

Foreign Diplomatic Interaction with the United States, 1990- 2000: A Gravity Model Approach

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1. Introduction

This research studies the diplomatic interaction among nations. The students of international relations, especially the realists, would look at the big powers and “ignore” the lesser powers in search of IR theory. They explain that it is because the big powers dominate the international system. The constant changing of the power basis of nations within the international system translates into the shifting of relative national powers and changing of international structure. This shift often occurs without notice. Nations that fail to capture the shift and the relative change of power may head into conflict without prudent calculations. The study on national power and its role international relations is rich; however, national power, like all other forces, is subject to the distance decay effect (O’Sullivan 1986). That is, the impact of one nation’s power diminishes when the distance between this nation and impacted nation increases. Therefore, not all nations will be under the same amount of pressure resulting from the national power of others. Nations will behave differently to their neighbors than to the distant ones. Distance is not just physical; it can be political, economic, and cultural, depending on how one defines distance. However, physical distance is easiest to operate and control. The effect of

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distance as an attribute of geography is an under-studied issue in international relations literature.

Similar research, on the other hand, is rich in international trade studies. Generally, the trade volume between two nations is hypothesized as the function of the size of the two nations and the distance between them. The gravity model, in this vein, has been very successful and continues to be used in international trade studies today.

The purpose of this research is two-fold: the first is to show how the gravity model fits the diplomatic interaction among nations; the second is to simulate the interactions with empirical data. The diplomatic interactions among nations are taken as the proxy variable for political interaction among nations. The main hypothesis is that the political interaction among nations, in terms of the number of diplomatic personnel sent among them, is the function of the national power of the nations and the physical and political distance between them. The model may serve as a reference to international relations study and should be of help for people to better understand the politics among nations.

My previous study of the foreign missions sent to the United States in 1999 shows that physical distance was not a significant factor determining the size of the missions in that year, while GDP turns out to be the deciding factor. Mearsheimer's take of wealth as the main indicator of national power seems quite right. However, it is unknown whether the effect of distance has been decreasing over the year. This paper expands the research scope and tries to answer how the factors I have studied for 1999 changes over the years from 1990 to 2000. I am expecting that the effect of distance in history was significant.

2. Literature review

2.1 Realists' view on political interaction among nations

Thucydides² argues that states are key units in the international system; they are power seekers as a means to an end or as an end in itself, and they behave rationally. The rise of Athens and the fear it caused to Sparta were the direct cause of war between them. Power and morality are detached in international relations. Thomas Hobbes³ believes the state of nature is the state of war in which self-preservation is the most important. States fight wars against each other to seek gain or glory, or due to fear. Machiavelli⁴ regards power as an end in itself and as a separate value system, that is, everything to preserve the state is good. Morgenthau⁵ argues that politics among nations has its roots in human nature. He assumes states are rational actors. His other assumptions include: 1. interest defined in terms of power; thus the goal for nations is to maximize benefits and minimize risks; 2. interest defined as power is objective concept unaffected by circumstances of time and place; 3. no universal moral principles applicable to the actions of states. Such realists consider prudence as the weighing of consequences of alternative political actions—as supreme virtue; 4. international laws and morals are no constraints on state actions. Military power is the most important form of power in terms of ability to influence other states' actions. Waltz rejects human nature as the cause; the key variable for Waltz is the systemic distribution of power—how the relationships among states are organized strongly affects state behavior towards one another. Waltz assumes that the internal characteristics of states do not vary; he accepts separation of international and

² Robert B. Strassler, 1996.

³ Thomas Hobbes, 1991.

⁴ Niccolò Machiavelli, 1985.

⁵ Hans Morgenthau, 1973.

domestic politics. Characteristics of the international system—decentralization and anarchy (politics in the absence of a world government)—are the ordering principles; states are not the only actors, but the major actors; states are undifferentiated by functions and distinguished primarily by greater or lesser capabilities for performing similar tasks; the structure of the system changes with variations in the distribution of capabilities across the system's units. All must be prepared to counter the use of force by others; states worry about survival and concern about relative gains. Mearsheimer⁶ argues that states in the international system fear each other; each state aims to guarantee its own survival; states aim to make their relative power position over others; the reason is the greater the power one state has over others, the more secure it is. Realists recognize that states sometimes operate through institutions, but believe that those rules reflect states' calculations of self-interest based on the international distribution of power. Mearsheimer thus argues that institutions have minimal influence on state behavior.

Thus, the constant changing of the power basis of nations within the international system translates into the shifting of relative national powers and changing of international structure. Any change in the national power of one nation is assumed to have direct impact on all other nations in the system, although the impact may vary toward different nations with different power. However, the projection of national power is limited by the distance factor. That is, the influence of one nation's power on other nations diminishes as the distance increases between them. With the establishment of such a world system, and inclusion of distance factor, one would be able to simulate the power interactions among nations. The best tool I imagine for this is the gravity model.

⁶ John J. Mearsheimer, 1990.

2.2 Gravity model

The gravity model is applied frequently in the social sciences, especially in economics and geography. The model is often used to study flows of varying types. The model generally says that interaction is the function of the size of the masses and the distance between them. “Since the early 1940s, the gravity model has been applied to a wide variety of goods and factors of production moving across regional and national boundaries under differing circumstances.”⁷ In its most crude form this model can be expressed with a simple equation⁸: $T_{ij} = P_i P_j / d_{ij}^x$. Here P refers to population, i and j the interacting centers, d the distance between i and j, and T the interaction.

Specifically applied to international trade flows, the gravity model states that the size or the magnitude of trade flows between two countries is determined by supply conditions at the origin, by demand conditions at the destination and by stimulating or restraining forces relating to the specific flows between the two countries. Regarding trade flow application, Tinbergen’s gravity model (1962) is “the most successful empirical trade flow equation, usually producing a good fit (Anderson 1979).”⁹ Tinbergen’s model provides an empirically tractable general equilibrium framework for bilateral trade flow analysis. His basic formulation of the gravity equation has income and population of trading partners and the distance between them as the independent variables, hypothesizing that the trade flows between two countries are mainly determined by these factors.

Therefore, many researchers, who believed in the existence of the many other factors that could impact international trade, have tried to enrich the model by

⁷ Oguledo & Macphee, p. 110

⁸ Kingsley E. Haynes and A. Stewart Fotheringham, 1984, p. 12

⁹ Karlirajan, p.186

introducing more variables into the model or simply taking other variables instead. There are several popular ways to do the modifications:

Changing population variables Many different variables can be used in this regard, for instance, the GDP, GNP per capita, geographic size, population size, etc. The researcher can plug in the variables s/he is interested in;

Changing distance variable The distance between two places can be measured in several ways. The common way is to measure the physical distance between centroids of the two places, be it province or country. When used in international trade, the gravity model distance can be the distance between the capitals of the two countries. Sometimes, people use the average of the distances between several of the largest cities of two countries. Moreover, other ways of distance measuring can be used, too. In many situations, traveling time and traveling cost could be the better variable to measure distance between two places. Distance between two places can also be estimated in abstract terms, such as political distance, social distance, cognitive distance, and psychological distance. There will be a special discussion on distance measurement in the next section;

Changing beta values The distance element is adjusted by an exponent to show whether the impact of distance is proportional or not. The “friction of distance” effect varies, depending on study subject. Even though distance is always assumed to have a negative influence in interaction, in some cases it may be more negative than in others. An exponent on the distance variable allows one to represent this variability. In general, a larger exponent indicates that the friction of distance becomes increasingly important in reducing the expected level of interaction between places. An exponent can also be added

to the population to allow for situations where there are variables other than population that affect spatial interaction between the two places. The larger the exponent, the greater the effect of population size on the interaction. The modification also includes adding of a scale parameter k to indicate magnitude of interaction;

Adding dummy variables Often “dummy” variables are added to the basic gravity model to add explanatory power to the model. Political scientists modify the model by plugging in some dummy variables such as regime type, languages, etc. International politics impact international trade.¹⁰ It is argued that trade between states with similar interests will be higher than that with dissimilar interests. International trade also differs between democratic and non-democratic dyads and between allies and non-allies. Plugging in of these dummies is to increase the explanatory power of the gravity model in the study of international trade.

2.3 Distance

Distance is essentially a measurement of spatial separation. There are various concepts of distance. Anthony Gatrell¹¹ identifies four concepts of distances: time distance, economic distance, cognitive distance, and social distance. Time distance is the amount of time spent in moving from one fixed point to the other fixed point. Depending on the mode of transportation, say by train or by air, the traveling time from one city to the other can be mapped. The same physical distance may take different amount of traveling time: inner lands typically take more time to travel. This can be a clue to the research at hand. For instance, traveling from North Korea to Washington D.C. must take

¹⁰ Morrow, Siverson, and Tabares, p. 649.

¹¹ Anthony Gatrell (1983).

a lot more time than traveling from South Korea, although the physical distance from the two states to the United States are almost the same. The economic distance is defined as “the monetary cost incurred in overcoming geographical distance.” The optimal shortest cost path often is not a straight line. The asymmetry in distance should be noted, that is, traveling the same distance from i to j may be quite different from traveling in the opposite direction both in terms of time and cost. The cognitive distance is how people conceive the spatial separation of objects. It is relevant to geographical study because of its relationship to behavior in space. The general method in empirical enquiries to cognitive distance has been “to solicit from a sample of respondents some estimates of the spatial separation of pairs of places.”¹² Measuring cognitive distance is difficult due to the variations in characteristics of the respondents and the variations in characteristics of the spatial environment that influence distance cognition.¹³ The social distance is to compare differences in social position or status. The “location” of individuals with respect to one another may be conceived in terms of attitudes, dominance relations, or relative frequency of shared interests.¹⁴ Distance can also be specified by culture. Brian Berry argues that the role of the cultural distance is important for international interactions.¹⁵ “Culture is the collective programming of the mind that differentiates the motivations and behavior of members of one society from those of other societies.”¹⁶ Cultural differences between nations can be an impeding factor to political interactions. At the civilization level, Samuel P. Huntington¹⁷ argues that after the Cold War the

¹² Ibid, p.63.

¹³ Ibid, p.71.

¹⁴ Ibid, p.73.

¹⁵ Brian Berry (1989), pp. 1-18.

¹⁶ Brian Berry (1989), p. 5.

¹⁷ Samuel P. Huntington (1993).

international conflicts most often occur along the fault line between civilizations. The incorporation of cultural factor to distance concept thus makes separation of nations much clearer. As the manifestations of culture, religion and language can act as surrogate measurements of cultural distances.

2.4 Differentiation of this research from existing literature

Three points needs mentioning. First, the research contributes to the understanding of the variation in the size of the diplomatic missions sent to the United States. Secondly, it reinforces the understanding of the distance decay effect in international relations. Thirdly, it contributes to inter-disciplinary integration of models. Although the gravity model has been frequently used in international trade flow and international migration study, direct application of the gravity model in the study of international relations is rare. The gravity model is capable of capturing the effects of geography in terms of distance between nations over their power interaction. The political impact of any nation will diminish due to the friction of distance. Mearsheimer noticed the effect of distance over national power projection, but he merely equated it to “the stopping power of water.”

3. Hypothesis

Political scientists argue that political interaction among nations is the function of national power, while geographers believe that distance impedes interactions. Here the political interaction is measured by the number of diplomatic personnel one sends to the other. Consequently, the general hypothesis here is that the number of diplomatic

personnel one nation sent to the United States increases with the increase of national power of the nation; while it decreases as the distance (physical, political, and cultural) between them increases. This hypothesis is tested for each year from 1990 to 2000. The purpose is to see how effect of the distance changed over the years.

I operationalize national power and distance to several concrete variables in the next parts of the paper. In general, the sub-hypotheses to test in each year are:

1. The number of diplomatic personnel sent to the United States increases with the increase in national power of the sending nation; specifically, the number of diplomatic personnel increases with the increase in population size, territorial size, military expenditure, military size, and GDP of the sending nation.
2. The number of diplomatic personnel sent to the United States decreases with the increase in the physical distance between the capital of the sending nation and Washington, D.C.
3. Nations that had/have ever been communist (ExCom) sent less number of diplomatic personnel to the United.
4. NATO members sent more diplomatic personnel to the United States than non-members.
5. EU members sent less diplomatic personnel to the United States than non-members.
6. ASEAN members sent less diplomatic personnel to the United States than non-members.
7. APEC members sent more diplomatic personnel to the United States than non-members.

8. Nations that have English as official/dominant language sent more diplomatic personnel to the United States than nations that do not have English as their official/dominant language.

9. Nations with Islam as the dominant religion sent less diplomatic personnel to the United States than other nations.

4. Methodology

This research uses a multiple linear regression. The dependent variable is the number of diplomatic personnel sent to the United States in 1990 to 2000. The independent variables are national power ingredients (as prescribed below by political scientists) of other countries and the distance between their capital and Washington D.C. The dummy variables that measure political and cultural distance as hypothesized above are included in the model.

Also crucial to the research is the measurement of national power. However, power is an elusive concept. Most theorists of international relations have some ways to measure national power. As Mearsheimer admits, there is considerable disagreement about what power is and how to measure it. This section will review what national power is, how national power is measured, and what my approach to measuring national power is. The three influential writers of realist schools, Morgenthau, Waltz, and Mearsheimer, all have their own way of defining powers. However, they have one theme in common, that is, the recognition of national power has been rooted in the hard resources one nation possesses.

Kenneth Waltz defines power in terms of the distribution of capabilities.¹⁸ National power is composed of the “size of population and territory, resource endowment, economic capability, military strength, political stability and competence.”¹⁹ Waltz criticizes Robert Dahl’s definition of power as control. Dahl defines power as “the ability to get people to do what one wants them to do when otherwise they would not do it.”²⁰ For Waltz, “an agent is powerful to the extent that he affects others more than they affect him.”²¹ However, he did not specify clearly how one could measure national power in a precise way.

For Mearsheimer, power is not defined as the outcomes of interactions between states, but “power is based on the particular material capabilities that a state possesses. The balance of power, therefore, is a function of tangible assets—such as armored divisions and nuclear weapons—that each great power controls.”²² He defines power largely in terms of military capability “because offensive realism emphasizes that force is the ultimate ratio of international politics.”²³ Mearsheimer takes population and wealth of a nation as the sinews of military power. He mainly uses wealth to measure national power, because, he argues, wealth incorporates both the demographic and the economic dimensions of power.

For Morgenthau, “Power may comprise anything that establishes and maintain the control of man over man.”²⁴ Morgenthau has a more systematic approach to measure national power. His elements of national power include geography (location and territory

¹⁸ Kenneth Waltz (1979), p.192.

¹⁹ Ibid, p.131

²⁰ Ibid, p.191

²¹ Ibid, p.192

²² John J. Mearsheimer (2001), p.55

²³ Ibid, p.56

²⁴ Hans J. Morgenthau (1973), p.9

size), natural resources (food and raw materials), industrial capacity, military preparedness (technology, leadership, quality and quantity of armed forces), population, national character, national morale, and the quality of diplomacy and government. Morgenthau warns against three “typical errors” in evaluation of national power: “Error consists in not correlating the power of one nation to the power of other nations;” “error consists in not correlating actual power at one time to possible power at some future time;” and “error consists in not correlating one power factor to others of the same nation.”²⁵

Clifford German²⁶ developed a world power index using a complex nonlinear multivariable index that attempted to both identify discrete variables and specify their interrelationships in 1960. The index took the following form: $G = \text{national power} = N*(L + P + I + M)$, where N is nuclear capability, L is land, P is population, I is the industrial base, and M is military size.

Norman Alcock and Alan Newcombe²⁷ in 1970 used a linear index of public perceptions of national power that utilizes multiple variables. Using regression analyses on three variables (per capita GNP, population, and population density), they attempted to rank the relative power scores of countries in the context of popular perceptions of national strength.

David Singer²⁸ devised another linear index of capabilities that focused on real national assets as opposed to the perception of those assets in the Correlate of War project in 1972. He added up population (understood both in terms of total and levels of

²⁵ Ibid, p.160

²⁶ F. Clifford German, 1960, pp.138-44

²⁷ Ashley J. Tellis et al, 2000, p. 29

²⁸ J. David Singer et al, 1972, pp.19-48

urban population), industrial capacity (understood in terms of energy consumption and iron and steel production), and military capabilities (understood in terms of military expenditure and force size) to provide values for a particular country, which were then assessed as a percentage of the global total.

Wayne Ferris²⁹ constructed an index in 1973 that used land area, total population, government revenue, defense expenditures, value of international trade, and the size of the armed forces to produce a historical comparison of international power for many countries.

Ray Cline³⁰ devised the more widely recognized indexes of national power in 1975. Cline's formula is $\text{Power} = (\text{Critical Mass} + \text{Economic Capacity} + \text{Military Capacity}) \times (\text{National Strategy Coefficient} + \text{National Will})$.

Against Morgenthau's warning, many would still only use one variable as the proxy for national power. Others use several variables to measure national power by adding or multiplying them in certain ways. In general, the frequently used variables include population size, military size, military expenditure, GNP/GDP, and territory size.

Generally, political scientists mainly take territorial size, population size, GDP/GNP, military size, military expenditure as the key variables that define national power. Political distance is measured through each nation's membership in international organizations such as ASEAN, NATO, EU, OPEC, and APEC. Cultural distance is measured by official language and dominant religion of each nation.

In this research, I use the major ingredients of national power such as population, territory size, GDP, military size, and military expenditure of a nation to predict the size

²⁹ W. Ferris, 1973.

³⁰ In Ashley J. Tellis et al, 2000, p. 30.

of diplomatic missions sent to the United States. The physical distance between nations is the distance between their capitals—the political centers. Political and cultural distances are operationalized as dummy variables.

5. Data

5.1 Dependent variable

The number of diplomatic personnel sent to the United States was gathered from the Department of State's quarterly publication, *The Diplomatic List*.³¹ The diplomatic personnel are counted by their positions in their foreign mission, and their spouse is not counted as diplomatic personnel. The number of diplomatic personnel listed in the last quarter of the year or the last holding for that year as available in the UC libraries is selected as the measure for all years. The number of diplomatic personnel is assigned zero for nations that have no diplomatic relations with the United States in the individual year.

The number of foreign missions received by the United States was growing from 1990 until 1997, since then it was stabilized around 170. This is resulted from the disintegration of Soviet Union and other Eastern European nations.

³¹ More recent publication is online at <http://www.state.gov/s/cpr/rls/dpl/>.

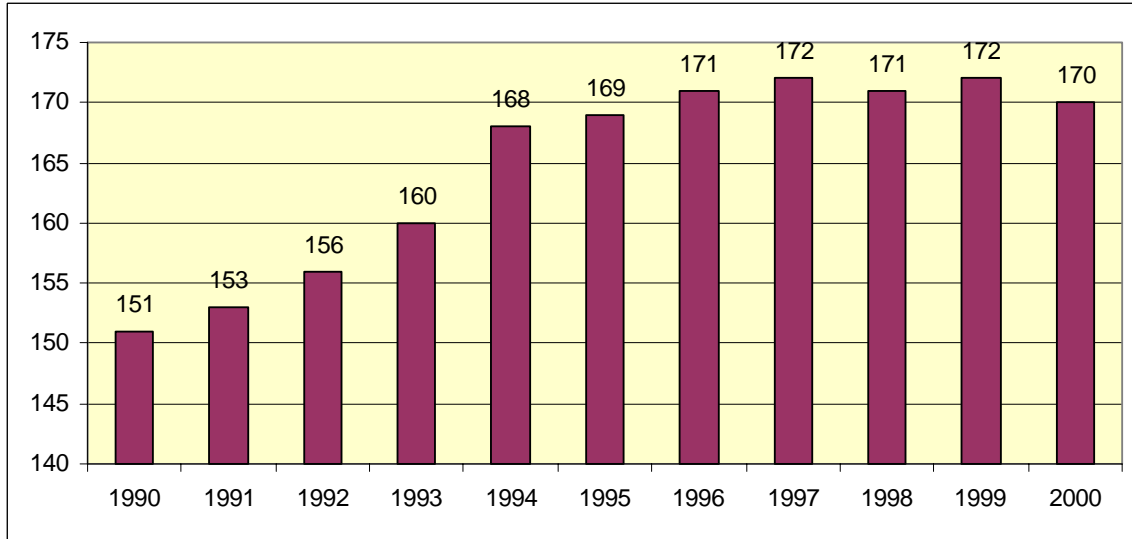


Table 1: The number of countries that have diplomatic relations with the United States, 1990-2000

Chart 1: The size of diplomatic missions

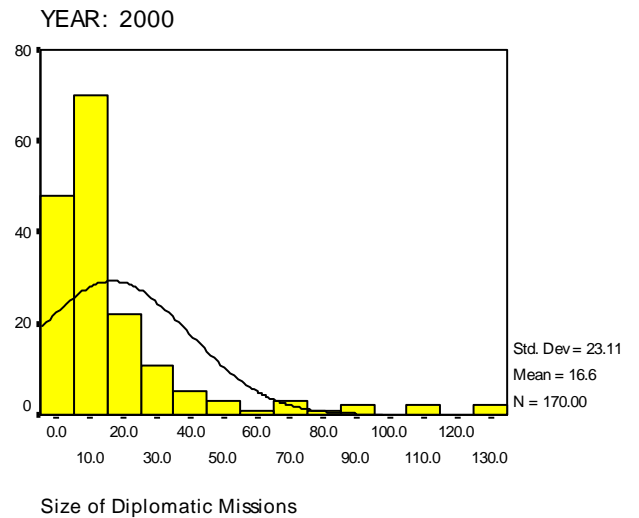
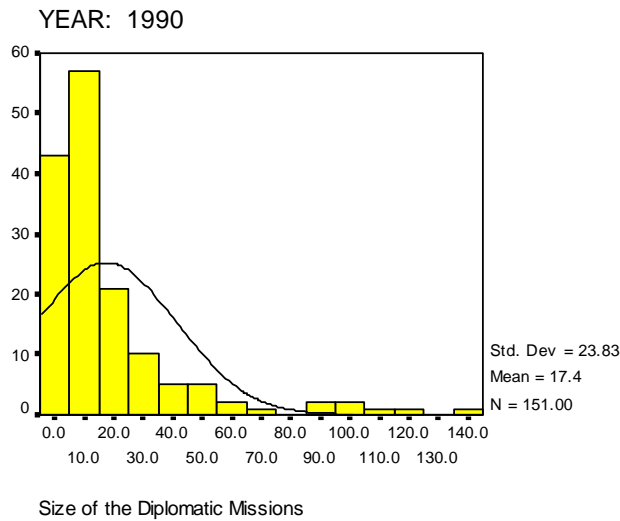
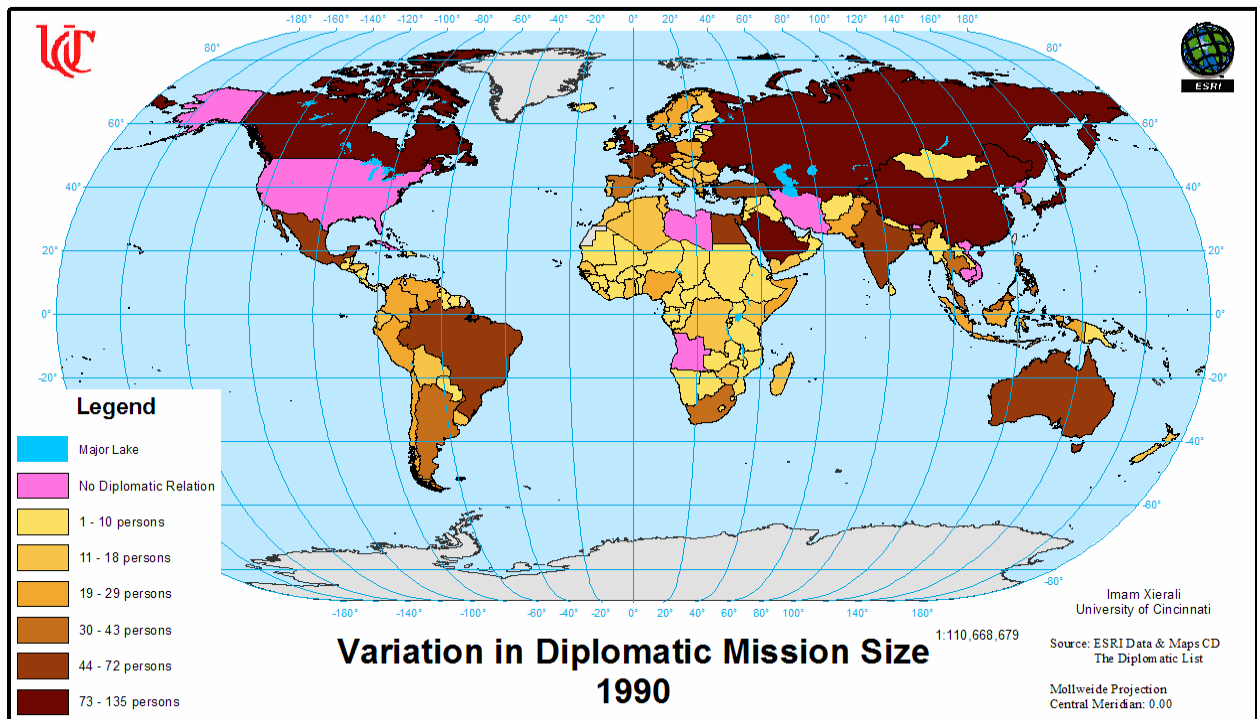


Table 2: Descriptive statistics of the Diplomatic List, 1990 – 2000 (EU excluded)

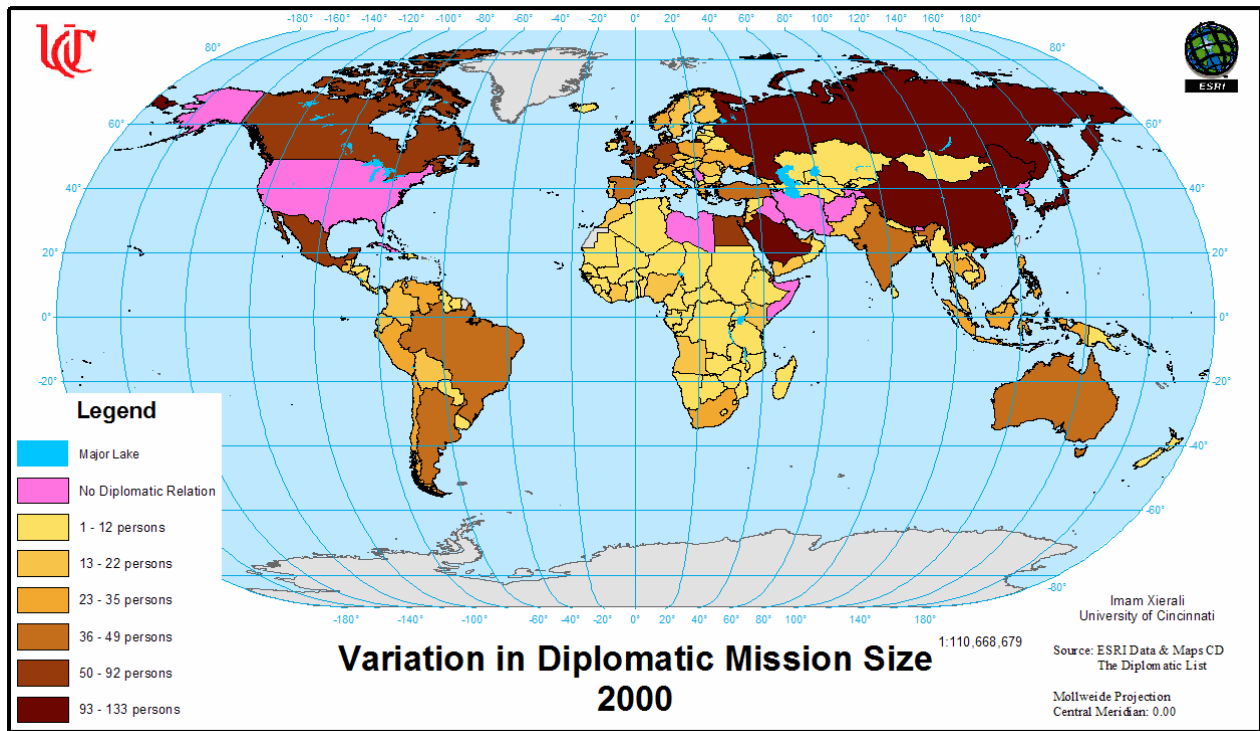
	<i>Year</i>	<i>Number of Missions</i>	<i>Size Range</i>	<i>Min</i>	<i>Max</i>	<i>Sum</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Skewness</i>	<i>Std. Error</i>
Diplomats Missions	1990	151	134	1	135	2633	17.44	23.83	2.709	0.197
Diplomats Missions	1991	153	136	1	137	2607	17.04	23.439	2.688	0.196
Diplomats Missions	1992	156	119	1	120	2587	16.58	22.869	2.592	0.194
Diplomats Missions	1993	160	120	1	121	2580	16.13	21.774	2.672	0.192
Diplomats Missions	1994	168	114	1	115	2689	16.01	21.994	2.684	0.187
Diplomats Missions	1995	169	111	1	112	2696	15.95	21.448	2.755	0.187
Diplomats Missions	1996	171	112	1	113	2674	15.64	21.04	2.752	0.186
Diplomats Missions	1997	172	116	1	117	2725	15.84	21.34	2.809	0.185
Diplomats Missions	1998	171	128	1	129	2753	16.1	22.037	2.95	0.186
Diplomats Missions	1999	172	129	1	130	2774	16.13	22.226	3.004	0.185
Diplomats Missions	2000	170	132	1	133	2828	16.64	23.112	3.075	0.186

The descriptive statistics of the missions received during the time period shows that the mission sizes are highly skewed, that is, there are a few nations that have large diplomatic mission while the majority missions only have small sizes. This is more striking when we look at the mean sizes (around 16 +/- 1) and maximum sizes of the missions.

Map 1: Variation in diplomatic missions sent to the United States, 1990



Map 2: Variation in diplomatic missions sent to the United States, 2000



5.2 Independent variables

The attributes of nations such as language and religion are gathered from the World Factbook. Population, territorial size, GDP, military expenditure, and military personnel data for 1990 to 2000 are gathered from World Bank's *The World Development Indicators*³². Missing data is filled from *The Military Balance*. Similar data are also available through "World Military Expenditures and Arms Transfers" (WMEAT) report by the US Department of State's Bureau of Verification and Compliance³³. There are some discrepancies between data from these different sources. Most obvious is the

³² The World Development Indicators is an online data base by World Bank.

³³ The "World Military Expenditures and Arms Transfers" (WMEAT), <http://www.state.gov/t/vc/rls/rpt/wmeat/>, April 18, 2004.

military expenditure. Population and territorial size also differ slightly. However, similar measurements from different sources highly correlate.

The latitude and longitude of capital cities are gathered from the GEOnet Names Server (GNS).³⁴ Then I use these data to calculate the great circle distance between two points on earth by spherical trigonometry.³⁵ This method assumes that 1 minute of arc is 1 nautical mile; 1 nautical mile is 1.852 km. Therefore, the great circle distance is:

$$\text{Distance} = 1.852 * 60 * \{ \text{ACOS} [\text{SIN} (\text{Lat1}) * \text{SIN} (\text{Lat2}) + \text{COS} (\text{Lat1}) * \text{COS} (\text{Lat2}) * \text{COS} (\text{Long2} - \text{Long1})] / \pi \} * 180 \text{ kilometers.}$$

Some dummy variables are developed to serve as proxies for cultural and political distance. These include (Ex-) Communist, NATO, ASEAN, European Union, APEC, OPEC, English³⁶, and religions³⁷. Nations that converted from communism to other regime forms and those still in communist political system are coded as 1, else 0. Nations with NATO formal membership in the year get 1 for NATO variable, else 0. Nations with EU formal membership get 1 for EU variable, else 0 in a specific year. The same rule applies for variable ASEAN, APEC and OPEC. If English language was the official language in that year, then English is assigned 1, else 0. If at least 50% of the population believes in one of the major religions, then this religion is assigned 1, else 0.

³⁴ The GEOnet Names Server (GNS) provides access to the National Geospatial-Intelligence Agency's (NGA) and the U.S. Board on Geographic Names' (US BGN) database of foreign geographic feature names. The database is the official repository of foreign place-name decisions approved by the US BGN, and is available online for the public at <http://gnswww.nga.mil/geonames/GNS/index.jsp>, April 26, 2004. When there are multiple locations found under one name, only the data for the one that is the capital of political entity (PPLC) used.

³⁵ *Calculating distance between two points*, Geoscience Australia, Australia Government, online at <http://www.ga.gov.au/nmd/geodesy/datums/distance.jsp>, May 1, 2004.

³⁶ Data from CIA World Factbook.

³⁷ Ibid.

6. Analysis

		Correlations						
		GDP current	Military Expenditure	Population	Military Size	Land (sqkm)	Distance	Diplomats
GDP current	Pearson Correlation	1	.831 **	.228 **	.257 **	.164 **	-.025	.645 **
	Sig. (2-tailed)	.	.000	.000	.000	.000	.291	.000
	N	1745	1389	1745	1574	1742	1745	1745
Military Expenditure	Pearson Correlation	.831 **	1	.275 **	.432 **	.276 **	-.088 **	.766 **
	Sig. (2-tailed)	.000	.	.000	.000	.000	.001	.000
	N	1389	1389	1389	1369	1389	1389	1389
Population	Pearson Correlation	.228 **	.275 **	1	.843 **	.442 **	.121 **	.482 **
	Sig. (2-tailed)	.000	.000	.	.000	.000	.000	.000
	N	1745	1389	1788	1606	1784	1788	1788
Military Size	Pearson Correlation	.257 **	.432 **	.843 **	1	.585 **	.099 **	.643 **
	Sig. (2-tailed)	.000	.000	.000	.	.000	.000	.000
	N	1574	1369	1606	1606	1606	1606	1606
Land (sqkm)	Pearson Correlation	.164 **	.276 **	.442 **	.585 **	1	.020	.615 **
	Sig. (2-tailed)	.000	.000	.000	.000	.	.403	.000
	N	1742	1389	1784	1606	1809	1809	1809
Distance	Pearson Correlation	-.025	-.088 **	.121 **	.099 **	.020	1	-.021
	Sig. (2-tailed)	.291	.001	.000	.000	.403	.	.373
	N	1745	1389	1788	1606	1809	1813	1813
Diplomats	Pearson Correlation	.645 **	.766 **	.482 **	.643 **	.615 **	-.021	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.373	.
	N	1745	1389	1788	1606	1809	1813	1813

** . Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlations for all observations in all years, 1990-2000.

The diplomatic personnel sent to the United States positively and significantly correlate with all independent variables except for physical distance. The correlation is especially high with military expenditure, GDP, military size, and territorial size. Although the distance does not significantly correlate with the dependent variable, the sign is negative, suggesting the impeding role of distance in determining the size of diplomatic mission. Among the independent variables, population and military personnel have high Pearson Correlation at .843; military expenditure and GDP also highly correlate at .831.

From simple Gravity model I designed the regression equation as the following:

$$\text{LN(Diplomat)} = \alpha + \beta_1 * \text{LN(Area)} + \beta_2 * \text{LN(Pop)} + \beta_3 * \text{LN(GDP)} + \beta_4 * \text{LN(MilSiz)} + \beta_5 * \text{LN(MilExp)} + \beta_6 * \text{LN(Dist)} + \beta_7 * \text{(ExCom)} + \beta_8 * \text{(NATO)} + \beta_9 * \text{(ASEAN)} + \beta_{10} * \text{(EU)} + \beta_{11} * \text{(APEC)} + \beta_{12} * \text{(OPEC)} + \beta_{13} * \text{(Islam)} + \beta_{14} * \text{(English)}.$$

The untransformed model did not work because of its failure in normality test—one the basic assumptions of linear regression model. Log transformation results in better linearity between dependent and independent variables. Besides, the transformation of the gravity model into linear one is widely adopted in trade flow studies. Since the untransformed regression does not meet the linearity assumption of general linear regression model, the results may be subject to misinterpretation of the relationship among the variables. Thus, a log-transformed model is used.

Initial round of regression shows that collinearity problem exists in the model. Military expenditure and GDP can not co-exist in the model for it to meet the regression assumption. Therefore, military expenditure is dropped from the regression model. Relevant checks of regression assumptions show that the new model meets the basic assumptions. The new model is shown in the following equation:

$$\text{LN(Diplomat)} = \alpha + \beta_1 * \text{LN(Area)} + \beta_2 * \text{LN(Pop)} + \beta_3 * \text{LN(GDP)} + \beta_4 * \text{LN(MilSiz)} + \beta_5 * \text{LN(Dist)} + \beta_6 * \text{(ExCom)} + \beta_7 * \text{(NATO)} + \beta_8 * \text{(ASEAN)} + \beta_9 * \text{(EU)} + \beta_{10} * \text{(APEC)} + \beta_{11} * \text{(OPEC)} + \beta_{12} * \text{(English)} + \beta_{13} * \text{(Islam)} .$$

This model is used for each year to predict the sizes of the diplomatic missions received by the United States over the years.

Model Summary^h

YEAR	Model ^a	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
						R Square Change	F Change	df1	df2	Sig. F Change	
1990	1	.898	.807	.784	.50054	.807	36.271	13	113	.000	1.565
1991	1	.912	.831	.811	.44923	.831	41.708	13	110	.000	1.814
1992	1	.890	.792	.770	.53015	.792	34.649	13	118	.000	1.702
1993	1	.919	.844	.828	.42490	.844	52.105	13	125	.000	2.029
1994	1	.922	.851	.836	.44348	.851	56.617	13	129	.000	1.908
1995	1	.911	.829	.812	.44288	.829	49.299	13	132	.000	1.837
1996	1	.910	.828	.812	.43203	.828	49.405	13	133	.000	1.913
1997	1	.920	.847	.832	.40245	.847	56.519	13	133	.000	1.786
1998	1	.905	.820	.802	.44551	.820	46.813	13	134	.000	1.719
1999	1	.907	.823	.806	.43390	.823	48.066	13	134	.000	1.347
2000	1	.914	.836	.820	.42130	.836	52.016	13	133	.000	1.585

^a. Predictors: (Constant), Islam, APEC Member, LN(Territory), NATO Member, English Language Official, OPEC, Ex_Com Status, LN(Distance), ASEAN Member, LN(GDP), EU Member, LN(Population), LN(Military Size). All requested variables are entered.

^h. Dependent Variable: LN(Diplomats)

Table 4: Regression model summary.

Regression model summary shows that the model is a robust one: R squares are between .792 and .844. This means that at least 79.2% of variation in the size of the diplomatic missions received by the United States in a year can be explained by the model. The model fits differently for different years: smaller R squares are observed for 1990 and 1992; larger R squares for 1993, 1994, and 1997.

Year	Constant	Ln(GDP)	LN(Territory)	LN(Military Size)	LN(Population)	LN(Distance)
1990	-0.944	0.273	0.030	0.119	0.087	-0.252
1991	-0.382	0.280	0.057	0.170	-0.020	-0.232
1992	-0.229	0.304	0.077	0.140	-0.026	-0.258
1993	-1.212	0.318	0.082	0.153	-0.046	-0.142
1994	-1.543	0.377	0.068	0.148	-0.054	-0.137
1995	-1.813	0.367	0.078	0.104	-0.035	-0.083
1996	-1.410	0.348	0.075	0.111	-0.038	-0.111
1997	-1.269	0.336	0.081	0.139	-0.059	-0.119
1998	-1.164	0.365	0.078	0.145	-0.098	-0.101
1999	-1.651	0.338	0.063	0.130	-0.023	-0.107
2000	-1.713	0.340	0.048	0.057	0.055	-0.132

Table 5: Regressions Coefficients. Significance: $p < 0.05$; $p < 0.10$.

Year	ExCom	NATO	ASEAN	EU	APEC	OPEC	English	Islam
1990	-0.061	0.186	-0.055	-0.335	0.351	0.060	0.078	0.048
1991	0.031	0.128	-0.030	-0.235	0.345	0.233	0.150	0.018
1992	-0.489	0.116	-0.087	-0.240	0.403	0.248	0.167	-0.033
1993	-0.342	0.055	-0.042	-0.242	0.263	0.142	0.109	-0.042
1994	-0.221	0.077	-0.039	-0.408	0.111	0.241	0.117	0.016
1995	-0.135	0.115	-0.160	-0.535	0.104	0.171	-0.007	-0.093
1996	-0.138	0.149	-0.131	-0.415	0.165	0.137	0.037	-0.083
1997	-0.064	0.204	-0.017	-0.427	0.166	0.087	0.020	-0.072
1998	-0.012	0.251	0.212	-0.533	0.098	0.177	0.108	-0.075
1999	0.029	0.113	-0.035	-0.413	0.100	0.173	0.074	-0.114
2000	-0.016	0.108	0.002	-0.394	0.093	0.198	-0.006	-0.128

Table 6: Regressions Coefficients. Significance: $p < 0.05$; $p < 0.10$.

The coefficients of the regressions shows that the size of GDP of the sending nation has always been positive and significant in determining the size of their diplomatic missions sent to the United States. Territory and military sizes of the nations have always been positive factors though not always significant factors in determining the size of the diplomatic missions. Population size has been negative and insignificant for most of the year in determining the mission sizes, contrary to the hypothesis about population. The physical distance has always been a negative factor, and it was significant in 1990 to 1992; however, since 1993 the effect of distance as an impediment has been insignificant. Among the dummies, EU membership has been always a negative factor in determining the mission sizes; it became a significant factor since 1995. The signs of NATO, APEC, and OPEC have always been positive, although the coefficients never been significant factor. ExCom, ASEAN, and Islam most of the time have been negative factors, while English language status most of the time has been positive but insignificant factor. In conclusion, GPD size is the key factor for the size of the diplomatic missions; physical distance, though always a negative factor, became insignificant in determining the

mission size since 1993. The change in coefficients of other variables indicates that the effect of these national attributes on the size of the diplomatic missions sent to the United States is not fixed.

Table 7: Cases whose residuals are outside 1.96 std deviations.

YEAR	Place	Std. Residual	LN(Diplomats)	Predicted Value	Residual	Diplomats	Predicted
1990	Iraq	-2.4544	2.0794	3.2999	-1.2205	8	27.1
	Saudi Arabia	2.7147	4.6347	3.2848	1.3499	103	26.7
	Somalia	2.7175	2.9957	1.6444	1.3514	20	5.2
	Liberia	2.9105	2.6391	1.1917	1.4473	14	3.3
	Namibia	-3.0705	0.0000	1.5269	-1.5269	1	4.6
1991	Chad	-2.0024	1.0986	1.9986	-0.9000	3	7.4
	Egypt, Arab Rep.	2.2029	4.1431	3.1530	0.9901	63	23.4
	Mali	-2.6427	0.6931	1.8810	-1.1879	2	6.6
	Saudi Arabia	2.5378	4.5850	3.4443	1.1407	98	31.3
	Liberia	3.3897	2.6391	1.1154	1.5236	14	3.1
	Uganda	-2.1727	1.0986	2.0752	-0.9766	3	8.0
1992	Belarus	-3.9343	0.0000	2.0832	-2.0832	1	8.0
	Saudi Arabia	2.1981	4.5747	3.4108	1.1639	97	30.3
	Ukraine	-3.1304	1.0986	2.7561	-1.6575	3	15.7
	Liberia	2.3929	2.0794	0.8124	1.2670	8	2.3
1993	Belarus	-2.8340	1.0986	2.2969	-1.1983	3	9.9
	Cape Verde	2.4715	1.6094	0.5644	1.0450	5	1.8
	Honduras	2.0418	2.8332	1.9699	0.8633	17	7.2
	Lithuania	-2.1923	0.6931	1.6201	-0.9270	2	5.1
	Saudi Arabia	2.4525	4.5326	3.4956	1.0370	93	33.0

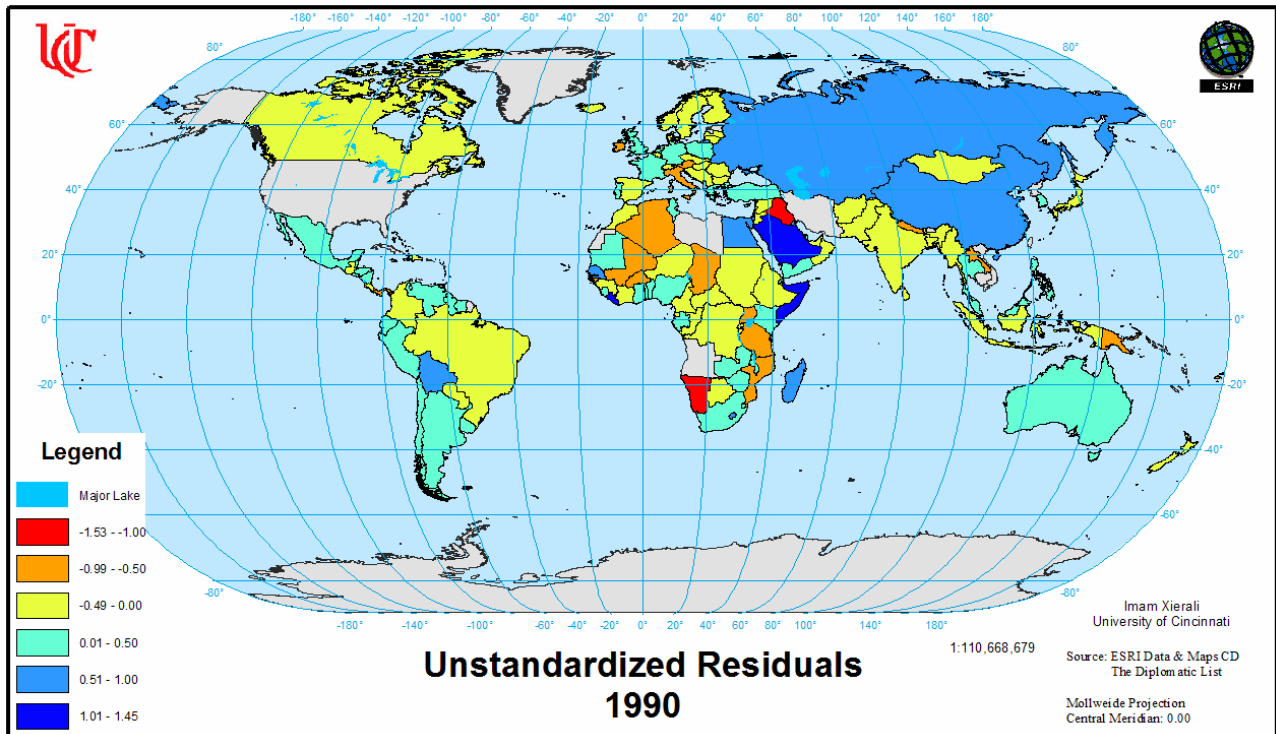
Table 8: Cases whose residuals are outside 1.96 std deviations.

YEAR	Place	Std. Residual	LN(Diplomats)	Predicted Value	Residual	Diplomats	Predicted
1994	Burundi	-2.2958	0.0000	1.0182	-1.0182	1	2.8
	Congo, Rep.	-3.2728	0.0000	1.4515	-1.4515	1	4.3
	Honduras	2.3809	2.8904	1.8344	1.0559	18	6.3
	Saudi Arabia	2.2010	4.5951	3.6189	0.9762	99	37.3
	Uzbekistan	-2.0779	1.0986	2.0202	-0.9216	3	7.5
	Tanzania	-2.1547	1.0986	2.0542	-0.9556	3	7.8
1995	Congo, Rep.	-3.7449	0.0000	1.6533	-1.6533	1	5.2
	Georgia	2.0870	2.3026	1.3812	0.9214	10	4.0
	Saudi Arabia	2.2941	4.5643	3.5516	1.0128	96	34.9
	Turkmenistan	-2.0430	0.6931	1.5951	-0.9019	2	4.9
1996	Cambodia	2.0224	2.5649	1.6941	0.8709	13	5.4
	Cape Verde	2.1831	1.6094	0.6694	0.9401	5	2.0
	Georgia	2.1172	2.3026	1.3909	0.9117	10	4.0
	Macedonia, FYR	-2.1852	0.6931	1.6341	-0.9410	2	5.1
	Saudi Arabia	2.4915	4.5539	3.4810	1.0729	95	32.5
	Fiji	-3.1866	0.0000	1.3722	-1.3722	1	3.9

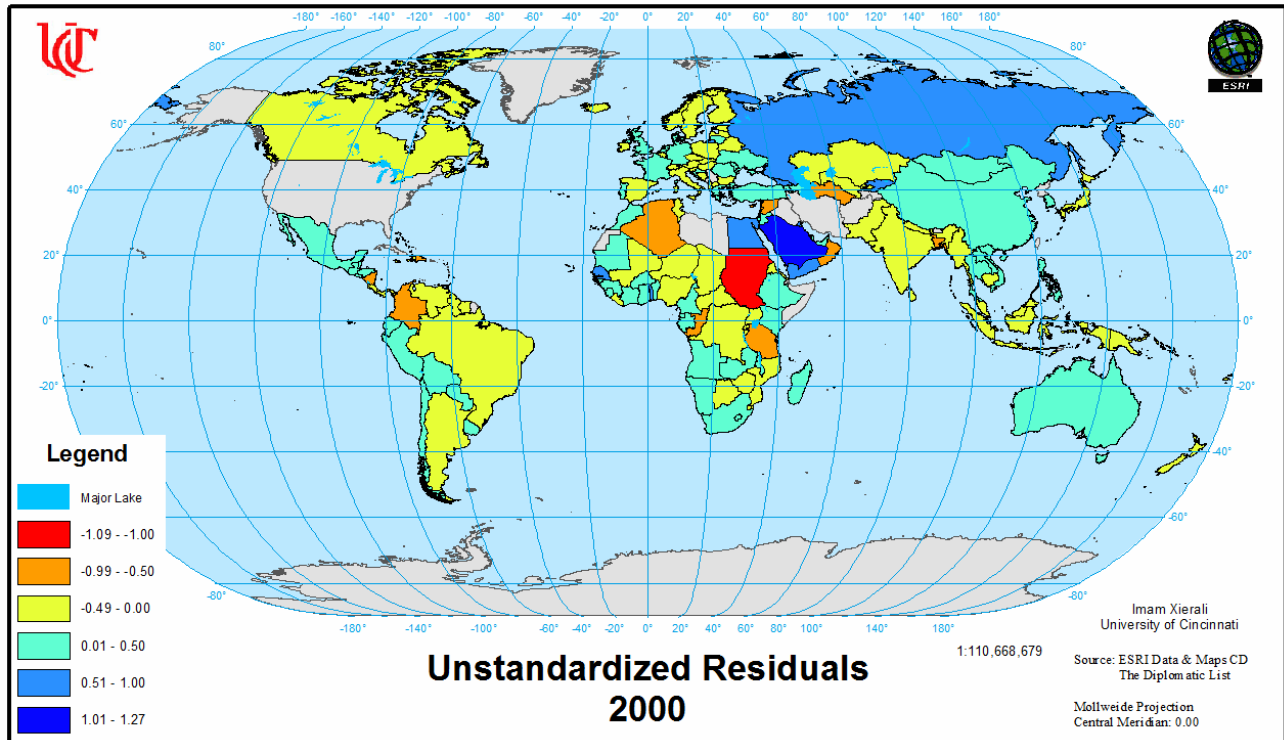
Table 9: Cases whose residuals are outside 1.96 std deviations.

YEAR	Place	Std. Residual	LN(Diplomats)	Predicted Value	Residual	Diplomats	Predicted
1997	Dominican Republic	-2.5395	1.3863	2.4065	-1.0202	4	11.1
	Lebanon	-2.0208	1.3863	2.1981	-0.8118	4	9.0
	Saudi Arabia	2.5041	4.5218	3.5158	1.0060	92	33.6
	Sudan	-2.1513	1.6094	2.4737	-0.8643	5	11.9
	Turkmenistan	-2.4052	0.6931	1.6594	-0.9663	2	5.3
	Rwanda	-2.0462	0.6931	1.5152	-0.8220	2	4.6
1998	Burundi	-2.4926	0.0000	1.1121	-1.1121	1	3.0
	Congo, Dem. Rep.	-4.6320	0.0000	2.0667	-2.0667	1	7.9
	Saudi Arabia	2.3850	4.5747	3.5106	1.0642	97	33.5
	Turkmenistan	-2.0782	0.6931	1.6204	-0.9272	2	5.1
1999	Congo, Dem. Rep.	-3.2974	0.6931	2.1203	-1.4272	2	8.3
	Congo, Rep.	-2.1345	0.6931	1.6170	-0.9238	2	5.0
	Saudi Arabia	2.7041	4.6347	3.4643	1.1704	103	32.0
	Turkmenistan	-2.1852	0.6931	1.6389	-0.9458	2	5.1
	Malta	-2.9894	0.0000	1.2939	-1.2939	1	3.6
2000	Egypt, Arab Rep.	2.0622	4.1744	3.3068	0.8676	65	27.3
	Nicaragua	-2.0879	1.0986	1.9770	-0.8784	3	7.2
	Russian Federation	2.1339	4.8903	3.9926	0.8978	133	54.2
	Saudi Arabia	3.0180	4.7274	3.4577	1.2697	113	31.7
	Sudan	-2.5817	1.3863	2.4724	-1.0861	4	11.9
	Togo	2.2651	2.3026	1.3496	0.9530	10	3.9
	Turkmenistan	-2.3009	0.6931	1.6611	-0.9680	2	5.3
	Barbados	2.0147	2.0794	1.2318	0.8476	8	3.4

Map 3: Regression residuals, 1990



Map 4: Regression residuals, 2000



The table 7 to 9 list countries whose residuals are over/under-predicted beyond 1.96 std deviations by the regression model. Saudi Arabia is consistently under-predicted over the decade. The residual maps show no big difference between 1990 and 2000. Sub-Sahara Africa, European between Western Europe and Russia (Soviet Union 1990), South Asia, Malaysia, Indonesia, and Japan sent smaller missions than the model would predict.

7. Conclusion

It can be concluded that certain national power ingredients are more important than others. The analysis shows that the role of different predictors varies over the years. In general, the size of foreign diplomatic missions sent to the United States is significantly and positively conditioned by GDP of nations. Among all the factors

considered, GDP size of nations is the single most important predictor, and the larger the GDP size of the nation, the larger the mission they sent. Military expenditure highly correlates with GDP. Countries with large GDP spend huge on military. Population size did not significantly affect the mission size. The larger nations in terms of the territorial size tend to send bigger missions. Physical distance has been no longer a significant factor affecting the size of foreign diplomatic missions sent to the United States since 1993. Nonetheless, the distance is a resistant to interaction. The distance concept is deceptively simple as we have discussed earlier. Spherical Distance may not reflect the actual resistance to interaction simply because the airways do not always follow the arc of the big circle that crosses the two capitals. Also, the same distance may look different for different nations due to physical and social factors. It must be acknowledged that this distance measure is rather crude surrogate for locational properties that influence interactions. Except for EU membership, the effects of the membership in international organization, English language status, religion, and whether communism ever prevailed did or not are insignificant. EU members tend to send smaller missions than non-members.

In this paper, I have reviewed the application of the gravity model in social sciences and applied it to predict the size of foreign diplomatic missions sent to the United States. However, I did not deal with problems like how having nuclear weapons has changed the interaction and how soft powers may influence the interaction. After all, the study does reveal some insight into the roles of the national power and the distance in political interactions among nations, and it could serve as a reference for international studies.

Further research is still necessary. First of all, more complex analysis techniques could be employed. Principle Component Analysis (PCA) is one candidate. The attributes of nations, no matter how many they are, could be molded into several factors by PCA technique that best explain the diplomatic interactions among nations. Secondly, it would be better if we study not just one nation's interaction with the rest of the world, but the interaction between each pair of nations. Thirdly, a better measurement of relative distance between nations could have important implication. The cultural and political distance measurements employed in this model can be improved. Finally, interviewing personnel at the foreign embassies in Washington D.C. can also tell us more about what factors affect the size of the missions.

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