Review of
Elżbieta Szulc and Dagna Wleklińska
The Spatial-Temporal Analysis of the Connections of the Stock Markets Considering the Economic vs. Geographical Distance

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Economic processes, including financial ones, always take place in a certain geographical space. Hence, since the early years of the nineteenth century, spatial economics has been developing as an independent economic discipline, which studies the influence of space (distance) on economic activity. For the purposes of this research, a number of specialized statistical and econometric tools were constructed to enable the inclusion of space in the analysis of economic phenomena and processes. A special place here is occupied by spatial econometrics and increasingly widely used panel spatial models.

The reviewed book is a spatio-temporal analysis of one of the most important issues of modern economics, which is the development of capital markets in the world and the links between them. The authors of the book have been dealing with this issue for many years and have a number of achievements in this respect (Szulc, Górna, and Wleklińska 2016; Szulc and Wleklińska 2015, 2019; Szulc et al. 2014). The discussed book is in a way both a summary and extension of a certain stage of their research. The authors hypothesize that the traditional way of defining neighborhood relations in spatial analyses is not widely used in the analysis of economic relationships between securities markets creating the global financial system. Therefore, when studying spatial interactions, the characteristics used so far, based on such physical properties as longitude or physical distance between the studied objects, should be supplemented, and perhaps even replaced, by a properly defined economic distance (page 8).

In the subsequent chapters of the book, the authors verify the hypothesis by presenting, among others, their own definition of economic distance.

The first chapter is devoted to the prominence of securities markets in the aspect of changes related to globalization. The authors discuss the role of capital markets in stimulating economic growth, as well as the issues of globalization and integration of financial markets, with particular emphasis on the importance of emerging markets in these processes. They show the impact of financial crises on globalization.

In the second chapter, the authors classify stock exchanges, using taxonomic methods. Taxonomic methods are employed to analyze complex processes, including economic ones, and enable ordering (classification) as well as grouping large sets of objects described by many attributes (variables). In this case, 45 stock exchanges in 2004–2013, 44 stocks in 2014–2015 and 40 stocks

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1. The book is published in Polish, original title: *Przestrzenno-czasowa analiza powiązań rynków papierów wartościowych z uwzględnieniem odległości ekonomicznej vs. geograficznej.*

in 2016–2018 were subjected to taxonomic methods. Each of the stock exchanges in the analysis period was described with 7 variables, which, using the substantive criterion, the authors adopted for the study:

- market capitalization (USD million),
- number of listed companies (units),
- total turnover value (USD million),
- share of 5% of domestic companies with the highest capitalization in the total capitalization of the stock exchange (%),
- share of 5% of domestic companies with the highest turnover in total turnover (%),
- gross domestic product per capita (USD), and
- ratio of exchange capitalization to gross domestic product (%).

Some doubts are raised by the adoption the GDP per capita as a measure of the development of stocks exchanges. I believe that this is a variable that could be used as an explanatory variable in panel models of the relationship between stock market development expressed by a taxonomic measure and economic development measured by GDP.

Fully recognizing the priority of substantive criteria in the selection of variables for the taxonomic measure, one should consider whether it would not be worth additionally using the formal criterion. Some of the variables can be very strongly correlated with each other and thus can carry very similar information about the studied phenomenon, consequently distorting the result, if, for example, such two strongly correlated variables are accepted for analysis. Therefore, it would be possible to additionally use, for example, a method of eliminating variables based on the condition number of a correlation matrix of potential explanatory variables (Malina and Zeliaś 1996, 86).[2]

In this book, the authors used the oldest and most common method, the so-called Hellwig development measure (Hellwig 1968), to construct a taxonomic measure of the development of stock exchanges (TMRG). Each year, the classification of the analyzed exchanges was obtained and their grouping was carried out. The highest TMRG values in the entire analyzed period were recorded by the New York Stock Exchange (NYSE), while the second place (except for 2005, 2006, and 2013) was occupied by the National Association of Securities Dealers Automated Quotations (NASDAQ). These two exchanges, along with the Tokyo Stock Exchange, were most often part of the first group of the most developed stock exchanges. The analysis of the values of TMRG in the years 2004–2018 allowed the authors to conclude that at that time there was a reduction in the development distance between stock exchanges located in America, especially in the USA and Asian stock exchanges (primarily Chinese and Indian). The position of Asian stock exchanges in relation to European stock exchanges has strengthened. The calculated TMRG values formed the basis for other analyses undertaken in the reviewed work.

In the third chapter, the results of the analysis of the spatial interdependence between the examined exchanges are presented. For this purpose, basic tools of statistics and spatial econometrics were used. The main research problem was to find an answer to the question whether the geographical location of the market and its neighborhood have an impact on its development and whether the frequently formulated hypothesis that location in geographical space loses its importance over time in favor of location in the so-called economic space. The starting point in the study of spatial interdependence is the matrix of neighborhood or distance. This matrix is defined in different ways. So far, the most commonly used criteria have been geographical: a common border and the distance expressed in km between objects (in this case, cities in which the surveyed exchanges are located). However, as globalization expands, physical distances may lose their importance. Therefore, the so-called economic distances based on economic indicators such as exchange rate volatility, the inflation level, bilateral trade, and the industrial structure began to be constructed.

In their research to measure the economic distance, the authors adopted the ratio of capitalization to gross domestic product (capitalization index). Therefore, the economic distance of the two exchanges is the absolute value of the difference in these indexes.

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2. An example of the use of this method for the selection of variables for the assessment of changes in the standard of living of the residents of Polish voivodships (NUTS 2) in the years 2005–2016 can be found in Bielak and Kowerski (2018).

Spatial autocorrelation determined by means of joint-count statistics was used to measure interdependence. At the same time, two variants of calculations were carried out. In the first variant, a neighborhood matrix based on the physical distance between cities where exchanges are located was used to measure autocorrelation. The second variant used a predefined economic distance based on capitalization indexes. The study showed that there are spatial dependencies between the exchanges under consideration. Their strength and scope vary, depending on the level of the development of the exchange and the year to which the analysis relates. These dependencies are greater between underdeveloped exchanges (with low TMRG values). It was not possible to verify the hypothesis of a "complete replacement" of geographical distance by economic distance. In some groups of exchanges distinguished on the basis of TMRG, statistically significant autocorrelation was calculated on the basis of economic distance, and in others on the basis of geographical distance.

The fourth chapter is devoted to the study of the convergence of stock exchanges in spatial terms. The dependent variable in the estimated convergence models was TMRG. The conducted research has shown that the convergence processes in the development of the analyzed exchanges occur to a small extent. The phenomenon of β-convergence was found only for the years 2004–2006. In the spatial model of β-convergence, assuming relationships according to economic distance in the years 2004–2013, the autoregression parameter turned out to be statistically significant.

Thanks to the extensive statistical material and various (although not always the most advanced) methods used, the authors achieved their goal. At the same time, their considerations may be an inspiration for further research. It is worth using more advanced inference methods, based on panel spatial models.

The publication should be of interest to academics dealing with the issue of the impact of broadly understood space on economic activity, financiers, and analysts dealing with capital markets as well as students of economics.

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