Evaluating the Conexus Indiana/Ball State University Manufacturing Scorecard: Evidence from 2008-2014

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Introduction

The Conexus Indiana/Ball State University Manufacturing Scorecard was begun in 2008 to provide a relative measure of the strength of manufacturing and logistics in each U.S. state. The methodology was updated in 2009 to separate grades by individual categories, and again in 2010 and 2012 to incorporate sector diversification and expected liability gap categories. As of the June 2014 release, the scorecard incorporated 46 separate rankings into nine functional areas. These data are updated each year to reflect the most recent data release as of early April in each year of the scorecard. See *Appendix Table 1.*

The variables were chosen and updated to reflect variables that were identified either in academic and scholarly research or through anecdote from businesses and site selectors to reflect those factors at the state level that would influence a business location decision. Obviously these are not exhaustive metrics. Businesses relocate for reasons other than these, to include proximity to input and output markets, location specific characteristics such as available water supply or an inexpensive railhead, and for idiosyncratic reasons such as an individual owner's household residence preferences.

In order to better understand what variables might be relevant, we recommend scholarly studies such as Love and Crompton (1999) and Buss (2001) along with others listed in the references. The focus here was to include more, rather than fewer, variables in each

category. The reason for this is that there would inevitably be a high level of covariance in these rankings, which would allow similar rankings to reinforce results, rather produce outliers. Moreover, weighting individual measures in a way that reflects their importance to specific types of manufactures is probably not possible. The reason for this is that such factors as the relative exportability of products, the deepness of supply chains for intermediate inputs, the wage rate, and the capital labor ratio would all influence the relative importance of particular factors.

An example of the difficulty in weighting specific variables would be to compare the cost of benefits between two firms, one that processes tomatoes into consumer products, and the other that manufactures precision medical devices. While both would be concerned with worker benefit costs, the per worker health care premium would likely be very similar across both businesses. Obviously, this would matter more to the first firm because this is a lower skilled, lower wage firm. So, a $1,000 per worker variation in health care premiums affects a business paying $29,000 per worker much more heavily than one paying $56,000 per worker. Thus, we do not weight the factors, allowing for covariance in specific categories to influence individual rankings.

However, the overall efficacy of the rankings should be of interest to policymakers and businesses and would serve as a tool for our own assessment of the ranking procedure and data. It is to that end we now turn our attention.

How Well Does the Scorecard Work?

To offer a preliminary test of this, we hypothesize that better rankings will correlate with higher levels of manufacturing growth at the state level. While there are few years of data available, we test the relationship between annual rankings and the growth in overall manufacturing real gross domestic product in each state from 2007 through 2013. Since the newest data from each annual manufacturing scorecard reflects data from the previous year, we construct a basic treatment model where the growth of manufacturing real GDP is a function of the relative raw scores (1 through 50, with lower numbers representing better relative scores) and statistical controls designed to account for factors that do not change at the state level during the test period (state fixed effects intercepts) and corrections for spatial and temporal autocorrelation (see Pesaran 2006).

This model takes the form:

$$\boldsymbol{Y_{s,t} - \overline{Y_t} = c + c_s + \rho R_{s,t} + \theta \delta_{s,t} + e_{s,t}}$$

where Y is real manufacturing gross domestic product for state s, in year t, and $\overline{Y_t}$ is the mean state real manufacturing GDP in log specification. This correction (Pesaran 2006) corrects for spatial autocorrelation which might otherwise bias the estimated value of ρ which is the marginal effect of the rankings, R, [1,50] for each state s, in year t. The

common intercept c and state specific intercept/error terms c_s control for common factors across all states and for conditions within states which are time invariant during this period. We also include a temporal autocorrelation control for a single lagged variable, $\theta\delta_{s,t}$, which we assume as AR(1) as well as a panel error term assumed iid → N[0,1], which is $e_{s,t}$.

We employ an alternative specification using a first order continguity matrix to estimate a spatial autocorrelation function for the 48 conterminous states, with cross sectional weighted (GLS) estimators. The coefficient from this estimate is smaller than either the method offered by Pesaran 2006 or the non-spatially adjusted estimate of ρ. Both estimated coefficients were strongly statistical significant. The magnitude of both estimates suggests important correlations between the manufacturing scorecard grades and real GDP growth during this period. See *Table 1.*

Table 1. Impact of Manufacturing Rankings on Real Manufacturing GDP Growth

Variable	Model 1	Model 2
Intercept	-0.60***	3.83***
	(-24.95)	(6.69)
Manufacturing Score	-0.002**	-0.001***
	(-2.17)	(-3.43)
Weighted Adjacent Mfg GDP	. . .	0.59***
		(10.91)
AR(1)	0.47***	0.49***
	(5.28)	(10.38)
Adjusted R2	0.97	0.99
F-statistic	2443.2***	5396.7***
Durbin Watson	2.01	2.15

Interpreting Model 2 is more intuitive because the dependent variable is percentage change in GDP in each state in a year. This estimate suggests there is a correlation for which growth in real manufacturing GDP from year to year will be 0.996 percent higher for each position in the ranking a state improves. For example, moving from 25th to 20th in the manufacturing scorecard ranking should increase a state's real manufacturing growth rate by 4.98 percentage points.

Summary

The manufacturing scorecard is designed to help policymakers and interested businesses leaders assess the health of their manufacturing sectors. The brief analysis suggests that the aggregate scorecard rankings do correlate strongly with growth in manufacturing production over the period 2008 through 2014 (data from 2007-2014). This finding should encourage policymakers to assess what among their rankings are relatively poor, and focus efforts on improving the underlying conditions if they wish to see an expansion of manufacturing in their state.

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Appendix

Table 1. Manufacturing Scorecard Data

Category and Item	Data Sources
Manufacturing Industry	
Manufacturing Share of Economy	Bureau of Economic Analysis
Manufacturing Wage Premium	Bureau of Economic Analysis
Per Capita Manufacturing Employment	Bureau of Economic Analysis, Census
Logistics Industry	
Logistics employment per Capita	Bureau of Economic Analysis, Census
Commodity Flows per Capita rail	Bureau of Transportation Statistics, Census
Commodity Flows per Capita Road	Bureau of Transportation Statistics, Census
Logistics Share of Economy	Bureau of Economic Analysis
State Infrastructure Spending (Share of Personal Income)	Bureau of Transportation Statistics, Bureau of Economic Analysis
All Modes Shipment of Commodities Value	Bureau of Transportation Statistics
All Modes Shipment of Commodities TONN	Bureau of Transportation Statistics
All Modes Shipment of Commodities TONN MILES	Bureau of Transportation Statistics
Highway Infrastructure Investment Total Distribution	Federal Highway Administration
T&I Comm. Infrastructure Investment Total	Federal Highway Administration
Human Capital	
Percent with High School Degree or Greater	Census-American Community Survey
Percent with BA Degree	Census-American Community Survey
1st Year Retention Rate CTC Colleges	National Center for Higher Education Management Systems
AA Awarded per Capita	National Center for Higher Education Management Systems
Enrollment in Adult Basic Education	National Center for Higher Education Management Systems
Younger Workers with AA	Census-American Community Survey
8th Grade Math Scores	National Center for Educational Statistics
High School Graduation Rate	National Center for Educational Statistics
Benefits Costs	
Health Care Premiums	National Center for Health Statistics
Long Term Health Care Costs	American Association of Retired Persons
Worker's Compensation Rates	National Academy of Social Insurance
Fringe Benefit Share of Wages	Bureau of Economic Analysis
Federal Total Expenditure	USA Spending
Global Position	
Manufacturing Exports per Capita	Census, Census of Manufacturers
Per Capita Income Derived from Foreign-Owned Manufacturers	Bureau of Economic Analysis
Export Growth	Census, Foreign-Trade
Reach of Foreign Direct Investment	Bureau of Economic Analysis
FDI Value Added in Manufacturing	Bureau of Economic Analysis
Demand Adaptability Index	CBER (Thaiprasert 2009)

Productivity and Innovation	
Growth in Manufacturing Value Added	Census, Census of Manufacturers
R&D Rank	National Science Foundation
Patents per Capita	U.S. Patent and Trademark Office, Census
Average MFG productivity of state	Bureau of Economic Analysis
Tax Climate	
Corporate Tax Index Rank	Tax Foundation, Internal Revenue Service
Individual Income Tax Index Rank	Tax Foundation, Internal Revenue Service
Sales Tax Index Rank	Tax Foundation, Internal Revenue Service
Unemployment Insurance Tax Index Rank	Tax Foundation, Internal Revenue Service
Property Tax Index Rank	Tax Foundation, Internal Revenue Service
Diversification	
Diversification Index	Bureau of Economic Analysis; Author Calculations
Expected Fiscal Liability Gap	
Unfunded Liability per Capita	Boston College Center for Retirement Research, Bureau of Economic Analysis
Unfunded Liability as a Percentage of GDP	Boston College Center for Retirement Research, Census
Average Benefits Rank (total benefits divided by total retirees)	Boston College Center for Retirement Research, Census
S&P Bond Ratings Rank	Standard and Poor's