The Impact of Globalization on the Changing Relationships Between Geographic and Economic Space: A geographically weighted regression analysis of global interlocking corporate directorates 1970 - 2000

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Abstract

This research examines the changing relationships between economic space and geographic space over the past thirty years as a result of the global dispersion of production and the expansion of transnational corporations, a process commonly referred to as “globalization”. We study a hypothesized de-coupling of economic and geographic space by examining the growth of transnational interlocking corporate directorates from 1970 to 2000, utilizing a new spatial analysis technique referred to as “geographically weighted regression”. This methodology will enable us to quantify the extent to which this separation has occurred as well as its regional differences and the factors that correlate with these differences.

Introduction

Historically, economic activity has been tied to geographic location. This is a relationship that emerged around 1000 AD, as political-military organizations (empires, monarchies, fiefdoms) absorbed autonomous cities, which were the centers of economic activity into their geographic territory. This geographic merger of military and economic activities resulted in the modern global inter-state system that delineates the physical boundaries of our world today (Tilly 1994). Over the past twenty years, however, this merger of geographic and economic space has begun to fracture. Economic activity is increasingly transnational in scope, which allows it to separate from the geographic (and political) space within which it was previously bound. This globalization of economic activity has been fueled by the global dispersion of production that began in the 1980s, as corporations shifted their manufacturing facilities to areas with lower cost labor, weaker environmental regulations and abundant raw materials (Sassen 1991). Low cost transportation, cheap wages, and high-tech telecommunications systems have made the relationships between geographic space and economic activity increasingly complex. For example, autos sold in any given country are no longer manufactured there. Individual components are manufactured in a multitude of countries, shipped to another country for assembly, and reshipped to its final market for sale. It has also become increasingly difficult for individual nation-states to regulate these global economic processes. Transnational corporations now have the ability to move capital and facilities wherever it best suits their corporate interests, and without much regard to the interests of any given country (McMichael 1996; Sklair 2001).

This twenty year period has also witnessed an astounding growth of the corporations that control this global economic activity. Corporate revenues of the world's 500 largest corporations, the "Global 500", are now nearly 30 percent of world GDP. Another statistic is particularly telling: of the world's 100 largest economies today, 51 are corporations and 49 are countries.

And these corporations are increasingly transnational in scope (Anderson and Cavanaugh 2001). The number of international subsidiaries of the Global 500 has grown from approximately 1,200 in 1960 to nearly 20,000 in 1998 (Kentor 2003). Moreover, there has been a dispersion of the geographic locations of the Global 500. In 1960, the vast majority of global 500 firms were located in a single country, the United States. By 1998, the U.S. accounted for only 37 percent of these companies, which are now headquartered in 25 countries.

Research Question

We propose to study the hypothesized separation of economic and geographic space by examining the extent to which interlocking corporate directorates have become less tied to geographic boundaries of the nations within which they are headquartered and are now increasingly transnational in scope. This "transnationalization" of interlocking directorates is a reflection of similar economic interests among transnational corporations, and a select group of individuals, which is no longer synonymous with the interests of any given country (Carroll and Fennema 2002, Kentor and Jang 2003, Robinson and Harris 2000).

Our *research hypothesis* that follows from the above discussion is, therefore: the separation of economic and geographic space will generate increased international interlocking directorates between transnational corporations, and a relative weakening of their domestic linkages, between 1970 and 2000.

Data

Data will be collected on geographic location of the world's 500 largest corporations as identified by Forbes Magazine, and the compositions of their boards of directors, at 10 year intervals between 1970 and 2000. This information is readily available from a variety of sources, including Dun and Bradstreet, Standard and Poor's and Moody's Directories. The data for 1980 and 2000 have already been collected (Kentor 2003). The director data will be entered into a software program written for this purpose, enabling us to calculate the domestic and international linkages (interlocks) between these firms.

Methodology

These data will be analyzed with a relative new spatial analysis technique known as *geographically weighted regression* (GWR). GWR quantifies the extent to which relationships between independent and dependent variables vary over a given geographic space. Specifically, it will enable us to estimate the extent to which corporate interlocks are affected by geographic location. We expect this spatial impact on interlocking directorates to decrease over the 30 year period in question, although this de-coupling is likely to display regional differences and patterns. GWR will also help to identify the factors that correlate with these differences.

<u>Spatial dependence, spatial heterogeneity and statistical analysis</u>

GWR quantifies two critical dimensions of the relationships between geo-referenced independent and dependent variables, namely, *spatial dependence* and *spatial heterogeneity*. Spatial dependency refers to the tendency for observations that are closer in geo-space to be more closely related that observations that are spatially distant. Standard regression analysis suffers if spatial dependency is present in the data: regression parameter estimates are not efficient and significance tests are unreliable in the presence of spatial autocorrelation (Anselin and Griffith 1988; Miron 1984). Spatial heterogeneity occurs since every location has an intrinsic degree of uniqueness due to its situation with respect to the rest of the spatial system. This results in the estimated parameters of a spatial model being inadequate descriptors of the process at any given location due to parameter drift across space (Anselin, Dodson and Hudak 1993; Fotheringham, Charlton and Brunsdon 1996, 1997; Fotheringham and Rogerson 1993).

Capturing spatial dependency in regression not only corrects the statistical problems mentioned above but can also extract additional information. Spatial dependency can indicate the presence of an unmeasured geographic effect (Bivand 1984). Determining the missing geographic effect can result in a more parsimonious model structure since it can be captured more directly rather than through indirect surrogates (i.e., the variables currently in the model). Techniques for capturing spatial dependency in regression have been available for approximately two decades; these include spatial autoregression and mixed regression-spatial autoregression models (Anselin 1988, 1993; Bivand 1984). Although useful, a problem is that these techniques still assume spatial homogeneity, i.e., they generate global parameter estimates that are assumed to describe the process adequately everywhere. Recent breakthroughs in spatial statistics are disaggregate or "local" measures of local spatial dependency. These are sometimes referred to collectively as local indicators of spatial association or LISA statistics; examples include the G statistic(Getis 1989, 1991; Getis and Ord 1992, 1996; Ord and Getis 1995), as well as local versions of traditional global spatial autocorrelation measures such as Moran's I, the Geary statistic and the gamma statistic (Anselin 1995).

The GWR technique

GWR capitalizes on long-standing developments in spatial regression with more recent advances in local measures of spatial association. GWR captures both spatial dependency and spatial heterogeneity in regression analysis. The basic GWR model is as follows (Fotheringham and Brunsdon 1999). Consider a standard regression model:

$$y_i = a_0 + \sum_{k=1}^{m} a_k x_{ki} + \varepsilon_i \text{ , } i = 1,\ldots,n$$

where y_i is the dependent variable for location *i*, x_{ki}, $k = 1...m$ are a set of independent variables, a_k are the regression parameters corresponding to the *m* independent variables, a_0 is the intercept term, ε_i is an error term and *n* is the number of locations. In this standard model, one parameter is estimated for the relationship between each independent variable and the dependent variable. GWR is an extension of standard regression that allows the parameters to vary by location, allowing the model to be rewritten as:

$$y_i = a_{0i} + \sum_{k=1}^{m} a_{ki} x_{ki} + \varepsilon_i \text{ , } i = 1,\ldots,n$$

where a_{ki} is the relationship between the kth independent variable and the dependent variable specific to location i and a_{0i} is a location-specific intercept.

GWR estimates the location-specific parameters using weighted least squares in a manner similar to kernel regression and kernel density estimation, except that weights are based on locations in geographic rather than attribute space. The GWR estimator function is:

$$\hat{\mathbf{a}} = \left(\mathbf{X}^T \mathbf{W}_i \mathbf{X}\right)^{-1} \mathbf{X}^T \mathbf{W}_i \mathbf{y}$$

where $\mathbf{W}_i$ is an n by n diagonal matrix whose elements indicate the influence of each location in the dataset on the given location i. GWR also supports comparisons of locally-varying parameter estimates with global estimates to assess whether GWR explains more of the data variance than the traditional, global approach. A statistical test is also available for assessing whether the parameter drift is significant across space. These tests can be used in both confirmatory and exploratory modes. With respect to the latter, the analyst can find other independent variables that display similar spatial patterns to the parameter drift and enter these into the GWR equation in a stepwise manner and retain these variables if they significantly reduce the drift. As mentioned above, this can lead to more parsimonious and powerful models (Brunsdon, Fotheringham and Charlton 1996; Fotheringham, Charlton and Brunsdon 1997).

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