing, publishing, and allied industries
        Major Group 28. Chemicals and allied products
        Major Group 29. Petroleum refining and related industries
        Major Group 30. Rubber and miscellaneous plastics products
        Major Group 31. Leather and leather products
        Major Group 32. Stone, clay, and glass, and concrete products
        Major Group 33. Primary metal industries
        Major Group 34. Fabricated metal products, except machinery and transportation equipment
        Major Group 35. Industrial and commercial machinery and computer equipment

Major Group 36. Electric and other electronic equipment and components, except computer equipment
Major Group 37. Transportation equipment
Major Group 38. Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks
Major Group 39. Miscellaneous manufacturing industries

Division E. Transportation, communications, electric, gas, and sanitary services
Major Group 40. Railroad transportation
Major Group 41. Local and suburban transit and interurban highway passenger transportation
Major Group 42. Motor freight transportation and warehousing
Major Group 43. United States Postal Service
Major Group 44. Water transportation
Major Group 45. Transportation by air
Major Group 46. Pipe lines, except natural gas
Major Group 47. Transportation services
Major Group 48. Communications
Major Group 49. Electric, gas, and sanitary services

Division F. Wholesale trade
Major Group 50. Wholesale trade-durable goods
Major Group 51. Wholesale trade-nondurable goods

Division G. Retail trade
Major Group 52. Building materials, hardware, garden supply, and mobile home dealers
Major Group 53. General merchandise stores
Major Group 54. Food stores
Major Group 55. Automotive dealers and gasoline service stations
Major Group 56. Apparel and accessory stores
Major Group 57. Home furniture, furnishings, and equipment stores
Major Group 58. Eating and drinking places
Major Group 59. Miscellaneous retail

Division H. Finance, insurance, and real estate
Major Group 60. Depository institutions
Major Group 61. Nondepostitory institutions
Major Group 62. Security and commodity brokers, dealers, exchanges, and services
Major Group 63. Insurance carriers

Major Group 64. Insurance agents, brokers, and service
Major Group 65. Real estate
Major Group 67. Holding and other investment offices

Division I. Services
Major Group 70. Hotels, rooming houses, camps, and other lodging places
Major Group 72. Personal services
Major Group 73. Business services
Major Group 75. Auto repair, services, and parking
Major Group 76. Miscellaneous repair services
Major Group 78. Motion pictures
Major Group 79. Amusement and recreation services
Major Group 80. Health services
Major Group 81. Legal services
Major Group 82. Educational services
Major Group 83. Social services
Major Group 84. Museums, art galleries, and botonical zoological gardens
Major Group 86. Membership organizations
Major Group 87. Engineering, accoutning, research, management, and related services
Major Group 88. Private households
Major Group 89. Miscellaneous Services

Division J. Public administration
Major Group 91. Executive, legislative, and general government, except finance
Major Group 92. Justice, public order, and safety
Major Group 93. Public finance, taxation, and monetary policy
Major Group 94. Administration of human resource programs
Major Group 95. Administration of environmental quality and housing programs
Major Group 96. Administration of economic programs
Major Group 97. National security and international affairs

Appendix B

Model 1

Interregional model with structural break

$$\ln EMW_t - \ln EMW_{t-1} = \alpha + \beta_1 (\ln EUS_t - \ln EUS_{t-1})$$
$$+ \beta_2 D74(\ln EUS_t - \ln EUS_{t-1}) + \varepsilon$$

ln	=	log valves
EMW	=	sector employment in Midwest
EUS	=	sector employment in U.S.
D74	=	1 if year $\geq$ 1974
		0 if year $<$ 1974
t	=	time period
α	=	intercept
β_1	=	relationship 1956-1973
β_2	=	coefficient on dummy variable
$\beta_1 + \beta_2$	=	relationship 1974-1989

Model 2

Interregional model with expansion and contraction

A. Without structural break

$$\ln EMW_t - \ln EMW_{t-1} = \alpha + \beta_1 \underset{(+)}{(\ln EUS_t - \ln EUS_{t-1}}$$
$$+ \beta_2 \underset{(-)}{(\ln EUS_t - \ln EUS_{t-1}) + \varepsilon}$$

B. With structural break

$$\ln EMW_t - \ln EMW_{t-1} = \alpha + \beta_1 \underset{(+)}{(\ln EUS_t - \ln EUS_{t-1}}$$
$$+ \beta_2 \underset{(+)}{D74(\ln EUS_t - \ln EUS_{t-1})} + \beta_3 \underset{(-)}{(\ln EUS_t - \ln EUS_{t-1})}$$
$$+ \beta_4 \underset{(-)}{D74(\ln EUS_t - \ln EUS_{t-1}) + \varepsilon}$$

where: EMW = sector employment in Midwest
EUS = sector employment in U.S.
ln = log values
D74 = 1 if year $\geq$ 1974
0 if year < 1974
t = time period
+ = $\ln EUS_t > \ln EUS_{t-1}$ (expansion)
- = $\ln EUS_t < \ln EUS_{t-1}$ (contraction)

A α = intercept
      β_1 = relationship in expansion
      β_2 = relationship in contraction

B α = intercept
      β_1 = expansion 1956-1973
      β_2 = expansion 1974-1989
      β_3 = contraction 1956-1973
      β_4 = contraction 1974-1989

Model 3

Trend and cycle model

$$lnE = \alpha + \beta T + \gamma (lnGNP - lnGNP^*) + \varepsilon$$

lnE   =   log of sector (or industry) employment

T   =   time trend

lnGNP   =   log of Gross National Product

lnGNP*   =   log of potential GNP

α =   intercept

β =   time

γ =   GNPGap

Model 4

Trend and cycle model with structural break

$$lnE = \alpha_1 + \alpha_2 D74 + (\beta_1 + \beta_2 D74)T$$
$$+(\gamma_1 + \gamma_2 D74)(lnGNP - lnGNP^*) + \varepsilon$$

lnE	=	log of sector (or industry) employment (or output)
T	=	time trend
lnGNP	=	log of gross national product
lnGNP*	=	log of potential GNP
D74	=	1 if year $\geq$ 1974
		0 if year $<$ 1974
α_1	=	intercept 1956-1973
α_2	=	intercept 1974-1989
β_1	=	time 1956-1973
β_2	=	time 1974-1989
γ	=	GNPGap 1956-1973
γ	=	GNPGap 1974-1989

Diversification index

This is an annual income based diversification index. There are three subscripts, representing, location, industry and time:

$$\Sigma_i \mid (INC_{rit}/INC_{rTt}) - ((INC_{USit}\text{-}INC_{rit}) / (INC_{USTt}\text{-}INC_{rTt})) \mid$$

Where INC = Income
        r   = region
        US = United States
        i   = 2 digit SIC industry
        T   = total nonagricultural sector
        t   = year

The region is subtracted from the United States numbers so as not to bias the index towards large regions.

This index relates each industry's share of income to the national average. Having a share 1% below the industry's national average has an equivalent effect on the index as a share 1% above the national average. So if many of a region's industries are highly specialized or non specialized, then the index will be large. If most of a region's industries have a share of income close to the national average, then the index will be small. The possible range of the index is zero to two.

Location quotient
The location quotient is an annual measure of the concentration of a region's income relative to the United States. The three subscripts identify region, industry and time.

$$INC_{rit}/INC_{rTt}) / (INC_{USit}/INC_{USTt})$$

Where INC = Income
        r   = region
        US = United States
        i   = industry
        T   = total nonagricultural sector
        t   = year

If an industry's share of income is equivalent to the national share then the location quotient is equal to one. If an industry is concentrated in a region, its share of income in the region is larger

than the industry's share of national income, then the location
quotient is greater than one. If the industry is not concentrated in the
region, then the location quotient is between zero and one.

Index of structural change
The structural change index is a cumulative measure of change based
on 2 digit SIC income. The index is region specific and has two
subscripts, the industry and year.

$$\Sigma_i \mid (INC_{it}/INC_{Tt}) - (INC_{i69}/INC_{T69}) \mid$$

Where   INC = Income for the region
          i = 2 digit SIC industry
          T   = total nonagricultural sector
          t = year
          69 = base year

This index compares an industry's share of total income to its share at
the beginning of the period (1969). The larger the absolute change in
the share of income, the larger will be the industry's effect on the
index. Both increases and decreases in the share increase the index.

Appendix C

Location quotients, 1963

Industry	Share of total U.S.	Midwest	Illinois	Indiana	Iowa	Michigan	Ohio	Wisconsin
Total	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00
01	0.032	1.09	0.89	1.34	4.76	0.55	0.55	1.64
07	0.004	0.79	0.69	0.66	2.10	0.57	0.76	0.98
10	0.002	0.37	0.02	0.14	.	1.58	0.02	0.23
12	0.005	0.80	1.37	1.04	0.17	.	1.13	.
13	0.047	0.22	0.52	0.12	0.00	0.14	0.12	0.00
14	0.002	1.01	1.11	1.24	1.64	0.84	0.83	0.86
20	0.020	1.25	1.52	1.46	1.86	0.77	0.92	1.71
21	0.004	0.04	0.02	0.06	.	0.05	0.06	0.01
22	0.004	0.19	0.15	0.05	0.06	0.12	0.30	0.46
23	0.006	0.43	0.56	0.38	0.21	0.47	0.36	0.28
24	0.006	0.59	0.35	1.24	0.55	0.60	0.33	1.26
25	0.003	1.32	1.26	2.16	0.63	1.50	1.17	0.91
26	0.008	1.14	0.81	0.75	0.35	1.04	1.10	3.57
27	0.013	1.22	1.85	0.88	0.88	0.67	1.22	1.10
28	0.012	0.96	1.04	1.26	0.63	1.02	0.95	0.48
29	0.010	0.80	0.99	1.78	0.08	0.40	0.89	0.11
30	0.005	1.88	0.97	1.97	1.61	1.18	3.98	0.76
31	0.002	0.81	0.99	0.34	0.10	0.36	0.64	2.82
32	0.008	1.29	1.04	1.44	1.01	0.93	2.15	0.57
33	0.022	1.87	1.16	3.66	0.52	1.69	2.75	0.74
34	0.017	2.12	1.80	1.61	0.54	2.98	2.64	1.44
35	0.021	2.14	2.03	1.48	1.98	2.30	2.19	2.95
36	0.012	1.56	1.68	2.64	1.23	0.56	1.72	1.88
371	0.012	3.27	0.37	1.98	0.09	0.11	1.88	2.52
379	0.017	0.50	0.30	1.18	0.13	0.21	0.88	0.17
38	0.004	0.87	1.56	0.91	0.31	0.45	0.61	0.63
39	0.004	1.13	1.49	0.95	0.90	0.94	0.92	1.32
40	0.014	1.15	1.43	1.28	1.43	0.70	1.20	0.83
41	0.006	0.77	0.90	0.93	0.52	0.48	0.76	0.95
42	0.014	1.19	1.18	1.30	1.38	0.95	1.26	1.31
44	0.003	0.33	0.28	0.05	.	0.23	0.74	0.22
45	0.004	0.59	1.22	0.27	0.15	0.39	0.42	0.20

Appendix C (cont'd)

Industry	Share of total U.S.	Midwest	Illinois	Indiana	Iowa	Michigan	Ohio	Wisconsin
46	0.001	0.72	0.93	0.71	0.90	0.34	0.91	0.23
47	0.002	0.83	1.39	0.51	0.46	0.56	0.72	0.58
60	0.014	0.96	1.19	0.70	0.96	0.87	0.86	0.96
61	0.002	0.91	0.55	2.08	1.20	1.27	0.62	0.29
62	0.004	0.59	0.96	0.28	0.46	0.49	0.49	0.45
63	0.009	0.94	1.20	0.89	0.98	0.73	0.84	0.92
64	0.006	1.00	1.13	0.97	1.20	0.79	0.93	1.11
65	0.092	1.06	1.03	0.98	1.37	1.03	1.02	1.17
70	0.007	0.75	0.91	0.63	0.75	0.65	0.63	0.93
72	0.011	1.01	1.12	0.92	1.04	0.93	0.97	1.01
73	0.016	0.88	1.24	0.47	0.50	0.88	0.82	0.60
75	0.005	0.90	0.85	0.88	1.13	0.93	0.91	0.85
76	0.003	0.82	0.90	0.66	1.06	0.79	0.75	0.89
78	0.002	0.48	0.61	0.45	0.54	0.42	0.38	0.42
79	0.005	0.83	0.85	0.64	0.63	0.87	0.93	0.77
80	0.027	0.98	0.99	0.82	1.02	0.95	1.01	1.11
81	0.010	0.94	1.27	0.69	0.87	0.69	0.89	0.97
82	0.006	0.75	0.91	0.77	0.83	0.49	0.76	0.69
83	0.009	0.98	1.07	0.92	0.98	0.92	0.99	0.83
84	0.009	0.80	0.94	0.53	0.51	0.97	0.74	0.62
88	0.008	0.68	0.62	0.66	0.77	0.68	0.73	0.63

Appendix C

Location quotient, 1986

Industry	U.S.	Midwest	Illinois	Indiana	Iowa	Michigan	Ohio	Wisconsin
Total	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00
01	0.023	1.21	0.89	1.31	5.45	0.58	0.59	2.12
07	0.004	0.70	0.67	0.60	1.39	0.58	0.62	0.92
10	0.001	0.29	.	.	.	1.39	.	0.06
12	0.004	0.85	1.52	1.39	0.05	0.03	1.08	.
13	0.026	0.14	0.10	0.03	0.01	0.29	0.22	0.01
14	0.001	0.63	0.66	0.99	1.20	0.37	0.49	0.65
20	0.017	1.31	1.45	1.09	2.28	0.89	1.11	1.86
21	0.002	0.00	.	0.01	.	.	0.01	.
22	0.005	0.17	0.17	0.06	0.15	0.09	0.20	0.35
23	0.005	0.56	0.33	0.43	0.36	1.24	0.43	0.34
24	0.006	0.73	0.30	1.47	0.91	0.46	0.61	1.75
25	0.003	1.30	0.75	1.95	0.85	2.51	0.77	1.15
26	0.008	1.23	0.76	0.71	0.54	0.75	1.01	4.81
27	0.011	1.09	1.56	0.92	1.01	0.61	1.03	1.10
28	0.016	1.20	1.34	1.60	1.12	0.90	1.42	0.54
29	0.007	0.93	0.88	0.41	0.20	0.52	2.12	0.14
30	0.007	1.64	1.25	2.41	1.44	1.27	2.21	1.40
31	0.001	0.88	0.62	0.76	0.36	0.63	0.79	2.70
32	0.006	1.13	0.68	1.48	0.77	0.91	1.87	0.94
33	0.010	2.24	1.36	4.70	0.62	1.87	3.34	1.07
34	0.015	2.04	1.61	1.78	1.02	2.63	2.54	1.82
35	0.041	1.60	1.35	1.16	2.28	1.53	1.56	2.55
36	0.023	1.04	1.02	2.04	0.99	0.47	1.06	1.07
371	0.012	3.40	0.49	2.42	0.53	10.5	2.66	1.60
379	0.013	0.63	0.39	1.20	0.04	0.40	1.20	0.12
38	0.008	0.60	0.72	0.96	0.40	0.42	0.54	0.53
39	0.004	1.06	1.26	1.26	1.23	0.51	1.03	1.29
40	0.005	1.10	1.35	1.45	1.47	0.65	1.07	0.77
41	0.002	0.72	1.00	0.77	0.57	0.40	0.38	1.41
42	0.015	1.29	1.28	1.75	1.33	1.03	1.34	1.21
44	0.002	0.30	0.34	0.28	0.12	0.18	0.47	0.18
45	0.007	0.68	1.46	0.34	0.16	0.53	0.40	0.24
46	0.001	0.48	0.62	0.60	0.46	0.39	0.45	0.26
47	0.003	0.88	1.58	0.41	0.39	0.77	0.65	0.56

Appendix C (cont'd)

Industry	U.S.	Midwest	Illinois	Indiana	Iowa	Michigan	Ohio	Wisconsin
60	0.017	0.82	0.73	0.98	1.64	0.76	0.69	0.86
61	0.002	1.30	1.98	1.06	1.46	0.71	1.44	0.47
62	0.008	0.77	1.54	0.29	0.38	0.39	0.66	0.49
63	0.010	1.03	1.23	0.93	1.16	0.80	0.97	1.11
64	0.006	0.94	1.17	0.82	1.15	0.76	0.82	0.92
65	0.107	1.00	1.00	0.88	0.97	1.05	0.96	1.11
70	0.006	0.52	0.65	0.49	0.44	0.45	0.44	0.51
72	0.007	1.00	1.03	1.08	1.05	0.89	1.00	0.96
73	0.035	0.88	1.27	0.52	0.69	0.87	0.70	0.72
75	0.008	0.90	0.94	1.03	0.93	0.89	0.86	0.76
76	0.003	0.87	0.93	1.00	0.83	0.97	0.73	0.69
78	0.002	0.37	0.66	0.23	0.20	0.45	0.19	0.15
79	0.005	0.73	0.78	0.59	0.47	0.70	0.83	0.73
80	0.045	1.04	0.97	1.03	0.93	1.04	1.16	1.05
81	0.010	0.84	1.22	0.58	0.74	0.72	0.75	0.63
82	0.006	0.85	1.14	0.79	0.85	0.50	0.88	0.78
83	0.009	1.02	1.14	0.92	0.90	1.01	1.01	0.96
84	0.015	0.88	0.98	0.52	0.47	1.09	1.01	0.53
88	0.002	0.60	0.62	0.57	0.71	0.54	0.65	0.55