Visualizing Globalization

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Abstract

This essay reviews current approaches to visualizing globalization. We give special attention to relational data-analytic approaches that implement social network analysis and geographic information systems, and emphasize the social structure of globalization as revealed in cross-national and city-to-city relations. Cross-national relations include international trade, comemberships in international governmental organization (IGO) and international nongovernmental organization (INGO), and other kinds of cross-national relations. City-to-city relations include air-passenger flows, transnational corporation (TNC) headquarter–subsidiary relations, among others. We conclude by discussing future directions in visualizing globalization. The analytical frontier in visualizing globalization lies squarely in statistical/model-based approaches to spatial and social network analysis. While these analytical approaches hold much promise for visualizing globalization, the dearth of geocoded subnational relational data and the complexity inherent to modeling them create significant obstacles.

FOUNDATIONAL RESEARCH

The concept of globalization has been analytically controversial from the outset. Popularized in the 1990s, globalization quickly became a topic of controversy. Most scholars acknowledged the strengthening of centripetal processes of globalization, but they disagreed over its definition, historical novelty, and its saliency for political-economic outcomes (Chase-Dunn, Kawano, & Brewer, 2000; Strange, 1996; Robinson, 2004). While some of this debate remains ongoing, there is an emergent consensus that globalization is best conceptualized as a set of "processes involving flows that encompass ever-greater numbers of world's spaces and that lead to increasing integration and interconnectivity among those spaces" (Ritzer, 2007, p. 1). That is, most conceptualize globalization as a set of inherently *relational* processes linking place-bound actors and fostering interdependence among the global populace, or in other words creating a "network society."

This relational conceptualization of globalization coalesces with a branch of social science called social network analysis (SNA), which focuses on

Emerging Trends in the Social and Behavioral Sciences. Edited by Robert Scott and Stephen Kosslyn.
© 2015 John Wiley & Sons, Inc. ISBN 978-1-118-90077-2.

"*relationships* among social entities, and on the patterns and implications of these relationships" (Wasserman & Faust, 1994, p. 3). More specifically, the foundational principles of SNA include an understanding of social actors as "interdependent, rather than independent, autonomous units"; of relational ties as "channels for transfer or 'flow' of resources"; and of social structure as "lasting patterns of relations among actors" that provide "opportunities for or constraints on individual action" (Wasserman & Faust, 1994, p. 4). Much empirical work on visualizing globalization thus makes copious use of social network analytic tools by defining node sets that vary from countries to cities to firms, and using network tools to visualize, quantify, and analyze the pattern of relationships between these nodes.

Visualizing Hierarchical Networks among Nation-States

The earliest network analysis of global relations predated the concept of globalization and instead found theoretical inspiration in world-systems analysis. Snyder and Kick (1979) analyzed four cross-national relations—international trade, diplomatic exchanges, military interventions, and joint treaty memberships—and found that the interaction pattern among these relations resembled a "core–periphery" network. As the hypothetical sociomatrix in Figure 1 illustrates, a core–periphery network is a network with one large and dense (many interconnections) component to which individual network members are more or less attached.[1] "Core-like" actors reside at the center of the network (upper left quadrant of Figure 1) and tend to forge relations with actors in both the core and periphery. Conversely, "peripheral-like" actors reside at the margins of the network (bottom right quadrant of Figure 1) and tend to forge relations primarily with core actors. Countries in the "core" of Snyder and Kick's analysis included most of the advanced industrial democracies, while extremely poor developing countries populated the periphery. The authors interpreted these findings as evidence in support of arguments from world-systems theory that nation-states occupied hierarchically ordered positions in an interdependent world-system structure.

Subsequent to the seminal work of Snyder and Kick (1979), other scholars analyzed a growing array of cross-national relations. One line of research analyzes multirelational commodity trade data by disaggregating trade into different levels of "industrial sophistication" varying from raw materials and animal products through light weight/low wage and into high tech/heavy

1. A sociomatrix (A) is a $N \times N$ matrix that typically consists of the same actors on the rows and columns, so that the cell A_{ij} records the presence/absence or value of the tie between i and j. N is the number of actors, and ij represents the tie (or cell) connecting actor i and actor j.

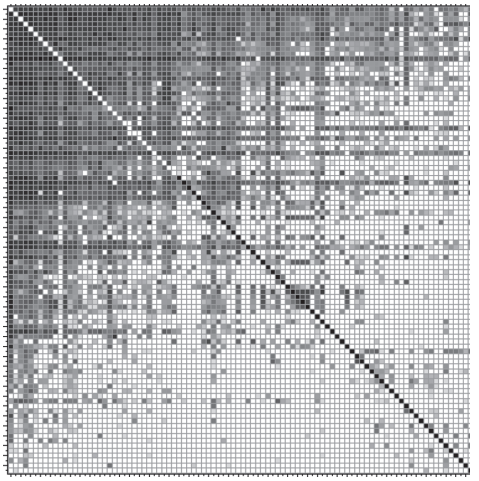

Figure 1 Hypothetical sociomatrix illustrating a core–periphery network. Notes: Dark areas indicate dense interaction; light areas indicate low or nonexistent interaction.

manufacturing. These studies replicate Snyder and Kick's (1979) initial finding of a core–periphery network. In addition to quantifying the structure formed by these trade relations, this body of research also analyzes the way in which interaction patterns vary by the type of trade relation and finds that commodities with low levels of "industrial sophisticated" tend to flow "up" the hierarchy (from the periphery to the core) while commodities with high levels of "industrial sophistication" tend to flow "down" the hierarchy (i.e., from the core to the periphery). These analysts suggest that these flow patterns illustrate a key mechanism of "unequal exchange" between the core and periphery (Smith & White, 1992). Moreover, studies in this lineage incorporate a longitudinal component, and therefore analyze not only the structure formed by international trade in a single point in time but also dynamic change in that structure as well as the mobility of individual countries within it (e.g., Mahutga, 2006; Mahutga & Smith, 2011; Smith & White, 1992). Empirical work at the intersection of cross-national relations and SNA is ongoing. This work includes continued efforts to quantify the network structure of trade (Clark & Beckfield, 2008), assess patterns of mobility in the international trade network (Clark, 2010), and move beyond trade to analyze the structure of international governmental organization IGO and international nongovernmental organization (INGO) networks (Beckfield, 2010), bilateral investment treaties (Bandelj & Mahutga, 2013), and voting alliances in the United Nations (Lloyd, 2005), among others. An important finding that emerges from the panoply of this research, however, is that most networks of

international relations resemble a core–periphery structure (Lloyd, Mahutga, & de Leeuw, 2009).

Visualizing Hierarchical Networks among Urban Spaces

Another prominent research tradition that allows for the visualization of globalization is world-city research. In contrast to the work reviewed previously, research on world-cities draws theoretical inspiration from urban geographers and sociologists including Friedman (1986); Sassen (1991), and Taylor (2004). The early writing of John Freedman was the first systematic attempt to "link urbanization processes to global economic forces," and subsequent work has proceeded in kind (1986, p. 69). In particular, research on global cities takes as given the argument that (i) cities vary in how they are linked into global capital circuits, (ii) this variation has significant implications for the kinds of economic activities that are contained within cities and for the developmental consequences of those economic activities, and (iii) political contestation in urban spaces should follow from the relation of (ii) to (i). In particular, prototypical "global" cities are the "command and control" centers of an expanding global economy, from which transnational corporation (TNC) headquarters orchestrate a spatially diffuse production system. Thus, research on global cities attempts to quantify the structure of the world-city system by analyzing city-to-city relations.

One of the foundational tasks adopted by world-city analysts has been the identification of prominence in world-city status. Early observers hypothesized that New York, Paris, London, and Tokyo were *the* global cities, and research utilizing relational data including city-to-city airline passenger flows (Smith & Timberlake, 2001), TNC headquarter–subsidiary relations (Alderson & Beckfield, 2004), and interlocking producer service firms (Taylor, 2004) tends to support this proposition, with caveats. That is, New York, Paris, London, and Tokyo stand out as exceptionally prominent world-cities because resident headquarters tend to send subsidiaries to many other cities, these cities send and receive large flows of airline passengers to/from many other cities, and contain a disproportionate share of important offices in the producer-service firm network. The image emerging from the litany of network analyses of the global city system is thus one of hierarchy, in which a handful of "global" cities operate as command and control centers. These cities are followed by cities with descending levels of status and prominence in the various networks analyzed. Thus, while no network analyses of world-cities have directly assessed the extent to which world-cities confirm to a core–periphery network, the structural insights that do emerge from research on global cities are exceedingly comparable. And, there is some evidence suggesting a close mapping of a city's centrality in

the world-city network to the "coreness" of the country in which it is located (Alderson & Beckfield, 2004; Mahutga, Ma, Smith, & Timberlake, 2010).

CUTTING-EDGE RESEARCH

Mapping Globalization with Geographic Information Systems

If the foundational research on visualizing globalization has to date focused primarily on using network analytical techniques to visualize and describe the structure of globalization that emerges in these networks, there is a good degree of unrealized potential in using geographic information systems (GISs) to map globalization processes. For example, trading patterns in the modern global community are complex and multifaceted. Tables presenting bilateral trading patterns in different commodities are often complicated and difficult to read. However, GIS can clearly visualize some of the more interesting two-way trade flows. The map displayed in Figure 2 focuses on four different bilateral trade flows in clothing, an industry that touches just about every resident of each country in the world-system. These examples highlight the spatiality of important organizational characteristics in the global clothing industry. For example, the bilateral trade flow of clothing between the United States and the United Kingdom is just about even, with the clothing imported into the United States from the United Kingdom just under $200 million and the imports from the United States to the United Kingdom at just over 200 million. The situation for China and Canada is quite different. Canada receives more than $800 million in clothing imports from China, but sends less than $400,000 to China. We could have picked almost any developed country to pair with China in garment trade and observed a large trade imbalance in clothing trade, because China and other developing countries have now become key countries in globally organized clothing value chains, where firms in developed countries engage in design, marketing, and retail, and those in developing countries engage in simple manufacturing (Mahutga, 2012).

The map in Figure 2 also illustrates the enduring influence of colonial legacies on the structure of globalization. For example, Cameroon exports very little clothing to France, but France has the second highest export tie to Cameroon, who imported just over $1 million in clothing from France in 2000. Finally, we present the trade flow in clothing between Italy and Brazil for the year 2000, which shows another imbalance in such goods. Italy, known as a *producer of fine fabrics and designer suits and dresses for both men and women*, serves a growing economic elite in Brazil with substantial imports of clothing, worth more than $17 million, while Brazil exports very little in the way of clothing to Italy, creating a substantial imbalance in this category

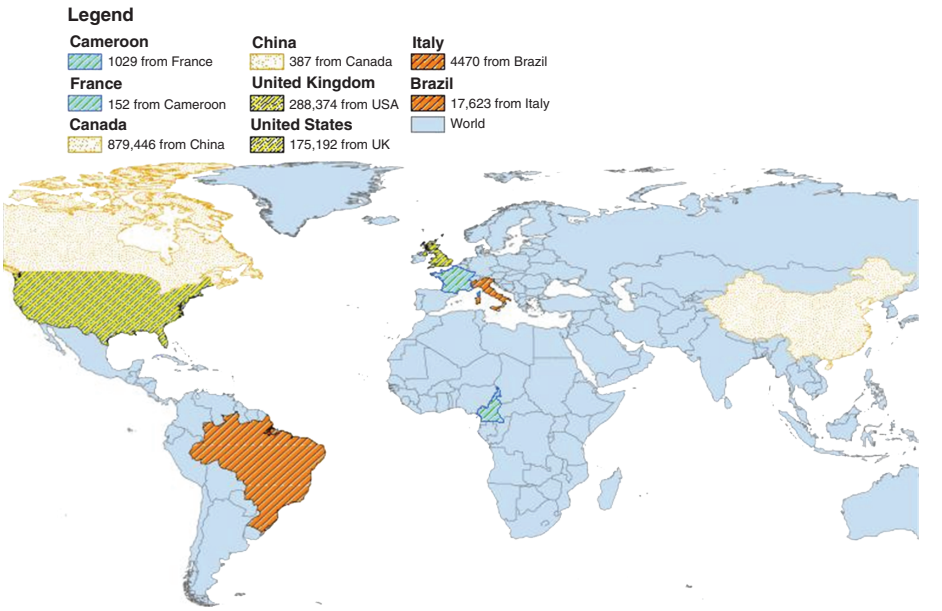

Figure 2 GIS map of clothing trade among key countries. Notes: Dollar amounts are expressed in thousands of US$ 2000.

of trade good. As the map in Figure 2 illustrates, relationships are readily discerned in a GIS format, and there are many additional tools that could enhance a map such as this including three dimensional mapping, where the height of each country could be a function of, say, trade dollar values to illustrate the relative importance of countries in a globalizing economy.

KEY ISSUES FOR FUTURE RESEARCH

The Analytical Frontier for Visualizing Globalization

The analytical frontier for research on visualizing globalization lies squarely in the identification of statistical network and spatial models to explain them. Recent examples include a study published in *Science* that not only visualized globalization via network analyses of commodity trade but also quantified the link between a country's position in these networks and economic development by highlighting the opportunities and constraints to economic development imposed by networks structure (Hidalgo, Klinger, Barabasi, & Hausmann, 2007). Similarly, a recent study of the world-city system analyzes the extent to which a city's integration into the global city system causes it to reduce its connections with cities in its own country (Ma & Timberlake, 2012). And, in a departure from the focus on either countries or cities, a recent study of the network formed by ownership relations among transnational

firms finds that it, too, resembles a core–periphery interaction pattern, and quantifies the concentration of ownership among a handful of firms, where 737 firms control 80% of the value of the full 43,060 firms analyzed (Vitali, Glattfelder, & Battiston, 2011).

While statistical network and spatial models do reside at the analytical frontier, there are two issues that limit the expansion of this frontier in the short term. First, statistical approaches to relational data in both their network analytical and spatial form are explicitly designed to deal with the violation of the assumption of independent observations. The extra analytical leverage provided by these models does not come without a cost. While the scope of this entry limits our ability to discuss technical details, the mathematical and computational procedures necessary for modeling relational data are well beyond the average social scientist's methodological toolbox. Moreover, there are comparatively few examples of statistical software for relational data. Those that do exist either do not include ready-made packages for statistical models (e.g., Borgatti, Everett, & Freeman, 2002) or have a steep learning curve (Statnet). Second, a key argument made by globalization scholars is that globalization transcends national borders, but most data is still collected at the national level (with the exception of the city-level data discussed previously). Thus, our ability to visualize globalization with tools such as SNA and GIS would be much improved by the compilation of subnational and geocoded relational data.

CONCLUDING COMMENTS

As processes of economic globalization progress, so, too, do social scientific efforts to visualize them. We have learned much about the structure of relations among countries and cities as this literature has matured, which in turn has helped us to understand the structure of globalization itself. In this essay, we reviewed the large and growing literature that employs social network analytic tools to visualize and analyze processes of economic globalization and highlighted some unrealized potential in the utilization of GISs for the same purposes. The primary limits to scientific efforts to visualize globalization lie in the complexity of efforts to collect and compile transnational relational data and simplify these data with visual and statistical techniques. While this limitation appears daunting, it also points to the limitless possibilities that exist for social scientists to advance the analytical frontier.

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