Manufacturing Jobs:
Fear and Loathing in the Midwest

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Introduction

Take any community of reasonable size in the Midwest, and chances are good that its local economic development institutions are currently engaged in one or more of the following: a strategic planning process, targeted industrial recruitment, and/or industrial cluster development. With state governments and grant-giving institutions promoting and rewarding regional development efforts, chances are also good these projects involve multiple communities or counties in a coordinated regional effort.

Such regional strategic planning and industry targeting efforts require taking stock of the region's current industrial structure and assessing its strengths, weaknesses, opportunities and threats. For manufacturing-dependent regions, this can be a sobering process. The threat of continued manufacturing job loss looms large, and local economic development officials in these regions are understandably nervous about investing more resources into a sector whose future growth prospects are unknown.

This research describes a practical risk assessment tool for measuring a region's vulnerability to near-term manufacturing job loss. Such a tool might be used to inform or prioritize regional strategic planning and industrial targeting efforts. As an additional benefit, the tool might help bridge the gaps between local expertise and regional understanding. Local development practitioners often have extensive knowledge of their own communities' industrial structures, but are less familiar with the industrial characteristics of surrounding communities and counties. This research provides a standardized way to compare counties in a region with one another, and identify structural similarities and differences in their manufacturing sectors.

Assessing Risk of Manufacturing Job Losses

Ideally, before investing in manufacturing cluster development or industry targeting strategies, local officials would have enough information to compare the possible payoffs of these strategies with the risks of continued manufacturing job losses in their communities. This exercise is complicated because a particular region's manufacturing sector is exposed to risks arising from multiple sources, many of which are firm-specific and industry-specific.

Unfortunately, firm-specific knowledge is usually available to company insiders only. Local economic development officials, unless they happen to also be company insiders, probably know far less about firms in their communities than they like to believe. Competitive information such as market share, product line restructuring, location and/or expansion decisions are mostly unknowable, especially for manufacturing firms that are not publicly traded.

Apart from the firm-specific risks, there are industry-specific risks to consider as well. Changes in technology and global competition pose additional threats that must be factored into any manufacturing risk assessment. Local officials may seek out industry

experts, read trade journals, and employ a variety of other sources to learn as much as possible about the particular industry or industries either present in, or targeted for, the region. Obtaining this knowledge can be costly and time-consuming. If there are multiple targets, the process can quickly become overwhelming.

Even detailed knowledge of industry-wide trends may not help predict local exposure to risk, because national trends often don't play out the same way across different regions. That, however, raises some interesting questions: Do some characteristics of regions help buffer them from national and global trends in manufacturing industries? Can these characteristics be measured? Are some of the firm-specific and industry-specific risks, while hard to measure directly, in evidence indirectly within the structure of the regional manufacturing sector?

This research seeks to identify characteristics of regional economies that might signal vulnerability to continued restructuring in the U.S. manufacturing sector. The paper compares counties that demonstrated resilience during recent, national manufacturing downturns with counties that were hit the hardest. A county-level model is developed to predict the risk of near-term manufacturing job loss based on several local and regional characteristics.

Related Research

The authors have assisted several multi-county development groups in Iowa with targeted industry assessments. Our experiences in working with these groups provided the impetus for this research. Their reactions to the word "manufacturing" elicit responses ranging from "the sky is falling" to a careful "wait and see" attitude. Many believe it's not a matter of if, but when, their remaining manufacturing jobs will disappear due to global competition or technological change. Whatever their current attitudes, though, the groups have consistently expressed a desire for more information about the future prospects of the national manufacturing sector in general, and their region's manufacturing sectors in specific. With this research, we hope to develop a prototype for delivering informed and easily interpreted technical assistance.

The framework for this analysis was borrowed, in part, from research examining patterns of job loss and recovery in the 9th Federal Reserve District which includes Montana, North and South Dakota, Minnesota, northwestern Wisconsin and the Upper Peninsula of Michigan. Hall *et al* [1] analyzed the job loss and recovery experiences of counties in the region from 1990 to 1993. The authors compared several socioeconomic indicators among counties that did and did not experience major job loss, and found few consistent patterns to explain which counties were more or less likely to experience such "job shocks." We have adopted the notion of studying job shocks for this research, although here we limit our analysis to the manufacturing sector.

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[1] Hall, Elizabeth, Terry Fitzgerald and Mark Holland, "County Employment: Shocks and Rebounds," *fedgazette*, Federal Reserve Bank of Minneapolis, November 2005.

For the basic premise of our analysis, we rely specifically on two pieces of research examining industry-specific and area-specific attributes and their relationships to a changing manufacturing sector. The first is a forward looking piece by David Barkley, which discusses the prospects for manufacturing job growth and retention in the Heartland States.[2] Barkley examines the likelihood of manufacturing firm growth in non-metropolitan areas from a variety of perspectives, and notes several factors that might improve their chances of attracting or retaining firms amid transformations in the manufacturing sector. The second piece is Timothy Wojan's retrospective on the U.S. manufacturing job crisis of 2001-2002.[3] Wojan examines factors at both the industry level and the county level that may have contributed to or mitigated employment losses during that period. Barkley and Wojan each find evidence that job growth or decline often occurs in manners inconsistent with conventional wisdom, and that adjustment to manufacturing sector change varies greatly from one region to the next.

Such research supports the premise that specific regional characteristics may improve or worsen the prospects of job loss during periods of restructuring in manufacturing industries. In essence, U.S. manufacturing industries are deciding where they want to "live," and a major job loss in a community may be viewed as a rejection of that particular mix of locational, industrial amenities. By examining patterns of these major job losses, or "shocks" regionally, we might discern patterns useful to for risk evaluation at the local level.

Methods and Data

1. *Model Selection and Unit of Analysis*

For this analysis, we are most interested in identifying risk factors that might signal a higher likelihood of near-term manufacturing job loss in a particular region. We are less interested in predicting actual rates or amounts of manufacturing job growth or loss. Our goal is to determine which characteristics of regions seem to be associated with higher rates of loss, especially during periods of stress in the national manufacturing sector. Ultimately, we would like to develop a tool for identifying high-risk regions based on a set of characteristics that might be measured and monitored over time.

We have chosen to use an ordinal logistic model to analyze manufacturing employment changes at the county level during periods of national manufacturing employment decline. This type of model estimates probabilities for the occurrence of three or more response events having a natural ordering. For our model, we have defined three events: manufacturing job growth, moderate loss, and major loss, or "job shock." The model's output includes predicted values indicating the probabilities of a county experiencing

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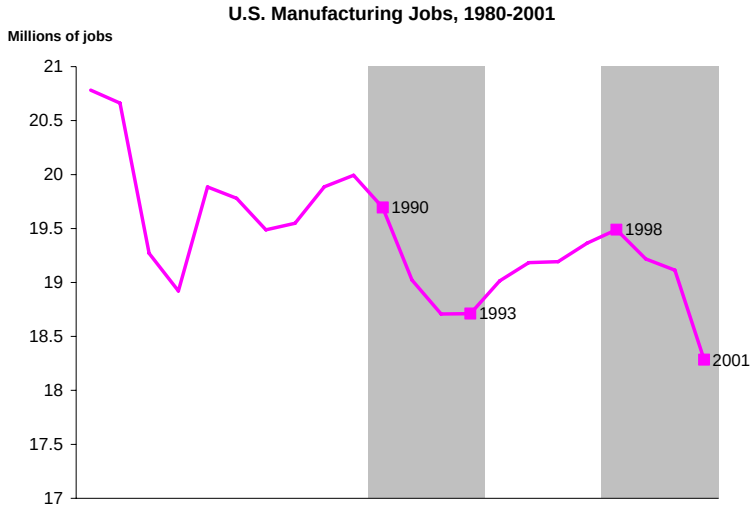
[2] Barkley, David L., "Turmoil in Traditional Industry: Prospects for Nonmetropolitan Manufacturing," in Economic Forces Shaping the Rural Heartland, Federal Reserve Bank of Kansas City, 1996.

[3] Wojan, Timothy, "Grace Under Pressure? Explaining Employment Resilience During the 2001-2002 Manufacturing Crisis," presented at the 2005 Meeting of the Southern Regional Science Association, Washington DC.

manufacturing job growth, moderate loss, or major loss. We have set job growth as the model's reference event. The individual parameter coefficients may be interpreted as increasing or decreasing odds of an event's occurrence in relation to the reference event, given a one unit change in the independent variable. In our model, parameters with negative coefficients may be viewed as favorable attributes for the county, because they would indicate a lower probability of job loss vs. job growth.

2. *Time Period and Selected Geographies*

Two periods of national manufacturing job loss are examined in this paper. The first period runs from 1990 to 1993, and the second runs from 1998 to 2001. The following chart illustrates total manufacturing employment levels for the United States. The two study periods are highlighted in grey.



For this paper, we focus on manufacturing employment change in 12 Midwestern states. We build two parallel models using county-level data sets for Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. For each time period, a set of indicators are used to model the likelihood of a county experiencing a manufacturing job "shock" during the downturn period.

Counties with manufacturing employment or other data suppressed for the periods of interest were removed from the data set. The final data set for the 1990-93 period includes 990 counties, of which 221 were metropolitan counties. The final data set for the 1998-2001 period includes 846 counties, with 215 classified as metropolitan.

3. *Defining the Event*

The response variable in the model was defined as a manufacturing job change "event." The counties were divided into three groups according to their level of manufacturing job

loss during the measurement periods. The groupings were defined separately for each of the two time periods as follows:

- *Low Vulnerability*. In the model, manufacturing job growth was set as the reference event. Any counties with manufacturing employment growth of 1 or more jobs were classified in the "Low Vulnerability" group.
- *Moderately Vulnerable*. Among all counties experiencing manufacturing job loss, those with both rates and amounts of manufacturing job loss that were less than the median loss values were classified as "Moderate Vulnerability" counties.
- *Highly Vulnerable*. All counties experiencing rates and numbers of manufacturing job loss exceeding the median loss values were classified as "Highly Vulnerable" counties. These counties are defined as the "job shock" counties.

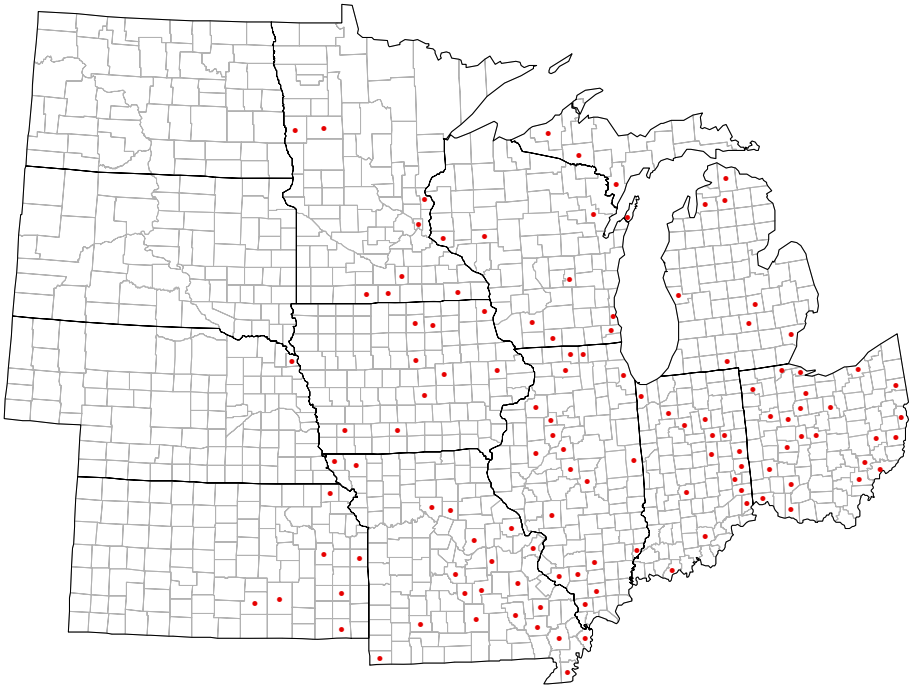
The nature and patterns of manufacturing job loss during these two periods were markedly different. The following table illustrates the number of counties by group for each of the two time periods. The threshold job change values between the moderate and high risk groups are also shown, as measured in number of jobs and percentage change.

County Group Size and Minimum Job Loss Values

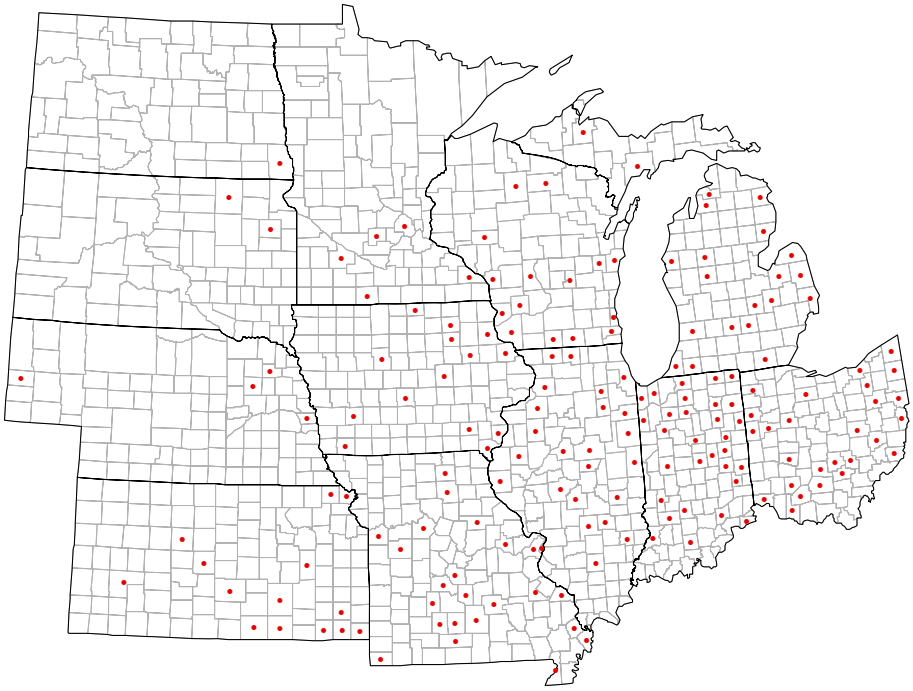
	1990-1993			1998-2001		
Risk Group	Counties	Job shock	Loss %	Counties	Job shock	Loss %
Low	569			266		
Moderate	298			401		
High	123	(113)	(8.14%)	179	(213)	(9.33%)

During the 1990-1993 period, 43 percent of the study counties experienced manufacturing job losses, with 12 percent suffering a "job shock" as defined in this analysis. In contrast, during the 1998-2001 period, 69 percent of the study counties experienced a manufacturing job loss and 21 percent suffered a manufacturing job "shock." The following maps illustrate the location of the "job shock" counties in each time period.

Location of Manufacturing Job "Shocks,"
1990-1993



Location of Manufacturing Job "Shocks,"
1998-2001



4. *Selected Measures*

Metropolitan status of county: Counties in the data set were dummy-coded with a value of 1 for metropolitan counties and 0 for non-metropolitan counties, according to the 1993 BEALE code classifications.

Percentage manufacturing jobs: This variable measures the county's relative dependence on manufacturing sector employment. Manufacturing jobs are expressed as a percentage of total, non-farm employment in 1990 and 1998. Source data were obtained from Bureau of Economic Analysis (BEA) Local Area Annual Estimates.

Average earnings per manufacturing job: This variable measures the quality of manufacturing jobs in the county using the average annual earnings per manufacturing job. The values are expressed in $000s, using BEA data for 1990 and 1998.

Nonfarm, non-manufacturing job growth: This variable is intended to reflect the vibrancy of the local economy in the 5 years proceeding the measurement period. The variable measures the percentage change in non-farm, non-manufacturing employment growth for 1985-90, and 1993-98, using BEA data.

Manufacturing industry specialization index: This variable measures the relative concentration of employment in the county's largest manufacturing industry group.

The employment by SIC code was estimated using the number of firms by employment size grouping and by 2-digit SIC code, obtained from 1990 and 1997[4] County Business Patterns data.

Firm size index: This variable measures the dispersion of manufacturing employment across firms of various sizes. The index is calculated by dividing the number of manufacturing firms by the sum of the squared shares of manufacturing employment by firm size grouping. The firm size groupings were obtained from 1990 and 1997 CBP data, which detail the number of firms within each of nine employment size classes. The smallest class includes firms with 1-4 employees, and the largest includes firms with 1,00 or more employees. The index increases with the number of firms in a county, and the degree to which employment is spread across firms rather than concentrated within a few, large firms.

National manufacturing indexes: The following set of variables measure the county's relative exposure to various manufacturing industry changes occurring at the national level. The national measures were calculated at the 2-digit SIC code level, and then applied to the individual counties using a vector of employment weights reflecting their estimated percentage manufacturing employment in each of the 2-digit SIC groups. The counties' employment percentages were estimated using 1990 and 1997 CBP data. The

[4] To maintain consistency, 1997 data were used for Period 2 because this was the last year in which the County Business Patterns data were available by SIC code.

employment-weighted values were summed to obtain the county's average exposure to the national manufacturing trends.

- National productivity growth index: This variable measures recent productivity growth in manufacturing industries as the percentage change in gross state product per job from 1986-1989 and 1994-97. The gross state product and employment estimates were obtained from SIC-based BEA Gross State Product data.
- Balance of trade change index: This variable measures recent shifts in the balance of trade, with the trade balance expressed as a ratio of domestic exports to imports for consumption by SIC code. The variable measures the change in export-to-import ratios from 1985-90 and from 1993-98. Source data were obtained from the Census Bureau's Statistical Abstract of the United States.
- National job change index: This variable measures the recent growth or decline in national manufacturing employment by SIC from 1986-89 and 1994-97.
- National export focus index: This variable reflects the domestic export-to-import ratio by SIC code in 1990 and 1998.
- Natural resource dependency index: This variable measures the industry dependence on agricultural commodity inputs, including food and timber, as a percentage of total input requirements. Source data were obtained from the BEA's 1992 Benchmark Input-Output accounts.

Percentage non-white or Hispanic: This variable measures the percentage of the county's residents who are not white or who are of Hispanic/Latino ethnicity. Source data were obtained from the 1990 Census of Population.

Percentage college-educated: This variable measures the percentage of adults ages 25 and older with a bachelor's degree or higher educational attainment. Source data were obtained from the 1990 Census of Population.

Results

The models for both time periods studied produce generally consistent results, at least in terms of the signs on the coefficients. Of the 13 variables included in the model, seven had a positive sign, suggesting that higher values for these indicators yield a higher probability of manufacturing job shock. Six of the variables had a negative sign, suggesting that higher values for these indicators were associated with lower risk of manufacturing job shocks.

Metropolitan counties were more likely to experience a job shock than non-metropolitan counties, as were counties with a higher percentage of manufacturing employment and higher average manufacturing wages. Greater dispersion of manufacturing employment across a greater number of firms also appeared to put counties at slightly higher risk. Counties with a relatively high mix of manufacturing industries experiencing recent productivity gains nationally were more vulnerable. Surprisingly, the variable measuring the change in the national balance of trade had a positive sign, suggesting that improvements in the nation's trade position were associated with manufacturing job losses in those industries. Finally, counties with relatively higher concentrations of non-white or Hispanic residents were more likely to experience manufacturing job losses.

Counties with relatively specialized manufacturing sectors were, all else equal, less likely to experience job losses. Counties with a mix of manufacturing sectors that had recently experienced job growth at the national level, or had relatively higher export to import ratio, or had a greater dependence on agricultural or timber imports were also less likely to experience manufacturing job losses. Finally, counties with a higher percentage of college-educated residents were less likely to lose manufacturing jobs.

The following tables summarize the parameter estimates for the two time periods. Detailed model output is included in an appendix to this paper. For reference purposes, minimum, median, and maximum values by county BEALE code for the 1990-93 model variables are also illustrated in the appendix.

The results of the regressions for the two time periods are shown below.

Model: Shock 1990-1993

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Const(1)	-2.406	0.453	-5.320	0.000			
Const(2)	-0.652	0.444	-1.470	0.142			
Metropolitan county (1 = metro)	0.066	0.197	0.340	0.737	1.070	0.730	1.570
Percentage manufacturing employment 1990	1.702	0.756	2.250	0.024	5.490	1.250	24.130
Average earnings per mfg job 1990	0.021	0.009	2.210	0.027	1.020	1.000	1.040
Nonfarm, non-mfg job growth 1985-90	-2.433	0.703	-3.460	0.001	0.090	0.020	0.350
Manufacturing specialization index 1990	-0.529	0.367	-1.440	0.149	0.590	0.290	1.210
Firm size index 1990	0.000	0.000	1.490	0.135	1.000	1.000	1.000
National productivity growth index 1986-89	2.815	1.279	2.200	0.028	16.690	1.360	204.670
Balance of trade change index 1985-90	0.900	0.672	1.340	0.181	2.460	0.660	9.190
National job change index 1986-89	-0.132	1.736	-0.080	0.939	0.880	0.030	26.320
National export focus index 1990	-0.490	0.405	-1.210	0.227	0.610	0.280	1.360
Natural resource dependency index 1992	-0.820	0.964	-0.850	0.395	0.440	0.070	2.910
Percentage non-white or Hispanic 1990	3.631	1.059	3.430	0.001	37.770	4.740	301.060
Percentage college-educated 1990	-0.747	1.477	-0.510	0.613	0.470	0.030	8.570

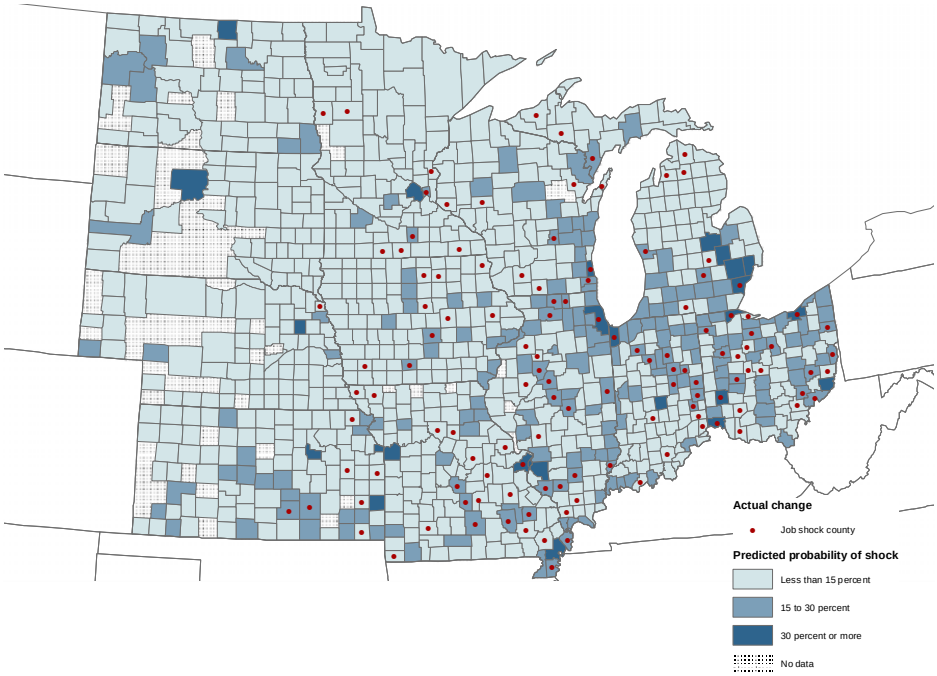
Model: Shock 1998-2001

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Const(1)	-1.317	0.531	-2.480	0.013			
Const(2)	0.961	0.530	1.810	0.070			
Metropolitan county (1 = metro)	0.178	0.197	0.900	0.366	1.200	0.810	1.760
Percentage manufacturing employment	3.745	0.861	4.350	0.000	42.290	7.820	228.580
Average earnings per mfg job 1998	0.006	0.008	0.690	0.487	1.010	0.990	1.020
Nonfarm, non-mfg job growth 1993-98	-0.616	0.685	-0.900	0.368	0.540	0.140	2.070
Manufacturing specialization index 1997	-0.343	0.437	-0.780	0.433	0.710	0.300	1.670
Firm size index 1997	0.000	0.000	0.510	0.611	1.000	1.000	1.000
National productivity growth index 1994-97	0.204	2.389	0.090	0.932	1.230	0.010	132.530
Balance of trade change index 1993-98	3.154	1.044	3.020	0.003	23.430	3.020	181.450
National job change index 1994-97	-2.916	2.904	-1.000	0.315	0.050	0.000	16.060
National export focus index 1998	-0.069	0.556	-0.120	0.902	0.930	0.310	2.780
Natural resource dependency index 1992	-2.424	1.187	-2.040	0.041	0.090	0.010	0.910
Percentage non-white or Hispanic 1990	4.891	1.368	3.570	0.000	133.040	9.100	1944.360
Percentage college-educated 1990	-2.176	1.492	-1.460	0.145	0.110	0.010	2.110

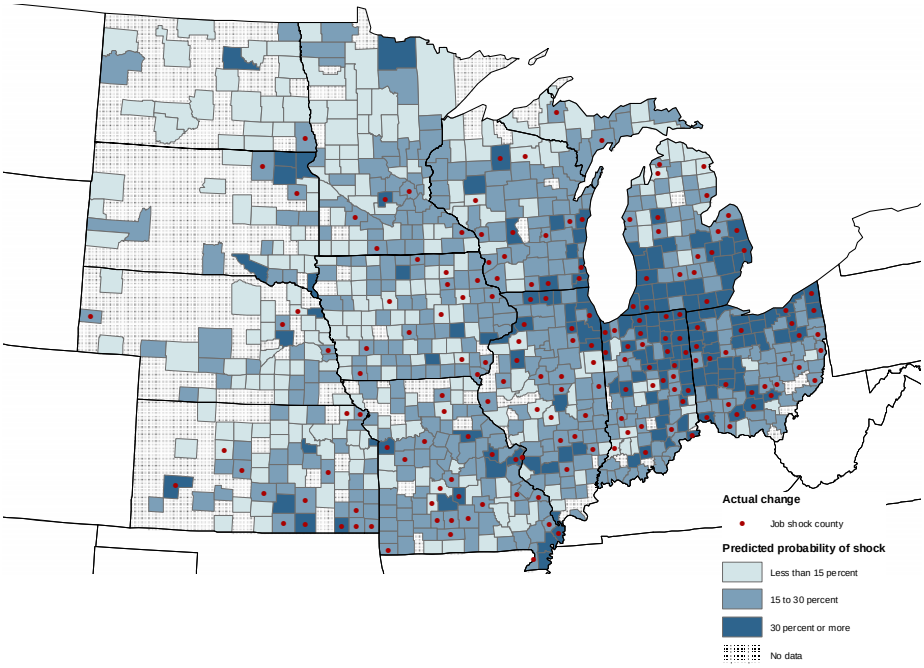
Predicted values for a job shock event at the county level are illustrated in the following two maps. Areas shaded in darkest blue had the highest predicted probabilities for a job shock. The two maps show stark contrast in the patterns of predicted job losses. In the first map, which illustrates the model results for the earlier time period, relatively fewer counties were predicted to experience job losses. The probabilities for experiencing a job shock were higher and more widespread in the later time period.

The actual locations of the job shock counties are overlaid on the maps to compare the actual county experiences with the predicted risks. For the most part, the actual locations of manufacturing job shocks did not align very well with the predicted locations. Our failure to predict manufacturing job losses in our own state of Iowa is notable. These results suggest the models fail to explain a large fraction of the variability in individual county experiences.

Probability of Manufacturing Job "Shocks," 1990-1993



Probability of Manufacturing Job "Shocks," 1998-2001



Discussion and Conclusions

Local development officials in many Midwestern communities are faced with a dilemma. Should they build upon their manufacturing foundation, even if it's showing cracks, or should they diversify and break ground in new industrial territory? While no economic development strategies provide guaranteed success, industry targeting or cluster development strategies tied to the manufacturing sector seem riskier than many local officials can bear. Some hold out hope the Biotechnology Fairy will leave a pharmaceutical cluster beneath their pillow, but this goal is unrealistic for most regions in the Midwest. Sometimes by default, these regions are concluding that their fortunes remain tied to the success of their manufacturing sectors.

In this paper, we have attempted to develop a technical assistance tool to assist local development officials in sorting out how dire predictions about the future of the U.S. manufacturing sector translate to their local economies. The modeling exercise detailed in this paper did not provide a very satisfactory tool for predicting major manufacturing job losses. Several data limitations may have contributed to the model's relatively poor performance. First, by working with manufacturing industry data at the aggregated, 2-digit SIC level, we lose some important detail and industry dynamics. County-level analysis introduces additional problems; at county level, we have difficulty obtaining detailed employment data by manufacturing industry, and must rely on estimates using firm size data. Even at the 2-digit industrial level, data suppression in several counties limits our analysis. Finally, several of the individual variables may have been oversimplified, especially those reflecting national trends in productivity and export or import focus.

The real value of this exercise may have been the development of the data set rather than the model itself. Our goal of distilling a collection of indicators into one predicted risk value may actually disserve our intended audience. As a next step, we are considering developing our data set into a schedule of individual risk factors, allowing for comparison of risk factors along a more detailed schedule of manufacturing industries at the local level. We also plan to investigate how counties recover from manufacturing job shocks, which might be of some assistance to local planners in planning for the aftermath of possible, future manufacturing job losses.

APPENDIX: DETAILED MODEL RESULTS

Model: Shock 1990-93

Ordinal Logistic Regression: Rvgroup versus Metro, Pctmfgjobs_90, ...

Link Function: Logit

Response Information

Variable	Value	Count
Rvgroup	1	123
	2	298
	3	569
	Total	990

Logistic Regression Table

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Const(1)	-2.40571	0.452581	-5.32	0.000			
Const(2)	-0.651987	0.444368	-1.47	0.142			
Metro	0.0663251	0.197129	0.34	0.737	1.07	0.73	1.57
Pctmfgjobs_90	1.70243	0.755560	2.25	0.024	5.49	1.25	24.13
Avgwg_90	0.0206605	0.0093493	2.21	0.027	1.02	1.00	1.04
NFNMjchg_8590	-2.43314	0.702544	-3.46	0.001	0.09	0.02	0.35
Firmcon1_90	-0.528506	0.366638	-1.44	0.149	0.59	0.29	1.21
Herf_90	0.0000608	0.0000407	1.49	0.135	1.00	1.00	1.00
Prodchg_P1	2.81451	1.27902	2.20	0.028	16.69	1.36	204.67
Trade_P1	0.900498	0.672412	1.34	0.181	2.46	0.66	9.19
Jobchg_P1	-0.132388	1.73602	-0.08	0.939	0.88	0.03	26.32
Export_90	-0.489691	0.404943	-1.21	0.227	0.61	0.28	1.36
NatResDep	-0.819913	0.963500	-0.85	0.395	0.44	0.07	2.91
Pctmin90	3.63140	1.05914	3.43	0.001	37.77	4.74	301.06
Pctcoll90	-0.747421	1.47735	-0.51	0.613	0.47	0.03	8.57

Log-Likelihood = -892.902
Test that all slopes are zero: G = 73.050, DF = 13, P-Value = 0.000

Goodness-of-Fit Tests

Method	Chi-Square	DF	P
Pearson	1931.26	1965	0.702
Deviance	1785.80	1965	0.998

Measures of Association:
(Between the Response Variable and Predicted Probabilities)

Pairs	Number	Percent	Summary Measures	
Concordant	171972	62.3	Somers' D	0.25
Discordant	102032	36.9	Goodman-Kruskal Gamma	0.26
Ties	2199	0.8	Kendall's Tau-a	0.14
Total	276203	100.0		

Model: Shock 1998-2001

Ordinal Logistic Regression: Revgrp versus Metro, Pctmfgjobs_98, ...

Link Function: Logit

Response Information

Variable	Value	Count
Revgrp	1	179
	2	401
	3	266
	Total	846

Logistic Regression Table

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Const(1)	-1.31674	0.530778	-2.48	0.013			
Const(2)	0.960808	0.529640	1.81	0.070			
Metro	0.178389	0.197272	0.90	0.366	1.20	0.81	1.76
Pctmfgjobs_98	3.74450	0.860912	4.35	0.000	42.29	7.82	228.58
Avgwg_98	0.0057219	0.0082353	0.69	0.487	1.01	0.99	1.02
NFNMjchg_9398	-0.616037	0.684505	-0.90	0.368	0.54	0.14	2.07
Firmcon1_97	-0.342542	0.436501	-0.78	0.433	0.71	0.30	1.67
Herf97	0.0000176	0.0000346	0.51	0.611	1.00	1.00	1.00
Prodchg_P2	0.204396	2.38901	0.09	0.932	1.23	0.01	132.53
Trade_P2	3.15386	1.04444	3.02	0.003	23.43	3.02	181.45
Jobchg_P2	-2.91565	2.90412	-1.00	0.315	0.05	0.00	16.06
Export_P2	-0.0685066	0.555886	-0.12	0.902	0.93	0.31	2.78
Natres	-2.42397	1.18704	-2.04	0.041	0.09	0.01	0.91
Pctmin90	4.89068	1.36837	3.57	0.000	133.04	9.10	1944.36
Pctcoll90	-2.17612	1.49179	-1.46	0.145	0.11	0.01	2.11

Log-Likelihood = -840.167
Test that all slopes are zero: G = 89.963, DF = 13, P-Value = 0.000

Goodness-of-Fit Tests

Method	Chi-Square	DF	P
Pearson	1649.94	1677	0.677
Deviance	1680.33	1677	0.472

Measures of Association:
(Between the Response Variable and Predicted Probabilities)

Pairs	Number	Percent	Summary Measures	
Concordant	147950	65.4	Somers' D	0.31
Discordant	76858	34.0	Goodman-Kruskal Gamma	0.32
Ties	1251	0.6	Kendall's Tau-a	0.20
Total	226059	100.0		

Minimum, Median, and Maximum Values of 1990-93 Model Variables by 1993 BEALE Code

BEALE	Minimum	Median	Maximum
Percentage manufacturing employment			
0	0.0517	0.1703	0.3087
1	0.0256	0.1756	0.3708
2	0.0306	0.2113	0.5051
3	0.0194	0.1646	0.5076
4	0.0553	0.2243	0.3709
5	0.0191	0.1588	0.3021
6	0.0055	0.1751	0.5043
7	0.0099	0.1521	0.4422
8	0.0112	0.0994	0.3889
9	0.0085	0.0724	0.4976
Average earnings per mfg job			
0	27.43	39.54	58.83
1	17.16	29.46	48.48
2	18.98	33.45	56.19
3	12.58	31.13	51.54
4	20.29	31.47	45.57
5	19.68	26.35	36.96
6	13.50	25.73	51.71
7	9.64	23.62	45.94
8	10.89	21.05	80.04
9	7.44	18.28	56.85
Nonfarm, non-mfg job growth			
0	-0.0130	0.2110	0.5310
1	-0.0850	0.2090	0.4180
2	-0.0080	0.1590	0.5100
3	-0.1150	0.1340	0.2720
4	-0.0130	0.1055	0.2510
5	-0.0490	0.0945	0.1970
6	-0.3560	0.0840	0.4460
7	-0.4560	0.0660	0.5610
8	-0.1530	0.0565	0.3070
9	-0.3360	0.0330	0.4890
Manufacturing specialization index			
0	0.1398	0.2165	0.3267
1	0.1294	0.3182	0.8000
2	0.1460	0.2857	0.8126
3	0.1624	0.3094	0.7911
4	0.1439	0.2820	0.6683
5	0.1993	0.3225	0.8142
6	0.1521	0.3956	0.9528
7	0.1448	0.4348	1.0000
8	0.2221	0.5559	0.9766
9	0.2210	0.5752	1.0000
Firm size index			
0	178	3048	64637
1	3	322	1410
2	30	723	7493
3	7	535	5904
4	89	338	1220
5	59	192	704
6	15	110	1048
7	4	77	855
8	3	35	413
9	1	19	452
National productivity growth index			
0	0.0179	0.0981	0.1715
1	-0.0141	0.0783	0.1955
2	-0.0465	0.0783	0.2172
3	-0.0212	0.0804	0.1765
4	0.0276	0.0967	0.1720
5	0.0140	0.0836	0.1618
6	-0.0695	0.0720	0.2175
7	-0.0767	0.0642	0.3231
8	-0.0919	0.0475	0.2646
9	-0.1100	0.0510	0.2586

BEALE	Minimum	Median	Maximum
Balance of trade change index			
0	0.1166	0.1970	0.2696
1	0.1187	0.1840	0.5176
2	0.0424	0.1825	0.3344
3	-0.0078	0.2137	1.0093
4	0.0607	0.1879	0.3199
5	0.0590	0.1684	0.4623
6	0.0041	0.1963	0.6164
7	0.0077	0.1973	0.6600
8	-0.0485	0.2220	0.6771
9	-0.0800	0.2186	0.6644
National job change index			
0	-0.0291	0.0395	0.1023
1	-0.0343	0.0337	0.1863
2	-0.0429	0.0377	0.1208
3	-0.0715	0.0358	0.1436
4	-0.0277	0.0293	0.0894
5	-0.0385	0.0254	0.1141
6	-0.1166	0.0307	0.2811
7	-0.1223	0.0314	0.3781
8	-0.0989	0.0366	0.0974
9	-0.1640	0.0366	0.4480
National export focus index			
0	0.7815	0.9811	1.1338
1	0.6205	0.9343	1.3077
2	0.5731	0.9322	1.5597
3	0.7003	0.9754	2.2039
4	0.7442	0.9101	1.1754
5	0.6148	0.9817	1.3218
6	0.3861	0.8871	1.5556
7	0.3368	0.9375	1.7000
8	0.2087	0.9903	1.6154
9	0.1903	1.0293	1.7000
Natural resource dependency index			
0	0.0038	0.0246	0.0716
1	0.0017	0.0236	0.3017
2	0.0032	0.0280	0.1952
3	0.0047	0.0502	0.2984
4	0.0044	0.0506	0.2372
5	0.0045	0.0587	0.3071
6	0.0009	0.0335	0.3257
7	0.0002	0.0298	0.3692
8	0.0006	0.0482	0.3681
9	0.0005	0.0270	0.3708
Percentage non-white or Hispanic			
0	0.0193	0.1129	0.4979
1	0.0095	0.0244	0.1620
2	0.0102	0.0515	0.2413
3	0.0057	0.0470	0.1816
4	0.0156	0.0446	0.1106
5	0.0169	0.0565	0.3344
6	0.0026	0.0159	0.1037
7	0.0006	0.0181	0.3370
8	0.0021	0.0121	0.4441
9	0.0010	0.0122	0.6697
Percentage college-educated			
0	0.1035	0.2097	0.4187
1	0.0602	0.1269	0.264
2	0.0665	0.1458	0.3415
3	0.0777	0.1561	0.4399
4	0.0849	0.13165	0.3836
5	0.0948	0.1459	0.3425
6	0.0522	0.1036	0.214
7	0.0605	0.1182	0.3627
8	0.0557	0.0977	0.1825
9	0.0483	0.10625	0.2414

Minimum, Median, and Maximum Values of 1998-2001 Model Variables by 1993 BEALE Code

Percentage manufacturing employment

BEALE	Minimum	Median	Maximum
0	0.0638	0.1514	0.2827
1	0.0115	0.1392	0.3401
2	0.0439	0.1951	0.4457
3	0.0378	0.1509	0.4438
4	0.0429	0.2080	0.3443
5	0.0232	0.1481	0.2740
6	0.0277	0.1729	0.4684
7	0.0183	0.1571	0.4472
8	0.0294	0.1277	0.5854
9	0.0105	0.1099	0.4650

Average earnings per mfg job

BEALE	Minimum	Median	Maximum
0	39.61	54.24	87.97
1	21.89	39.00	74.15
2	24.33	43.96	88.62
3	26.23	41.30	82.32
4	23.73	40.44	61.54
5	20.36	34.36	45.10
6	20.82	34.14	77.07
7	7.15	32.73	56.78
8	9.89	29.34	51.67
9	8.45	26.90	64.41

Nonfarm, non-mfg job growth

BEALE	Minimum	Median	Maximum
0	-0.0240	0.1500	0.3390
1	0.0610	0.2295	0.4670
2	0.0300	0.1475	0.5360
3	-0.0150	0.1160	0.3220
4	-0.0180	0.1060	0.2570
5	-0.1210	0.1105	0.1800
6	-0.0960	0.1200	0.7430
7	-0.1500	0.1100	0.3560
8	-0.1460	0.1110	0.4180
9	-0.0380	0.1075	0.7420

Manufacturing specialization index

BEALE	Minimum	Median	Maximum
0	0.1478	0.2113	0.3050
1	0.1553	0.3076	0.6790
2	0.1516	0.2778	0.7495
3	0.1530	0.2876	0.6746
4	0.1464	0.2621	0.6837
5	0.1585	0.3325	0.8376
6	0.1646	0.3774	0.9446
7	0.1474	0.4348	0.8978
8	0.1957	0.4200	0.7615
9	0.2445	0.5000	0.9091

Firm size index

BEALE	Minimum	Median	Maximum
0	251	4024	55688
1	56	437	2457
2	67	904	8245
3	79	702	5446
4	88	423	1569
5	43	224	690
6	13	144	1167
7	6	104	1207
8	8	54	424
9	5	39	400

National productivity growth index

BEALE	Minimum	Median	Maximum
0	0.0105	0.0723	0.0856
1	0.0106	0.0681	0.1125
2	0.0193	0.0621	0.1375
3	-0.0231	0.0652	0.1013
4	0.0196	0.0647	0.1007
5	0.0245	0.0670	0.1173
6	-0.0471	0.0582	0.1231
7	-0.0532	0.0579	0.1675
8	-0.0262	0.0575	0.1606
9	-0.0672	0.0512	0.1274

Balance of trade change index

BEALE	Minimum	Median	Maximum
0	-0.2185	-0.1336	-0.0626
1	-0.3341	-0.1184	-0.0364
2	-0.3208	-0.1353	-0.0300
3	-0.2735	-0.1380	-0.0427
4	-0.2902	-0.1293	-0.0086
5	-0.3034	-0.1389	-0.0642
6	-0.3259	-0.1230	0.0147
7	-0.3727	-0.1366	0.0648
8	-0.3144	-0.1578	-0.0061
9	-0.4019	-0.1659	-0.0076

National job change index

BEALE	Minimum	Median	Maximum
0	0.0146	0.0335	0.0570
1	-0.0155	0.0364	0.0590
2	-0.0182	0.0368	0.0617
3	-0.0066	0.0360	0.0675
4	-0.0718	0.0361	0.0661
5	-0.0008	0.0329	0.0584
6	-0.0714	0.0380	0.0728
7	-0.1132	0.0349	0.0800
8	-0.1152	0.0411	0.0729
9	-0.0972	0.0347	0.0778

National export focus index

BEALE	Minimum	Median	Maximum
0	0.6662	0.8550	0.9748
1	0.6267	0.7832	1.1519
2	0.5591	0.8320	1.1651
3	0.6101	0.8301	1.1043
4	0.5638	0.8054	1.1386
5	0.6933	0.8635	1.0899
6	0.2945	0.7792	1.1448
7	0.3261	0.7977	1.1751
8	0.2955	0.7923	1.0586
9	0.3207	0.7217	1.3273