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Spatial Shift-Share Analysis of the Leisure and Hospitality Sector on the Gulf Coast following Hurricane Katrina

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Abstract

Employment shifts in the Leisure and Hospitality sector along the Gulf coast following Hurricane Katrina were explored using spatial shift-share analysis. Using a spatial weights matrix that incorporated relative employment, and distance measures relative to the track of the storm we calculated classical and spatial shift-share components. Each of the spatial components then was regressed on net employment change, and the results were statistically significant, and similar to results obtained by Marquez and Ramajo (2005). These results provide evidence that spatial interaction between employment centers as well as with the storm track, was a relevant aspect of the employment shifts that occurred following Hurricane Katrina.

JEL Classification: R11, R12, J21

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Introduction

Katrina, the second of two Category 5 hurricanes of the 2005 Atlantic season, made landfall on the gulf coast near Buras-Triumph, Louisiana on August 29. It was the sixth-strongest Atlantic hurricane ever recorded. It caused severe destruction in Louisiana, especially New Orleans, where more than 1500 lives were lost as a result of failures in the levee system, and across the entire Mississippi coast. Following Katrina, FEMA designated disaster areas included Baton Rouge, Houma-Bayou, Cane-Thibodaux, Lafayette, Lake Charles, and New Orleans-Metairie-Kenner in Louisiana, Gulfport-Biloxi, Hattiesburg, and Pascagoula in Mississippi, and Mobile, Alabama. Flooding characterized the damaging effects of the storm in Louisiana, while Mississippi, and to a lesser extent Alabama and Florida, suffered more from wind and storm surge.

The effects of the storm on population and employment were especially pronounced in its aftermath. The highest population decreases were recorded in Orleans, St. Bernard, Jefferson, and Plaquemines parishes in Louisiana, and Hancock County in Mississippi (Claritas); more than 400,000 persons moved away from these five counties alone. Both Louisiana and Mississippi experienced a sharp rise in mass layoff events and unemployment rates after Hurricane Katrina (Kosanovich, 2006). Mass layoffs resulting from Katrina were concentrated mostly in the accommodation and food services sector, followed by retail trade, and healthcare and social

assistance sectors of the economy; 57,551 separations over the September-December 2005 period were recorded (Brown and Carey, 2006).

Hurricane Katrina also had a strong effect on employment in Louisiana and Mississippi. In the two months following Hurricane Katrina, nonfarm payroll employment in Louisiana fell by 241,000, a decline of 12 percent, while in Mississippi, nonfarm payroll employment fell by 14,000, or about one percent during the same period (Brown *et al.*, 2006). However, the effect of the storm on employment was higher for coastal counties, and concentrated in different sectors: in Louisiana, the education and health services and leisure and hospitality industries lost the most jobs; in Mississippi the leisure and hospitality industry had the highest level of employment decline.

In this paper we examine changes in employment under the lens of shift share analysis, a method by which changes in local employment can be decomposed into various effects. The classical shift-share approach essentially uses three components to explain the disparity between regional and national growth (Heijman and van der Heide, 1998).

The three components of classical shift-share analysis (Table 1) are: [1] a national growth component, which mirrors national trends - it is the share of local job growth that can be attributed to growth of the national economy; [2] an industry mix component, which isolates the fact that nationwide, some industries have grown faster or slower than others; and [3] a competitive share component that is usually attributed to some local comparative advantage such as natural resources, linked industries, or favorable local labor situations - it describes the extent

to which factors unique to the local area have caused growth or decline in regional employment. Note that the terminology for the three components varies in the literature (Herzog and Olsen, 1977); a brief list of alternative names for each of the effects is presented in the heading of Table 1.

The three components of classical shift-share can be obtained with the following identities (Table 2), where E_t is national total employment at time t, E_{it} is national employment in sector i at time t, and e_{it} is regional (*ie*., county-level) employment in sector i at time t.

Table 1. Classical Shift-Share Components

National Growth Effect, Share Effect, Total Share	Industry Mix Effect, Proportional Shift, Compositional Effect	Competitive Effect, Differential Shift, Regional Share
G	$G_i - G$	$g_i - G_i$

Table 2. Employment Change Identities

National Change	National Sector Change	Local Sector Change
$G = (E_t - E_{t-1})/E_{t-1}$	$G_i = (E_{it} - E_{it-1})/E_{it-1}$	$g_i = (e_{it} - e_{it-1})/e_{it-1}$

If we use X_{it-1} to denote the initial level of employment in sector i at time t-1, then:

$$X_{it} = X_{it-1} \cdot G + X_{it-1} \cdot (G_i - G) + X_{it-1} \cdot (g_i - G_i)$$

As an example, consider a hypothetical rural county that experienced employment growth in the manufacturing sector – let the initial level of employment be 1,050 and suppose it grew to 1,085 jobs, or about 3.3%. During the same period, national employment growth was 1.6%, while manufacturing growth at the national level declined, and was -0.6% for the same period.

For this example, g_i= 3.3%, G= 1.6%, and G_i = -0.6%.

National growth effect =	1050 * 0.016	= 16.8
Industry mix effect =	1050 * (-0.006 – 0.016)	= -23.1
Competitive effect =	1050 * (0.033 - (-0.006))	= 41.0
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Total effect =		= 34.7 jobs

For an interpretation of this example analysis recall that the total effect is the sum of the national, industry mix, and competitive effects and is equal to the new level of employment, or 1085 jobs. The analysis suggests that much of that gain (17 jobs) was due to national economic growth, however the manufacturing sector was not as competitive as the national economy, which slowed local employment growth (-23 jobs), and acted to offset the positive local competitive effect.

Shift-share analysis was apparently first used in 1942 by the U.S. National Resources Planning Board (Hoover, 1971). Hoover noted that regional pathologies can arise when a region whose economy is heavily based on a few activities finds itself with shrinking shares of declining activities; shift-share analysis is a useful tool to identify the changing parts of regional activity.

Notable advancements in the use and extension of shift-share analysis include: the use of a homothetic sectoral employment by region that leads to the identification of additional, allocation effects (Esteban-Marquillas, 1972); an alternative approach that includes a specific regional effect and a sectoral regional effect, reflecting the amount of growth derived from the regional industry mix (Arcelus, 1984).

Any spatial unit is affected by the positive and negative effects transmitted from its neighbouring regions (Isard, 1960). Nazara and Hewings (2004) incorporated spatial structure within shift-share analysis and developed an extensive taxonomy of regional growth decomposition based on that idea. The general formula for their model (1) replaces G_i with Wg_i, which is a spatial lag variable that denotes the growth rate of sector i in the neighborhood regions.

$$(1)\ g_i = G + (Wg_i - G) + (g_i - Wg_i)$$

The spatial lag variable is essentially a weighted average of neighboring regions, and is obtained by multiplying a square spatial weights matrix, W, times the conformable column vector of neighboring values. W is a spatial weights matrix whose elements w_{ij} describe the level of interdependence between spatial units i and j. The elements of the spatial weights matrix are

non-negative (Anselin, 1988), based on physical contiguity (Moran, 1948; Geary, 1954), or some measure of similarity (Case et al., 1993; Boarnet, 1998), or some measure of distance (Molho, 1995; Fingleton, 2001). For contiguity, $w_{ij}=1$ if i and j are neighbors according to usually a queen or rook-based strategy, and $w_{ij}=0$ otherwise, with the elements along the main diagonal being equal to zero. Typically the weights in the matrix are standardized with the following conditions:

$$0 \leq w_{ij} \leq 1$$

$$\Sigma_j w_{ij} = 1; \text{ for each row i}$$

An alternative to (1) is Marquez and Ramajo's (2005) concept of pure spatial shift-share (2), which extends the classical model with three additional components that account for the interaction of the neighboring regions.

$$(2)\ g_i = G + (G_i - G) + (g_i - G_i) + (Wg - g_i) + (Wg_i - Wg) + (g_i - Wg_i)$$

The first three components comprise the classical shift-share model, and the last three components include spatial lags. Compared to (1), the first two spatial components include spatial lags for overall growth rates in neighboring regions, Wg. The authors denote the first term as the "net local effect" by which they interpret to be a supra-regional growth rate effect of local type. The second pure spatial component is denoted as the "local structural effect", and represents the influence on the growth of the evolution of sector i at the local (neighborhood) level. The third component is denoted the "local differential effect" and is equivalent to Nazara

and Hewing's "neighbor-region sectoral regional-shift effect"; it is sector i's growth difference between a specific region and its corresponding neighbors, and reflects the reversed impact that neighbors bring into the region under study (Nazara and Hewings, 2004). Marquez and Ramajo applied their model to the study of total value added in the manufacturing sector for 15 Spanish peninsular regions by rearranging (2) and regressing each of the effects, in turn, on "net change", or ($g_i - G$). Their results suggested that the spatial effects, as well as the classical effects were statistically relevant.

Methods

The objective of this research was to: [1] explore employment shifts along the Gulf coast following Hurricane Katrina using classical shift-share analysis; [2] develop a weighting scheme that would incorporate proximity to the storm track; [3] calculate spatial shift-share components after Marquez and Ramajo and test for statistical significance.

For this paper the focus was on fourth-quarter employment change from 2004 to 2005. Considering the importance of tourism along the gulf coast, we considered an important economic sector that accounts for a substantial part of national place-of-work employment: leisure and hospitality services.

Initially we selected a number of counties that were near to the coast and along the path of Hurricane Katrina (HK). While this seemed to be a reasonable method, we ultimately decided to

use a methodology that was more geo-centric and methodological. Counties were selected if the straight-line distance from the county's centroid was less than or equal to 120 nautical miles from the HK storm track, and located within a band that extended from 28.2 degrees North latitude, and 31.9 degrees North latitude. It was within this range that HK sustained hurricane force winds (*i.e.*, 74 miles per hour). Using this method, 58 county areas were selected for the target area, including five counties in Alabama, one county in Florida, 27 parishes in Louisiana, and 25 counties in Mississippi.

Development of the spatial weights matrix was based on two considerations: [1] it should be a row-standardized weighting scheme consistent with the theoretical model of local employment and migration (Molho, 1995; Burridge and Gordon, 1981); and [2] the spatial interaction should incorporate proximity of the target county and neighbors to the storm track, as well as distance from target counties to neighboring counties. Distance-based weights are typically inverse distance (the farther away a neighbor is the less spatial interaction occurs), or exponential (Molho, 1995). The weighting scheme we used was:

$$w_{ij} = (E_j / E_i) \cdot 1 / \text{sqrt}(d_{ij}^2 + d_{is}^2);$$

where: $w_{ii} = 0$

E_i = employment level in county i

E_j = employment level in county j

d_{ij} = distance from county i to county j

d_{is} = distance from county j to the storm track

and: $w_{ii} = 0$

The weighting scheme implies that the spillover effect of employment change in county j on employment change in county i will increase with the level of employment in county j, and decrease with the distance between the two areas, and that the distance of either county from the track of the storm (*i.e.,* the inverse distance measure is effectively the distance from county i to the point along the storm track that is closest to county j).

Neighboring counties were identified for each of the 58 target counties on the basis of proximity with the range set to less than or equal to 30 nautical miles. This guaranteed that each target county had at least one neighbor.

Data

County-level employment data for Louisiana, Mississippi, and Alabama were obtained online from the Bureau of Labor Service's Quarterly Census of Employment and Wages. Fourth quarter employment was calculated for each county as the average of the last three months of each year, 2004 and 2005. Latitude and longitude data for each county were obtained from the Bureau of Justice Statistics, U.S. Counties geographical identifiers and base demographic data file. The storm track datum for Hurricane Katrina was obtained from the National Oceanographic and Atmospheric Administration.

Results

Computation of the shift-share components took approximately 10 minutes using a PHP script on a Linux server. Summary statistics of the 348 classical and spatial shift-share components, along with a measure of net change (NC) are presented in Table 3. Net change for all counties was negative 2.87%, indicating that average growth of the leisure and hospitality sector for the target counties was nearly three percent lower than the national growth rate of employment in the nation. Average sectoral mix (SE) and differential effects (DE) were also negative. The average net local effects (NLE), as were the Local Sectoral Effects (LSE), while the average local differential effect (LDE) was positive.

Table 3. Summary Statistics

	Classical Shift-Share			**Spatial Shift-Share**		
	NC $g_i - G$	SE $G_i - G$	DE $g_i - G_i$	NLE $Wg - g_i$	LSE $Wg_i - Wg$	LDE $g_i - Wg_i$
Mean	-0.0287	-0.0032	-0.0256	-0.0162	-0.0321	0.0483
Minimum	-0.9344	-0.0032	-0.9313	-0.5957	-0.2487	-0.3897
Maximum	0.6429	-0.0032	0.6461	0.5405	0.1494	0.6113
Standard Deviation	0.2244	0.0000	0.2244	0.1708	0.0810	0.1837

After Marquez and Ramajo we regressed each of the spatial shift-share components on the measure of Net Change (NC) using Ordinary Least Squares. Parameter estimates for each of the spatial components had a high degree of statistical significance. The coefficient for the NLE

model was negative, indicating that increasing net local effects lowers the growth rate of net change, while the parameter estimates on LSE and LDE were both positive.

Table 4. Regression results for spatial shift-shares on net change.

	Coefficients	**Standard Error**	**T**	**P-value**	**N**	**R Square**
Intercept	-0.044578	0.020020	-2.226712	0.03	58	0.5507
NLE	-0.975235	0.117720	-8.284362	< .0001		
Intercept	0.018716	0.027067	0.691469	0.49	58	0.2852
LSE	1.479819	0.313091	4.726482	< .0001		
Intercept	-0.055560	0.027399	-2.027837	0.047	58	0.2065
LDE	0.555195	0.145430	3.817599	< .0001		

Summary

Employment in Louisiana fell sharply following Hurricane Katrina and remains well below its August 2005 level, while employment in Mississippi edged down after Hurricane Katrina, but returned to its pre-hurricane level by February 2006. Why has Mississippi recovered from a decline in employment following Katrina, while employment shifts in Louisiana persist? The impact of Hurricane Katrina on local employment is an important consideration for policy makers concerned with economic development. By identifying the industries that have positive

comparative advantage, regional and state economic development practitioners may be able to target industries for possible relocation or expansion (Harris *et al.*, 2004).

In this paper we explored employment shifts in the Leisure and Hospitality sector along the Gulf coast following Hurricane Katrina. Using a spatial weights matrix that incorporated relative employment as well as distance measures relative to the track of the storm, components of classical and spatial shift-share analysis were calculated. Each of the spatial components then was regressed on net employment change, and the results had a high level of statistical significance, providing evidence that spatial interaction is a relevant aspect of the employment shifts that occurred from 2004 to 2005. Furthermore, these results are similar to those obtained by Marquez and Ramajo, insomuch as the signs of the parameter estimates match, and are statistically significant.

Shift-share analysis is a useful tool for examining the basis for economic shifts. However, the traditional analysis assumes that each region is independent from other regions, even if they happen to geographically, fiscally, or economically close to one another. Clearly this is an assumption that implies that there is no spatial interaction. Previous research (Nazara and Hewings, 2004; Marquez and Ramajo, 2005; Fernandez and Mendez, 2005) demonstrates that spatial dependence is an important consideration when investigating the evolution of change, and the results presented here confirms that spatial interaction is a relevant and important aspect of change. Furthermore, this research points to the importance of space when considering potentially event-driven changes, such as a hurricane, and sets out a new method for defining the spatial interaction that exists not only between employment bases, but also the proximity to

storm tracks. Future work should explore the importance of storm proximity and how it relates to employment change, as well as a better understanding of how employment changes in the years following a catastrophic storm.

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