Is there convergence across countries? A spatial approach

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Abstract
We analyze convergence across countries over the last half century as a result of
globalizing forces. Drawing on theories of modernization, dependency, the
world-system, political trade blocs, and the world-society, we consider eco-
nomic, demographic, knowledge, financial, and political dimensions of conver-
gence. Using a new methodology, we calculate the minimum volume ellipsoid
encompassing different groupings of countries, finding that during the 1960–
2009 period, countries have not evolved significantly closer or similar to one
another, although groups of countries based on their core-periphery status or
membership in trade blocs exhibit increasing internal convergence and diver-
gence between one another.
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INTRODUCTION

One of the most vexing debates about globalization has to do with
whether it produces convergence across countries or not. The globa-
lizing processes caused by sweeping economic, cultural, and techno-
logical forces have led a number of social scientists to conceptualize
globalization in terms of its effects on the institutional and structural
characteristics of countries (for reviews, see Campbell, 2004; Guillén,
2001b; Hargittai & Centeno, 2001). Some theorists see globalization
as a set of forces tending towards convergence, that is, the elimination
of differences across countries, including modernization scholars,
who beginning in the 1950s saw the process of economic develop-
ment as one resulting in increasing similarity (Kerr, Dunlop,
Harbison, & Myers, [1960] 1964; Rostow, 1960), an argument later
popularized by Harold Levitt's "Globalization of Markets" (1983) and
Kenichi Ohmae's *Borderless World* (1990), and more recently recast as
the "world is flat" argument by Thomas Friedman (2005).

Four groups of scholars, however, have challenged the theoretical
premises underlying the argument that globalization leads to
convergence. First, dependency and world-system theorists argue
that exploitative relationships between developed and developing
countries can cause peripheral countries to become more impover-
ished as they engage in international trade (Bruton, 1998; Frank,
1967; Furtado, 1970; Prebisch, 1950; Wallerstein, 1974). The second

takes the argument about duality further by emphasizing that globalization is far from being a uniform, irreversible, and inexorable trend. Rather, scholars have argued that globalization is a fragmented, incomplete, discontinuous, contingent, and in many ways contradictory and puzzling process (Gilpin, 2000: 294; Guidry, Kennedy, & Zald, 2000; Held, McGrew, Goldblatt, & Perraton, 1999: 431), thus casting doubt on the argument that countries are converging. Giddens (1990: 64, 175) noted that globalization "is a process of uneven development that fragments as it coordinates. […] The outcome is not necessarily, or even usually, a generalized set of changes acting in a uniform direction, but consists in mutually opposed tendencies" (see also Held et al., 1999: 431, 441). The third group of scholars argues that global trade and competition invite national economic systems to differentiate themselves as opposed to converge on each other, creating a pattern of geographic specialization, "societal advantage" (Biggart and Guillén, 1999) or "varieties of capitalism" (Berger & Dore, 1996; Soskice, 1999; Streeck, 1991).

A fourth argument casting doubt on unfettered convergence is the world-society approach, which observed a decoupling between formal structures and outcomes. During the 20th century the expansion of rationalized activities acquired a momentum of its own, fueled by the "exigencies of global social organization whose logic and purposes are built into almost all states." From this perspective, nation-states are seen as exhibiting convergent structural similarity, although there is a "decoupling between purposes and structure, intentions and results" (Meyer, Boli, Thomas, & Ramirez, 1997: 145, 148, 152–154, 161).

The theoretical debates over cross-national convergence have triggered a considerable amount of empirical work in several areas, including demography (Dorius, 2008; Wilson, 2011), cultural values (Inglehart & Baker, 2000), industrial policies (Henisz, Zelner, & Guillén, 2005), national economic performance (Bandelj, 2009; Cohen & Centeno, 2006), regional development (Monfort, 2008), institution-building (Polillo & Guillén, 2005), the network structure of the world polity (Beckfield, 2010), inter-governmental networks (Ingram, Robinson, & Busch, 2005), Internet use (Guillén & Suárez, 2005), national systems of innovation, trade, and investment (Doremus, Keller, Pauly, & Reich, 1998), and dyadic institutional distances between pairs of countries along a variety of dimensions (Berry, Guillén, & Zhou, 2010), among others. Most of these empirical studies find fragmentation and continuing heterogeneity, that is, little evidence of convergence across countries over time.

The one exception in which scholars of various theoretical stripes find convergence is levels of per capita income at the country level. In a well-known study using a panel of 100 countries for four decades between 1960 and 1989, economist Robert Barro (1997) found that the speed of economic convergence across countries in income per capita is about 2.5% per year (see also Bond, Hoeffler, &Temple, 2001; Milanovic, 2009). Sociologists have also found convergence in income levels across countries, mostly as a result of rapid industrial growth in China and South Asia (Firebaugh & Goesling, 2004).

We contribute to this debate by examining the extent to which there is convergence in the world using a spatial approach, which allows us to assess change over time for the world as a whole and for various groups of countries. We propose to look at the problem in terms of changes over time in distances between pairs of nation-states, which determine the volume (or size) of the world. We thus define convergence as a process resulting in smaller volumes, which we calculate as the minimum volume ellipsoid (MVE) encompassing all countries. While previous research has tended to assess convergence along one single dimension, in this paper we examine convergence across a battery of dimensions using different indicator variables for each of them. We focus the attention on economic, demographic, knowledge, financial, and political dimensions, for which there are reasonably complete data available between 1960 and 2009 for a large number of countries. Our main finding is that countries have not evolved significantly closer or similar to one another, although groups of countries based on their core-periphery status or membership in trade blocs exhibit increasing internal convergence and divergence from one another.

GLOBALIZATION AND CONVERGENCE

Previous research has proposed five basic globalizing mechanisms that can produce convergence across countries, including competition (Dobbin, Simmons, & Garrett, 2007; Henisz et al., 2005; Polillo & Guillén, 2005), coercion (Henisz et al., 2005; Polillo & Guillén, 2005), emulation (Fourcade-Gourinchas & Babb, 2002; Westney, 1987), mimicry (Weber, Davis, & Lounsbury, 2009), and normative pressures (Bandelj, 2009; Dobbin et al., 2007). Rather than examining the explanatory power of each of these mechanisms, we focus our analysis on the amount and pattern of convergence that has taken place over time as a result of the causal effects of one or more of these globalizing forces.

Convergence in the Global System as a Whole

The contemporary intellectual origins of the convergence thesis are to be found in modernization theory. Rostow (1960) proposed that nation-states evolve from "undeveloped" to "developed" via five stages as long as the right value incentives are in place: traditional society, preconditions for take-off, take-off, maturity, and high mass-consumption. Each stage was seen as a prerequisite for the next because new political, economic, and social institutions were supposed to make possible ever more economically advanced and differentiated activities over time.

Modernization theorists thought of economic, political, and social development as contributing to a convergence of economies and societies, a trend towards homogeneity, or at least towards a restricted set of alternatives (Kerr et al., [1960] 1964; see also Albrow, 1997: 49; Robertson, 1992: 91; Waters, 1995: 13–19). Based on these arguments about globalization and pressures for convergence, we formulate the general prediction:

Hypothesis 1a: Since the mid-20th century, globalizing forces have encouraged convergence across countries over time.

Other researchers, however, have emphasized that globalization is far from being a uniform, irreversible, and inexorable trend. Rather, they propose that it is a fragmented, incomplete, discontinuous, contingent, and in many ways contradictory and puzzling process (Gilpin, 2000: 294; Guidry et al. 2000; Held et al., 1999: 431). There are several theoretical mechanisms that can potentially account for these effects, including incomplete globalization, institutional path dependency, and specialization-driven differentiation.

Proponents of the incomplete globalization thesis argue that not all parts of the world have been uniformly affected by globalizing trends (Ghemawat, 2003). Moreover, there is resistance and even backlash against globalization in some parts of the world (Stiglitz, 2002), a trend that the recent economic crisis has accelerated. For example, Zelner, Henisz, and Holburn (2009) found that reversal of economic reforms is driven by discontent and by the process that led to adoption of the reforms in the first place.

Institutional path dependency argues that countries persevere in their institutional development over time for a variety of reasons, including inertia, and the desire to buffer themselves from the vagaries of global market forces (Katzenstein, 1985; Rodrik, 1999). The literature on comparative institutions has argued and shown empirically through case studies that once countries embark on a specific trajectory after adopting certain institutions, they become locked into a path-dependent dynamic.

Scholars have also argued that certain aspects of globalization – especially increasingly free trade – encourage countries to specialize, to adopt a strategy of differentiation in order to compete successfully in the global economy. This effect has been theorized and documented by both economists (Feenstra, Hanson, & Swenson, 2000), and sociologists (Biggart & Guillén, 1999). Over time, countries develop institutions that enable them to compete successfully in certain industries but not others. Agglomeration effects over time result in specialization by location (Krugman, 1991; Feenstra, 1998), which further reinforce the dynamic tending towards diversification and increasing differences across countries. These arguments imply that globalization, far from generating convergence, generates resistance and underpins the resilience of national paths to development, leading to the alternative prediction that:

Hypothesis 1b: Since the mid-20th century, globalizing forces have encouraged divergence across countries due to diversification, differentiation, and specialization dynamics.

Convergence within Global Subcomponents

While the arguments for and against convergent globalization focus on the global level of analysis, social scientists have also challenged the premise that postwar socioeconomic change was homogeneous in its effects, and explored the boundary conditions around global convergence pressures. During the 1950s and 60s, the main theoretical challenge came from dependency scholars. In the 1970s and 80s world-system theorists also cast doubt on the modernization thesis. The emergence of continental-size trade blocs and other supranational cooperation regimes since 1990 gave scholars a third opportunity to examine convergence within and across groups of countries.

Dependency scholars noted that developing countries were dependent on more advanced ones, often former colonizers, for capital, technology, and access to markets. Dependency theorists observed that the terms of trade between advanced (core) countries and developing (peripheral) countries tended to evolve against the latter, who would become more impoverished as they engaged in international trade (Bruton, 1998; Frank, 1967; Furtado, 1970; Prebisch, 1950). Thus, the tendency of capitalist development

was to create exploitative relationships between developed and underdeveloped countries (Cardoso & Faletto 1973; Evans, 1979).

Building on the dependency perspective, Wallerstein (1974) proposed another influential theory of societal development that emphasized systemic patterns of dependence in the global political economy and the emergence of subcomponents in the global system. He saw underdevelopment as the result of a country's integration into the modern "world-system" created by the capitalist development of Western Europe since the 16th century. In this view, global capitalist forces generate oppression and duality between the "core," on the one hand, and the undeveloped "periphery" and developing "semi-periphery," on the other. Recent empirical research has found that the world-system is indeed formed of core, semi-peripheral, and peripheral subcomponents in terms of the role that countries play in global economic, financial, political, diplomatic, and military affairs, and that those subcomponents remain relatively stable over time (Chase-Dunn, Kawano, & Brewer, 2000; Kentor, 2008; Smith & White, 1992; Van Rossem, 1996).

The third theory emphasizing the emergence of subcomponents in the global system has to do with trade blocs. The first modern trade bloc was the German *Zollverein* of 1834, which created a customs union among the various German-speaking principalities. The world has witnessed the emergence of continental-sized trade blocs such as the European Union (EU), North American Free Trade Agreement (NAFTA), and Mercosur, among others. A simple functional analysis highlights that trade blocs tend to be formed by countries geographically adjacent or close, with similar trade policies or regimes, and sharing a desire to organize regionally (Brown & Stern, 2011; De Melo & Panagariya, 1992; Mansfield & Milner, 1999). Based on a variety of empirical models, a consensus has emerged in the political economy literature that regional trade agreements are trade-creating for member states, but could lead to trade diversion or destruction relative to non-members (Frankel & Rose, 2000; Thursby & Thursby, 1987; Rose, 2000). For example, Bayoumi and Eichengreen (1997) found that the formation of the European Economic Community reduced the annual growth of trade between members and industrialized non-members by 1.7 percentage points, while Leonardi (1995) analyzed per capita income convergence relative to the period 1970–1995 and found convergence at both the regional and national level for European countries. Soloaga and Winters (2001)

showed that the EU, the European Free Trade Association (EFTA), and the NAFTA led to a decline in levels of trade with third countries. Moreover, the formation of a trade bloc requires political commitments and extensive institution building and policy coordination among member countries (Fligstein & Sweet, 2002; Gilpin, 1987; Mansfield & Milner, 1999).

In addition to generating convergence among member countries, trade blocs tend to diverge from one another. Perhaps the most important reason for divergence across trade blocs is that they tend to have very different characteristics to begin with. For example, some entail a coordination of overall trade policy and even many aspects of macroeconomic management (e.g., a customs union such as the EU), while others are limited to the removal of internal barriers (e.g., a free trade area such as the NAFTA). Some blocs entail deeper agreements over matters such as labor mobility, taxes, regulation, antitrust policies, and even monetary affairs. There are other reasons why trade agreements generate convergence within the bloc but divergence across blocs. Trade blocs have often resulted in pressures to initiate political reforms (as in Southern and Eastern Europe prior to accessing the EU), enhanced power in global trade negotiations, and an extension of influence over weaker nation-states, especially in the developing world (Mansfield & Milner, 1999).

Dependency, world-system, and political-economic trade-bloc theories emphasize the emergence of a multi-layered world as a result of economic and sociopolitical development, one in which countries within each subcomponent – developed/developing, core/semi-periphery/periphery, or trade blocs – become more similar to one another while each subcomponent becomes more distinct than the others. According to these theories, convergence is expected within components while divergence obtains across subcomponents. Thus, we predict that

Hypothesis 2: Convergence within each subcomponent of the global system of nation-states increases over time.

Hypothesis 3: Divergence across subcomponents of the global system of nation-states increases over time.

DATA
Unlike previous research, we examine convergence across countries during the 1960–2009 time period by taking into account multiple dimensions of societal change, which allows us to be more comprehensive

Table 1 Component variables used to construct volume measures

Dimension	Component variables	Source	Years available	# of countries (in 2004)
1. Economic				
Income	GDP per capita, 2000 USD	WDI	1960–2009	193
Exports	Exports of goods and services (% GDP)	WDI	1960–2009	179
Imports	Imports of goods and services (% GDP)	WDI	1960–2009	179
2. Demographic				
Life expectancy	Life expectancy at birth, total (years)	WDI	1960–2009	191
Total fertility rate	Total fertility rate (children per woman)	WDI	1960–2009	193
Population under 14	Population ages 0–14 (% of total)	WDI	1960–2009	190
Population over 65	Population ages 65 and above (% of total)	WDI	1960–2009	190
3. Knowledge				
Patents	Number of patents per 1 million population	USPTO	1977–2007	165
Scientific articles	Number of scientific articles per 1 million population	WDI & ISI	1960–2007	91
University enrollments	Number of university enrollments per 10,000 population	CNTS	1960–2007	188
4. Financial				
Private credit	Domestic credit to private sector (% GDP)	WDI	1960–2009	178
Stock market capitalization	Market capitalization of listed companies (% GDP)	WDI	1988–2009	112
Listed companies	Number of listed companies (per million population)	WDI	1988–2009	113
6. Political				
Size of the state	Government consumption (% GDP)	WDI	1960–2008	174
Democracy score	Degree of political freedom and civil liberties	Freedom House	1972–2008	190
Foreign direct investment	Inward foreign direct investment as a % of GDP	WDI	1970–2009	188

Notes: For the economic dimension, we also tested unemployment rate (% of total labor force) and gross domestic savings (as a percent of GDP) and found virtually identical results. We do not report the results with these variables because we are limited to a starting date of 1980 when we use those variables.
For the political dimension, we also tested policy making uncertainty and found similar results.

and to ensure that our conclusions are robust across the dimensions. We focus on dimensions that both theorist and critics of modernization suggest are central to the evolution of societies. First, we examine the economic dimension, given its central role in theories of both modernization and dependency (Rostow, 1960; Frank, 1967; Rostow, 1960; Wallerstein, 1974). Second, we consider the demographic dimension because of the prominent place it occupies in analyses of the modernization of societies, and specifically of the labor force (Kerr et al., [1960] 1964). Third is the knowledge dimension, which is a central aspect of the world-society approach (Meyer et al., 1997) as well as modernization theory itself (Apter, 1965; Rostow, 1960). Fourth, we include the financial dimension, which figures prominently in analyses of modernization and dependency (Evans, 1979; Gereffi & Wyman, 1990; Haggard, 1990). Lastly, we analyze the political dimension given the emphasis by modernization theorists on changes tending towards representative forms of government (Apter 1965; Kerr et al., [1960]

1964; Lipset, 1959). Although important to modernization analyses (Apter 1965; Kerr et al., [1960] 1964; Rostow, 1960), we did not include the cultural dimension. The reason is that the most comprehensive dataset, the World Values Survey, starts only in the 1980s, covers a relatively small number of countries, and does not offer annual data (Englehart and Welzel, 2005).

Our choice of specific indicator variables for each of the five dimensions was driven by theoretical considerations, subject to data availability (see Table 1). For the economic dimension we include measures of inflation-adjusted national income, and exports and imports as a percentage of GDP. National income, measured by GDP per capita, is the key variable in both modernization and dependency research because it epitomizes modernity given that it "suggests the existence of a previously developed, complex standard of measurement of income and expenditures, investment and consumption" (Apter 1965: 72). Export and imports are also a key economic variable in modernization theories because of their role in creating the

conditions for economic takeoff and for reaching the mature stage of high consumption (Rostow, 1960: 31–33, 200–203). Dependency and world-system theories are also predicated on the assumption that countries become linked to the global economy as they develop (Evans, 1979; Wallerstein, 1974).

For the demographic dimension, we include life expectancy, the total fertility rate, and the proportions of population below age 14 and above age 65. In closed populations, these variables characterize population increase and the age distribution, the two key attributes identified in modernization analyses (Kerr et al., [1960] 1964: 82; Rostow, 1960: 20–22). For the knowledge dimension we use university enrollments, patents, and scientific articles (all per capita), which capture the "knowledge and technology" essential to development in its various stages from takeoff to maturity (Rostow, 1960, 6, 32, 67–78; Kerr et al., [1960] 1964: 85). The stock of knowledge and technology is considered to be "the most strategic test of modernization" (Apter 1965: 72). For the financial dimension we include private credit as a percent of GDP, stock market capitalization (% of GDP), and the number of publicly listed companies as indicators, following the emphasis in the modernization and dependency literatures of the changing role of different types of enterprises and of financing over the course of economic development (Evans, 1979; Gereffi & Wyman, 1990; Guillén, 2001a; Haggard, 1990; Kerr et al., [1960] 1964).

Finally, for the political dimension we use as indicators the size of the state, the extent to which the political system is democratic, and the country's openness to foreign direct investment. The size of the state, measured as government consumption as a percentage of GDP, is a readily available proxy for the importance of the bureaucratic apparatus, which is an important variable associated in modernization and dependency theories with the process of economic development (Evans, 1979; Kerr et al., [1960] 1964; Rostow, 1960). Modernization theory proposed democracy as an effective, even symbiotic, system of "orderly change and peaceful succession in office" that helps in coping with the complex social and political change engendered by economic growth (Apter 1965: 2; Kerr et al., [1960] 1964; Lipset, 1959). We use Freedom House's democracy score to measure the extent to which the political system is democratic. Following the observation by modernization theorists that international capital is not "an essential condition" for economic takeoff but a sign of "maturity" (Rostow, 1960: 49), we use

inward foreign direct investment as a percentage of GDP as an indicator of the polity's openness to, and ability to cope with, foreign influence and decision making. As dependency theorists noted, "foreign capital gives the local bourgeoisie, and more particularly the local state, power that it did not have before," thus contributing to a transformation of domestic politics (Evans, 1979: 81; see also Haggard, 1990: 191–222).

METHODS

We examine patterns of global convergence using annual data from 1960 to 2009, and a novel multidimensional geometric approach in which we analyze changes over time in the amount of space between nation-states or countries. For a given distance dimension (e.g., political, economic, demographic, etc.), we observed a set of k variables[1] each year for each country being considered in the analysis. We can thus think of countries as points lying in a k-dimensional characteristic space, where the points move over time. Convergence can be conceptualized as the process of these points moving closer together – that is, countries becoming less distant over time.[2]

To measure global volume, which is an index of divergence, we calculate the k-dimensional ellipsoid of minimum volume that contains all of the country points in each year. The volume of this ellipsoid is the MVE measure. The MVE has been used in the robust statistics literature for both outlier detection and robust regression (see Rousseeuw & Leroy 1987). It can be computed through non-linear optimization. Let $V_t \subset \mathbb{R}^k$ be the set of k-dimensional country points in year t (as in Figure 1a). Formally, the MVE in year t is the k-dimensional ellipsoid $\{v \in \mathbb{R}^k : (v - \hat{c}_t)^T \hat{A}_t^{-1}(v - \hat{c}_t) = k\}$, where $\hat{A}_t$ is a $k \times k$ positive semi-definite matrix and $\hat{c}_t$ is a $k \times 1$ vector that jointly solve

$$\min_{A_t, c_t} \log(\det(A_t))$$

subject to $(v - c_t)^T A_t^{-1}(v - c_t) \leqslant k$ (for each $v \in \mathcal{V}_t$).

We compute a different $(\hat{A}_t, \hat{c}_t)$ pair for each year and then calculate the associated ellipsoid volume for each year between 1960 and 2009. Because we have data for several distance dimensions, we calculate a separate volume for each distance dimension in each year. We then plot our volume time series. Since the volumes are an index, we scale them to equal 1 in the year 2006.

In non-mathematical terms, we are simply estimating the size of the smallest ellipsoid
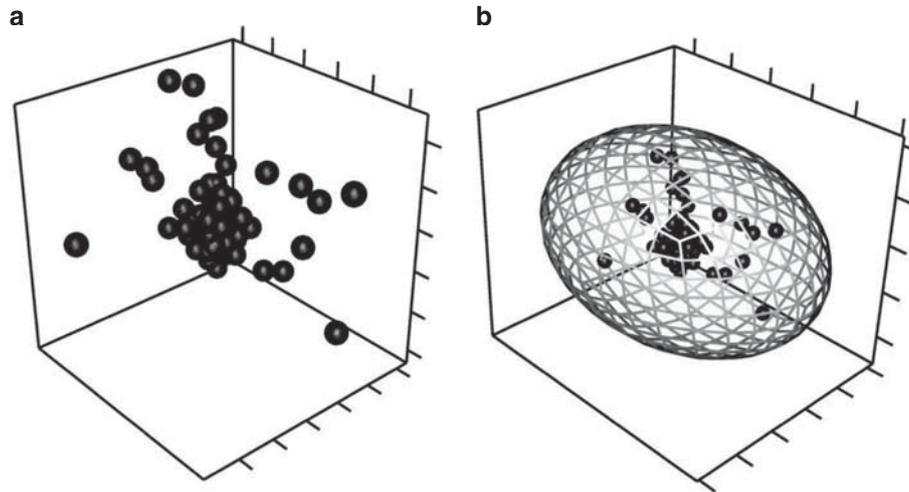
Figure 1 Countries in 3-dimensional financial characteristic space, 2007.

(a multidimensional generalization of an ellipse) that contains all country points in the world. The volume of the ellipsoid can be thought of as the size of the world. Generally, as the dyadic distances between countries decrease or increase the volume of the ellipsoid will shrink or grow. As an example of our approach, consider Figure 1a, which depicts 1 year of the financial raw data for all country points in a $k = 3$-dimensional space. The axes in this graph represent private credit (% of GDP), stock market capitalization (% of GDP), and listed companies per million population. Thus, each point represents a given country's private credit, stock market capitalization, and listed companies. The MVE enclosing all of the country points in the world is shown in Figure 1b. This is the smallest ellipsoid that contains all the points, and it thus is a good estimate of the "size" of the world in 2007 in terms of the financial dimension. If we repeat the process for 2001 and later years and find progressively smaller volumes, we consider this to be evidence of convergence along the financial dimension.

In our first hypothesis, we consider the global system as a whole and thus estimate MVEs that contain all country points for the whole world. To test our second and third hypotheses, we consider subcomponents of the global system of nation-states and compare our MVE measures both within and across these subcomponents. Figure 2 provides an example of how these subcomponent patterns might look when examining the patterns suggested by the second and third hypotheses. Frame (a) in Figure 2 shows country-level data for a particular year. Each point represents a country and each axis

represents a variable. Collectively, the axes define a distance dimension (see Table 1). When measuring global volumes, we enclose the points in an MVE, as shown in frame (b). If we suspect distinct group patterns, we define the subcomponents (e.g., trade blocs) and enclose each set of subcomponent points in its own MVE as in frame (c). Continuing the trade bloc example, one MVE would contain all countries that make up one trade bloc, and the other MVE would contain all countries that make up another trade bloc. Frame (d) shows the subcomponent ellipsoids along with the world ellipsoid. If subcomponents have their own distinct patterns over time, then it is easy to imagine a scenario where within-subcomponent convergence coexists with world-wide divergence.

There are several useful features of the MVE measure. The most important is that it measures joint convergence across multiple variables, which sets it apart from previous methodologies that focus on convergence in single variables (e.g., GDP per capita). Another appealing property is that it is not affected by affine transformations of the raw data, which means that the measure is scale-invariant and robust to linear combinations of the k component variables.[3] This is particularly useful for our purposes since the k variables are in general measured in different units and are correlated. Third, the ellipsoid volumes are indices, so that multiplying any time series of volumes by a fixed constant does not affect our inference. If the MVE measure were not an index, then it would be difficult to make comparisons across subcomponents of the global system. A fourth appealing feature of this method is that the
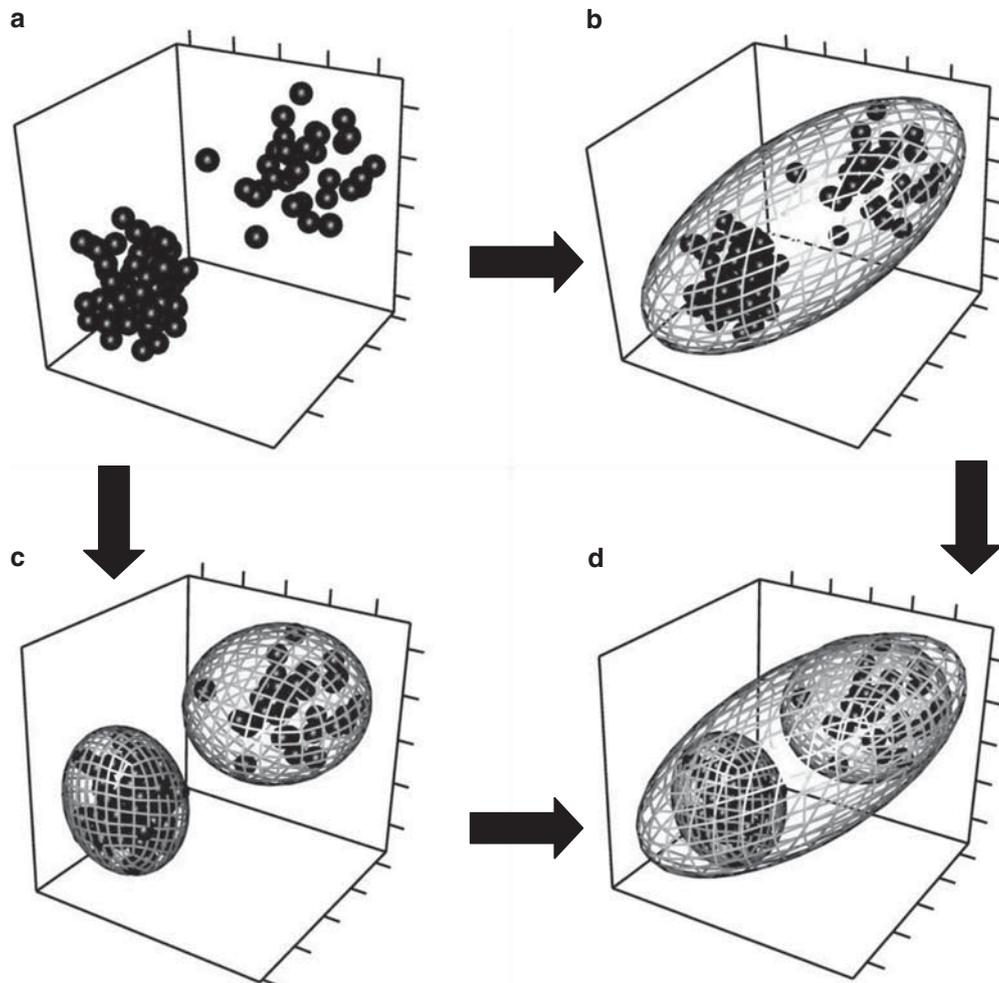
Figure 2 Example of subcomponent volume calculation.

assumption of an ellipsoidal pattern closely approximates the shape of the actual data. Finally, the MVE method has an intuitive interpretation that lends itself to our hypotheses and for consideration of convergence/divergence over time.

In comparison to other convergence metrics, the MVE measure is theoretically well-motivated and statistically sound. The MVE method is a direct test of convergence – rather than measuring movement towards a theoretical steady state, the MVE volume is an estimate of dispersion, and thus directly measures the closeness of nation-states in terms of their observed characteristics. The MVE volume can also gauge joint convergence in multiple characteristics and it takes into account scale and correlation between variables. There is strong precedent for using a dispersion-based convergence measure like the MVE volume as opposed to a location estimator like beta convergence. Quah (1993), for example,

shows that the beta convergence measure used in macroeconomics is an example of Galton's fallacy of regression towards the mean, and thus tells us very little about actual convergence of nations. We follow Quah's (1993) advice of using a distributional or dispersion-based measure instead.[4]

For comparison and robustness, we calculate volume indices using two other methods: a mean-based and a median-based measure of the size of the world. The mean-based measure acts as a check of whether the change in volumes is being driven by the average country. The median-based measure is robust to outlying observations. Since the median-based volumes are robust to outliers, this implies that our inference isn't strongly affected by potential outlier countries. As a second check, we trim extreme observations from our data and then re-estimate the MVE volumes, finding a very similar pattern after trimming 10%, 20%, and then 30% of outlier
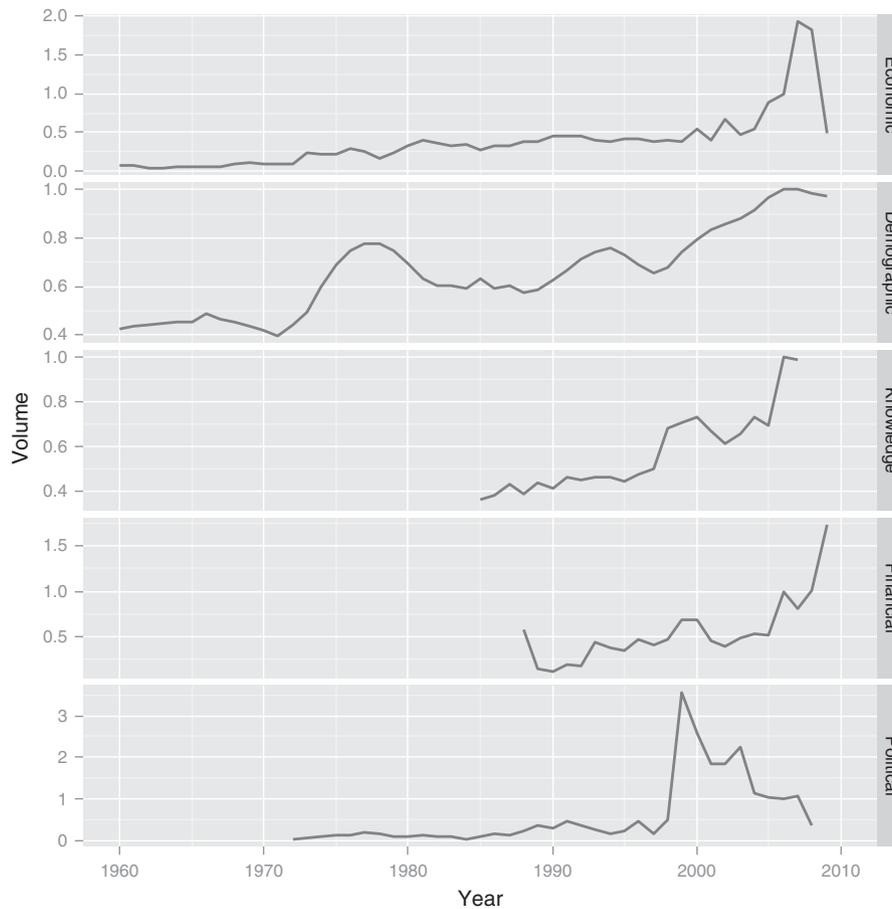
Figure 3 Global volumes, 1960–2009.
Note: All volume time series are calculated using MVE method and are scaled to equal 1 in 2006.

countries from the dataset (see Rousseeuw & Leroy 1987). These strategies each indicate that our MVE measure is not adversely affected by potential outlier countries.

As a final methodological note, it must be emphasized that the MVE measure is not meant to estimate global, individual-level inequality, like the Gini coefficient or similar measures used in the global inequality literature. Rather, our MVE measure is designed as a metric to test theories of global convergence at the nation-state level. Therefore, it would be inappropriate to use population weights in our analysis. Since nation-states are the primary units of our theoretical and empirical analysis, we give equal weight to all nation-states: a small country like Costa Rica counts as much as a large country like the United States.

RESULTS

Hypothesis 1a predicted that globalizing forces have encouraged convergence across countries over time while Hypothesis 1b posited that globalizing forces have encouraged divergence across countries over time. Figure 3 shows the MVE volumes for each of our five distance dimensions over time. There are different time periods reflected in each of these graphs due to data availability across dimensions. The y-axis represents the volume index, scaled to equal 1 in 2006. Figure 3 shows that world volumes have increased over time for the economic, demographic, knowledge, and financial dimensions. The political volumes appear to exhibit more frequent and sharper cycles over time than the other distance dimensions, but they also reveal increasing trends. The sharp ups and downs since the mid-2000s are mostly due to the extreme economic and financial conditions prevalent before, during, and after the global crisis. These graphs suggest that global volume is not decreasing as a function of time for any of the five dimensions of distance.

To formally test Hypotheses 1a and 1b, we implement a variant of Kendall's tau test. Kendall's tau is a

Table 2 Trend test for world volumes, 1960–2009

Distance dimension	Correlation
Economic	0.82***
Demographic	0.67***
Knowledge	0.82***
Financial	0.63***
Political	0.63***

*p<0.05, **p<0.01, ***p<0.001.
Note: Test statistics are Kendall's tau estimates of rank correlation between world volumes and time. Significance implies that the volume of the world is changing over time.

non-parametric statistic that takes values between –1 and 1, measuring the rank correlation between two sets of data. By estimating the rank correlation between volumes and the years in which they were measured, we obtain a quantity that summarizes the extent to which the volumes exhibit time trends. We specify a two-sided test where the null hypothesis is zero correlation (no trend). These tests, reported in Table 2, indicate no significant decrease in volumes (a lack of convergence). All five test statistics are positive and statistically significant, indicating a significant increase in volumes, or divergence. Thus, we find evidence in favor of Hypothesis 1b.[5]

We conducted several robustness checks, finding that the MVE volume measure is positively correlated with both the mean-based and median-based volume measures.[6] Since the median-based volume measure is less sensitive to outliers, the positive correlation implies that inference based on the MVE measure is not heavily influenced by outlying countries. To evaluate the claim that distances between countries may have become smaller in recent years as opposed to during the entire 1960–2009 period, we calculated the Kendall's tau trend test for the 1985–2009 period (not shown). We did not find evidence of smaller volumes at the 5% significance level. As a further robustness check, we trimmed 10%, 20%, and then 30% of country-points that lie on the boundary of the MVE and found that the lack of convergence result is robust to potential outlying countries for each of the five dimensions. The median-based measure mentioned above also suggests that the increasing MVE volume trends are robust to outlying countries.

To ensure that our results are not driven by differential time patterns of missing data, we recalculated the MVE measure using only those countries that had complete data in the starting year of the analysis. These volumes are qualitatively very similar to those in Figure 3, and a Kendall's tau trend test for

these volumes once again indicates a lack of convergence for all distance dimensions.

In our second hypothesis, we argued that smaller distances and volumes may be expected *within subcomponents* of the global system of nation-states over time. This relaxes the strong-form hypothesis of *global* convergence to allow for the possibility that some countries, particularly those that have become more connected to each other or to the global system, have converged while others have not. To test this hypothesis, we considered two different groupings of countries: core/semi-periphery/periphery subcomponents and trade blocs. We start by discussing the core/semi-periphery/periphery results.

First, we grouped countries into core, semi-periphery, and periphery categories following Kentor (2008). Similar to our approach in the first hypothesis, we calculated the MVE volumes for each of the core/semi-periphery/periphery subcomponents of the global system. As with the global volumes, we estimate subcomponent volumes for the economic, financial, demographic, knowledge, and political dimensions. Though not reported below, the MVE volume calculations for each of the distance dimensions over time show no trends of smaller volumes (similar to Figure 3). The rank correlation tests (Kendall's tau trend tests as reported in Table 3), which test for an association between the volumes and the years in which they were measured, show little to no evidence of convergence within the core, semi-periphery, and periphery subcomponents. Only one of the volume series – demographic volumes in the core – exhibits a statistically significant negative time trend, indicating that there has been demographic convergence in the core.[7] The four other dimensions in the core show an increase in volumes (significant divergence). Within the semi-periphery and periphery we also find evidence of divergence (Table 3).

To further examine Hypothesis 2, we considered whether the volumes of trade blocs have decreased over time. We calculated all volume measures and tests for 10 different trade blocs, including free trade areas, customs unions, single markets, and one currency union (see Appendix Table A1 for trade bloc country classifications). For each bloc, we took into account the year of entry by each country. We started by examining three free trade areas: the Association of Southeast Asian Nations (ASEAN), the Central European Free Trade Agreement (CEFTA), and the South Asian Association for Regional Cooperation (SAARC). The tests of rank

Table 3 Trend test for within core, semi-periphery, and periphery volumes, 1960–2009

Distance dimension	Core	Semi-periphery	Periphery
Economic	0.70***	0.41***	0.68***
Demographic	−0.80***	−0.08	0.69***
Knowledge	0.71***	0.86***	0.70***
Financial	0.40**	0.63***	0.65***
Political	0.77***	0.24	0.60***

*$p<0.05$, **$p<0.01$, ***$p<0.001$.
Note: Test statistics are Kendall's tau estimates of rank correlation between subcomponent volumes and time. Significance implies that the volume of the subcomponent is changing over time.

Table 4 Trend test for within trade bloc volumes, 1960–2009

Distance dimension	ASEAN	CEFTA	SAARC	Andean Community	Mercosur	SACU	CARICOM	EU	Eurozone	NAFTA
Economic	0.71***	0.65***	0.61***	0.24*	0.11	0.04	0.60***	0.82***	−0.53*	−0.11
Demographic	0.45***	−0.06	0.43**	—	—	−0.42***	−0.28*	0.40***	0.56**	0.08
Knowledge	0.55***	0.64**	0.13	−0.16	0.60*	–	0.64**	0.85***	0.89***	0.02
Financial	0.65***	0.18	0.34*	0.03	0.53*	−0.14	−0.52	0.61***	0.85***	−0.37*
Political	0.60***	0.69***	0.58***	0.14	0.22	0.28*	0.13	0.76***	−0.67	−0.28

*$p<0.05$, **$p<0.01$, ***$p<0.001$.
Note: Test statistics are Kendall's tau estimates of rank correlation between trade bloc volumes and time. Significance implies that the volume of a subcomponent is changing over time. The Andean Community and the Mercosur did not have enough data to calculate volumes for the demographic dimension and SACU did not have enough data to calculate volumes for the knowledge dimension.

correlation (Kendall's tau, as reported in Table 4) between the volumes and the years in which they were measured show no significant decreasing time trends across any of the five dimensions.

We then considered whether the countries in three customs unions – which entail tighter economic integration than a free trade area – have converged over time. We examined the Andean Community, the Mercosur, and the South African Customs Union (SACU). Similar to the case of the free trade areas, the tests of rank correlation (see Table 4) between the volumes and the years in which they were measured show only one statistically significant negative trend across all of these blocs and the five dimensions: a downward trend in the demographic volume for the SACU. None of the other volumes are decreasing over time in any customs union.

Next, we examined whether countries which are members of common markets have converged over time, an arrangement that connotes greater integration than customs unions. Our common market blocs include the Caribbean Community (CARICOM) and the European Union (EU-27). The tests of rank correlation (see Table 4) between the volumes and the years in which they were measured only show convergence for the demographic volumes in CARICOM.

We also considered the European Monetary Union (the Eurozone) as the trade bloc with the highest degree of integration. The Kendall's tau tests for the original 11 member countries of the Eurozone (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Portugal, and Spain) are reported in Table 4. These results show statistically significant evidence of convergence for the economic volumes for the original member countries of the Eurozone.

Lastly, we analyzed the volumes generated by the three member countries of NAFTA. Because the MVE method requires that we have, for each trade bloc, at least one more country than variables included in the calculation, we cannot compute MVEs for NAFTA. However, because we are interested in examining the volume occupied by countries within this bloc, we calculated approximate hypersphere volumes.[8] While this approach is inferior to the MVE method because it not provide as tight a fit, the fairly consistent data coverage across the member countries helps to make this approximation more robust. Table 4 reports a significant downward trend for the financial volumes only among the five dimensions.

In sum, across all the trade bloc results reported in Table 4 we find limited support for Hypothesis 2 that volumes within subcomponents of the global system are decreasing over time. The trade blocs with

Table 5 Trend test for between core/semi-periphery/periphery subcomponent dyadic distances, 1960–2009

	Core	Semi-periphery	Periphery
Core	—		
	—		
	—		
	—		
	—		
Semi-periphery	E = 0.50***	—	
	D = 0.65***	—	
	K = 0.37**	—	
	F = −0.12	—	
	P = −0.59***	—	
Periphery	E = 0.84***	E = 0.46***	—
	D = 0.90***	D = 0.54***	—
	K = 0.82***	K = −0.41**	—
	F = −0.06	F = −0.13	—
	P = 0.00	P = 0.17	—

*p<0.05, **p<0.01, ***p<0.001.
Note: Test statistics are Kendall's tau estimates of rank correlation between dyadic distances and time. The column and row names indicate the world-system subcomponents between which dyadic distances are calculated. Within each cell the test statistics for different distance dimensions are arranged into a single column in the following order: economic (E), demographic (D), knowledge (K), financial (F), and political (P). Significance implies that the distance between subcomponents is changing over time. For example, the Kendall's tau estimate of the demographic distance trend between the core and semi-periphery is 0.65. This number is positive and statistically significant, indicating that the demographic distance between the core and semi-periphery has increased over time.

any evidence at all of convergence include the Eurozone (for the economic distance dimension) and NAFTA (for the financial distance dimension). The demographic dimension shows some evidence of within-bloc convergence, consistent with theories of demographic transition, but this pattern is not universal across trade blocs. The global demographic divergence result is consistent with the limited evidence of within-bloc convergence. Recent findings in the fertility and mortality literatures also emphasize heterogeneity, highlighting the role of "reverse transitions" in Sub-Saharan Africa and Eastern Europe in driving demographic divergence (Dorius, 2008; Moser, Shkolnikov, & Leon, 2005). In some blocs (ASEAN, SAARC, the EU, and the Eurozone), we find mostly significant evidence of divergence. The results concerning the EU and the Eurozone are sobering given the troubles and fragmentation presently afflicting that part of the world.

Finally, in our third hypothesis, we argued that distance between subcomponents of the global system of nation-states is increasing over time. To test this hypothesis, we calculated trend tests for the distances between each pair of subcomponents, including both the core/semi-periphery/periphery subcomponents and trade blocs. For each subcomponent, we computed the centroid of the MVE. We calculated the Mahalanobis distance (see Berry et al.,

2010) between each pair of centroids for each year in our data. We considered increasing dyadic distances over time to be evidence of cross-subcomponent divergence. To formally test for cross-subcomponent divergence, we calculated Kendall's tau rank correlation between dyadic distances and time. A positive value indicates increasing volumes (divergence).

Tables 5 and 6 show the results of these tests. For the world-system subcomponents, Table 5 reports the test statistics comparing the core, semi-periphery, and periphery subcomponents. These results show significant evidence of divergence between the core and semi-periphery subcomponents for the economic, demographic, and knowledge distance dimensions, with convergence along the political dimension. There is also divergence between the core and periphery subcomponents for these three distance dimensions. We find evidence that the semi-periphery and periphery are diverging from each other along the economic and demographic dimensions and converging along the knowledge dimension. Of the 15 tests listed in Table 5, eight tests show significant evidence in favor of Hypothesis 3 (that there is divergence across subcomponents over time), and two show evidence of convergence. Thus, the results from our core/semi-periphery/periphery subcomponents analysis support divergence.

In Table 6, we report these tests for each pair of trade blocs. Though the existence of divergence varies from one trade bloc pair to another, these results demonstrate significant evidence of divergence over time across several distance dimensions. Out of 199 tests in Table 6, 97 of them (49%) reveal that trade blocs are significantly diverging from each other, in support of Hypothesis 3, and only 31 (16%) present evidence of convergence. The NAFTA and the Eurozone exhibit very little divergence between one another, and actually show some evidence of convergence in the political and knowledge dimensions.

DISCUSSION AND CONCLUSION

In this paper we have offered a new way of thinking about globalization, convergence, and the evolution of the global system of nation-states over time. We focused on the characteristics of countries as nodes in the system along several dimensions, which define the distance between them. Based on those dyadic distances, we calculated volumes over time and assessed to what extent there was convergence or divergence across countries using a battery of empirical dimensions. Our methodology allows us to analyze convergence across a number of dimensions and over time, both for the world as a whole and for distinct clusters of countries.

Our main empirical findings show long-term divergence. Over the last half century, nation-states in the global system have not evolved significantly closer (or more similar) to one another along a number of dimensions. Though this finding stands in contrast to prior studies finding convergence in income per capita (Barro, 1997) or income levels (Firebaugh & Goesling, 2004), it is consistent with a long tradition of research in sociology about the resilience of the nation-state in the face of globalizing tendencies (Evans, 1997; Meyer et al., 1997), and several other empirical studies (Campbell, 2004; Guillén, 2001b, Hargittai & Centeno, 2001). This lack of evidence of convergence gives credence to theories emphasizing differentiation across countries as a result of globalization. For instance, the "varieties of capitalism" perspective in political science has long argued and documented that different ways of organizing the society and the economy can and do coexist (Berger and Dore 1996; Soskice 1999; Streeck 1991). Further, sociologists have argued that countries develop "societal advantages" which enable them to play differentiated roles in the global economy (Biggart & Guillén 1999).

We have also explored the possibility that the lack of evidence of convergence at the global level has to do with the heterogeneous effects of globalizing forces, an argument that both sociologists and political scientists have made (Giddens, 1990: 64, 175; Gilpin, 2000: 294; Guidry et al., 2000; Held et al., 1999: 431). We did not find consistent evidence, however, of convergence within subcomponents of the global system due to the different structural effects of globalization, as predicted by dependency and world-system theories (Frank, 1967; Furtado, 1970; Wallerstein, 1974).

Following our theoretical expectations, we found evidence that subcomponents of the global system – both trade blocs and core/semi-periphery/periphery components – have become more distant from one another over time. This finding is consistent with recent theoretical and empirical work in both sociology (Fligstein, 2002) and political science (Brown & Stern, 2011; Gilpin, 2000; Mansfield & Milner, 1999) highlighting the rising importance of blocs in global economic affairs and governance. These results also line up with findings of sigma divergence (Quah, 1993). Our empirical evidence indicates that the formation and expansion of trade blocs around the world over the last half century has had far-reaching effects along not only economic and financial dimensions but also politically and socially.

The empirical results concerning the divergence within the EU and the Eurozone help put in perspective the current difficulties afflicting this part of the world. We found consistent evidence of divergence within the EU along all five dimensions, and divergence within the Eurozone along the demographic, knowledge, and financial dimensions, although we did find convergence from an economic point of view. The predictions that institution-building and joint decision making would produce convergence in these types of blocs do not seem to have materialized (Fligstein & Sweet, 2002; Gilpin, 1987; Mansfield & Milner, 1999). Our results resonate with the fundamental problem in the building of a united Europe, namely, its increasing fragmentation along the North–South and East–West dimensions.

Considering our combined findings across our three hypotheses, we show empirical evidence of divergence overall across all countries, inconsistent evidence of convergence within clusters or groups of countries, and consistent evidence of divergence across countries. While our results show limited evidence of financial convergence within the NAFTA and economic convergence within the Eurozone, our results across our five dimensions, including

Table 6 Trend test for between trade bloc dyadic distances, 1960–2009

		ASEAN	CEFTA	SAARC	Andean	Merc.	SACU	Caricom	EU	E. zone
ASEAN	E	—								
	D	—								
	K	—								
	F	—								
	P	—								
CEFTA	E	0.77***	—							
	D	0.27	—							
	K	0.42*	—							
	F	−0.54*	—							
	P	−0.65***	—							
SAARC	E	0.34*	0.18	—						
	D	−0.55***	0.03	—						
	K	0.90***	0.88***	—						
	F	−0.21	−0.03	—						
	P	0.15	−0.23	—						
Andean	E	0.84***	0.75***	0.35*	—					
	D	—	—	—	—					
	K	−0.24	−1.00	1.00***	—					
	F	−0.72***	0.05	−0.42*	—					
	P	0.40***	−0.38	0.41**	—					
Mercosur	E	0.59***	0.58***	0.44**	0.32*	—				
	D	—	—	—	—	—				
	K	−1.00**	−1.00	1.00***	0.20	—				
	F	−0.93***	0.43	−0.05	0.11	—				
	P	0.53**	−0.21	0.58	0.23	—				
SACU	E	0.22*	−0.75***	−0.69***	−0.14	−0.39*	—			
	D	0.78***	0.79***	0.39**	—	—	—			
	K	—	—	—	—	—	—			
	F	−0.70***	0.24	0.18	0.36*	0.38	—			
	P	0.35**	−0.21	−0.43**	−0.21	−0.53**	—			
CARICOM	E	0.23*	−0.42*	−0.62***	−0.11	−0.60***	−0.23*	—		
	D	−0.54***	−0.03	−0.87***	—	—	0.22	—		
	K	0.35	−1.00	0.82***	−0.35	0.60	—	—		
	F	0.33	−0.67	−0.71*	−0.43	0.00	−0.60	—		
	P	0.47***	0.12	0.20	−0.21	−0.16	−0.15	—		
EU	E	0.65***	0.75***	0.69***	0.85***	0.49**	0.68***	0.64***	—	
	D	0.79***	−0.30	0.63***	—	—	0.90***	0.69***	—	
	K	0.58***	0.52*	0.87***	0.49*	0.20	—	0.85***	—	
	F	0.32*	0.49*	0.65***	0.82***	0.93***	0.71***	0.43	—	
	P	0.59***	0.34	−0.56***	0.42***	0.35*	0.41***	0.38**	—	
Euro	E	0.78***	0.89***	0.60**	0.56**	0.05	0.75***	0.67**	0.85***	—
	D	0.78***	0.94***	0.71***	—	—	0.93***	0.75***	0.49*	—
	K	0.83***	0.90***	0.89***	1.00***	1.00***	—	1.00***	0.50*	—
	F	0.89***	−0.14	0.35	0.75***	0.80*	0.86***	0.81**	−0.24	—
	P	−0.47	−0.64*	−0.51*	−0.51*	−0.51*	−0.51**	−0.56*	0.33	—
NAFTA	E	0.66***	0.72***	0.91***	0.80***	0.75***	0.44**	−0.05	0.78***	0.13
	D	0.59**	−0.29	0.56**	—	—	1.00***	0.36	−0.03	0.43
	K	0.30	0.39	0.45*	0.80*	0.80*	—	0.80*	0.22	−0.72**
	F	−0.47**	−0.09	0.47**	0.16	0.60**	0.28	0.07	−0.01	0.02
	P	0.03	−0.05	0.45*	−0.30	−0.42*	−0.43*	0.10	0.42*	−0.67*

*$p<0.05$, **$p<0.01$, ***$p<0.001$.

Note: Test statistics are Kendall's tau estimates of rank correlation between dyadic distances and time. The column and row names indicate the trade blocs between which dyadic distances are calculated. Within each cell the test statistics for different distance dimensions are arranged into a single column in the following order: economic (E), demographic (D), knowledge (K), financial (F), and political (P). Significance implies that the distance between subcomponents is changing over time. For example, the Kendall's tau estimate of the knowledge distance trend between SAARC and the EU is 0.87. This number is positive and statistically significant, indicating that the knowledge distance between SAARC and the EU has increased over time. The Andean Community and the Mercosur did not have enough data to calculate volumes for the demographic dimension.

economic, demographic, knowledge, financial, and political factors, reveal substantial divergence within trade blocs. In other words, though groups of countries based on their core-periphery status or membership in trade blocs exhibit both internal convergence and divergence from one another, our main finding is that countries have not evolved significantly closer to one another, with our combined results suggesting that divergence in the world as a whole is driven by divergence between clusters, with little convergence within clusters.

The empirical results presented in this paper in no way can be taken as definitive. Social scientists have had a hard time producing evidence of convergence in the wake of globalization, with most of them finding fragmentation, heterogeneity, and variegated patterns of change over time. The most important exception is the well-established result in the economics literature of convergence in income levels (Barro, 1997; Bond et al., 2001). Our findings – using a different methodology and data on a much wider range of relevant dimensions – should be taken as an incentive to undertake further research in this area. Conceptually, researchers have either focused on the characteristics of the nodes (countries) or on the relationships between nodes and the resulting network structure.

Future studies could make a contribution by developing new theoretical models that incorporate both nodal and inter-nodal arguments and variables. Methodologically, the idea of "volume" could be combined with that of the network for the global system as a whole or for its various subcomponents in a way that helps us better understand the spatial effects of network relationships in addition to their structural consequences. And empirically, the theoretical and methodological approach in this paper could be applied to nodes at different levels of analysis in addition to nation-states and clusters of nation-states (such as trade blocs), as in the cases of sub-national regions and cities. These and other avenues for future research represent new opportunities for advancing the sociology of the global system in ways that have the potential of contributing not only to a better understanding of the world but also to theory and methodology.

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NOTES
[1] k is in general different for each distance dimension.

[2] In empirical studies on convergence in the economics literature, it is common to use either a regression of growth rates (the beta measure) to examine whether countries are converging to the same steady-state levels (Barro, 1997) or coefficients of variation (the sigma measure) of economic data over time (Ertur, LeGallo, & Baumont, 2006; Magrini, 2004). The approach we adopt in this paper is closer to economic studies that have examined coefficients of variation, but we include a broader definition (beyond economic variables) of how countries can differ. In addition, we incorporate a spatial dimension into our analysis by constructing an MVE measure, which determines the extent to which country points compress or expand over time.

[3] Mathematically, this property is derived from the fact that the MVE measure is invariant to affine transformations of V_t. If we were to premultiply each $v \in \cup V_t$ by the same fixed, non-singular matrix and add a k-vector to each product, the resultant volumes would not be affected except perhaps by a constant multiple. Since the MVE measure is an index, the constant multiple is irrelevant and would not affect our inference (proof available upon request).

[4] One important point about the MVE method is that it assumes an ellipsoidal form. There are good reasons to assume an ellipsoid as opposed to other shapes. First, as mentioned above, the MVE is not affected by time-invariant issues of correlation and scale (covariance and variance). Consider the following example. A country's university enrollments, the number of patents a country issues, and the number of scientific articles a country publishes are highly correlated. If we are using all of these variables to determine the world's volume, we would ideally like to measure the volume on a de-correlated scale. Otherwise, the distance between countries would be artificially inflated (or deflated) and this would in turn artificially inflate (deflate) the volume.

The MVE volume is not susceptible to this problem. Also, the variables are measured on different scales (enrollments per 10,000 population, patents per million population, and articles per million population) and thus may not be directly comparable. The MVE volume measure is not susceptible to this issue either.

[5]A regression of volumes on time shows similar patterns of rejection. Kendall's tau, however, is less restrictive due to its ordinal nature.

[6]The correlations between the MVE and median-based volumes for the economic, demographic, knowledge, financial, and political distance dimensions are, respectively: 0.87, 0.42, 0.79, 0.72, and −0.39.

[7]For all subcomponents, we calculate the Kendall's tau trend tests restricting the years to 1985–2009. The rejection patterns are similar to the full set of volumes (1960–2009), indicating a lack of evidence for recent convergence.

[8]We calculated the Mahalanobis distance between each country point and the arithmetic mean of all NAFTA country points. We used the maximum of these distances as the hypersphere's radius.

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APPENDIX

Table A1   Trade bloc member states

Trade bloc	Nations and their years of participation
ASEAN	Brunei Darussalam (1984), Indonesia (1967), Cambodia (1994), Laos (1997), Myanmar (1997), Malaysia (1967), Philippines (1967), Singapore (1967), Thailand (1967), Vietnam (1995)
CEFTA	Albania (2007), Bulgaria (1999–2007), Bosnia and Herzegovina (2007), Czech Republic (1992–2004), Croatia (2007), Hungary (1992–2004), Kosovo (2007), Moldova (2007), Macedonia, FYR (2006), Montenegro (2007), Poland (1992–2004), Romania (1997–2007), Serbia (2007), Slovak Republic (1992–2004), Slovenia (1996–2004)
SAARC	Afghanistan (2005), Bangladesh (1985), Bhutan (1985), India (1985), Sri Lanka (1985), Maldives (1985), Nepal (1985), Pakistan (1985)
NAFTA	Canada (1992), Mexico (1992), United States (1992)
Andean Community	Bolivia (1969), Colombia (1969), Ecuador (1969), Peru (1969)
Mercosur	Argentina (1991), Brazil (1991), Paraguay (1991), Uruguay (1991)
SACU	Botswana (1969), Lesotho (1969), Namibia (1969), South Africa (1969), Swaziland (1969)
CARICOM	Antigua and Barbuda (1974), Bahamas(1983), Barbados (1973), Belize (1974), Dominica (1974), Grenada (1974), Guyana (1973), Haiti (2002), Jamaica (1973), St. Kitts and Nevis (1974), St. Lucia (1974), St. Vincent and the Grenadines (1974), Suriname (1995), Trinidad and Tobago (1973)
EU-27	Austria (1995), Belgium (1952), Bulgaria (2007), Cyprus (2004), Czech Republic (2004), Germany (1952), Denmark (1973), Spain (1986), Estonia (2004), Finland (1995), France (1952), United Kingdom (1973), Greece (1981), Hungary (2004), Ireland (1973), Italy (1952), Lithuania (2004), Luxembourg (1952), Latvia (2004), Malta (2004), Netherlands (1952), Poland (2004), Portugal (1986), Romania (2007), Slovak Republic (2004), Slovenia (2004), Sweden (1995)
Eurozone-11	Austria (1999), Belgium (1999), Finland (1999), France (1999), Germany (1999), Ireland (1999), Italy (1999), Luxembourg (1999), Netherlands (1999), Portugal (1999), Spain (1999)

Note: Years of participation are given in parentheses. A single year indicates that the country entered the bloc and is still a member.

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