Revisiting Manufacturing Employment in South Carolina

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ABSTRACT

This paper uses panel data from South Carolina to determine the impact of the regional economy on local manufacturing employment from 2001-2009. Tests for spatial dependence confirm the impact of the regional economy on manufacturing employment change. As such, studies disregarding the effects of location are yielding biased estimates. The results show that it may be in the best interest of state officials to target manufacturing development to regions with existing manufacturing growth.

INTRODUCTION

Most industrialized nations have experienced a decline in manufacturing employment over the last few decades (Fisher 2004). Only the developing nations like China and India have experienced growth in manufacturing employment due to low labor and transportation costs. Prior to 2010, there had been a steady decline in manufacturing jobs for the state of South Carolina as well as the nation since the 1980's. Data from the Bureau of Economic Analysis show that the state lost thirty percent of its manufacturing jobs from 2001-2009.

Fisher (2004) provided three reasons why manufacturing employment was declining. The reasons include international conditions, taxes, and productivity growth. Then, in 2010, there was an increase in American manufacturing employment. This was a very important for counties dependent on manufacturing as it brought jobs to those areas. This recent change in manufacturing growth spurred several questions. First, what caused this change? Was it due to the American economy rebounding from the recession? Did it signal a reversal in the composition in the American economy? Next, did all states in the nation share in this growth? Also, was the growth limited to specific regions within the states?

Manufacturing plants tend to locate in regions with other manufacturing plants. Regional clusters, like the I-85 automotive corridor in South Carolina, provides lower costs to related firms in the industry due to the presence of related input suppliers. These clusters, or agglomerated economies, have been shown to influence employment growth (James et al. 2002 and Gruidl and Walzer 1992). This location effect suggests another issue that must be addressed: spatial dependence. Spatial dependence refers to the fact that an observation at one location depends on factors from that location as well as factors from other locations. Uncontrolled spatial dependence results in the possibility of biased and sometimes inconsistent parameter estimates (Elhorst 2001). Lesage (1999) provides an example of how the unemployment rate and labor force would exhibit spatial dependence because workers could easily move across county lines when seeking employment.

The objectives of this study, which are consistent with those outlined in Lewis et al. (2012), are to test for the presence of spatial dependence and determine the importance of the regional economy in explaining the change in manufacturing employment. The unique contribution of this paper is to shed light on the spillover effects of manufacturing growth. South Carolina has been successful at recruiting large manufacturers to the state like BMW and Boeing. However, this was not free. Millions of dollars in tax incentives was provided to the firms to relocate to the state. Given this history, it is safe to say that the state will be using additional tax incentives to increase manufacturing recruitment. It would be best to control for spatial dependence to prevent the possibility of relying on biased and inconsistent estimates to design economic development policies to increase manufacturing employment.

LITERATURE

Manufacturing importance

Mature manufacturing industries prefer rural areas as they provide the key production input: cheap unskilled labor. This sector tends to be the dominant industry in most rural counties, accounting for 36 percent of personal income (Henry 1993) and 22 percent of jobs (Bloomquist 1988). South Carolina, like most of the states in the southeast United States, is predominantly rural and dependent on manufacturing. Thirty of the 46 counties in South Carolina are rural. In addition, manufacturing employment accounted for over 16 percent of total employment in South Carolina in 2010 (Clayton 2011).

Productivity Growth

Productivity is usually defined and measured as output per worker. Generally speaking, better technology results in lower production costs which results in increased output. Decades prior to 2010, manufacturing employment in the United States decline while manufacturing output increase. Several studies have concluded that this increase in output was partly a result of technological improvement (Fisher 2004, Bivens 2004, Brauer 2004, and Fisher and Rupert 2005). While globalization gets most of the blame for the declining manufacturing employment in the United States, some of the blame must be placed on worker productivity.

Local Economy

Stronger local economies tend to have greater economic growth and development (James et al. 2002). Various measures have been used to capture the strength of the local economy. Luloff and Chittenden (1984) used the presence of a manufacturing industry while Gruidl and Walzer (1992) used manufacturing density. In addition, the unemployment rate is often used to measure the strength of the local economy. Bartik and Eberts (1999) suggested including employment growth rates and industry mix variables to capture the true strength of the local economy. Similarly, Goetz et al. (1998) added job growth and retail employment to measure the strength of the local economy.

Spatial dependence

Spatial dependence is the cross section equivalent to serial correlation in time series data. Serial correlation occurs when the error terms are correlated in time series data. Specifically, the error term in one time period is correlated with error terms from different time periods. On the other hand, spatial dependence or spatial correlation occurs when the error term from one location (space) is correlated with the error term from another location. In both cases, the correlation results from the error term capturing the effects of omitted variables. As a result, failure to control for either type of correlation results in estimates that are inefficient, biased, or inconsistent.

Spatial econometrics is employed to control for the effects of location in sample data. Lesage (1999) explains the modeling techniques required to perform spatial analysis. Previous studies examining spatial dependence looked at retail prices, consumer demand, government taxation, agriculture, corruption, and job growth (Elhorst 2010, Ivanova 2011, Kumar 2011, Brueckner 2003, and Baltagi et al. 2000). In each study, an economic activity in the local area was influenced by neighboring communities. For example, Elhorst (2010) used spatial econometrics to explain changed in consumer demand for cigarettes. His study found that cigarette demand increased in one state as neighboring states implemented higher cigarette taxes.

The growth of spatial econometrics can be linked to the publication of Spatial Econometrics: Methods and Models by Luc Anselin in 1988. There are three models of spatial dependency. First, there is the spatial error model (SEM). In this model, spatial dependency operates through the error term. Next is the spatial autoregressive model (SAR). This model has spatial dependency operating through lags of the dependent variable. The last model is the general spatial model (SAC). This model is a combination of the SEM and the SAR.

The SEM takes the following form:

$$y = X\beta + \varepsilon \quad (1)$$
$$\varepsilon = \delta W\varepsilon + e \quad (2)$$
$$e \sim N(0,\sigma^2 I_n) \quad (3)$$

where y is a nx1 vector of the dependent variable, X is the nxk matrix of explanatory variables, β is the k parameters estimated for the explanatory variables, δ is the spatial error autocorrelation coefficient, W is the spatial weight matrix, and ε is the normal error term for the regression model. The SAR takes the form:

$$y = \rho Wy + X\beta + \varepsilon \quad (4)$$
$$\varepsilon \sim N(0,\sigma^2 I_n) \quad (5)$$

In this model, ρ is the spatial autoregressive parameter. The SAC takes the form:

$$y = \rho Wy + X\beta + \varepsilon \quad (6)$$
$$\varepsilon = \delta W\varepsilon + e \quad (7)$$
$$e \sim N(0,\sigma^2 I_n) \quad (8)$$

The researcher must perform a step by step procedure to determine which model is appropriate to ensure consistent and unbiased parameter estimates.

DATA AND METHODS

The data used in the models are consistent with those explored in Lewis et al. (2012). Unemployment rates were obtained from the Bureau of Labor and Statistics and county identifiers were extracted from the United States Department of Agriculture. County Business Patterns (U.S. Census Bureau) provided the employment data and Regional Economic Information System (REIS) from the Bureau of Economic Analysis provided data on per capita income.

Data collected on employment change in manufacturing for 46 counties (1998 to 2009) was used in this paper. Because counties within a state tend to have more similarities than states in distant regions within a nation, counties are employed as the spatial unit for the spatial analysis. However, this eliminates testing for the importance of productivity as output is not measured at the county level.

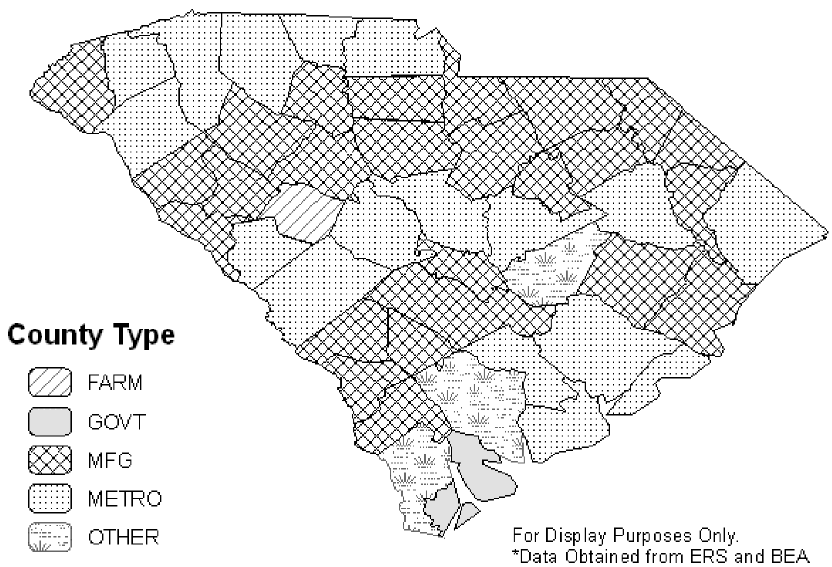
<u>Test for Spatial dependency</u>

The investigation for spatial dependence is consistent Boarnet (1994). A spatial contiguity matrix of n x n (46 x 46 for South Carolina) is developed for this paper with the elements having a value of 1 if the county i is contiguous to county j; else, the value is 0. This matrix is then used to test for spatial dependence using the models described in the literature review. The routines employed in this paper were developed by J. Paul Elhorst. These and other spatial routines can be found at his website www.regroningen.nl/elhorst.

It should be noted that three labor markets are not fully captured because of state boundaries and lack of data. The areas include Charlotte, North Carolina, Augusta, Georgia, and Savannah, Georgia. These metro areas border South Carolina and commuting statistics show that residents of South Carolina are crossing the state line for employment in these areas. Consequently, the potential labor markets for these areas are understated.

Figure 1 shows South Carolina counties based on industry dependence. The dark shaded regions (cross-hatch) are counties dependent on manufacturing employment (over 20 percent of total employment is in manufacturing). It is no surprise that counties with a large share of manufacturing employment are clustered together. This clustering suggests that a spatial dependence is present and should be tested for in models attempting to explain the change in manufacturing employment.

Figure 1: Industry Dependence for SC Counties



Model

The model employed in this paper is based on the structure outlined in Lewis et al. (2012). The econometric specification adopted to predict manufacturing employment change takes the following form:

Mfgchg = $\beta 0$ + $\beta 1$ UnEmp + $\beta 2$ Empchg + $\beta 3$ Income + $\beta 4$ RetEmpC

where,

Mfgchg	= change in county manufacturing employment
UnEmp	= county unemployment rate
Empchg	= change in total employment in county
Income	= county per capita income
RetEmpC	= change in retail employment in county

Independent variables

Unemployment rate is the unemployment rate for the local county and measures the influence of the local economy. It is generally understood that higher unemployment rates are associated with weaker economies. It is expected that the sign on this coefficient will be negative.

Employment growth is a proxy for total employment growth in the local county, and acts as another measure for the strength of the local economy. It is believed that total employment growth is positively associated with growth in individual industry sectors. Therefore, this variable is expected to have a positive sign as strong job growth signals an expanding economy.

Per capita income is used to measure a county's level of development. It is believed that greater incomes exemplify healthy, diversified economies that support service industries. Since national trends indicate a switch to services from manufacturing. Employment in manufacturing is expected to fall as per capita income rises.

As another measure for the strength of the local economy, Retail Employment growth is included in the model and measures the total retail employment growth in the local county. Retail employment growth may decrease manufacturing, and it is worthwhile to investigate this possibility.

RESULTS

Both the Lagrange Multiplier (LM) and the robust LM tests confirm the existence of spatial autocorrelation in the ordinary least squares model (see Table 1: OLS). The null hypothesis of no spatial correlation in the spatially lagged dependent variable and no spatial correlation in the spatial error term are rejected. Hence, there is spatial dependence in manufacturing employment in South Carolina and must be accounted for before interpreting any regression coefficients.

The spatial fixed effects model is selected over the spatial random effects model due to the fact that many South Carolina counties fall in the Black Belt. This region is historically noted for high rates of unemployment and persistent poverty. After controlling for the spatial fixed effect, the LM-tests reject the hypothesis of no spatial dependence in the spatial lag (Table 1: Spatial Fixed Effects). However, the LM-tests fail to reject the hypothesis of spatial dependence in the error term. Thus, there is no need to consider the spatial error model. The SAC model is not considered as it is a combination of the spatial lag and spatial error model. It reduces to the spatial lag model if spatial dependence is not present in the error term of the SAC model. The above procedures indicate that it is appropriate to model manufacturing employment change using a spatially lagged dependent variable with spatial fixed effects.

After controlling for spatial dependence, all explanatory variables in the fixed effects model are highly significant. Initially, the variables for the unemployment rate and per capita income were insignificant in the OLS model.

Table 1. Determination of appropriate model

Determinants	OLS	Spatial Fixed Effects	Spatial Lag with FE
Intercept	89.133(0.53)		
UnEmp	-5.64(-0.59)	-52.56(-3.8) ***	-40.107(-2.72) ***
Income	-0.01(-1.83)	0.03(2.52) **	0.021(2.02) **
EmpChg	0.13(8.65) ***	0.12(8.61) ***	0.119(8.05) ***
RetEmpC	-0.48(-5.55) ***	-0.46(-5.64) ***	-0.48(-5.69) ***
MfgFirmChg	20.12(3.4) ***	12.42(2.24) **	13.37(2.34) **
W*MfgChg			0.18(3.05) ***
R2	0.2440	0.3784	0.3935
LM spatial lag	19.39***	9.49***	
LM spatial error	12.88***	5.88**	
Robust LM spatial lag	8.1***	5.07**	
Robust LM spatial error	1.58	1.46	

Notes: t-values in parentheses; Significance levels ** = 0.05, *** = 0.01

This illustrates the importance of controlling for the spatial dependence before attempting to interpret regression results.

The results find manufacturing employment in South Carolina declines with increases in the local unemployment rate and with increases in retail employment. Specifically, a one percentage point increase in the unemployment rate decreases manufacturing employment by 0.02 percent. In addition, a one percentage point increase in retail employment decreases manufacturing employment by 0.48 percent.

On the other hand, job growth, per capita income, and new manufacturing firms have a direct relationship with manufacturing employment change in the model. A percentage point increase in per capita income increases manufacturing employment by 0.02 percent. Similarly, the same increase in total employment change in the local county results in a 0.12 percent increase. Lastly, the addition of a new manufacturing firm creates approximately 13 jobs.

The coefficient on the spatial lag variable is positive and highly significant. The positive sign confirms the results from Figure 1: counties are similar to their neighbors. They are grouped in clusters. As a result, manufacturing employment in one county depends on manufacturing employment in surrounding counties. In other words, manufacturing employment rises in the local county as manufacturing employment increases in the surrounding counties.

IMPLICATIONS

These findings should provide significant insight for government officials with regards to manufacturing recruitment. For other states that are similar to South Carolina, officials should first determine if a manufacturing region or cluster exists in their state and then apply development strategies for region. The location effect suggests that manufacturing employment is affected by the local economy as well as the economy of neighboring counties. As a result, it would be best for government officials to target future manufacturing growth to regions with manufacturing clusters.

It is reasonable to assume that local governments will continue to offer financial incentives to firms to locate in their areas. Hence, officials should seek the best return on their tax dollars. The competitive nature of this practice reduces the success of any one county being successful at recruiting firms. A regional development authority would have better results at increasing manufacturing employment for all counties within the region. This research supports counties working together is a more beneficial option as manufacturing employment in each county grows as manufacturing employment in the surrounding area grows.

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