International geopolitics

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Abstract

Since the Age of Discovery, the world has become economically integrated, while remaining politically disintegrated as a collection of nation-states. The nation-state system is robust because borders, which divide the world landmass into states, interact with economic integration to absorb shocks. We build a tractable general equilibrium model of international trade and national borders in the world. Over a long time horizon, declining trade costs alter trade volumes across states but also incentivize states to redraw borders, causing states to form, change, and dissolve. Our model has significant implications for the global economy and politics, including trade patterns, political geography, state-size distribution, and the risks of militarized disputes. These implications are supported by modern and historical data.

Keywords: nation-state, endogenous borders, militarized disputes, trade costs

JEL Classification Numbers: F50, N40.

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1 Introduction

The Age of Discovery created connections between different parts of the world that had previously been separated. A time traveler from the 18th century might have mixed feelings about the present world. Economically, the world has become remarkably integrated. Thanks to low trade costs, consumers purchase what they want globally, as do producers. But politically, the world remains disintegrated: politics are often local, policies are mostly regional, and nation-states remain the basic units of global affairs, just as in her time. She needs little time to understand the present world political map. Indeed, neither do we need training to understand the Peace of Westphalia.

Although the nation-state system remains, individual states have come and gone. The system serves as a stage where states form, change, and dissolve, dividing the world's landmass differently from time to time. In this paper, we provide a general equilibrium model of international trade and national borders in the world. Consider a linear world populated by a continuum of locales. Locales form joint states that reflect a tradeoff between gains from trade and losses of governability. Domestic trade is less costly than foreign trade, thereby encouraging locales to choose large state sizes, while a large state has more internal conflicts of interest, which encourage locales to choose small state sizes. The nation-state system is in effect a market of statehood where locales select other locales with whom to form states.

Our model characterizes how land, labor, goods, and statehood interact with each other. Locales have land and labor as their endowments in the goods market, and locations as their endowments in the statehood market. Given a linear world geography, locales choose to join their neighbors who have more locational advantages. Those neighbors also prefer to join their own neighbors who have even more locational advantages. Locales that are declined by their better-off neighbors end up joining neighbors who have less advantageous locations. There is a simultaneous and unique general equilibrium, where both the goods market and the statehood market clear.

Our use of a linear geography does not simply emulate the tradition of linearization in economics. It is a reasonable approximation of the real world geography. The earth is a three-dimensional sphere, though inhabitable landmass accounts for only a third of its surface and is disjointedly distributed into continents. As a result, some locations are more advantageous than others because they are closer to the rest of the world. The linear world geography does not deviate far from world geographic and economic data, but provides a highly tractable way to model locational advantages that have important implications for the global economy and politics.

In the economic aspect, our model demonstrates that international trade varies with foreign trade costs not only directly through the attrition between borders, but also indirectly, because borders themselves respond to foreign trade costs, altering sizes of economies and their relations with the rest of the world. In the political aspect, our model illustrates how political globalization halts as economic globalization proceeds. As foreign trade becomes easier, common interests shared by locales within a state start loosening. This occurs earlier to the regions closer to the world geometric center (GC), causing regional instability.

The linear world geography, which produces clear-cut testable hypotheses, connects our theory closely with the data. We find three patterns in digitized world maps that are consistent with what our theory predicts. First, states farther from the world GC set their borders farther apart to keep their price levels low, resulting in larger territories. The positive association between territorial area and distance from the world GC applies to both Eurasian and non-Eurasian states, and is found in different historical periods in addition to the modern time.

Second, when the state at the world GC ("state 0") is larger in size, other states will be farther away from the world GC, and the magnitude of this effect is increasing in a state's relative distance to the world GC. Take state 0's neighbor state 1 (the first nearest state to the world GC) and state 30 (the 30th nearest state to the world GC). When state 0 has a larger size, both states 1 and 30 will be "pushed away" from the world GC, and thus have to be larger as their gained locales have worse locations than their lost ones. This effect is stronger for state 30 than for state 1, because state 30's locational deterioration is more severe than that of state 1.

Third, the positive association between territorial area and distance from the world GC also applies to sub-state jurisdictions ("provinces") in states that use a federal system. Provinces under a federal system have a certain degree of autonomy, behaving as semi-states. Thus, within a state, the provinces that are farther from the world GC are also expected to be larger, for the same reason as at the cross-state level. Digitized maps of the four largest states that use a federal system (Brazil, Canada, Russia and the United States) support this hypothesis. This finding also addresses an empirical concern over the earlier cross-state results. States closer to the world GC might be smaller for ad hoc reasons, but such reasons cannot explain the within-state association between province size and distance from the world GC.

Our model also sheds light on international security issues. With the same scale, military disputes that occur nearer to the world GC involve more states. Additionally, within a militarized dispute, the side nearer to the world GC is more likely to request revisions to existing borders because, according to our model, a marginal change to a given border affects the welfare of the states on the proximal (closer to the world GC) side more than it does the states on the distal (farther from the world GC) side. Notice that this does not mean that states on the proximal side tend to resort to military solutions. According to our empirical results, they are no more likely to originate militarized disputes than states on the distal side.

The major contribution of this paper is providing a unified framework to consolidate international trade and international institutions. Existing studies have examined the connection between international trade and various *domestic* institutions. Since international trade differentially advantages various groups within a state, it has a substantial influence on domestic institutions. In the literature, the domestic institutions found to be influenced by trade range from check and balance (Acemoglu, Johnson, and Robinson, 2005) to parliamentary operations (Puga and Trefler, 2014), military operations (Acemoglu and Yared, 2010; Bonfatti and O'Rourke, 2014; Martin, Mayer, and Thoenig, 2008a; Skaperdas and Syropoulos, 2001) and contract enforcement (Anderson, 2009; Ranjan and Lee, 2007). Unlike domestic institutions, international institutions do not directly influence individual welfare, but define the rules for states to interact with each other. Such interactions are found to have enormous impacts on individual welfare indirectly, through the feasibility of long-distance trade (Greif, 1994, 2006), domestic interdependence among state economies (Keller and Shiue, 2015), and institutional integration of states (Guiso, Herrera, and Morelli, 2016). These channels mostly operate through the nation-state system in modern times, and we look into the mechanism of the nation-state system itself in this study.

A methodological dilemma emerges as to how to position states as players in international institutions. Specifically, if states in a model act too strategically, the model easily loses micro-foundations at the individual (citizen) level. If states in a model are plainly benevolent social planners, the model would confront the observed diversity of political regimes in the world. We strike a balance between the two considerations by specifying minimal capacities of states, and focus on the interactions among locales within and across states. All locales in our model seek to maximize their real income. States in our model serve only as the demarcation between domestic markets (i.e., without foreign trade costs) and foreign markets (i.e., with foreign trade costs), and have no other functions such as providing public goods. The specification of such "hollow" states insulates the mechanism of our model from the studies on the origin of states (Ang, 2015; Bates, Greif, and Singh, 2002; Carneiro, 1970; Hobbes, 1651; Tilly, 1985; de la Sierra, 2015) and the capacities of states (Aghion, Persson, and Rouzet, 2012; Alesina and Reich, 2015; Besley and Persson, 2009; Iyigun, Nunn, and Qian, 2015). Meanwhile, as these elements are shut down rather than replaced by other elements, they can be restored individually when the need arises to incorporate them at the interstate level.

Our paper is related to the literature on the efficient size of states (Alesina and Spolaore, 1997, 2005, 2006; Brennan and Buchanan, 1980; Desmet, Le Breton, Ortuño-Ortín, and Weber, 2011; Friedman, 1977). In particular, the tradeoff between trade and governability builds on the pioneering model by Alesina, Spolaore, and Wacziarg (2000, 2005). We depart from the literature by incorporating world geography. With a world geography specified, state territories are endogenously asymmetric within any period on the theoretical front, and thus are connectable with cross-sectional data for every period on the empirical front.

Moreover, including geography in the model enables us to assess every locale's common interests with every other locale, with their own state, and with their neighboring states.[1] The goal of this paper is not to characterize how the number of states evolves over time but rather to rationalize how the nation-state system serves as a platform for locales to interact with each other within each time period. States in our model emerge, change, and dissolve through border reshuffling, which is driven by welfare calculations at the locale level.

Geopolitical analysis, started by Huntington (1907), Mackinder (1904) and Fairgrieve (1917), is not a well-defined discipline or sub-discipline in the social sciences, in spite of its significant influence on the work of historians (Braudel, 1949), human geographers (Diamond, 1999), and political scientists (Morgenthau, 1948; Kissinger, 1994, 2014; Brzezinski, 1997). It is controversial among social scientists because of the determinism to which it alludes. Schools on the liberalism side criticize its lack of moral relevancy (Berlin, 1954; Popper, 1957), while schools on the realism side believe that focusing only on one factor oversimplifies international relations (Morgenthau, 1948). As economists, we agree with the importance of free choice. Endogenous variables, as a reflection of free choice, are the crux of economic models. Economic methodology helps us avoid equating geopolitics with determinism. In our model, geographic positions of locales are exogenous, while their statehood choices remain endogenous, and different parameters of the model lead to distinct state partitions in the world. To this end, our paper also provides a general contribution to the social sciences. We believe that more work in this direction will make geopolitics more analytical, tractable, and conclusive.

Perhaps surprisingly, the literature on international trade, where the nation-state is both the analytical unit in theory and the administrative unit in practice, has not considered endogeneity in the formation of nation-states. Suppose that the division of the world into states adjusts to facilitate trade among locales in the world, then the estimated impacts of trade costs on trade volumes would be biased towards zero. This supposition has a pronounced factual basis, as regional trade agreements — a supranational arrangement in international economics and politics — are extensively documented to be endogenous (Baier and Bergstrand, 2002, 2004; Egger, Larch, Staub, and Winkelmann, 2011; Krishna, 2003; Keller and Shiue, 2014; Shiue, 2005). There also exists plenty of evidence that wars, which often lead to births, deaths, and changes of nation-states, are intertwined with trade (Martin, Mayer, and Thoenig, 2008b, 2012; Polachek, 1980, 1992).

There exist two international trade studies relevant to our approach. Anderson and van Wincoop (2003) analyze the effects of crossing-the-border on bilateral trade volumes between US states and Canadian provinces. They show that, for a given unit of border-induced cost, local economies in a smaller country (Canada) substitute foreign trade for

[1] Lan and Li (2015) analyze different levels of nationalism across regions within a state. They find that regions that receive globalization shocks endorse the existing state configuration less, because they share less (respectively, more) common interests with their domestic peer regions (respectively, the rest of the world).

domestic trade by a larger magnitude than those in a larger country (the US). Their analysis, despite treating borders as exogenous, demonstrates the asymmetric effects of the same border for economies on its different sides. In our paper, borders are endogenously formed and have asymmetric effects on their two sides, both economically and politically. Allen, Arkolakis, and Takahashi (2014) examine how a social planner would allocate trade costs across given states in the world. States in our model are endogenous and trade costs are the outcome of statehood choices. Different from their work, our interest lies in the landscape of states in a decentralized equilibrium, a positive topic that targets rationalizing the observed modern political geography.

The rest of the paper is organized as follows. In Section 2, we illustrate why linearity is a reasonable approximation of world geography. In Section 3, we present our theoretical model and derive testable hypotheses. In Section 4, we report our empirical results. In Section 5, we extend our study to international security issues. In Section 6, we conclude.

2 Linear Approximation of World Geography

In this study, we use a line to approximate the geography of inhabitable landmass in the world. The necessity of using a specific geography stems from the need to model national borders. International trade theories, from traditional ones to the new trade theory, do not require specific geographies, because grouping different economies into conceptual countries suffices to let different parts of the world interact economically.[2] However, our theory is also concerned with the behavior of national borders that interact with each other. National borders divide the world landmass into states, which must have shapes and therefore have to build on a specific geography.

Real-world national borders, as lines, divide two-dimensional real-world landmass into two-dimensional state territories. We reduce the dimensions by letting theoretical borders, which take the form of points, divide a one-dimensional world landmass into one-dimensional states. The reduction in dimension is for tractability. Note that in a unit disk (the most tractable two-dimensional shape), any two straight lines have numerous possible combinations, dividing the disk in numerous possible ways. Dropping one dimension enables us to tract the behaviors of borders, states, trade, and migration, even though close-form solutions are still sometimes unobtainable. This practice follows the tradition in economics that uses one-dimensional models to tackle multi-dimensional issues.[3]

Of course, tractability alone does not justify linear simplification. A line model im-

[2]Such geographic neutrality also applies when migration is integrated into trade models (known as the economic geography models), including those building on monopolistic competition (e.g., Fujita et al. (1999)) and perfect competition (e.g., Allen and Arkolakis (2014); Ahlfeldt et al. (2015)).

[3]For example, Hotelling (1929) on spatial competition, Dornbusch et al. (1977) on comparative advantage, Black (1948) and Downs (1957) on majority-rule voting, and Ogawa and Fujita (1980) on urban structures.

poses geometric centrality on the theoretical world geography, where the midpoint is the point closest to the rest of the world. In the rest of this section, we conduct two reality checks on the geometric centrality. The first is a geographic check, examining whether a state's estimated total distance to the rest of the world (ROW) is quadratically increasing in its distance from the estimated world geometric center (GC). The check will fail if the real-world landmass does not exhibit geometric centrality.[4] The second is an economic check, examining whether the distance between a state and the estimated world GC is correlated with the state's foreign trade volumes. The check will fail if the geometric centrality does not bring economic advantages or disadvantages to states in the world economy.

Notice that a circle (a disk without an interior) is an alternative tractable geography of the world. Unlike lines, circles do not exhibit geometric centrality because all points on a circle have the same total distance from all other points on the circle. We believe that this symmetric structure deviates too far from the real-world geography. The two reality checks in this section help us determine which of the two geometric shapes is more realistic.

Another notable issue here is that the line approximation is for the landmass of the world. The line is not, and should not, be weighted using observed population or other socioeconomic variables. In our framework, it is the landmass that provides the platform for borders to form. Once borders form, trade, migration, and policies arise endogenously. Thus, economic and socioeconomic features should not be used to weight any geographic feature (except when a threshold population is needed to exclude uninhabitable landmass, as detailed later). A landmass weighted by population and similar variables would give the landmass of industrial clusters (where population density is high) too large weights, confounding the geographic patterns of landmass.

In the rest of the section, we first describe the data we use to estimate geographic features, including world GC, distance, and total distance with the rest of the world. The data described here are also the primary data used in Section 4. Then we present the specifications and results of the two reality checks.

Data on World Geography

Our major data source is digitized political maps of the world. Our benchmark map is the political world map of the year 1994. We refer to 1994 as the modern period, because no major border change has occurred in the world since then. We use historical world maps to supplement the modern one. Historical world maps were digitized using historical atlases of the world, including Barraclough (1994), Rand McNally (1992, 2015) and Overy (2010). We used multiple atlases because maps in historical atlases are provided for different region-

[4] A simple example of the failure is when the landmass is uniformly distributed on the surface of the earth. The earth is a three-dimensional sphere, so that its surface does not have a geometric center.

time blocks rather than for the whole world over time. Combining different sources enabled us to compile a world map for different historical periods, each starting from a *base* year and extending to approximately 20-30 years later. We successfully compiled three historical world maps, with base years 1750, 1815, and 1914-1920-1938 (explained below), respectively. For simplicity, we refer to them as the 18th century, 19th century, and early 20th century in the rest of the paper.

The selection of base years inevitably involves judgments, since a balance has to be struck between historical significance and map availability. In principle, we selected years that (i) follow major wars and (ii) precede relatively peaceful 20-30 year periods. World political geography in those base years resulted from the resolution of the power imbalances that triggered the wars, and was marked by temporary regional stability afterwards. Specifically, 1750 followed the War of the Austrian Succession, and 1815 was the year when the Treaty of Paris was signed. It is difficult, using this principle, to find a qualified base year in the early 20th century, because two world wars took place during the first half of the century. WWI was too close to the beginning of the century, and the interwar years (1919-1938) were too short as a peaceful period. In this setting, choosing a single year would risk using a political map filled with persuasive regional tensions that changed borders rapidly. At the same time, the first half of the 20th century, as a notable period of struggle in modern history, should not be plainly excluded. As a compromise, we pooled all states that existed in three separate base years — 1914, 1920, and 1938.[5]

Similar judgments were made when we determined what states in world maps to exclude. In principle, territories with ambiguous sovereignty statuses were excluded. By this principle, small island states were usually excluded, because many of them were dependent territories. There are two exceptions to this principle. First, although colonies had ambiguous sovereignty statuses, they were good examples of border reshuffling and state formation. Thus, colonies were treated as independent states in their own periods if they later transitioned to independent states. Second, kingdoms in the 18th century were considered to be independent states as long as they were independent from neighboring states that had clear sovereignty statuses. Without making these two exceptions, states in historical periods would be quite small in number.

Apart from the geographic variables, we extracted population, iron and steel production, military expenditures, and primary energy consumption from the national material capabilities dataset (version 4) compiled by Singer (1987), which is part of the Correlates of War (COW) project.[6] The dataset is regularly updated and thus beyond the year 1987, providing us with control variables that reflect every country's national power and industrialization level. Its coverage begins with the year 1815 and thus the data are unavailable

[5]If a state altered its name across the three base years, we treated it as a new state. If a state kept its old name, we treated it as a "steady state" and accordingly averaged its variables across the three base years.

[6]The COW project is accessible online: www.correlatesofwar.org.

for our 18th century sample. The data on world political geography and industrialization are the main variables in this study. Their summary statistics are reported in Table 1. The world geometric centers (world GCs) in the table will be explained below, and other data used later will be described when they are used.

Table 1: Summary Statistics

Variable	Obs	Mean	STD	Min	Max	Obs	Mean	STD	Min	Max
	Panel A: Modern period					*Panel B: The 18th century*				
Distance from the world GC (km)	162	5365	3575	132.2	17968	121	4959	3609	364.7	17620
Area (square km)	162	86.41	274.7	0.338	2806	121	71.00	269.7	0.0269	2664
Coast dummy	162	0.753	0.433	0	1	121	0.752	0.434	0	1
Island dummy	162	0.123	0.330	0	1	121	0.182	0.387	0	1
Military expenditure#	156	3.548e+06	9.153e+06	4783	5.700e+07					
Iron and steel production (tons)	156	5054	19802	0	205259					
Primary energy consumption*	156	118773	308762	25.74	2.461e+06					
World GC (Lat, Lon)	Hradec Kralove, Czech Republic (50.21,15.83)					Kisvarda, Austrian Empire (48.22,22.08)				
	Panel C: The 19th century					*Panel D: Early 20th century*				
Distance from the world GC (km)	137	4945	3867	110.9	17970	174	5606	3523	194.0	17968
Area (square km)	137	84.07	308.4	0.0148	2976	174	120.1	387.7	0.338	3401
Coast dummy	137	0.679	0.469	0	1	174	0.828	0.379	0	1
Island dummy	137	0.153	0.362	0	1	174	0.126	0.333	0	1
Military expenditure#	51	5146	4316	14.73	20687	75	745823	1.919e+06	0	9.970e+06
Iron and steel production (tons)	51	325.5	444.2	0	2806	75	1908	5953	0	45349
Primary energy consumption*	51	7100	9968	0	62639	75	30703	100490	0	809321
World GC (Lat, Lon)	Weißwasser, Germany (51.50,14.64)					Hradec Kralove, Austro-Hungarian Empire (50.21,15.83)				

Notes: # Following the COW database, the unit is 1,000 US dollars (1,000 British Pounds) in Panels A and D (Panel C). * The unit is 1,000 of coal-ton equivalents.

Geographic Check

As explained earlier, this check is concerned with whether inhabitable landmass in the world demonstrates geometric centrality as a line does. Point a in the line $[-1, 1]$ has a distance $|a|$ with the line's GC at $a = 0$. Meanwhile, it has a total distance $a^2 + 1$ from all other points in the line, which is quadratically increasing in $|a|$ and minimized at the GC. Correspondingly, we examine whether the total distance of a state with the rest of the world (ROW) is increasing quadratically in its distance from the world GC.

We start with constructing a set of locales in the world. A locale in the world is defined as an administrative division in the world map with a population of at least 15,000. The population threshold is set moderately low to ensure that the landmass is used for permanent residence.[7] The information on within-country administrative divisions is obtained from the GeoNames database, including geographic coordinates and population.[8] For the modern time (defined as the year 1994), there are 21,068 such locales. There exist no GeoName data corresponding to historical periods. We use the modern GeoName data to construct the

[7] A high threshold would limit the sample to industrial clusters while too low a threshold would cause the locales with only temporary public projects, scattering periodic employers, or seasonal school enrollments to be over-represented. The value 15,000 is the lowest population requirement used by the US Census to determine central cities of metropolitan statistical areas. Lowering that population threshold to zero is equivalent to treating every state as a polygon. We use that as a robustness check later.

[8] The database is accessible online www.geonames.org, with both free and paid data services provided.

set of locales for historical periods, since the GeoNames data represent the largest possible set of inhabitable locales in the past.

To estimate the location of the world GC, we first calculated $D(t, t')$, which is the orthodromic distance between any two locales in the world (i.e., $t, t' \in W$), and then calculated every local t's total distance with the rest-of-the-world locales.[9] The locale with the smallest total distance is designated as the world GC:

$$GC \equiv \arg\min_{t} \sum_{t' \in W} D(t, t'). \tag{1}$$

The last row of Table 1 reports the locations of world GCs over time.

Every state, as a collection of locals, has an average distance to the world GC,

$$Dist(n) \equiv \frac{1}{N_n} \sum_{t \in n} D(t, GC), \tag{2}$$

where N_n is the number of locales in state n, and an average total distance to the rest of the world

$$TDist(n) = \frac{1}{N_n} \sum_{t \in n} \sum_{t' \in W} D(t, t'). \tag{3}$$

If the real-world geography exhibits geometric centrality, we should see that a state with a larger $Dist$ has a quadratically larger $TDist$. Thus, the geographic check takes the form of regressing $TDist(n)$ on a constant term, a first-order $Dist(n)$, and a second-order $Dist(n)^2$. The coefficient of the second-order term $Dist(n)^2$ is hypothesized to be positive. The constant and first-order terms, expected to be either positive or zero, adjust for functional forms.[10]

Panel A of Table 2 reports regression results. The coefficients of the constant term, $Dist$, and $Dist^2$ are all positive and statistically significant. This relation holds for every period and the R^2 statistics are between 0.978 and 0.994, indicating that $TDist(n)$ fits geometric centrality to a high degree. In the second column of every period, we experiment with including coast and island dummy variables, as well as continent fixed effects, which turn out not to change the findings. They do alter the relative sizes of those coefficients, though not leading to significant R^2 improvement. Panel B of Table 2 elaborates on the modern period by including different orders of $Dist(n)$. Its first column reproduces the second regression for the modern period in Panel A. Geometric centrality is observed again. Also, when still higher orders of $Dist$ are incrementally added into the regression, the fitness shows little

[9] Orthodromic distance (great-circle distance) is the shortest distance between two points on the surface of the earth. It is measured along the surface rather than through the interior of the earth.

[10] The constant term of the regression corresponds to the 1 in the $TDist$ formula $TDist(a) = a^2 + 1$. The first-order term is absent in the formula because its GC is precisely at the midpoint of the line (i.e., $a = 0$). When it is not at the midpoint, a first-order term is present.

improvement.

Table 2: Geographic Check

Panel A: Dep. Variable is TDist				
	Period: 18th century		Period: 19th century	
Constant term	87212030.837***	95456240.911***	1.054e+08***	1.168e+08***
	(845,514.069)	(1682650.484)	(536,585.529)	(1822809.178)
Distance from the world GC	7,276.891***	4,864.358***	7,449.707***	4,720.678***
	(564.896)	(717.695)	(464.220)	(877.438)
Distance from the world GC^2	0.188***	0.321***	0.169***	0.409***
	(0.051)	(0.075)	(0.045)	(0.092)
Coast and island dummies	No	Yes	No	Yes
Continent FE	No	Yes	No	Yes
Observations	121	121	137	137
R-squared	0.969	0.994	0.978	0.990
	Period: early 20th century		Period: modern	
Constant term	1.088e+08***	1.187e+08***	1.088e+08***	1.187e+08***
	(1115661.126)	(1707038.555)	(1095266.681)	(1810979.989)
Distance from the world GC	7,757.427***	5,286.812***	7,823.481***	5,206.437***
	(646.753)	(808.303)	(644.294)	(818.453)
Distance from the world GC^2	0.209***	0.410***	0.205***	0.412***
	(0.061)	(0.080)	(0.061)	(0.082)
Coast and island dummies	No	Yes	No	Yes
Continent FE	No	Yes	No	Yes
Observations	174	174	162	162
R-squared	0.984	0.993	0.984	0.993
Panel B: Dep. Variable is TDist, Modern Period+				
Constant term	1.187e+08***	1.234e+08***	1.248e+08***	1.234e+08***
	(1810979.989)	(647,497.479)	(662,080.449)	(1029453.236)
Distance from the world GC	5,206.437***	2,382.739***	-992.376	2,427.142
	(818.453)	(509.458)	(1,845.611)	(2,854.955)
Distance from the world GC^2	0.412***	0.732***	2.452**	0.063
	(0.082)	(0.160)	(0.973)	(3.050)
Distance from the world GC^3		0.000	-0.000	0.000
		(0.000)	(0.000)	(0.001)
Distance from the world GC^4		-0.000***	0.000	-0.000
		(0.000)	(0.000)	(0.000)
Distance from the world GC^5			-0.000	0.000
			(0.000)	(0.000)
Distance from the world GC^6			0.000	0.000
			(0.000)	(0.000)
Distance from the world GC^7				-0.000
				(0.000)
Distance from the world GC^8				0.000
				(0.000)
Observations	162	162	162	162
R-squared	0.981	0.997	0.997	0.997

Notes: + Panel B includes coast and island dummies and continent fixed effects in all columns (just as the second column of the modern period in Panel A). Robust standard errors in parentheses. *** p<0.01, ** p<0.05.

Economic Check

The geometric centrality established in Table 2 does not necessarily have economic relevance. Trade is the best indicator of interstate economic linkages. The standard method of analyzing trade data is the gravity model.[11] Following the literature, we formulate the following gravity regression:

$$\ln T(n,n') = \mu \ln D(n,n') + \bar{\vartheta} \cdot \begin{bmatrix} \ln Size(n) \\ \ln Size(n') \end{bmatrix} + \bar{\omega} \cdot \begin{bmatrix} \ln Dist(n) \\ \ln Dist(n') \end{bmatrix} + \iota' Z_{nn'} + \epsilon_{nn'} \tag{4}$$

where $T(n,n')$ is the value of imports of state n from state n', $D(n,n')$ is the distance between the two states, $Size(n)$ and $Size(n')$ are their sizes (either population or area), $Z_{nn'}$ are control variables, and $\epsilon_{nn'}$ is the error term. We added two novel terms $Dist(n)$ and $Dist(n')$ to capture the role of each country's unilateral *Dist* in its trade volume with every trade partner. The coefficients $\bar{\omega}$ are hypothesized to be negative. That is, a country farther from the world GC is expected to have a locational disadvantage in its trade with every trade partner.

We extracted the year 1994 from the CEPII gravity dataset to estimate the gravity regression (4).[12] Panel A of Table 3 reports the estimates from the gravity model. The estimated parameters are consistent with our expectation; specifically, the coefficients of the two $\ln Dist(\cdot)$ terms are both negative and statistically significant.

Regression (4) is usually referred to as the reduced-form gravity model. It can alternatively be estimated with two state fixed effects instead of the two state-size variables. This fixed-effect specification is sometimes termed the structural gravity model, where the two fixed effects have a theoretical interpretation — they capture the inverse of each state's "remoteness" to the rest of the world. Following this reasoning, we hypothesize that the remoteness is increasing in our estimated $\ln Dist(\cdot)$. To implement this idea, we run regression (4) using the fixed-effect approach as described in the literature, and extract the exporter's fixed effect. A smaller fixed effect suggests that the corresponding state is remoter from the rest of the world. In Panel B of Table 3, we regress these estimated fixed effects on $\ln Dist(\cdot)$. We find a negative correlation between them, indicating that a larger $\ln Dist(\cdot)$ is associated with a greater remoteness from the rest of the world in trade.

It is important to note that the results in Table 3 are merely a reality check of $Dist(\cdot)$'s economic relevance. It demonstrates that a shorter distance from the world GC explains *some* of a state's locational advantage in global trade. We are not proposing a new *Dist*-based approach to estimate gravity models. In fact, the existing gravity estimation methods do not

[11] See Anderson (2011) and Head and Mayer (2014) for reviews of the gravity model.

[12] The CEPII data are widely used in international trade studies. It is accessible online: `www.cepii.fr`. For details, see Head, Mayer, and Ries (2010) and Head and Mayer (2014).

Table 3: Economic Check

Panel A: Dep. variable is ln(Trade volume)				
	Size=population		*Size=area*	
ln(Size of exporter)	0.518***	0.499***	0.323***	0.313***
	(0.009)	(0.009)	(0.009)	(0.009)
ln(Size of importer)	0.444***	0.426***	0.260***	0.251***
	(0.009)	(0.009)	(0.009)	(0.008)
ln(Bilateral distance)	-0.466***	-0.253***	-0.404***	-0.222***
	(0.021)	(0.023)	(0.022)	(0.025)
ln(Exporter's distance from the world GC)	-0.305***	-0.331***	-0.404***	-0.408***
	(0.014)	(0.014)	(0.015)	(0.016)
ln(Importer's distance from the world GC)	-0.255***	-0.281***	-0.332***	-0.335***
	(0.014)	(0.014)	(0.016)	(0.016)
Other control variables+	No	Yes	No	Yes
Observations	18,839	18,839	19,019	19,019
Panel B: Dep. variable is estimated fixed effect in the structural gravity model				
ln(Distance from the world GC)		-0.230**		
		(0.112)		
Coast and island dummies		Yes		
Observations		155		

Notes: The data are for the year 1994 in both panels. + Control variables include dummies for being in the same regional trade agreement(s), sharing legal origins, sharing currency, sharing border(s), sharing official language, dummy for being a GATT member (each side), dummy for selling to colony, dummy for buying from a colony. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

rely on any specific geography, and thus can account for any specific geography. Estimating the coefficients of the $\ln Dist(\cdot)$ terms are for motivating our following theoretical model.

3 Theory

3.1 Environment

Consider a world represented by a continuum of locales, indexed by $t \in [-1, 1]$. All locales have the same quantities of land z and initial labor l, which are inelastically supplied to produce locale-specific differentiated goods. Locales use an equally efficient technology

$$y(t) = z(t)^{\alpha} l(t)^{1-\alpha}, \tag{5}$$

where $\alpha \in (0,1)$, $z(t)$ represents land, and $l(t)$ represents labor. Firms within a locale compete perfectly. The land of a locale t is immobile, owned by the lord of the locale, while labor can freely move across locales within a state. Every locale belongs to a state, defined as an interval of locales. The state to which locale t belongs is denoted by n_t.

Both lords and labor are consumers. Every consumer at locale t consumes goods made locally and elsewhere:

$$C(t) \equiv \exp\{\int_{-1}^{1} \ln c(t,s)ds\}, \tag{6}$$

where $c(t,s)$ is the quantity of the good made by locale s and consumed at locale t. Cross-locale trade is costless if the two locales are in the same state, but has an iceberg cost if the two locales are in two different states. That is, only one unit of the good arrives if $d(t,s) \geq 1$ units are shipped, where

$$d(t,s) = \begin{cases} 1, & \text{if } s \in n_t, \\ \inf_{t \in n_t} \exp\{\tau \,|s-t|\}, & \text{if } s \notin n_t, \end{cases} \tag{7}$$

The parameter $\tau > 0$ is the foreign trade cost parameter.[13]

Without loss of generality, we let consumers incur trade costs and pay for them. Suppose that the factory-gate price of locale s's good is $p(s)$. At that price, firms do not discriminate between markets. They ship quantity $y(t,s)$ to locale t. Then $c(t,s) = y(t,s)/d(t,s)$ units are delivered for consumption at locale t, where consumers pay the price $p(t,s) = d(t,s)p(s)$ per unit. In other words, at the factory-gate price $p(s)$, the firms at locale s do not care about how their output is distributed across destinations, but simply sell all of their output. The market clearing condition of the good made by locale s is

$$\int_{-1}^{1} y(t,s)dt = y(s), \tag{8}$$

where $y(s)$ is locale s's total output.

3.2 Endogenous Borders

The timing of events is the following. On date 1, lords in the world group themselves into states, such that their lands become the territories of their states, and the initial labor on those lands becomes the nationals of their states. On date 2, nationals freely move across locales within a state to form local labor forces, who join immobile local lands to produce local goods. On the same date, all local goods are traded and consumed as described earlier.

[13] The assumption of iceberg trade cost follows Krugman (1980). The exponential function in equation (7) results from aggregating incremental iceberg costs as the distance between the increments tends to zero (see Allen and Arkolakis (2014)). Zero domestic trade cost is not essential in our context. A positive domestic trade cost does not alter our findings as long as it is smaller than foreign trade cost per unit of distance.

Lords and labor, both as consumers, obtain utility from consumption. A larger size of the state saves foreign trade costs and thus boosts consumption. Meanwhile, lords of a state have to coordinate with each other to govern the state. A larger group of lords would have more internal conflicts of interest, so that a larger state is less governable. Formally, we let the lord of locale t have utility function

$$U(t) = \frac{1}{1-\gamma} C^z(t)^{1-\gamma} - hS(t), \tag{9}$$

where $\gamma > 1$, and $h > 0$ represents a constant marginal disutility h from its state's size $S(t)$, and let the labor of locale t have utility function

$$V(t) = \frac{\psi}{1-\gamma} C^l(t)^{1-\gamma}, \tag{10}$$

where $\psi > 0$ is a free scalar that allows a potential difference in marginal utility of consumption between the two types of consumers. Both $C^z(t)$ and $C^l(t)$ follow the Cobb-Douglas structure (6). The term $-hS(t)$ in the lord's utility, following Alesina, Spolaore, and Wacziarg (2000, 2005), keeps state sizes limited.[14] The lord of every locale t maximizes $U(t)$ as a tradeoff between the trade cost and the governance cost, by choosing its optimal state size $S(t)$.

The state size $S(t)$ in equation (9) is a locale-level variable, and a state is a group of locales. Since the lords of different locales have different $C^z(\cdot)$, they have different optimal state sizes $S^*(t)$ in mind. We define an equilibrium state n as a group of locales $\{t \in n\}$ who adopt the smallest optimal state size $S^*(t)$ among all its constituent locales as the size of their state:

$$S_n = \min\{S^*(t) : t \in n\}. \tag{11}$$

This definition of state requires that none of a state's constituent lords wants to exclude any other constituent lord. All lords in a state have economic interests abroad through consuming foreign goods, and thus have incentives to incorporate new constituents into the state, in order to have more savings in foreign trade costs. By requiring every lord to endorse a limited "statehood," the state does not expand infinitely to include all locales in the world. The lord with the smallest optimal state size will veto further expansion when further expansion would make the state too large for her.

Without a specific geography, the set of world state sizes $\{S_n\}$ has numerous possible cases. The locales $\{t\}$ in the world, if not anchored to a specific geography, can be grouped

[14] There are several interpretations of the disutility term $hS(t)$. For example, one can interpret it as a "cost of heterogeneity" as in Alesina et al. (2000), which arises because a larger state means that more heterogeneous people (in terms of ethnicities, races, origins, etc.) have to conform to uniform state institutions. An alternative way is to think of h as the cost of expanding borders for the locale per unit of distance. The cost is paid by local income tax and thus is written into the utility function of locales.

arbitrarily into any $\{S_n\}$. In that case, any locale's state choice depends on every other locale's state choice, rendering the equilibrium $\{S_n\}$ indeterminable. The linear geography $\{t\} = [-1, 1]$, introduced at the beginning of this section, makes the equilibrium $\{S_n\}$ determinable by imposing the constraint that locales can only form states with their neighbors. This simplifies $\{S_n\}$ to be a partition of the world $\{b_n\}$:

$$\{b_n\} \equiv \{b_{-N}, ..., b_{-1}, b_{-0}, b_0, b_1, ..., b_N\}, \tag{12}$$

where S_n now refers to a unique interval of locales between b_{n-1} and b_n. The state that contains the midpoint locale, namely the world geometric center (GC), consists of the locales (b_{-0}, b_0). There are a total of $2N + 1$ states in the world. In the following, without loss of generality, we analyze the right half of the world, where state size S_n corresponds uniquely to the size of the state formed by locales $[b_{n-1}, b_n)$. We refer to that state as state n, which is also the n-th nearest state to the world GC. Notice that from here on, there is no need to differentiate a state size (a scalar such as $S_n = b_n - b_{n-1}$) from a state (an interval of locale indexes such as $n : [b_{n-1}, b_n)$).

Reverting to the lord's utility function (9), the major decision for the lord of locale t is choosing a state $n : [b_{n-1}, b_n)$ that satisfies three criteria:

1. (Location) $t \in [b_{n-1}, b_n)$,
2. (Constitution) She and her peers, namely the lords of $[b_{n-1}, b_n)$, have the same $S_n = \min\{S^*(s) : s \in n\}$, and
3. (Well-being) $U(t \in n) > U(t \in n')$ for any $n' \neq n$.

In other words, she chooses neighbors (criterion 1) who share the same view about their common state size (criterion 2) to maximize her utility (criterion 3). The notation n_t (the state of locale t) used at the beginning of this section consists of locales $[b_{n_t - 1}, b_{n_t})$. The choices of neighbors made by all lords in the world constitute the equilibrium partition of the world

$$\{b_n^*\} \equiv \{b_{-N}^*, ..., b_{-1}^*, b_{-0}^*, b_0^*, b_1^*, ..., b_N^*\}. \tag{13}$$

With the equilibrium partition, equilibrium consumption and production easily follow.

3.3 Equilibrium

We are now ready to solve the equilibrium. Through backward induction, we start with date 2 to solve the economic aspect of the model, conditional on the partition of the world determined on date 1. Then we revert to date 1 to solve the equilibrium partition itself.

Date 2 On date 2, lords and labor, both as consumers, purchase goods worldwide. The trade costs they face have been determined on date 1, in the form of a partition of the world. To make consumption decisions, they maximize their utility (equations (9)-(10)) subject to their respective budget constraints. At locale t, the total consumption of the good made by locale s has a value of (see Appendix A.1.1 for the detailed derivation):

$$p(t,s)c(t,s) = \frac{C^z(t)^{1-\gamma}}{\lambda^z(t)} + \frac{\psi C^l(t)^{1-\gamma}}{\lambda^l(t)} \equiv \kappa(t), \tag{14}$$

where $\lambda^z(t)$ and $\lambda^l(t)$ are the shadow prices (Lagrange multipliers) of the lord and labor, respectively. We introduce the function $\kappa(t)$ for convenience. By taking the integral of equation (14) across destination locale t's, we obtain the nominal GDP of an origin locale s:

$$p(s)y(s) = \int_{-1}^{1} p(t,s)c(t,s)dt = \int_{-1}^{1} \kappa(t)dt \equiv \kappa \text{ for any } s, \tag{15}$$

where $p(s)$ and $y(s)$ are locale s's factor-gate price and total output, respectively, as mentioned earlier. Recall that trade costs are incurred and paid by consumers. Equation (15) implies that all locales in the world have the same total sales, hereafter denoted by κ.

Then the incomes of every locale s's lord and labor follow from the production function (5):

$$r(s)z = \alpha p(s)y(s) = \alpha\kappa, \tag{16}$$

and

$$w(s)l(s) = (1-\alpha)p(s)y(s) = (1-\alpha)\kappa. \tag{17}$$

Since labor can freely migrate across domestic locales, there is a national labor market equilibrium, within national borders determined on date 1. Initial labor of the locales of state n becomes the labor supply in state n's national labor market. By equation (17), they are uniformly distributed across the state's locales in equilibrium. This is because any locale with a labor employment larger than its initial labor endowment would have a lower wage rate, causing some labor to leave for other locales. As a result, the labor employed at every locale s in state n is equal to the state's average labor endowment across its locales:

$$l(s \in n) = l_n \equiv \frac{\int_{t\in n} l(t)dt}{S_n}. \tag{18}$$

The output of locale t in state n is

$$y(s \in n) = y_n \equiv Az^{\alpha} l_n^{1-\alpha}. \tag{19}$$

Equations (15)-(19) are a full characterization of the equilibrium on date 2, conditional on the partition of the world determined on date 1.

Date 1 We now revert to date 1 to solve the equilibrium world partition $\{b_n^*\}$. On date 1, lords in the world choose their neighbors, who all have perfect foresight about what will happen on date 2 (as solved above). For convenience, the choices made *by the lords* and the choices made *by the locales* are two terms used interchangeably hereafter. We divide the following discussion into three steps: (i) preparation, (ii) find an equilibrium partition, and (iii) show the found equilibrium partition to be unique.

(i) Preparation Equation (16) shows that the lord at locale s receives an income of $r(s)z = \alpha p(s)y(s)$. By choosing different neighbors, the lord cannot improve her nominal income. Recall that land and initial labor are uniformly distributed across all locales in the world. Including/excluding a neighboring locale affects neither its land z, nor the quantity of labor employed at the locale. As a result, whichever neighbors she chooses, the land/labor ratio remains the same for the locale, so that her $r(s)$ does not change. Therefore, the previous equations (18) and (19) become

$$l(s) = l \equiv \frac{\int_{t\in n} l(t)dt}{S_n}, \text{ and } y(s) = y \equiv Az^{\alpha}l^{1-\alpha}, \text{ for any } s. \tag{20}$$

Namely, $l(s)$ and $y(s)$ are invariant across locales in the world. So, the real aspects of locale s's economy, characterized by $y(s)$, $l(s)$ and $z(s)$, are the same across locales in the world. The nominal aspects, characterized by three variables $p(s)$, $w(s)$ and $r(s)$, satisfy

$$p(s)y = r(s)z + w(s)l. \tag{21}$$

where $r(s)z/(p(s)y(s)) = \alpha$. There is an extra degree of freedom in equation (21). For later convenience, we normalize $p(s) = r(s)z/2$ for every locale s, by choosing an appropriate unit for the output.[15]

Now define

$$R(t) \equiv \exp[\int_{-1}^{1} \ln d(t,s)ds], \tag{22}$$

which is the measure of locale t's remoteness from the rest of the world. Then, the lord's economic concerns have a concise sufficient statistic:

$$C^z(t) = 1/R(t). \tag{23}$$

The detailed derivation is provided in Appendix A.1.2. $R(t)$ can be considered as the price index faced by locale t's lord. Recall that the numeric value of t represents locale t's distance from the midpoint of the line (i.e., the world GC). It follows that $R(t)$, namely remoteness and (lord) price index, rises if locale t is farther from the world GC.

[15] The $p(t)/r(t)$ ratio has to be the same across all locales. This is because the lord is the only land supplier at every locale. If $p(t)/r(t)$ varies across locales, land supplies may be different across locales.

With a partition of the world $\{b_n\}$, every locale t is located in a state, such that

$$R(t) = R_{n_t} = \exp\{\int_{-1}^{b_{n_t-1}} \tau(b_{n_t-1} - s)ds + \int_{b_{n_t}}^{1} \tau(s - b_{n_t})ds\} \tag{24}$$

$$= \exp\{\frac{\tau}{2}[(1 + b_{n_{t-1}-1})^2 + (1 - b_{n_t})^2]\}. \tag{25}$$

where the first (second) term corresponds to the remoteness to the rest of the world on its left (right). Note that other locales in state n_t (not yet solved) have remoteness measures that equal R_{n_t}. Notice that, for a general state n to be formed, its price index R_n has the following partial derivatives:

$$\frac{\partial R_n}{\partial S_n} = -\tau(1 - b_{n-1} - S_n)R_n < 0, \tag{26}$$

$$\frac{\partial R_n}{\partial b_{n-1}} = \tau(2b_{n-1} + S_n)R_n > 0, \tag{27}$$

$$\frac{\partial R_n}{\partial \tau} = \frac{1}{2}[(1 + b_{n-1})^2 + (1 - b_{n-1} - S_n)^2]R_n > 0. \tag{28}$$

In particular, the farther a state is from the world GC, the higher its (lord) price index.

The political concerns of the lord of locale t are represented by the disutility term $hS(t)$ in her utility function (9). The lord's choice of neighbors is determined by the tradeoff between $1/R(t)$ and $hS(t)$. Clearly, having more neighbors in the state reduces her $R(t)$ (thereby making the lord better off) but meanwhile raises $hS(t)$ (thereby making the lord worse off). Every lord makes a tradeoff to select her neighbors. As a result, the linear world has an equilibrium partition $\{b_n^*\}$. As shown below, there is a unique equilibrium partition of the world.

(ii) Equilibrium partition The equilibrium partition is easy to find, if we let locales decide their neighbors sequentially in the ascending order of their locale index t (i.e., from 0 to 1). By equation (22), the $R(t)$ at the world GC, namely $R(t = 0)$, is the global minimum of $R(t)$, such that the lord's consumption $C^z(t = 0)$ is the global maximum of $C^z(t)$. The choice of neighbors made by locale $t = 0$ depends on its first-order condition, derived from equations (9), (23), and (26),

$$\tau R_0^{*\gamma-1}(1 - b_0^* - b_{-0}^*) = h. \tag{29}$$

Following this condition, the lord at locale $t = 0$ chooses b_0^* and b_{-0}^* to maximize her utility. The two borders are symmetric in equilibrium. $R_0 = R(t = 0)$ represents locale $t = 0$'s price index, which is also the price indexes of the neighbors chosen by locale $t = 0$'s lord. For convenience, we let state 0's territories be the open interval (b_{-0}^*, b_0^*). That is, the two marginal locales $t = b_0^*$ and $t = b_{-0}^*$ are excluded by state 0. Letting state 0's territories be the closed interval $[b_{-0}^*, b_0^*]$ instead would make no difference to our later findings.

The neighbors chosen by locale $t = 0$'s lord will also choose the lord's locale and the other neighbors she chooses, because $R(t = 0)$ is the lowest possible lord price index. In this sequential game, all locales in the world want to be in locale $t = 0$'s state, but only those chosen by locale $t = 0$'s lord are accepted into the state. Locale $t = 0$, who has the lowest possible $R(t)$, has the highest intolerance of state size. Consider locale $t = b_0^*$, which is the marginal locale excluded by state 0. Its lord wants to join state 0 but is excluded because a state 0 with locale $t = b_0^*$ included would be too large for locale $t = 0$. Such a stringent setup of state 0, maintained by locale $t = 0$, is endorsed by all neighbors chosen by locale $t = 0$'s lord as parts of her state. This is because those chosen neighbors would not be part of state 0 if they do not endorse locale $t = 0$'s optimal state size, and they have no better states to join. Notice that some of state 0's constituent locales, especially those close to state 0's right border b_0^*, may be better off if locale $t = b_0^*$ becomes part of state 0. However, they cannot incorporate locale $t = b_0^*$ because locale $t = 0$ will veto that.

The lord of locale $t = b_0^*$ now has to find her own solution. She will form a state with her reasonably close neighbors, following

$$\tau R_1^{\gamma-1}(1 - b_0^* - S_1) = h, \tag{30}$$

where b_0^* is fixed by state 0 and the decision is on $S_1 = b_1^* - b_0^*$ (essentially, on b_1^*). In theory, all the locales $(b_0^*, 1]$ want to join locale $t = b_0^*$. Again, the locales chosen by locale $t = b_0^*$ also choose locale $t = b_0^*$ and the other neighbors chosen by locale $t = b_0^*$, and all locales not chosen by locale $t = b_0^*$ are excluded. The mutually chosen locales form state 1, with territory $[b_0^*, b_1^*)$. From there onward, states $2, 3, ..., N$ form, following the example of state 1. For a general state $n \geq 1$, the first-order condition is

$$\tau R_n^{\gamma-1}(1 - b_{n-1}^* - S_n) = h, \tag{31}$$

where b_{n-1}^* is fixed by the previous state and the decision is on $S_n = b_n^* - b_{n-1}^*$ (essentially, on b_n^*). This leads to the equilibrium borders $\{b_n^*\}_{n=-N}^{N}$, where the number of states in the world is $2N + 1$, with[16]

$$2N = \{2n : \frac{S_0}{2} + \sum_{i=1}^{n} S_i \leq 1 \text{ and } \frac{S_0}{2} + \sum_{i=1}^{n+1} S_i > 1\}. \tag{32}$$

(iii) Uniqueness In fact, the above equilibrium is sequential only in the rhetorical sense. All information in this model is public, such that letting proximal (i.e., closer to the world

[16] We leave the locales in $[b_N, 1]$ and $[-1, b_{-N}]$ as minor dependent territories of some other states who accept them for idiosyncratic reasons. These locales do not form states because such states would have extremely high foreign trade costs. In the states that accept them, these dependent territories are not granted the status of constituent locales.

GC) side locales decide first reveals no additional information and alters no decision made by the followers. The linchpin of the mechanism is that no locales choose to be in a different state than their proximal side neighbors unless forced to do so. When a locale is excluded by its proximal side neighbors, it is forced to form a state with some of its distal (i.e., away from the world GC) side neighbors. The dominant strategy of "joining the proximal" stems from the linear geography, or more specifically, the monotonic price-index increase for a locale farther from the world GC (recall equation (25)). If all locales make simultaneous decisions, they reach the same partition of the world as found above.

In Appendix A.1.3, we provide a formal proof of the uniqueness of the above equilibrium. The intuition of the proof is as follows. Choose any state in the known equilibrium and set its distal border differently. Any outward manipulation would be vetoed by the state's most proximal locale. Any inward manipulation would be resisted by every locale in the state as that would make every locale worse off.

To close the model, with the equilibrium partition $\{b_n^*\}$ uniquely pinpointed above, $R(t)$ settles for all locales in the world, and is equal across locales within every state. $R(t)$, along with the earlier equations (15)-(19), constitute the equilibrium of the whole model. In summary, the model follows a simple idea. All locales in the world are nominally symmetric, and lords choose a partition of the world that reflects their tradeoffs between price level and governability. An even simpler model would follow if domestic migration is not allowed. In that case, the locale symmetry delivers the nominal symmetry immediately and the real considerations faced by the lords remain the same.

3.4 Global Trade and Politics

The above model provides rich comparative statics that shed light on global affairs. We provide two examples below, one economical and one political.

Global trade International trade volume, as the major indicator of global economic integration, affects and at the same time is affected by the partition of the world. We derive a gravity equation of bilateral trade from the above model:

$$X_{m,n} = \zeta S_m S_n \exp\{-\tau(b_n - b_m)\}, \tag{33}$$

where $X_{m,n}$ represents the exports from state m to a nonadjacent state $n > m$, ζ is a positive parameter that applies to all pairs worldwide, and $(b_n - b_m)$ is the distance between the two states. The detailed derivation is provided in Appendix A.1.4.

This gravity equation delivers implications that are absent in the international trade literature, where national borders are assumed to be fixed. Define a percentage change notation $\hat{v} = dv/v$. The impact of a foreign trade cost reduction (i.e., $d\tau < 0$) can be decomposed into three parts:

$$\underbrace{\hat{X}^{d\tau<0}_{m,n}}_{\lesseqgtr 0} = \underbrace{\hat{S}_m + \hat{S}_n}_{\text{size effect}<0} \underbrace{-(b_n - b_m)d\tau}_{\text{direct effect}>0} \underbrace{-\tau d(b_n - b_m)}_{\text{location effect}>0}. \tag{34}$$

In equation (34), the *size effect* refers to the fact that both states shrink in size when τ lowers.[17] The *direct effect* is self-explanatory, which is a standard result in the trade literature. The net of these two effects has an ambiguous sign. There is also a *location effect* that adds to the ambiguity. The location effect is positive, because as reducing τ leads to smaller states worldwide, the shrinkage of the states located between state m and state n brings the two states closer to each other. In the short run, when state borders are fixed, the direct effect is the only effect. In the long run, when state borders are endogenous, the size and location effects emerge and oppose each other; therefore, the total effect of $d\tau < 0$ on trade volume is ambiguous.

A rearrangement of equation (34) illustrates how a reduction in trade cost, a force believed to promote economic integration, may instead affect the world's political geography:

$$|b_n - b_m|d\tau = \underbrace{-\hat{X}_{m,n}}_{\text{economic integration}} + \underbrace{\hat{S}_m + \hat{S}_n}_{\text{political disintegration}} \underbrace{-\tau d(b_n - b_m)}_{\text{in-between room}}. \tag{35}$$

Here, a reduction in trade costs $d\tau < 0$ is absorbed collectively by three margins: (i) trade volume rises (i.e., $\hat{X}_{m,n} > 0$), (ii) state sizes shrink (i.e., $\hat{S}_m < 0$ and/or $\hat{S}_n < 0$), and (iii) states become farther from each other (i.e., $|b_n - b_m|$ rises). It could be mainly absorbed by margin (ii). Alesina et al. (2005) mention that the ease of trade was the reason that city states of Italy and the Low Countries in Europe stayed small. Alternatively, it could be mainly absorbed by farther apart states. Fazal (2007) finds that "buffer states" (small states located between large states) became less likely to break up in the recent decades.

Global politics The first-order condition (31) suggests that the marginal disutility from state size S becomes more tolerable for all locales as the trade cost parameter τ decreases. Specifically, $dh/d\tau > 0$, and is decreasing in $|b_n|$ (see Appendix A.1.5 for details). That is, if τ lowers worldwide, h should decrease worldwide to keep borders in the world unchanged. Such h-compensation is needed more if a state is nearer to the world GC. Intuitively, when foreign trade cost lowers, locales have less need to maintain large domestic markets. In other words, they can afford to be smaller and thus states that formed given the previously high τ now tend to collapse. If h declines at this point, old states may be sustained. If h remains unchanged, old states would start collapsing. All else being equal, the collapse starts at the middle of the world, because the price index R_n of a more proximal state is more sensitive

[17] All states shrink in size when τ lowers. This can be seen from equations (45) and (47) in Appendix A.1.6.

to τ.

The above finding demonstrates the relation between τ, the parameter that underpins economic disintegration, and h, the parameter that underpins political disintegration. If a lower τ follows from shocks in transportation technologies and no social policy intervention is undertaken on h, border changes will begin around the world GC.

Also interestingly, political integration as well as economic integration influences international trade. Consider a marginal decrease in h in the context of the earlier gravity equation (33):

$$\underbrace{\hat{X}_{m,n}^{dh<0}}_{\lesseqgtr 0} = \underbrace{\hat{S}_m + \hat{S}_n}_{\text{size effects}>0} \underbrace{-(b_n - b_m)d\tau}_{=0} \underbrace{-\tau d(b_n - b_m)}_{\text{location effect}<0}. \tag{36}$$

Here the size effect is positive because state sizes grow when h decreases, and the location effect is negative as m and n are farther apart owing to the expansion of the in-between states. The net of the two effects is ambiguous. Put differently, states that are more politically integrated trade more with each other only when political integration sufficiently enlarges their sizes.

3.5 Testable Hypotheses

Below, we derive three hypotheses that will be tested later. The first hypothesis is concerned with the relationship between a state's distance from the world GC and its territorial area. The first-order condition (31) implies that

Hypothesis 1: Unless τ is very low, states farther from the world GC have larger territories.

A formal proof of this claim is provided in Appendix A.1.6. Intuitively, unless τ is too low to matter, locales farther from the world GC tend to have a larger $R(t)$, thus having to incorporate more locales to keep their price levels low.

Hypothesis 1 applies to all states except state 0. Recall that state 0 and other states solve different optimization problems (equation (29) vs. equation (31)). State 0, which solves its both borders, does not have to be smaller than state 1 (or -1). We provide a formal proof of this claim in Appendix A.1.7. Intuitively, state 0 could be large because when it sets its two borders in two different directions, the disutility from extending borders spreads across its two fronts. This effect applies to none of the other states.

This claim concerning state 0, arguing for an indeterminate sign, does not by itself provide a testable hypothesis. Nevertheless, it reminds us of empires throughout history. Note that in Table 1, the world GCs were in large states in three out of the four periods (Austrian Empire, Germany, and Austro-Hungarian Empire, respectively). If we consider such empires as "state-0 shocks," we obtain Hypothesis 2:

Hypothesis 2: (a) The number of states in the world is smaller when state 0 is larger. (b) Every state n is farther from the world GC when its contemporary state 0 is larger, an effect that is increasing in the index value n (i.e., $\frac{\partial^2 b_n}{\partial b_{n-1} \partial b_0} > 0$ and is increasing in n).

Hypothesis 2 builds on Hypothesis 1 (i.e., it holds when τ is not too low). We provide a formal proof of the claim in Appendix A.1.8. The rationale behind the hypothesis is as follows. Given a larger state 0, all other states are "pushed away" from the world GC. When pushed away, those states have to be larger in size, as their constituent locales have less advantageous locations than before. This reduces the total number of states in the world (part (a) of the hypothesis). The states that have been pushed farther from the world GC retain their state indexes, rising from 1 to n in the ascending order of the relative distance from the world GC. State n, the n-th nearest state to the world GC, has borders b_{n-1} and b_n. In a period with a larger state 0, every rank value n refers to a state farther from the world GC. Formally, a larger n is associated with an even larger $|b_n - b_{n-1}|$ increase. This is because the farther a state is from the world GC relative to other states, the more it has to expand in size to compensate for its even less advantageous location (part (b) of the hypothesis).

Our last hypothesis, Hypothesis 3, has the same theoretical foundation as Hypothesis 1, but will be tested using within-state data. In states that use a federal system, every sub-state jurisdiction ("province") enjoys a certain degree of autonomy from the federal state. Federalism divides powers between the state and its provinces. The division of political powers between the two layers varies from state to state, though one of the two layers is granted residual political powers not claimed by the other. Therefore, it is a reasonable to consider each province in a state that uses a federal system as a semi-state. Then we expect a semi-state version of Hypothesis 1:

Hypothesis 3: Unless τ is very low, within a state, provinces farther from the world GC have larger territories.

It is important to note that the distance in Hypothesis 3 is not the distance between individual provinces and their national capitals. Provinces under a federal system (i.e., semi-states) are treated here as if they had full autonomy. In other words, if all states in the world use the same federal system, then the world can be considered as a collection of semi-states instead of a collection of states.

Both Hypothesis 2 and Hypothesis 3 address an empirical challenge concerning Hypothesis 1. The earth is the only planet that hosts humans, economies, and states. Using state-level data to test Hypothesis 1 risks capturing an "earth fixed effect." For example, the earth, owing to some ad hoc reasons (such as topographical, vegetative, or climatic peculiarities), can only accommodate small economies in its middle regions. For another, states closer to the real-world GC are older, therefore having stronger institutional inertia that limits their sizes. Such speculations are unfalsifiable and thus cannot be addressed directly. However, they can neither generate the other two hypotheses nor explain their testing results reported later.

A Historical Note Hypothesis 1 and its underlying mechanism provide a way to rationalize the history of modern states. When trade costs were prohibitively high in the Pre-Columbian era, borders were not officially drawn and sovereignty was not clearly defined. The Age of Discovery was driven by the craving for foreign consumption goods, just as described by the huge marginal utility from any new variety in equation (6). After global trade became possible, modern states started forming and a world economy emerged as a collection of statewide markets (for further discussion of this transition, see for example Chapter 3 in Palmer, Colton, and Kramer (2007)). Sovereignty defines an integrated domestic market, which is the economic foundation of a nation-state. Nation-states represent the common interests shared by domestic locales, transforming inter-locale affairs to inter-state geopolitics.

Hypothesis 2 also has counterparts in history. Recall that our estimated world GC is located in Eastern and Central Europe (ECE). Geopolitical theorists in the early 20th century were usually strong advocates of the strategic location of ECE. For example, Mackinder (1904, 1919) emphasized the strategic importance of Eastern European states in his famous dictum:

> Who rules Eastern Europe commands the Heartland;
> who rules the Heartland commands the World-Island;
> who rules the World-Island commands the world.

On one hand, such prophetic claims are clearly oversimplistic and overreaching, if not outright erroneous. On the other hand, they do capture some of the complex political and military power interactions in place at that time, as attested to by the two subsequent world wars and the Cold War. Territories in the world have asymmetric relevance to the rest of the world. In a globalized world, such as the one characterized by our model, states closer to the world GC have a stronger association with global politics.

We now move on to a formal empirical testing of Hypotheses 1-3.

4 Empirical Evidence

4.1 Hypothesis 1

Hypothesis 1 contends that states farther from the world GC have larger territorial areas. To test it, we start with a simple regression of $\ln Area(n)$ on $\ln Dist(n)$. The regression results are reported in Table 4, where a positive and statistically significant correlation between $\ln Area(n)$ and $\ln Dist(n)$ is extensively found. We include continent fixed effects in all regressions. In Panel A, we limit control variables to geographic characteristics: a coast dummy and an island dummy. Column (1) of Panel A corresponds to the modern period. Since $Dist(n)$ is a state's average distance across its locales, we experiment with weighting regressions using numbers of locales at the state level to address potential heteroskedasticity. The results turn out to be similar. We minimize the use of control variables in Panel A to maximize sample sizes. In column (1) of Panel B, we control for military expenses, iron and steel production, and primary energy consumption. With national powers controlled for, our sample size slightly shrinks (from 162 to 156). The coefficient of $\ln Dist(n)$ remains positive and statistically significant, either unweighted or weighted. In later tables, we report only unweighted results to save space.[18]

Columns (2)-(4) in both panels of Table 4 correspond to historical periods. There are two motivations for testing Hypothesis 1 using historical data. First, cross-state variations are confounded by cross-sectional idiosyncrasies within a given period, and thus checking every period helps to mitigate the identification problem. Specifically, the variations in $Dist(n)$ in a single historical period are different from those in the modern period along three separate margins. To demonstrate the differences, equations (1)-(2) can be rewritten, for a period in history, as

$$Dist(n^0) \equiv \frac{1}{N_{n^0}} \sum_{t \in n^0} Dist(t, GC^0), \tag{37}$$

where

$$GC^0 = \arg\min_{t} \sum_{t' \in W^0} Dist(t, t'). \tag{38}$$

where n^0 is a state in history, GC^0 is its contemporary world GC, and W^0 is the set of its contemporary states. The first margin of difference stems from the birth and death of states. That is, not every n^0 has a modern counterpart n, and not every modern state n has a counterpart n^0 in history. For a state that exists both now and in that historical period, $Dist(n)$ and $Dist(n^0)$ are normally different, because its two compositions $\{t \in n\}$ and $\{t \in n^0\}$ are usually different (the second margin) and the location of the world GC changes as well (the third margin).[19] These three margins are exclusive of each other, producing three sets of additional variations. Second, influential events in one period, such as large-scale wars and (de)colonization, may drive the results in a single period. We mitigate their impacts by applying the same specification to three other periods. Again, we experiment with adding control variables related to national powers (unavailable for the 18th century as noted in Section 2) and weights. The findings from historical periods are similar to those from the

[18]Weighted results are available upon request. We are in favor of the unweighted specification because the application of weighted regressions to non-survey data is controversial. Weighting regressions may aggravate rather than mitigate heteroskedasticity (Solon, Haider, and Wooldridge, 2015).

[19]The world GC changes in location over time because previously uninhabited regions later become inhabitable and therefore enter into the sample.

Table 4: Hypothesis 1 (Baseline Results)

Dependent variable is ln(Area)	(1)	(2)	(3)	(4)
	Modern	18th century	19th century	Early 20th century
Panel A: Full sample				
ln(Distance from the world GC)	0.628***	0.760***	0.651***	0.383***
	(0.196)	(0.204)	(0.122)	(0.130)
Coast dummy	1.745**	-0.116	0.704***	0.456*
	(0.703)	(0.359)	(0.266)	(0.275)
Island dummy	-2.089***	-1.038**	-1.439***	-1.376***
	(0.598)	(0.401)	(0.467)	(0.371)
If weights are used:#				
ln(Distance from the world GC)	0.607***	0.701***	0.628***	0.639***
	(0.153)	(0.234)	(0.196)	(0.102)
Continent FE	Yes	Yes	Yes	Yes
Observations	162	121	137	174
Panel B: With national power controls				
ln(Distance from the world GC)	0.522***		1.937***	0.850***
	(0.110)		(0.643)	(0.248)
Coast dummy	-0.400*		0.939**	0.012
	(0.223)		(0.406)	(0.452)
Island dummy	-1.025***		-2.474*	-1.006***
	(0.328)		(1.273)	(0.349)
ln(Military expenses)	0.003		-0.068	0.037
	(0.130)		(0.290)	(0.127)
ln(Iron & steel production)	0.027		0.449*	0.001
	(0.056)		(0.254)	(0.099)
ln(Primary energy consumption)	0.487***		-0.116	0.255***
	(0.103)		(0.206)	(0.068)
If weights are used:#				
ln(Distance from the world GC)	0.774***		2.239***	1.511***
	(0.129)		(0.768)	(0.254)
Continent FE	Yes		Yes	Yes
Observations	156		51	75

Notes: # In both panels, regressions are rerun under the same specification but with weights (number of locales), with only the coefficient of ln(Distance from the world GC) reported as a separate row (other coefficients available upon request). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

modern period.

World geography in the benchmark model is a continuous landmass, whereas the landmass of the earth is divided by oceans into different continents. Among all continents, the geography of Eurasia fits our theoretical construct best. We rerun the regressions in Table 4 using the subsamples of Eurasian and Non-Eurasian states in each period. The results are reported in Table 5. To keep the largest number of observations, we do not include national power control variables in this table. Both subsamples display patterns consistent with Hypothesis 1.[20]

We also experiment with using the rank value of $Dist(n)$ instead of $\ln Dist(n)$ as the main explanatory variable. The state which is the n-th nearest to the world GC has a rank value n. The merit of using the rank value is that it reduces potential mechanical correlation between $\ln Area(n)$ and $\ln Dist(n)$. That is, a larger state has a larger radius which mechanically increases the state's distance from the world GC. This tendency is limited to states near the world GC. We normalize the rank value between 0 (nearest to the world GC) and 1 (farthest from the world GC) within every period, so that the rank value is unaffected by the different numbers of states across periods.

In Table 6, the rank value is used instead of $\ln Dist(n)$ and the specifications are otherwise the same as in Table 4. It shows results that highly resemble those in Table 4. The shortcoming of the rank value is its lack of cardinal meaning. The variation in the rank value is ordinal and thus the differences among its values are difficult to interpret. For Hypothesis 1, we use the rank value only as a robustness check. Its main use is for testing Hypothesis 2.

Additional Results Locale-level data are used above to construct the world GC and $Dist(n)$. As a robustness check, we also take a different approach to construct them. We use the centroid of every state (i.e., the arithmetic mean position of all the points in the state as a polygon) as the state's GC, and the centroid of the world as the world GC. This approach can be easily implemented using GIS software. We find the centroid of the modern world to be at (40.52N, 34.34E), located in Yarımca, Uğurludağ, Çorum, Turkey. Based on these coordinates, we recalculate $Dist(n)$ and rerun our study for the modern period. The centroid-based results are reported in Table A1, where both regression specification and sample states follow Table 4. As in Table 4, a positive and statistically significant correlation is found between $\ln Area(n)$ and $\ln Dist(n)$. The centroid approach serves only as a robustness check, since it overstates the importance of territories with low (including zero) population density.

One may expect that Hypothesis 1 also applies to every single continent. That is, all else held equal, states farther from their corresponding continents' local geometric centers (hereafter, LCs) should also be larger in size. Put differently, because of the mechanism

[20] Since the density of locales has a large variation across continents, regressions are weighted for the non-Eurasian sample.

Table 5: Eurasia and non-Eurasia

Dependent variable is ln(Area)	(1)	(2)	(3)	(4)
	Modern	18th century	19th century	Early 20th century
Panel A: The Eurasian subsample				
ln(Distance from the world GC)	0.410***	0.868***	0.620***	0.356**
	(0.135)	(0.229)	(0.132)	(0.136)
Island and coast dummies	Yes	Yes	Yes	Yes
Observations	82	67	81	90
Panel B: The Non-Eurasian subsample				
ln(Distance from the world GC)	1.033**	1.554***	1.673***	1.027**
	(0.427)	(0.451)	(0.270)	(0.445)
Island and coast dummies	Yes	Yes	Yes	Yes
Continent fixed effects	Yes	Yes	Yes	Yes
Observations	80	54	56	84

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05.

Table 6: Robustness: Rank Instead of Distance

Dependent variable is ln(Area)	(1)	(2)	(3)	(4)
	Modern	18th century	19th century	Early 20th century
Panel A: Full sample				
Rank (Distance from the world GC)	0.007**	0.021***	0.017***	0.007**
	(0.003)	(0.005)	(0.004)	(0.003)
Coast dummy	0.202	-0.205	0.709**	0.528*
	(0.254)	(0.364)	(0.281)	(0.276)
Island dummy	-1.355***	-1.067***	-1.401***	-1.383***
	(0.371)	(0.403)	(0.458)	(0.356)
Continent FE	Yes	Yes	Yes	Yes
Observations	162	121	137	174
Panel B: With national power controls				
Rank (Distance from the world GC)	0.008***		0.058***	0.014**
	(0.003)		(0.018)	(0.005)
Coast dummy	-0.342		1.155***	0.192
	(0.230)		(0.427)	(0.483)
Island dummy	-0.965***		-2.403*	-0.885**
	(0.328)		(1.316)	(0.371)
ln(Military expenses)	0.022		-0.025	0.044
	(0.133)		(0.288)	(0.137)
ln(Iron & steel production)	-0.014		0.463	-0.038
	(0.054)		(0.297)	(0.098)
ln(Primary energy consumption)	0.512***		-0.235	0.267***
	(0.105)		(0.253)	(0.074)
Continent FE	Yes		Yes	Yes
Observations	156		51	75

Notes: This table is a robustness check for Table 4. All specifications here are the same as those in Table 4, except that the main regressor is Rank (Distance from the world GC) instead of ln(Distance from the world GC). Rank 0 (respectively, 1) means the shortest (longest) distance from the world GC. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

underpinning Hypothesis 1, having a shorter distance from the LCs is also a locational advantage, just as having a shorter distance from the world GC. We estimate the locations of LCs in different continents using the method in Section 2, and report them in Panel A of Table A2.

We regress $\ln Area(n)$ on both distances (from the world GC and from the corresponding LC). The results are reported in Panel B of Table A2. We find that the two distances shares some but not all variations. When only the distance from the corresponding LC is included in regressions, being farther from the LC is weakly associated with a larger territory in the 19th, early 20th, and modern samples. However, when both distances are included, the distance from the corresponding LC becomes statistically insignificant. This is not very surprising, considering the locations of those LCs reported in Panel A. For example, states in North and South America that are close to Florida are also relatively close to Europe (where the modern world GC is located). Nevertheless, it is clear that the distance from the world GC has its unique variations that cannot be explained by the distance from the corresponding LC.

4.2 Hypothesis 2

Hypothesis 2(a) says that the number of states is smaller when state 0 is larger. Over time, state 0 becomes smaller in territorial area (recall Table 1). The modern state 0, the Czech Republic, has the smallest size in comparison with its historical counterparts. In contrast, state 0 in the 18th century, the Austrian Empire, had quite a large territory. Meanwhile, states in the world shrink in size over time, a fact that is illustrated in Figure 1 where the dispersion of $\ln Area(n)$ is presented for every period.

Figure 2 displays a direct support for Hypothesis 2(a). It demonstrates the correlation between state 0's area and the number of states in the world over different time periods. A negative association between the two variables is evident. In the lower panel, we add a post-war observation (Czechoslovakia in 1920), an interwar observation (Poland in 1938), and another post-war observation (Czechoslovakia in 1945). The negative correlation remains and actually becomes more pronounced.[21]

There are two concerns over Hypothesis 2(a) and Figure 2. First, it has too few observations. Second, it is confounded by the fact that all states (including state 0) in a world with a greater number of states are expected to be mechanically smaller. In other words, if the world's area is randomly cut into states, a smaller state 0 might simply be driven by more and finer "cuts" of the earth's surface. That thought experiment, however, does not generate the pattern predicted by Hypothesis 2(b).

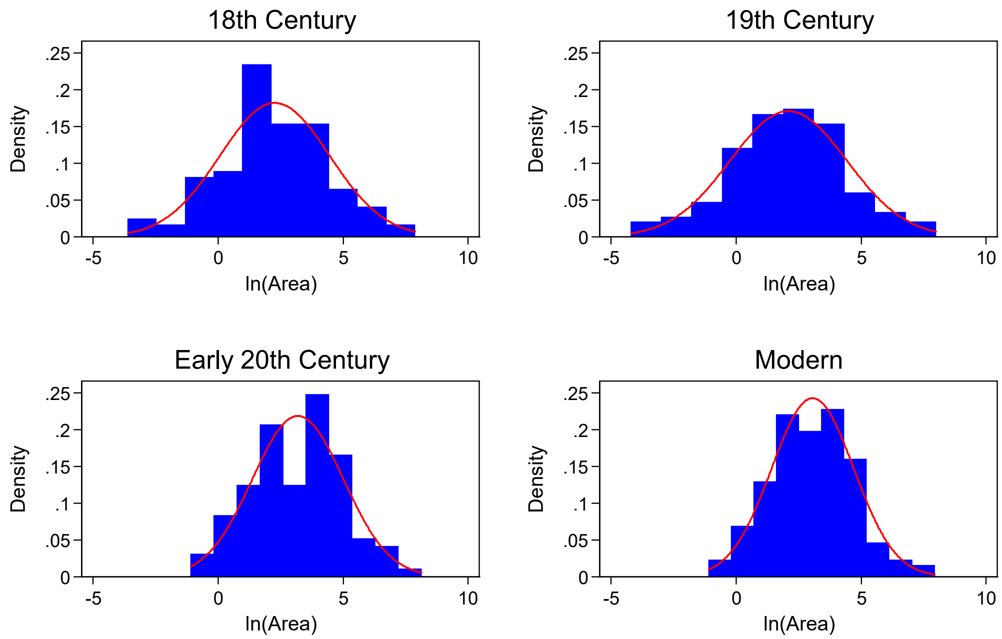
Hypothesis 2(b) informs a difference-in-differences specification:

$$\ln(Dist_{n,pr}) = \eta_0 \times Rank_n + \eta_1 \times State0Area_{pr} + \eta_2 \times Rank_n \times State0Area_{pr} + \bar{\xi}' X_{n,pr} + \epsilon_{n,pr}, \tag{39}$$

where $Rank_n$ is the normalized rank value of state n. The value is 0 (respectively, 1) if state n is the nearest to (farthest from) the world GC. Its coefficient η_0 is expected to be positive. We limit n to 1-30, 1-50, and 1-70, respectively. We do not consider $n > 70$ because states with very large rank values do not exist in every period. $State0Area_{pr}$ is the area of state 0 in period pr, and $X_{n,pr}$ is a vector of control variables. η_1, expected to be positive, captures the

[21] A possible concern is that the total inhabitable area in the world increases over time, though that works against finding a negative correlation between the two variables.

Figure 1: Dispersion of Territorial Area across States in the World

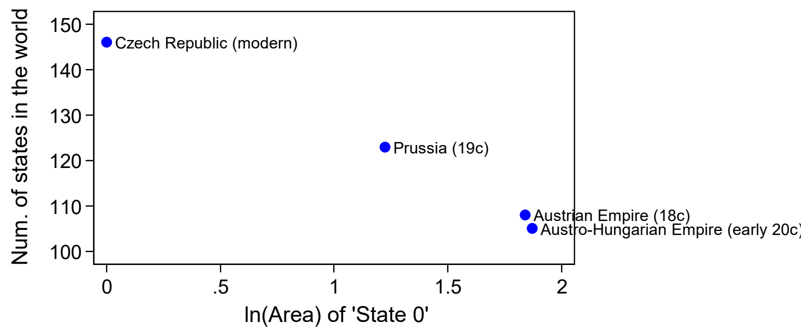


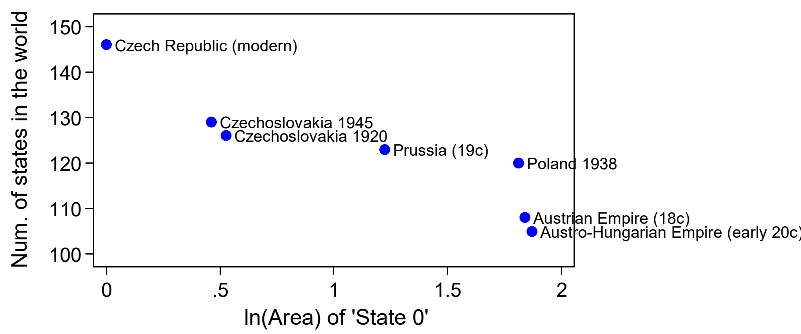
mechanical fact that a larger state 0 means that all other states are farther from the world GC. What interests us is η_2, which is expected to be positive according to Hypothesis 2(b). As an alternative to including $State0Area_{pr}$ in the regression, we can use a more inclusive period fixed effect to absorb its own variation, with the interaction term $Rank_n \times State0Area_{pr}$ unchanged.

The design of Hypothesis 2(b) addresses the two vulnerabilities of Hypothesis 2(a) and Figure 2 mentioned earlier. Its difference-in-differences specification interacts state 0's different sizes over time with their contemporary states' rank values. This avoids using only the time dimension of the data, and considerably increases the variations in use.

The regression results are reported in Table 7. The sample used in Panel A is states 1-30 in each of the four periods, so that the full sample size is 120. We use $State0Area_{pr}$ in columns (1) and (2) and use period fixed effects instead in columns (3) and (4). We include no national power control variables in columns (1) and (3), so that their numbers of observations are both 120. In columns (2) and (4), we include national power control variables, which are unavailable for all states in the 18th century and for some states in later periods. Therefore, the sample size shrinks to 78 in these two columns. The coefficient of the interaction term, namely $\hat{\eta}_2$, is positive and statistically significant in all columns. The specifications in Panels B and C are the same as in Panel A, except that their samples include states 1-50 and states 1-70, respectively. Very similar findings are obtained from them.

Figure 2: Number of States and 'State 0'





Notes: c is the abbreviation of century. The lower panel includes three additional observations related to the two world wars, which are excluded by the upper panel. Czech Republic (modern) has the smallest area among all state 0's. We normalize it to one (zero in log). For all other periods, the ln(Area) of state 0 refers to the difference between actual ln(Area) and the ln(Area) of Czech Republic (modern). This normalization is in order to keep the horizontal axis short.

4.3 Hypothesis 3

To test Hypothesis 3, we consider the four largest states in the world that use a federal system — Brazil, Canada, Russia, and the United States — and we utilize only their within-state variations. We use their GIS maps to calculate the areas of their provinces.[22] Since some provinces are small in size and thus have no locales that have populations of 15,000 or more, we use the centroid approach to pinpoint the geographic coordinates of all provinces. We calculate every province's distance from the world GC and rerun the regression of $\ln Area(n)$ on $\ln Dist(n)$ within each of the four states, where n now indexes domestic provinces.[23]

The regression results are reported in Table 8, and a graphical demonstration of the

[22]Their GIS maps are accessible online: www.gadm.org.
[23]Using the centroid of the world instead does not alter our findings.

Table 7: Hypothesis 2 (State 0 and Rest of the World)

Dependent variable is ln(Distance from the (contemporary) world GC)				
	(1)	(2)	(3)	(4)
Panel A: 30 Nearest States to the World GC				
Rank (Distance from the world GC)¶	4.052***	4.940***	3.573***	5.025***
	(0.852)	(0.886)	(0.554)	(0.887)
Size of State 0	-0.382	1.363**		
	(0.486)	(0.532)		
Rank (Distance from the world GC)	12.458***	9.034**	15.163***	9.420***
× Size of State 0	(3.413)	(3.449)	(2.722)	(3.516)
Period FE	No	No	Yes	Yes
National power countrols¥	No	Yes	No	Yes
Island and cost dummies, and continent Fes	Yes	Yes	Yes	Yes
Observations	120	78	120	78
Panel B: 50 Nearest States to the World GC				
Rank (Distance from the world GC)¶	4.361***	5.263***	4.254***	5.297***
	(0.402)	(0.471)	(0.270)	(0.475)
Size of State 0	0.049	1.552***		
	(0.346)	(0.380)		
Rank (Distance from the world GC)	8.295***	5.694***	9.124***	6.078***
× Size of State 0	(1.408)	(1.725)	(1.193)	(1.742)
Period Fixed Effect	No	No	Yes	Yes
National power countrols¥	No	Yes	No	Yes
Island and cost dummies, and continent FEs	Yes	Yes	Yes	Yes
Observations	200	121	200	121
Panel C: 70 Nearest States to the World GC				
Rank (Distance from the world GC)¶	5.220***	5.322***	5.082***	5.363***
	(0.203)	(0.418)	(0.215)	(0.419)
Size of State 0	0.706**	1.757***		
	(0.274)	(0.358)		
Rank (Distance from the world GC)	3.538***	3.333**	4.006***	3.508**
× Size of State 0	(0.826)	(1.501)	(0.803)	(1.516)
Period Fixed Effect	No	No	Yes	Yes
National power countrols¥	No	Yes	No	Yes
Island and cost dummies, and continent FEs	Yes	Yes	Yes	Yes
Observations	280	151	280	151

Notes: ¶ Rank (Distance from the world GC) is the normalized rank value of state-level "Distances from world GC" within each periods. 0 (respectively, 1) means the shortest (longest) distance to the world GC. ¥ National power controls include military expenses, iron & steel production, and primary energy consumption (all in log terms). Robust standard errors in parentheses. *** p<0.01, ** p<0.05.

correlation is presented in Figure 3. In all four states, a positive correlation is found. The positive correlation is statistically significant in three of them. The insignificant case of Canada is likely caused by its small number of provinces, as the positive correlation is present in the panel for Canada (CAN) in Figure 3. In other words, within every one of those states,

Table 8: Hypothesis 3 (Within-state Correlations)

Dependent variable is ln(Area of province)				
	(1)	(2)	(4)	(5)
State	Russia	Canada	US	Brazil
ln(Distance from the world GC)¶	1.637***	3.132	5.689*	4.811**
	(0.216)	(5.057)	(3.203)	(1.751)
Observations	83#	13	51+	27
R-squared	0.478	0.032	0.139	0.120

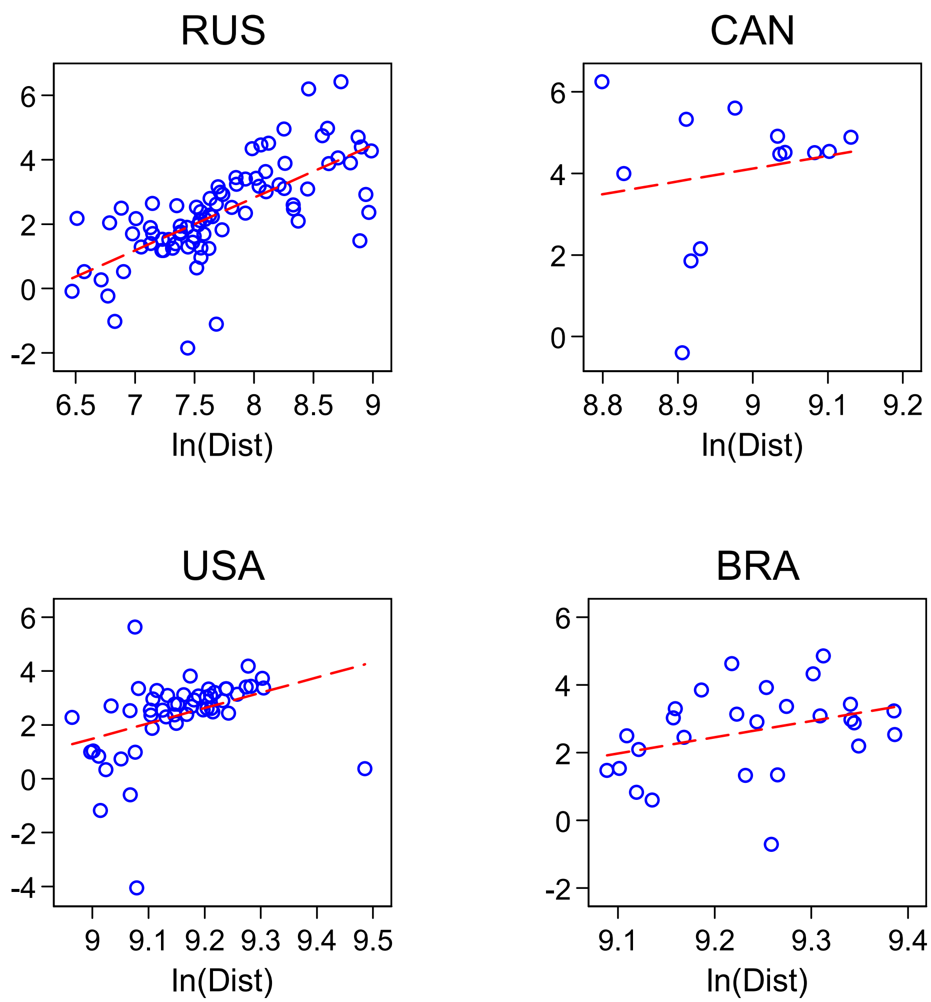
Notes: ¶ ln(Distance from the world GC) is here the distance between a province in a given state (labeled in each column) and the world GC. # There were 89 federal units in Russia in 1993, when the Constitution of Russia became effective; the number decreased to 83 owing to several mergers. +District of Columbia is treated as a state, but excluding it does not affect the results. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

provinces that are closer to the world GC are smaller. This offers further support for our theory at the semi-state level, especially considering that the four states have dissimilar cultural traditions, political histories, types of representative democracies, and legal origins.

5 Extension: International Security

The linear model in Section 3 has two implications on international security. The first is on militarized disputes: a militarized dispute with a given scale involves more states if it occurs nearer to the world GC. The second is on border tensions: altering a border affects the welfare of its proximal (nearer to the world GC) side state than the welfare of its distal (farther from the world GC) side state. The first implication is self-explanatory, because states closer to the world GC are smaller. The second implication stems from the Cobb-Douglas consumption structure (6) — for a given border, its proximal side state is smaller, so that a change in the border affects the proximal side state's welfare more than it does the distal side state's welfare (see Appendix A.1.9 for the derivation). That is, for the proximal side state, obtaining a locale it wants to obtain generates a larger welfare gain, and losing a locale it wants to keep generates a larger welfare loss. Below, we test each of the two implications.

Figure 3: Within-State Correlations



Notes: The vertical axis is ln(Area), while the horizontal axis is ln(Distance from the world GC). RUS: Russia. CAN: Canada. USA: United States. BRA: Brazil.

Militarized Disputes The data we use in this section are from two other datasets, MID (version 4.1) and MIDLOC (version 1.1), both from the aforementioned COW project. The MID dataset provides data on militarized disputes in the world, including their involved states, originators, fatalities, and reciprocalities (explained later). The MIDLOC dataset provides geographic coordinates of militarized disputes. Both datasets cover the years 1816-2001. We divided this coverage into three periods, 1816-1900, 1900-1945, and 1994-2001, corresponding to the three periods in our data. Summary statistics of our working dataset are provided in Table A3.

We calculated the distance between every militarized dispute and its contemporary world GC. Figure 4 combines six data plots, in which each row is linked to one period and the left (right) column does not (does) distinguish westward from eastward distances on the horizontal axis. As shown, the number of involved states is decreasing in the militarized dispute's distance from the world GC.

A limitation of Figure 4 is that it cannot control for the scales of militarized disputes. Militarized disputes closer to the world GC may have larger scales, which automatically involve more states. To address this possibility, we next conduct a regression analysis. Table 9 reports the regression results. The dependent variables are various measures of the number of states involved in militarized disputes. The MID dataset categorizes involved states in every militarized dispute into two sides: A (the originator) and B (the target). We proxy for the scale of a militarized dispute using its fatality scale index. Fatality is a commonly used criterion for gauging the scales of militarized disputes.[24] In the MID data, the fatality scale is measured by a 0-to-9 index (0 means no death). Reciprocated disputes usually involve more fatalities, so that we include a reciprocated dummy along with the fatality index.[25]

As predicted, in Table 9, fewer states are involved in militarized disputes farther from the world GC. This association holds for all three periods and for both sides of the militarized disputes. It also holds regardless of how multi-state participation is measured, qualitatively (as a 0-1 indicator) or quantitatively (as a count). The qualitative measure is less driven by influential large counts.

Revisionism The second implication we test is whether states on the proximal side of borders are more likely to request revising existing borders than states on the distal side. Unfortunately, we do not have data on border-specific revision requests. Our data on revision requests are from the MID dataset used above, which reports which side of the militarized dispute raised a border revision request (i.e., in its original terms, "*be a revisionist*").[26] This being said, sample selection is an empirical concern here, because (a) not every border in the world was contested, and (b) those contested did not necessarily cause militarized disputes. In other words, only the high-stakes borders were contested and caused militarized disputes. As a result, using the MID dataset to test the implication risks exaggerating the effects for which we search.

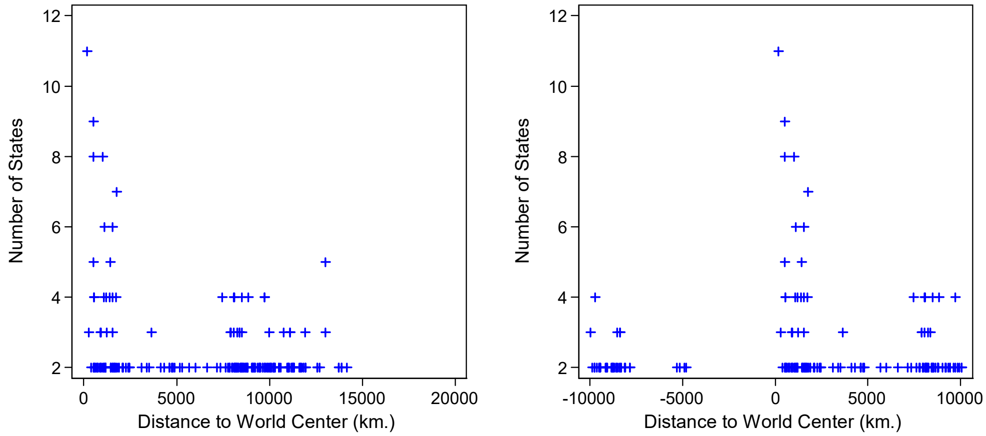
[24] See Buhaug and Lujala (2005) for discussion on the difficulty of estimating scales of conflicts. For an example of using fatality to measure the scales of conflicts, see Harrison and Wolf (2012).

[25] A reciprocated dispute is defined as one in which at least one state on side B takes military action against side A.

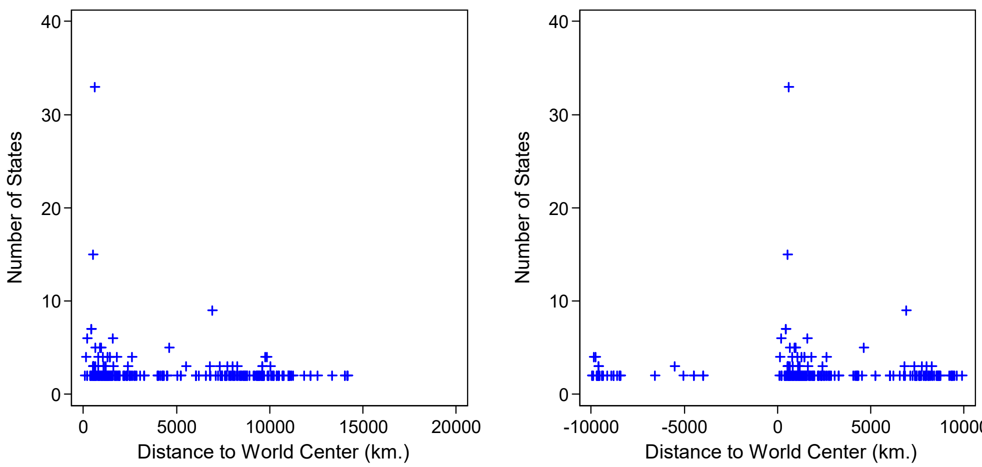
[26] A state is a revisionist if it is "dissatisfied with the existing status quo prior to the onset of the militarized dispute." If both sides are dissatisfied with the status quo, the state that "openly attempts to challenge the pre-dispute condition" is coded as the revisionist. There are cases where all involved states are coded as revisionists, meaning that they all openly attempted. Those cases are excluded from our sample because there is no within-dispute variation among them.

Figure 4: Number of Involved States and Locations of Militarized Disputes

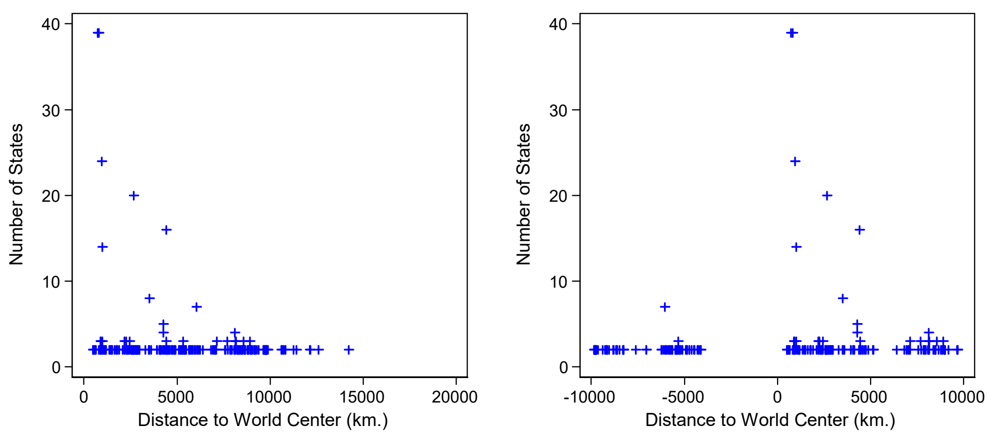
▼ The 19th century



▼ Early 20th century



▼ Modern (1994 and after)



We control for the indicator of originator as a partial solution to the sample selection concern. The reasoning is that if states that are closer to the world GC are more likely to resort to military action for everything including border issues, that tendency would be absorbed by the originator control variable. With the originator control variable included

Table 9: Number of Involved States in Militarized Disputes

Dependent variable:	(1) Prob. of having more than two states	(2) Total num. of states	(3) Num. of states on Side A	(4) Num. of states on Side B	(5) Total num. of states	(6) Num. of states on Side A	(7) Num. of states on Side B
			Panel A: 19th century				
ln(Distance from the world GC)#	-0.094***	-0.176***	-0.235***	-0.104***	-0.129***	-0.188***	-0.057**
	(0.031)	(0.050)	(0.070)	(0.040)	(0.039)	(0.059)	(0.028)
Scale (fatality scale index)¶					0.073***	0.076**	0.070***
					(0.019)	(0.030)	(0.020)
Reciprocated dummy+					-0.000	-0.039	0.044
					(0.064)	(0.116)	(0.039)
Observations	192	192	192	192	192	192	192
			Panel B: Early 20th century				
ln(Distance from the world GC)#	-0.057***	-0.120**	-0.123*	-0.117**	-0.135***	-0.141**	-0.131***
	(0.019)	(0.049)	(0.065)	(0.047)	(0.042)	(0.058)	(0.047)
Scale (fatality scale index)¶					0.132***	0.158***	0.104**
					(0.042)	(0.054)	(0.042)
Reciprocated dummy+					-0.006	-0.094	0.084
					(0.045)	(0.062)	(0.055)
Observations	343	343	343	343	343	343	343
			Panel C: Modern				
ln(Distance from the world GC)#	-0.058*	-0.401***	-0.432**	-0.381*	-0.402***	-0.407**	-0.374*
	(0.030)	(0.135)	(0.197)	(0.212)	(0.138)	(0.182)	(0.203)
Scale (fatality scale index)¶					0.195***	0.256***	0.050
					(0.062)	(0.095)	(0.070)
Reciprocated dummy+					0.173	0.445	-0.085
					(0.185)	(0.282)	(0.095)
Observations	229	229	229	229	229	229	229

Notes: Column (1) uses linear probability regressions. Using probit or logit regressions instead does not change our findings. Columns (2)-(7) use negative binomial regressions. # Distance from the world GC is calculated using the geographic coordinates provided in the MIDLOC dataset (v1.1) and Table 1. ¶ In the MID data, fatality level is measured by a 0-to-9 scale index (0 means no death). +Reciprocated dummy: it equals to one if at least one country on side B takes a military action against at least one state on side A. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

in the regression, the coefficient of the distance from the world GC captures whether the probability of a state closer to the world GC is more likely to raise a border revision request in a militarized dispute, regardless of which side originated the militarized dispute. Admittedly, this does not fully address the sample selection issue, because militarily contested borders are still not a random sample of national borders in the world.[27] This being said, our following findings apply only to borders that were militarily contested.

[27] The data do not report the specific contested borders of the participating states, so that we cannot randomize contested borders with non-contested borders.

We specify regressions in the following form:

$$\Pr(RE_{n,md} = 1) = \rho + \chi \ln Dist(n) + \bar{\delta}' X_{n,md} + \epsilon_{n,md} \tag{40}$$

where md indexes militarized disputes, $RE_{n,md}$ equals 1 if state n in militarized dispute md is a revisionist, and $X_{n,md}$ is a vector of control variables. When militarized-dispute (md) fixed effects are included in the regression, only within-dispute variations are used.

Regression results are reported in Table 10, where a negative and statistically significant $\hat{\chi}$ is found, indicating that dispute-participating states nearer to the world GC are more likely to be revisionists. We use the linear probability model, though using probit or logit instead does not change our findings.[28] In Panel A, columns (1)-(3) use militarized-dispute fixed effects, while columns (4)-(5) are without militarized-dispute fixed effects. Column (5) uses time-period fixed effects.[29] All columns lead to similar results, and $\hat{\chi}$ with dispute fixed effects are larger in magnitude. The coefficient of the originator indicator is positive, suggesting that the propensity of being an originator is, as expected, positively correlated with that of being a revisionist. This, however, does not alter the sign or the significance of $\hat{\chi}$.

In addition, we conduct a counter-check by switching the indicator of revisionist and the indicator of originator in the regression. The results are reported in Panel B of Table 10, where no significant correlation between the dependent variable and the distance from the world GC is found when within-dispute variations are used (columns (1) to (3)). There is a positive and marginally significant correlation between the two variables when the variations are not limited to those within disputes (columns (4) and (5)), suggesting that the militarized-dispute fixed effects difference out distance-related military tendency. Notice that the probability of resorting to militarized disputes is actually higher for states farther from the world GC, even though they have less interest in borders (shown in Panel A). This further demonstrates that the earlier empirical concern is not a critical issue.

6 Concluding Remarks

Linearization is a common modeling technique in economics, and we apply it to the world geography. It proves very useful in rationalizing geopolitics, which play a vital role in shaping the global economy and politics but are poorly understood. Our model bridges local economies with the world economy, local welfare with foreign welfare, and national borders with the worldwide nation-state system. Our findings are robust to time. Theoretically, the interplay between trade and autonomy analyzed here has been a perpetual theme for

[28]Using probit or logit instead is less convenient computationally because of the large number of fixed effects used in regression (40).

[29]We do not call them year fixed effects because only years with militarized disputes have those fixed effects.

Table 10: Revisionism in Militarized Disputes

	(1)	(2)	(3)	(4)	(5)
Panel A: Dep. Variable is Indicator of Revisionist					
ln(Distance from the world GC)#	-0.135***	-0.133***	-0.048**	-0.035***	-0.057***
	(0.024)	(0.024)	(0.023)	(0.012)	(0.013)
Indicator of originator		0.332***	0.360***	0.255***	0.262***
		(0.076)	(0.080)	(0.050)	(0.049)
ln(Military expenses)			0.095***	0.025***	
			(0.008)	(0.004)	
Other control variables¶	No	No	No	Yes	Yes
Military dispute FE	Yes	Yes	Yes	No	No
Period FE	No	No	No	No	Yes
Observations	1,376	1,376	1,330	1,330	1,376
Panel B: (Counter-Check) Dep. Variable is Indicator of Originator					
ln(Distance from the world GC)#	-0.004	0.003	-0.004	0.013*	0.015**
	(0.013)	(0.013)	(0.014)	(0.007)	(0.007)
Indicator of revisionist		0.054***	0.069***	0.063***	0.062***
		(0.014)	(0.016)	(0.014)	(0.013)
ln(Military expenses)			-0.006	0.001	
			(0.005)	(0.002)	
Other control variables¶	No	No	No	Yes	Yes
Military dispute FE	Yes	Yes	Yes	No	No
Period FE	No	No	No	No	Yes
Observations	1,376	1,376	1,330	1,330	1,376

Notes: All columns use linear probability regressions. Using probit or logit regressions instead does not change our findings. Panels A and B use the same sample, in which only one side raises revision requests. ¶ Other control variables refer to fatality scale index (as in Table 9), reciprocated dummy (as in Table 9), and number of states in the dispute. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

locales, states, and the world as a whole over centuries. Empirically, the hypotheses derived from our data are supported by historical and modern data.

The limitations of this study are threefold, each providing an avenue for future research. First, on the theoretical front, the downside of using a linear world geography stems from the loss of interplay between states with the same distance from the world geometric center. Advancements in this direction mandate a two-dimensional world geography, thus facing the challenge of characterizing arbitrary one-dimension borders in a two-dimensional geography. We did not find a mathematical tool to address this challenge, and speculate that differential geometry may provide a solution. Second, on the empirical front, we did not find worldwide bilateral trade data dating back to the 18th and 19th centuries. If found, such data would be valuable for evaluating how trade volumes and nation-states influence each other over time. Such data are scarce, although they have started to become accessible for certain regions, such as Western Europe and East Asia. Third, colonization is not studied here, but our model provides a framework for studying that process. A full general equilibrium of colonization is expected to be complicated, as it involves international migration, international trade, and national borders on the sides of both the empire and the colony. The world map in the era of colonization was closer to linearity (Eurocentric and with few Pacific routes) than in later eras. Thus, our linear world model offers a promising way to model the general equilibrium of colonization.

References

Acemoglu, Daron, Simon Johnson, and James A. Robinson (2005), "The Rise of Europe: Atlantic Trade, Institutional Change, and Economic Growth." *American Economic Review*, 95, 546–579.

Acemoglu, Daron and Pierre Yared (2010), "Political limits to globalization." *American Economic Review: Papers and Proceedings*, 100, 83–88.

Aghion, Philippe, Torsten Persson, and Dorothee Rouzet (2012), "Education and Military Rivalry." NBER Working Paper 18049.

Ahlfeldt, Gabriel M., Stephen J. Redding, Daniel M. Sturm, and Nikolaus Wolf (2015), "The Economics of Density: Evidence From the Berlin Wall." *Econometrica*, 83, 2127–2189.

Alesina, Alberto and Bryony Reich (2015), "Nation building." Working paper.

Alesina, Alberto and Enrico Spolaore (1997), "On the Number and Size of Nations." *Quarterly Journal of Economics*, 112, 1027–56.

Alesina, Alberto and Enrico Spolaore (2005), "War, peace, and the size of countries." *Journal of Public Economics*, 89, 1333–1354.

Alesina, Alberto and Enrico Spolaore (2006), "Conflict, defense spending, and the number of nations." *European Economic Review*, 50, 91–120.

Alesina, Alberto, Enrico Spolaore, and Romain Wacziarg (2000), "Economic integration and political disintegration." *American Economic Review*, 90, 1276–1296.

Alesina, Alberto, Enrico Spolaore, and Romain Wacziarg (2005), "Trade, Growth and the Size of Countries." In *Handbook of Economic Growth (vol. 5)* (Philippe Aghion and Steven Durlauf, eds.), 1499–1542, Elsevier.

Allen, Treb and Costas Arkolakis (2014), "Trade and the Topography of the Spatial Economy." *Quarterly Journal of Economics*, 129, 1085–1140.

Allen, Treb, Costas Arkolakis, and Yuta Takahashi (2014), "Universal Gravity." NBER Working Paper 20787.

Anderson, James (2009), "Does trade foster contract enforcement?" *Economic Theory*, 41, 105–130.

Anderson, James E. (2011), "The gravity model." *Annual Review of Economics*, 3, 1–668.

Anderson, James E. and Eric van Wincoop (2003), "Gravity with gravitas: A solution to the border puzzle." *American Economic Review*, 93, 170–192.

Ang, James B. (2015), "What drives the historical formation and persistent development of territorial states?" *Scandinavian Journal of Economics*, 117, 1134–1175.

Baier, Scott L. and Jeffrey H. Bergstrand (2002), "On the endogeneity of international trade flows and free trade agreements." Working paper.

Baier, Scott L. and Jeffrey H. Bergstrand (2004), "Economic determinants of free trade agreements." *Journal of International Economics*, 64, 29–63.

Barraclough, Geoffrey (1994), *The times atlas of world History (4th ed.)*. BCA London.

Bates, Robert, Avner Greif, and Smita Singh (2002), "Organizing Violence." *Journal of Conflict Resolution*, 46, 599–628.

Berlin, Isaiah (1954), *Historical Inevitability*. Geoffrey Cumberlege, Oxford University Press.

Besley, Timothy and Torsten Persson (2009), "The Origins of State Capacity: Property Rights, Taxation, and Politics." *American Economic Review*, 99, 1218–44.

Black, Duncan (1948), "On the rationale of group decision-making." *Journal of Political Economy*, 56, 23–24.

Bonfatti, Roberto and Kevin Hjortshøj O'Rourke (2014), "Growth, import dependence and war." NBER Working Paper 20326.

Braudel, Fernand (1949), *The Mediterranean and the Mediterranean World in the Age of Philip II*. University of California Press (1995).

Brennan, Geoffrey and James M. Buchanan (1980), *The Power to Tax: Analytic Foundations of a Fiscal Constitution*. Cambridge University Press.

Brzezinski, Zbigniew (1997), *The Grand Chessboard: American Primacy And Its Geostrategic Imperatives*. Basic Books.

Buhaug, Halvard and Päivi Lujala (2005), "Accounting for scale: Measuring geography in quantitative studies of civil war." *Political Geography*, 24, 399–418.

Carneiro, Robert L. (1970), "A theory of the origin of the state." *Science*, 169.

de la Sierra, Raul Sanchez (2015), "On the origin of states: Stationary bandits and taxation in eastern congo." Working paper.

Desmet, Klaus, Michel Le Breton, Ignacio Ortuño-Ortín, and Shlomo Weber (2011), "The stability and breakup of nations: a quantitative analysis." *Journal of Economic Growth*, 16, 183–213.

Diamond, Jared M. (1999), *Guns, Germs, and Steel: The Fates of Human Societies*. W. W. Norton & Company.

Dornbusch, Rudiger, Stanley Fischer, and Paul A Samuelson (1977), "Comparative Advantage, Trade, and Payments in a Ricardian Model with a Continuum of Goods." *American Economic Review*, 67, 823–39.

Downs, Anthony (1957), *An Economic Theory of Democracy*. Harper Collins.

Egger, Peter, Mario Larch, Kevin E. Staub, and Rainer Winkelmann (2011), "The Trade Effects of Endogenous Preferential Trade Agreements." *American Economic Journal: Economic Policy*, 3, 113–43.

Fairgrieve, James (1917), *Geography and world power*. E. P. Dutton & Company.

Fazal, Tanisha M. (2007), *State Death: The Politics and Geography of Conquest, Occupation, and Annexation*. Princeton University Press.

Friedman, David (1977), "A theory of the size and shape of nations." *Journal of Political Economy*, 85, 59–77.

Fujita, Masahisa, Paul Krugman, and Anthony J. Venables (1999), *The Spatial Economy*. The MIT Press.

Greif, Avner (1994), "Cultural beliefs and the organization of society: A historical and theoretical reflection on collectivist and individualist societies." *Journal of Political Economy*, 102(5), 912950.

Greif, Avner (2006), *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade*. Cambridge University Press.

Guiso, Luigi, Helios Herrera, and Massimo Morelli (2016), "Cultural Differences and Institutional Integration." *Journal of International Economics*, 99, S97–S113.

Harrison, Mark and Nikolaus Wolf (2012), "The frequency of wars." *The Economic History Review*, 65, 1055–1076.

Head, Keith and Thierry Mayer (2014), "Gravity equations: Workhorse, toolkit, and cookbook." In *Handbook of International Economics* (Elhanan Helpman, Kenneth Rogoff, and Gita Gopinath, eds.), 131–195, Oxford.

Head, Keith, Thierry Mayer, and John Ries (2010), "The erosion of colonial trade linkages after independence." *Journal of International Economics*, 81, 1–14.

Hobbes, Thomas (1651), *Leviathan*. Clarendon Press, Oxford.

Hotelling, Harold (1929), "Stability in competition." *Economic Journal*, 39, 41–57.

Huntington, Ellsworth (1907), *The Pulse of Asia, a Journey in Central Asia Illustrating the Geographic Basis of History*. Houghton, Mifflin and Company.

Iyigun, Murat, Nathan Nunn, and Nancy Qian (2015), "Agricultural productivity, conflict, and state size: evidence from potatoes, 1400-1900." Working paper.

Keller, Wolfgang and Carol H. Shiue (2014), "Endogenous Formation of Free Trade Agreements: Evidence from the Zollverein's Impact on Market Integration." *Journal of Economic History*, 74, 1168–1204.

Keller, Wolfgang and Carol H. Shiue (2015), "Market integration as a mechanism of growth." Working paper, Working paper.

Kissinger, Henry (1994), *Diplomacy*. Simon & Schuster.

Kissinger, Henry (2014), *World Order*. Penguin Press.

Krishna, Pravin (2003), "Are Regional Trading Partners "Natural"?" *Journal of Political Economy*, 111, 202–231.

Krugman, Paul (1980), "Scale Economies, Product Differentiation, and the Pattern of Trade." *American Economic Review*, 70, 950–59.

Lan, Xiaohuan and Ben G. Li (2015), "The Economics of Nationalism." *American Economic Journal: Economic Policy*, 7, 294–325.

Mackinder, H. J. (1904), "The geographical pivot of history." *Geographical Journal*, 23, 421–437.

Mackinder, H.J. (1919), *Democratic Ideals and Reality: A Study in the Politics of Reconstruction*. Holt.

Martin, Philippe, Thierry Mayer, and Mathias Thoenig (2008a), "Civil Wars and International Trade." *Journal of the European Economic Association*, 6, 541–550.

Martin, Philippe, Thierry Mayer, and Mathias Thoenig (2008b), "Make Trade Not War?" *Review of Economic Studies*, 75, 865–900.

Martin, Philippe, Thierry Mayer, and Mathias Thoenig (2012), "The Geography of Conflicts and Regional Trade Agreements." *American Economic Journal: Macroeconomics*, 4, 1–35.

Morgenthau, Hans J. (1948), *Politics Among Nations*. Alfred A. Knopf.

Ogawa, Hideaki and Masahisa Fujita (1980), "Equilibrium land use patterns in a non-monocentric city." *Journal of Regional Science*, 20, 455–475.

Overy, Richard (2010), *The Times Complete History of the World*. Times Books.

Palmer, R.R., Joel Colton, and Lloyd Kramer (2007), *A History of the Modern World, to 1815*. McGraw Hill.

Polachek, Solomon William (1980), "Conflict and trade." *Journal of Conflict Resolution*, 24, 55–78.

Polachek, Solomon William (1992), "Economics of arms reduction and the peace process." In *Conflict and trade: an economics approach to political international interactions* (W. Isard and C. H. Anderton, eds.), 89–120, Elsevier Science Publishers.

Popper, Karl (1957), *The Poverty of Historicism*. Beacon Press.

Puga, Diego and Daniel Trefler (2014), "International Trade and Institutional Change: Medieval Venice's Response to Globalization." *Quarterly Journal of Economics*, 129, 753–821.

Rand McNally, (1992), *Atlas of World History*.

Rand McNally, (2015), *New Historical Atlas of the World*.

Ranjan, Priya and Jae Young Lee (2007), "Contract Enforcement And International Trade." *Economics and Politics*, 19, 191–218.

Shiue, Carol H. (2005), "From political fragmentation towards a customs union: Border effects of the German Zollverein, 1815 to 1855." *European Review of Economic History*, 9, 129–162.

Singer, J. David (1987), "Reconstructing the correlates of war dataset on material capabilities of states, 1816-1985." *International Interactions*, 14, 115–32.

Skaperdas, Stergios and Constantinos Syropoulos (2001), "Guns, butter, and openness: On the relationship between security and trade." *American Economic Review*, 91, 353–357.

Solon, Gary, Steven J. Haider, and Jeffrey M. Wooldridge (2015), "What are we weighting for?" *Journal of Human Resources*, 50, 301–316.

Tilly, Charles (1985), "Bringing the state back." In *War Making and State Making as Organized Crime* (Peter Evans, Dietrich Rueschemeyer, and Theda Skocpol, eds.), Cambridge University Press.

Appendices

A.1 A1.Proofs and Derivations

A.1.1 Equation (14)

At locale t, the lord maximizes $U(t) = \frac{1}{1-\gamma} C^z(t)^{1-\gamma} - hS(t)$, where $C^z(t) \equiv \exp\{\int_{-1}^{1} \ln c^z(t,s) ds\}$, subject to the budget constraint $\int_{-1}^{1} p(t,s) c^z(t,s) ds = r(t)z$. The first-order condition is

$$p(t,s)c^z(t,s) = \frac{C^z(t)^{1-\gamma}}{\lambda^z(t)} \equiv \kappa^z(t). \tag{41}$$

If plugging it back to the budget constraint, we obtain $\kappa^z(t) = r(t)z/2$.

At locale t, the labor maximizes $V(t) = \frac{\psi}{1-\gamma} C^l(t)^{1-\gamma}$, where $C^l(t) \equiv \exp\{\int_{-1}^{1} \ln c^l(t,s) ds\}$, subject to budget constraint $\int_{-1}^{1} p(t,s) c^l(t,s) ds = w(t)l(t)$. The first-order condition is

$$p(t,s)c^l(t,s) = \frac{\psi C^l(t)^{1-\gamma}}{\lambda^l(t)} \equiv \kappa^l(t). \tag{42}$$

If plugging it back to the budget constraint, we obtain $\kappa^l(t) = w(t)l(t)/2$.

So, the aggregate first-order condition is the sum of equations (41) and (42):

$$p(t,s)c(t,s) = \frac{C^z(t)^{1-\gamma}}{\lambda^z(t)} + \frac{\psi C^l(t)^{1-\gamma}}{\lambda^l(t)} \equiv \kappa(t).$$

This is equation (14) in the text. The value of $\kappa(t)$ is $\kappa(t) = \kappa^z(t) + \kappa^l(t) = (r(t)z + w(t)l(t))/2$.

Notice that the aggregate first-order condition is used to derive the aggregate consumption of locale s's goods at locale t, namely $p(t,s)c(t,s)$. The lord and labor solve their own utility maximization, and no social welfare maximization is involved here.

A.1.2 Equation (23)

By equation (41), we have $c^z(t,s) = \kappa^z(t)/p(t,s)$. By inserting the $c^z(t,s)$ into $C^z(t)$, we obtain

$$\begin{aligned}
C^z(t) &= \exp\{\int_{-1}^{1}(\ln\kappa^z(t) - \ln p(t,s))ds\} \\
&= \exp\{\int_{-1}^{1}(\ln\kappa^z(t)/p - \ln d(t,s))ds\} \\
&= \exp\{2\ln\kappa^z(t)/p - \int_{-1}^{1}\ln d(t,s)ds\} \\
&= (\kappa^z(t)/p)^2\exp\{\int_{-1}^{1}\ln d(t,s)ds\} \\
&= (\frac{r(t)z}{2p})^2\exp\{\int_{-1}^{1}\ln d(t,s)ds\} \\
&= (\frac{r(t)z}{2p})^2/R(t),
\end{aligned}$$

where p is the normalized factory-gate price $p = r(t)z/2$ in the text. Thus, $C^z(t) = \frac{1}{R(t)}$, which is equation (23) in the text.

A.1.3 Uniqueness

Recall the equilibrium partition in the text

$$\{b_n^*\}_{-N}^{N} \equiv \{b_{-N}^*, ..., b_{-1}^*, b_{-0}^*, b_0^*, b_1^*, ..., b_N^*\}.$$

We now use mathematical induction to show that any other equilibrium partition is identical with $\{b_n^*\}$. Denote such an equilibrium by

$$\{b_n'\}_{-N'}^{N'} \equiv \{b_{-N'}', ..., b_{-1}', b_{-0}', b_0', b_1', ..., b_{N'}'\}.$$

Without loss of generality, consider the right half of the world. First, $b_0' = b_0^*$ must hold, because the first-order condition (29) would otherwise be violated. Then suppose that $b_g' = b_g^*$ holds for $g = 1, 2, .., k$; that is, this new partition coincides with the found equilibrium partition up to the k-th border. We want to show that, based on the k-th border, the $k+1$-th border still coincides: $b_{k+1}' = b_{k+1}^*$.

By equations (9) and (25), in the state of locale $t = b_{k+1}'$, locale $t = b_k'$ has the smallest ideal size of the state among all locales in $[b_k', b_{k+1}')$. If $b_{k+1}' > b_{k+1}^*$, then locale $t = b_k'$ would veto it, because $\frac{\partial U(t=b_k')}{\partial b_{k+1}}|_{b_{k+1}=b_{k+1}'} < 0$. Thus, any such distal b_{k+1}' cannot constitute an equilibrium partition. If $b_{k+1}' < b_{k+1}^*$, then $\frac{\partial U(t)}{\partial b_{k+1}}|_{b_{k+1}=b_{k+1}'} > 0$, for any $t \in [b_k', b_{k+1}')$, including the most size-intolerant locale $t = b'_k$. Thus, including the locales in $[b'_{k+1}, b^*_{k+1})$ into the state benefits all current locales $[b'_k, b'_{k+1})$. The inclusion is thus proposed. Notice that the locales in $[b'_{k+1}, b^*_{k+1})$ will accept the proposal, which reduces their price indexes from at least $R(t = b'_{k+1})$ to $R(t = b'_k)$. Therefore, $b'_{k+1} = b^*_{k+1}$. To summarize, if $b'_g = b^*_g$ holds for $g = 1, 2, .., k$, then $b'_{k+1} = b^*_{k+1}$, resulting in the same state $k+1$ as in the found equilibrium.

To conclude, any other equilibrium partition of the world is identical with the found one.

A.1.4 Derivation of Equation (33)

The exports volume from state m to state n is

$$\begin{aligned} X_{m,n} &= S_m \int_{b_{n-1}}^{b_n} p(s)c(s, b_m)ds = \frac{S_m}{2} \int_{b_{n-1}}^{b_n} \kappa d(s, b_m)^{-1} ds \\ &= \frac{\kappa}{2\tau} S_m [\exp\{-\tau(b_{n-1} - b_m)\} - \exp\{-\tau(b_n - b_m)\}]. \\ &= \frac{\kappa}{2\tau} S_m \exp\{-\tau(b_n - b_m)\} \times (\exp\{\tau S_n\} - 1). \end{aligned}$$

where the second equality stems from equation (15). Since states sizes are small compared with 1 (the total size of all states is 1 on both sides), $\exp\{\tau S_n\} - 1 = \tau S_n$. So, equation (33) is obtained:

$$X_{m,n} = \zeta S_m S_n \exp\{-\tau(b_n - b_m)\},$$

where $\zeta = \kappa/2$ applies to all pairs worldwide.

A.1.5 $dh/d\tau$ (Global Politics)

$dh/d\tau > 0$ follows from equations (44) and (47) (located in the following Appendix A.1.6). With $|b_{n-1}|$ given, the F_h in equation (44) is constant while the F_τ in equation (47) is decreasing in $|b_n|$, so $dh/d\tau > 0$ is decreasing in $|b_n|$.

A.1.6 Hypothesis 1

Equation (31) is equivalent to

$$F \equiv \tau R_n^{\gamma-1}(1 - b_{n-1} - S_n) - h = 0, \tag{43}$$

which implies the following partial derivatives:

$$
\begin{aligned}
F_h &= -1 < 0, &(44)\\
F_S &= -(\gamma-1)R_n^{\gamma-1}\tau^2(1-b_n)^2 - \tau R_n^{\gamma-1} < 0, &(45)\\
F_{b_{n-1}} &= (\gamma-1)R_n^{\gamma-1}\tau^2(2b_{n-1}+S_n)(1-b_{n-1}-S_n) - \tau R_n^{\gamma-1}, &(46)\\
F_\tau &= R_n^{\gamma-1}(1-b_n)\{1+\tau(\gamma-1)\frac{1}{2}[(1+b_{n-1})^2+(1-b_n)^2]\} > 0. &(47)
\end{aligned}
$$

By equation (46), $F_{b_{n-1}} > 0$ if

$$\tau > \frac{1}{(\gamma-1)(b_0(1-b_0))}. \tag{48}$$

By total differentiation, $\frac{\partial S_n}{\partial b_{n-1}} = -\frac{F_{b_{n-1}}}{F_S}$. Recall $F_S < 0$ in equation (45). Thus, $\frac{\partial S_n}{\partial b_{n-1}} > 0$ so long as inequality (48) holds.

A.1.7 State 0's Size

The first-order condition for state 0 is

$$\tau R_0^{\gamma-1}(1-\frac{S_0}{2}) = h. \tag{49}$$

The first-order condition for state 1 is

$$\tau R_1^{\gamma-1}(1-\frac{S_0}{2}-S_1) = h. \tag{50}$$

Recall $R_0 < R_1$ and $\gamma > 1$. The only requirement on the relative sizes of S_0 and S_1 is that $1-\frac{S_0}{2}$ must be greater than $1-\frac{S_0}{2}-S_1$. That always holds. So, S_0 could be greater than, less than, or equal to S_1. Similarly, the first-order condition for state n is

$$\tau R_n^{\gamma-1}(1-[\frac{S_0}{2}+\sum_{k=1}^{n-1}S_k]-S_n) = h. \tag{51}$$

If n is very large, $\sum_{k=1}^{n-1}S_k + S_n$ would be so large that equations (49) and (51) do not hold simultaneously. Otherwise, state 0 could be larger than state n. The possibility for state 0 to be smaller than state n is obvious.

A.1.8 Hypothesis 2

Part (a) A simple manipulation of equation (31) shows

$$\frac{\partial b_n}{\partial b_{n-1}} = \frac{\partial(b_{n-1}+S_n)}{\partial b_{n-1}} = 1 + \frac{\partial S_n}{\partial b_{n-1}} > 0, \tag{52}$$

where $\frac{\partial S_n}{\partial b_{n-1}} > 0$ stems from the proved Hypothesis 1. By equation (52),

$$\frac{\partial b_n}{\partial b_0} = \prod_{i=0}^{n-1} \frac{\partial b_{n-i}}{\partial b_{n-i-1}} > 0, \tag{53}$$

for any $n \geq 1$, and thus

$$\frac{\partial S_n}{\partial b_0} = \frac{\partial S_n}{\partial b_{n-1}} \frac{\partial b_{n-1}}{\partial b_0} > 0. \tag{54}$$

That is, a larger state 0 results in larger sizes of all states in the world, meaning a smaller number of states in the world.

Part (b) Since $\frac{\partial^2 b_n}{\partial b_{n-1} \partial b_0} = \frac{\partial^2 S_n}{\partial b_{n-1} \partial b_0} = \frac{\partial^2 S_n}{\partial b_0 \partial b_{n-1}}$, we can show instead that $\frac{\partial^2 S_n}{\partial b_0 \partial b_{n-1}} > 0$ and is increasing in n. Recall equation (54) above. Its first term is positive and increasing in n, which follows from the proved Hypothesis 1. Specifically, for a greater n (and thus $n-1$), b_n has to be extended further from b_{n-1}, resulting in a larger S_n.

Now move on to the second term in equation (54), which equals

$$\frac{\partial b_{n-1}}{\partial b_0} = \prod_{i=1}^{n-1} \frac{\partial b_{n-i}}{\partial b_{n-i-1}},$$

following equation (53). Here, every term inside the product is weakly greater than 1. They all equal 1 if all states from 1 to $n-1$ keep their original sizes but move outward. For a greater n (and thus $n-1$), the product has one more term in it. It will weakly increase. Notice that this result is independent from the change in b_n (and thus S_n).

To combine the two terms, one can see that $\frac{\partial^2 S_n}{\partial b_0 \partial b_{n-1}} > 0$ and is increasing in n.

A.1.9 Welfare Change Resulting from a Border Change

Consider three borders in the right half of the world: b_{k-1}, b_k and b_{k+1}. Locales $[b_{k-1}, b_k)$ are state k, and locales $[b_k, b_{k+1})$ are state $k+1$. Holding borders b_{k-1} and b_{k+1} constant, we show below that a change in b_k affects state k more than it does state $k+1$.

Recall $R_n = \exp\{\frac{1}{2}\tau[(1 + b_{n-1})^2 + (1 - b_{n-1} - S_n)^2]\}$. It follows that $\frac{\partial R_n}{\partial S_n} = -\tau(1 - b_{n-1} - S_n)R_n$, which can be rearranged as

$$-\frac{\partial R_n / \partial S_n}{R_n} = \tau(1 - (b_n - b_{n-1})), \tag{55}$$

where $S_n \equiv b_n - b_{n-1}$. Since $b_{k+1} - b_k > b_k - b_{k-1}$, the percentage change in the price index (thus welfare) is greater for state k than for state $k+1$.

A.2 Additional Tables

Table A1: Robustness: Results based on Centroids

Dependent variable is ln(Area)		
	(1)	(2)
ln(Distance from the world centroid)	0.554**	0.411**
	(0.236)	(0.172)
Coast dummy	0.226	-0.365
	(0.284)	(0.257)
Island dummy	-1.674***	-1.127***
	(0.448)	(0.407)
ln(Military expenses)		0.047
		(0.152)
ln(Iron & steel production)		-0.052
		(0.064)
ln(Primary energy consumption)		0.580***
		(0.127)
Observations	162	156

Notes: The data is based on the 1994 world map. The set of states is the same as in column (1) of Table 4. Robust standard errors in parentheses. *** p<0.01, ** p<0.05.

Table A2: LCs in the World

Panel A: List of LCs

Continents	Period+	Center	Lat, Lon
Eurasia	18th century	Surovikino, Russia	48.61, 42.85
	19th century	Surovikino, Russia	48.61, 42.85
	Early 20th century	Surovikino, Russia	48.61, 42.85
	modern	Surovikino, Russia	48.61, 42.85
America	18th century	Barranquilla, Viceroyalty of Peru	10.97,-74.78
	19th century	Tampa, Florida, United States	27.95,-82.46
	Early 20th century	Tampa, Florida, United States	27.95,-82.46
	modern	Tampa, Florida, United States	27.95,-82.46
Africa	18th century	N'guigmi, Bornu-Kanem	10.11,14.45
	19th century	N'guigmi, Bornu-Kanem	14.25,13.11
	Early 20th century	Paoua, Kamerun	7.24,16.44
	modern	Paoua, Central African Republic	7.24,16.44

Panel B: Dep. variable is ln(Area) ++

	Period: 18th century		Period: 19th century	
ln(Dist from the LC)	0.561	-0.197	0.525*	-0.288
	(0.350)	(0.452)	(0.312)	(0.383)
ln(Dist from the world GC)		0.850***		0.739***
		(0.304)		(0.174)
	N=118		N=134	
	Period: early 20th century		Period: modern	
ln(Dist from the LC)	0.343*	0.074	0.368*	0.169
	(0.197)	(0.246)	(0.196)	(0.225)
ln(Dist from the world GC)		0.352**		0.313**
		(0.164)		(0.151)
	N=171		N=159	

Notes: (+) the four periods refer to those defined in Section 2. (++) Island dummy, coast dummy, and continent fixed effects are included in all regessions. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Summary Statistics for Section 5

Variable	Obs	Mean	STD	Min	Max
Panel A: Number of involved states (corresponding to Table 9)					
A1. 19th Century					
Total num. of states	192	2.46875	1.265351	2	11
Num. of states on Side A	192	1.333333	1.055196	1	8
Num. of states on Side B	192	1.135417	0.4933016	1	5
Fatality scale index	192	0.8489583	2.034544	0	6
Reciprocated (or not) dummy	192	0.4375	0.4973753	0	1
Distance from the world GC	192	5635.049	3547.611	168.4559	10084.53
A2. Early 20th Century					
Total num. of states	343	2.355685	1.960581	2	33
Num. of states on Side A	343	1.215743	1.359432	1	23
Num. of states on Side B	343	1.139942	0.8329522	1	11
Fatality scale index	343	0.6326531	1.65762	0	6
Reciprocated (or not) dummy	343	0.3556851	0.4794198	0	1
Distance from the world GC	343	4129.122	3368.796	98.16036	9942.989
A3. Modern					
Total num. of states	229	2.751092	4.10862	2	39
Num. of states on Side A	229	1.458515	3.228747	1	38
Num. of states on Side B	229	1.292576	2.586569	1	38
Fatality scale index	229	0.3231441	1.021882	0	6
Reciprocated (or not) dummy	229	0.3799127	0.4864281	0	1
Distance from the world GC	229	5362.322	3016.856	491.6061	9869.512
Panel B: Revisionism (corresponding to Table 10)					
Indicator of revisionist	1376	0.4789244	0.4997372	0	1
Indicator of originator	1376	0.8888081	0.3144839	0	1
Distance from the world GC	1376	4546.508	3651.731	52.12795	18007.49