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GEOG 596 B

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Using GIS in International Relations

For my capstone project, I used geospatial analysis to assess the diplomatic relations between Russia and 46 other countries chosen for their proximity and historical relationship with Russia. These countries were: Albania, Afghanistan, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Cambodia, China, Croatia, Cuba, Czechia, Estonia, Finland, Georgia, Germany, Hungary, Iran, Japan, Kazakhstan, Kosovo, Kyrgyzstan, Laos PDR, Latvia, Lithuania, Moldova, Mongolia, Montenegro, North Korea, North Macedonia, Norway, Poland, Romania, Serbia, Slovakia, Slovenia, South Korea, Sweden, Syria, Tajikistan, Turkey, Turkmenistan, Ukraine, United States, Uzbekistan, and Vietnam.

One of the reasons I chose Russia is because of the current war on Ukraine as well as its somewhat recent annexation of Crimea in 2014. Another reason I chose Russia is because of its vast expanse of land and the ample number of countries surrounding its landscape which all in turn have been a part of Russia's extensive history of invading and being invaded. Robert D. Kaplan in his book, "The Revenge of Geography" goes into detail about the history of Russia's invasions and being invaded. Kaplan argues a large contributing factor to Russia's extensive history of invasion is its geography and the country's lack of natural borders, its flat expanse, the history of its people, and its cold and unforgiving climate (155). It can also not go without mentioning Russia's history with creating the Soviet Union and the influence this had on its neighboring countries. All these different but equally important factors make examining Russia and its diplomatic relations with its bordering countries an important study.

Studying the diplomatic relations between Russia and its surrounding countries can indicate the relationship between the two countries and whether they have many ties to each other, indicating a good working relationship, or a lack of ties, indicating a negative relationship. The type of relationship may be an indicator of the likelihood of invasion or war between the two countries. My study will compare the relationship between Russia and the surrounding countries using several variables such as trade, income inequality, political memberships, ethnicity, and economics.

I created a ranking system for the diplomatic relations between Russia and the surrounding countries. To do this, I took the overall trade of both imports and exports between Russia and the surrounding countries, whether the surrounding countries are in the North Atlantic Treaty Organization (NATO), the Collective Security Treaty Organization (CSTO), or neither, and lastly, whether the countries were a part of the Soviet Union, under the influence of the Iron Curtain or neither.

I then examined the income inequality, ethnicities, and economics using statistical analysis and compared these with the diplomatic relations ranking structure between each surrounding country to Russia.

Starr has done extensive analysis of GIS and International Studies, especially when analyzing the quality of borders (2013). He breaks down his comparisons by opportunity—the possibilities, or constraints that decision-makers face, and willingness—the choices decision-makers will make considering opportunity. Ultimately his study stresses the importance of looking at a multitude of variables to gain a well-rounded

picture that will give the best insight into the opportunity and willingness of a country's relation to another. In a study of his done in 2002, Starr reconceptualized using GIS by analyzing a border's length, area, and whether a border is a homeland border or generated by colonial territory, terrain, and territorial disputes all while connecting his findings back to opportunity and willingness. My study aims to build upon this idea of border analysis through its various characteristics. Ultimately, instead of analyzing the border through willingness and opportunity, I hope to gauge the countries' characteristics and compare them to their respective country's diplomatic relations.

Diplomatic Ranking

I have chosen to create a diplomatic ranking score based on my own variables and scoring so that I can include the variables I find most relevant to assessing a country's relationship with its surrounding countries. My goal for this study was to be able to replicate the study in other regions of the world to assess the diplomatic relations with surrounding countries and whether there can be any conclusions drawn from the characteristics of the countries. The variables I have included in this study are specific to this region but could also be altered so that a ranking score could be used in any other region of the world. The variable of whether the countries are currently in NATO or CSTO is specific to this region and would not be usable in another region. However, the idea should hold that the point system I will create can be replicated.

To create the diplomatic ranking score, I used the variables of export shares, import shares, CSTO, and the Soviet Union. To create the score, I created a weighted average and assigned a respective weight to each variable to equate to 100. Presuming that not all variables would hold the same importance to the diplomatic relations of a country. For whether a country is a part of the CSTO or not, I assigned the weight of 60 out of 100 as this variable likely has the most influence over the diplomatic relations of a country. Subsequently, I assigned a 10 out of 100 to whether a country was a part of the Soviet Union or not as, although holding a strong influence over diplomatic relations in the past, is no longer as influential and therefore, was given a lower score. For the import and export trade data, I gave both a 15 for a total of 30 out of 100. Trade has a larger influence on diplomatic relations, assuming more trade with a country would equate to better relations. A note here is the trade data used was gathered pre-Ukraine and Russia war before the heavy sanctions were put on Russia by many countries used in this study.

DATA

Ethnicities

Ethnicity data for various countries is difficult to capture from one homogenous source. Each country conducts its own census and how the data is collected, what data is gathered, and how the data is disseminated differs. Some countries like Cuba and the United States have very broad categories for ethnicities such as Asian, Black, or White. Other countries like Germany, do not collect ethnicity data for their census at all, (Stillwell, 2022). Because of this, I needed to gather my ethnicity data from a few sources to collect the necessary data for all countries. Below are the four sources I used to collect ethnicity data from the 46 countries.

Statista (Puri-Mirza, 2022) – Afghanistan

Undata (2023) – Albania, Armenia, Azerbaijan, Belarus, Bulgaria, China (does not include data for Hong Kong Special, Macao and Taiwan), Croatia, Cuba, Czech Republic, Estonia, Georgia, Hungary, Iran, Islamic Republic, Kazakhstan, Kyrgyz Republic, Lao PDR, Latvia, Lithuania, Mongolia, Montenegro, North Macedonia, Poland, Romania, Serbia (does not include data for Kosovo and Meohia), Slovak Republic, Slovenia, Russia, Tajikistan, Ukraine, United States (Used the Russian language data as a way to get the Russian ethnicity population), Vietnam

World Atlas (Pariona, 2018) – Finland,

World Factbook (Ethnic Groups, n.d.) – Bosnia and Herzegovina, Cambodia, Germany (data represents population by nationalist. Germany does not collect ethnicity information, (Stillwell, 2022)), Japan, Kosovo (estimates may under-represent Serb, Romani, and some other ethnic minorities because they are based on the 2011 Kosovo national census, which excluded northern Kosovo (a largely Serb-inhabited region) and was partially boycotted by Serb and Romani communities in southern Kosovo), Moldova, Norway, Republic of Korea, Democratic Republic of Korea, Sweden, Syrian Arab Republic, Turkey (Russian ethnicities are residence permits), Turkmenistan, Uzbekistan

I assembled the data into an Excel spreadsheet with the country, the ethnic groups present in each country, the date the data was gathered, the percentage of each ethnic group, and in most cases, the count. From there I was able to produce three variables for the project, Russian Ethnicity, Common with Russia, and 0.1% or Higher Common with Russia. The Russian Ethnicity variable refers to any of the 46 countries which stated having Russian ethnicity and the percentage present. The Common with Russia variable refers to any match of ethnicities in the 46 countries compared to the list of ethnicities in Russia and their total percentage. A country with more ethnicities in common with the ethnicities in Russia would have a higher percentage present. Lastly, because there were a lot of ethnicities listed in Russia with some of them being a very small percentage, the 0.1% or Higher Common with Russia variable refers to only the ethnicities which have a presence of higher than 0.1% in Russia, and are also present in one of the other 46 countries.

Trade Data

For trade data, I used data from the World Integrated Trade Solutions (WITS) website which has trade information gathered by the World Bank Organization (Trade Stats, 2022). I downloaded all the relevant trade information in a comma-delimited format for the 13 bordering countries. The data contained many categories such as trade balance, total import/export in USD, and export/import share in total products percentage between the 42 countries and Russia. For my data, I used the export share percentage and import share percentage in total products between the 42 countries and Russia. This would give an idea of how much trade goes on between the countries and Russia within their total trade. For instance, a country with a 70% export trade balance with Russia means that 70% of the country's total exports go to Russia with the other 30% being exported to other countries.

Income Inequality

For income inequality data, I used the Gini coefficient from the World Income Inequality Database (WIID, 2022). The Gini coefficient is a percentage representation of the wealth inequality in a country. When the percentage is close to 0, it means the distribution of wealth in the country's population is

equal. When the percentage is close to 100, it means the wealth in the country would belong to one person/household.

Political Relation

For the political relations variable, I confirmed whether the bordering country was part of NATO, the CSTO, or neither. I assigned a weight of 0 for being a part of NATO as this would be an indication that the county has little intention of diplomatic ties with Russia. I assigned a 1 for being a part of neither NATO nor the CSTO as this would indicate more that the country could be neutral. Finally, I assigned 2 for a country being a part of the CSTO as this would be a direct indicator of having diplomatic ties with Russia. To confirm whether a country is a part of NATO, the CSTO, or neither I utilized the NATO website, (NATO, 2020) as well as an assessment of the CSTO by Weitz from the Strategic Studies Institute and U.S. Army War College Press, (2018).

As another political variable, I used whether a country was a part of the Soviet Union, under the influence of the Iron Curtain, or neither. Similar to the CSTO weight scale, I assigned 0 to any country which was part of neither, 1 if the country was under the Iron Curtain, and a 2 if the country was a part of the Soviet Union. Some of the countries like Eastern Germany, Czechoslovakia, and Yugoslavia have since divided or in Eastern Germany's case, united. For this reason, I assigned Germany a 1 as still being under the Iron Curtain as well as Czech Republic and the Slovak Republic (formerly Czechoslovakia) and Bosnia and Herzegovina, Croatia, North Macedonia, Slovenia, Serbia and Montenegro (formerly Yugoslavia). I used an article by PBS to identify which countries were part of the Iron Curtain (1999). To identify which countries were part of the Soviet Union I used an article by HISTORY (2022).

Economic

For economic data, I used the GDP per capita from the World Bank which measures the "economic output of a nation per person," (Countries and Economic, n.d.).

METHODS

After gathering all the data, I wanted to do some exploratory analysis of the data to examine any relationships between variables, the strength of these relationships, and shortcomings in the data gathered.

To start with my analysis of the data I used R-Studio with the packages: car, corrplot, ggplot2, pastecs, psych, and QuantPsyc. I started by exploring the data through descriptive statistics and graphical summaries. In RStudio I ran 'describe' on the dataset to produce the table of statistics seen below in Table 1. This produced a table of the variables: n (number of data points), mean, median, minimum value, maximum value, skewness, and the difference between the mean and the median.

There was the possibility to run correlation analysis and regression analysis on the data using Russian ethnicity as the independent variable to test the relationship between the variables and model that relationship respectively. However, that would require normality in the data and after running a few tests, it was unlikely that I would get the data to normalize without putting it through some

transformations. Ultimately, I did not want to break the reliability of the data by transforming it, but it seemed worth further examination of the data to glean any other insights.

Variable	n	mean	median	min	max	skew	m&m dif
ExShare	45	29.84	22.69	0.02	92.72	0.77	7.15
ImShare	45	25.79	23.09	0.02	85.91	0.9	2.7
Gini Coefficient	46	33.58	33.6	23.23	49.9	0.55	-0.02
CSTO	46	0.8	1	0	2	0.13	-0.2
Soviet Union	47	0.89	1	0	2	0.19	-0.11
Russian Ethnicity	45	0.03	0	0	0.25	2.52	0.03
Common With Russia	43	0.61	0.91	0	1	-0.57	-0.3
.1 % or Higher	44	0.25	0.03	0	1	1.16	0.22
GDP Per Capita	46	17211.3	9482.65	368.8	89154.3	1.84	7728.65

Table 1. A summary of descriptive statistics for the Country Variable dataset

One test is to identify if the mean and median values are similar, which would indicate the data's distribution is considered approximately normal. The last column in Table 2 shows the difference between the mean and median. The Gini, CSTO, Soviet Union, and three Russian Ethnicity variables all show the mean and median being of similar values. Another test to examine normality is to look at the skewness. Examining the skew can show any large departures from normality. Larger positive numbers indicate positive outliers in the data while larger negative numbers indicate negative outliers in the data range. The Export, Import, and GDP all have large skews being above ± 1.0 meaning they have larger departures from normality.

Next, I produced graphical summaries of the data by creating histograms as shown in Figure 1 below. The Gini Coefficient appears the only histogram to have somewhat of a normal distribution while the other histograms all have positive or negative skews to their distribution. For the export and import trade variables, both histograms have more negative skews indicating that Russia has lower levels of import and export trade with a majority of the countries. Belarus and Kazakhstan had the highest trade exports from Russia while Belarus and China have the highest imports to Russia. Similarly, the GDP per Capita has a heavy negative skew indicating that most of the countries have a similar lower GDP compared to a small number of countries that appear to have abnormally high GDP per capita compared to the sample countries selected. Norway, the United States, and Sweden were the highest GDPs while Tajikistan, Afghanistan, and Syria were the lowest.

Including the CSTO membership and Soviet Union variables, helped visualize where most of the surrounding country's memberships in either NATO, CSTO, or the Soviet Union and Iron Curtain. As seen in the CSTO histogram, the majority of the border countries are members of neither organization, as seen by the middle bar while the bar furthest to the right represents CSTO membership and the bar furthest to the left represents NATO membership.

The histogram of the Russian Ethnicity variable shows the majority of the countries did not have the Russian ethnicity in their population. On the other hand, the histogram of the Common Ethnicity variable shows that the majority of countries shared similar ethnicities to the ones present in Russia.

However, when only including the ethnicities present in Russia which have a percentage above .1%, majority of the countries so not share similar ethnicities to Russia.

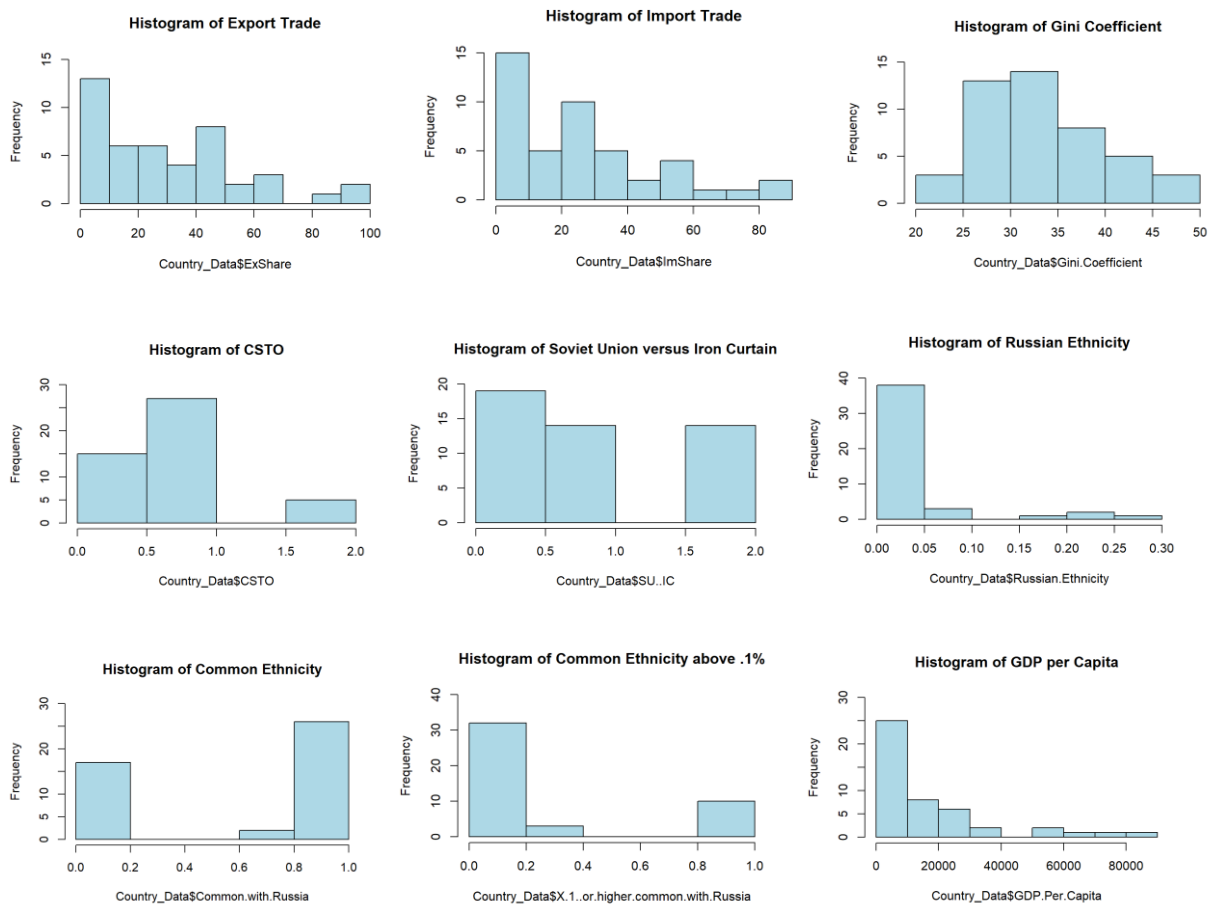


Figure 1. Histogram of Country data variables

Next in exploring the data, I conducted normality tests using the Shapiro-Wilk test since my data had only 46 samples and the Shapiro-Wilk test is best conducted with fewer than 50 samples (STHDA, n.d.). When conducting the normality test, a p-value of less than or equal to 0.05 will fail. Table 2 below shows the Gini Coefficient is the only variable that did not fail the normality test.

Variable	p-value
ExShare	0.003377
ImShare	0.0007357
Gini Coefficient	0.09055
CSTO	3.699E-07
Soviet Union	0.000000589
Russian Ethnicity	3.27E-11
Common With Russia	3.211E-08
.1 % or Higher	1.938E-09
GDP Per Capita	2.374e-07

Table 2. The results of the Shapiro-Wilk normality test on the country variables

Since the data are not normally distributed and they have shown strong indicators of outliers, the next step would be to transform the data. Since my dataset is so small and dependent upon the country, normality was not the goal. The idea was simply to get a better idea of the data and to see if there were any strong correlations between the variables. If the data had been more normally distributed, other statistical tests could have been performed such as regression to further the analysis of any ties between the variables. However, the data was not normally distributed so for my project, I moved forward with more exploratory means of analyzing the data.

I investigated the relationship between the CSTO data and the rest of the data using boxplots.

From the CSTO boxplots, it seemed that the export trade data made sense in that it was reasonable to assume that countries a part of the CSTO would have higher trade with Russia being that they are in a treaty with Russia. Interestingly, however, the import data did not reflect similarly. It seemed that almost the same amount of import trade was being done with countries who are a part of NATO as countries in the CSTO. This could be due to the higher amount of Russian oil which was being imported to many NATO countries prior to the Ukrainian and Russian war.

The majority of the CSTO countries had a lower Gini score which would indicate the wealth distribution is more equal.

When it comes to having the Russian ethnicity listed in the countries' census, there doesn't seem to be an overwhelming positive for the CSTO, NATO, or neither. However, when looking at countries that have ethnicities in common with ethnicities present in Russia, the CSTO countries are all above the average with NATO and neither country has a wider range of countries with common ethnicities or not. Similarly, when the percentage of ethnicities in common with Russia has to be above .1%, the CSTO countries still have the majority with one outlier being less (Kyrgyz Republic) with only 25% and far few NATO and neither country having similar ethnicities to Russia. This data point makes sense as all the CSTO countries were previous Soviet Union countries where more ethnical integration would have occurred. Countries that are not a part of the CSTO but were a part of the Soviet Union would likely have higher percentages of similar ethnicities to Russia as well. Germany for example, being the East Germany was a part of the Soviet Union, has 87% of its ethnicities in common with Russia's at .1% and above.

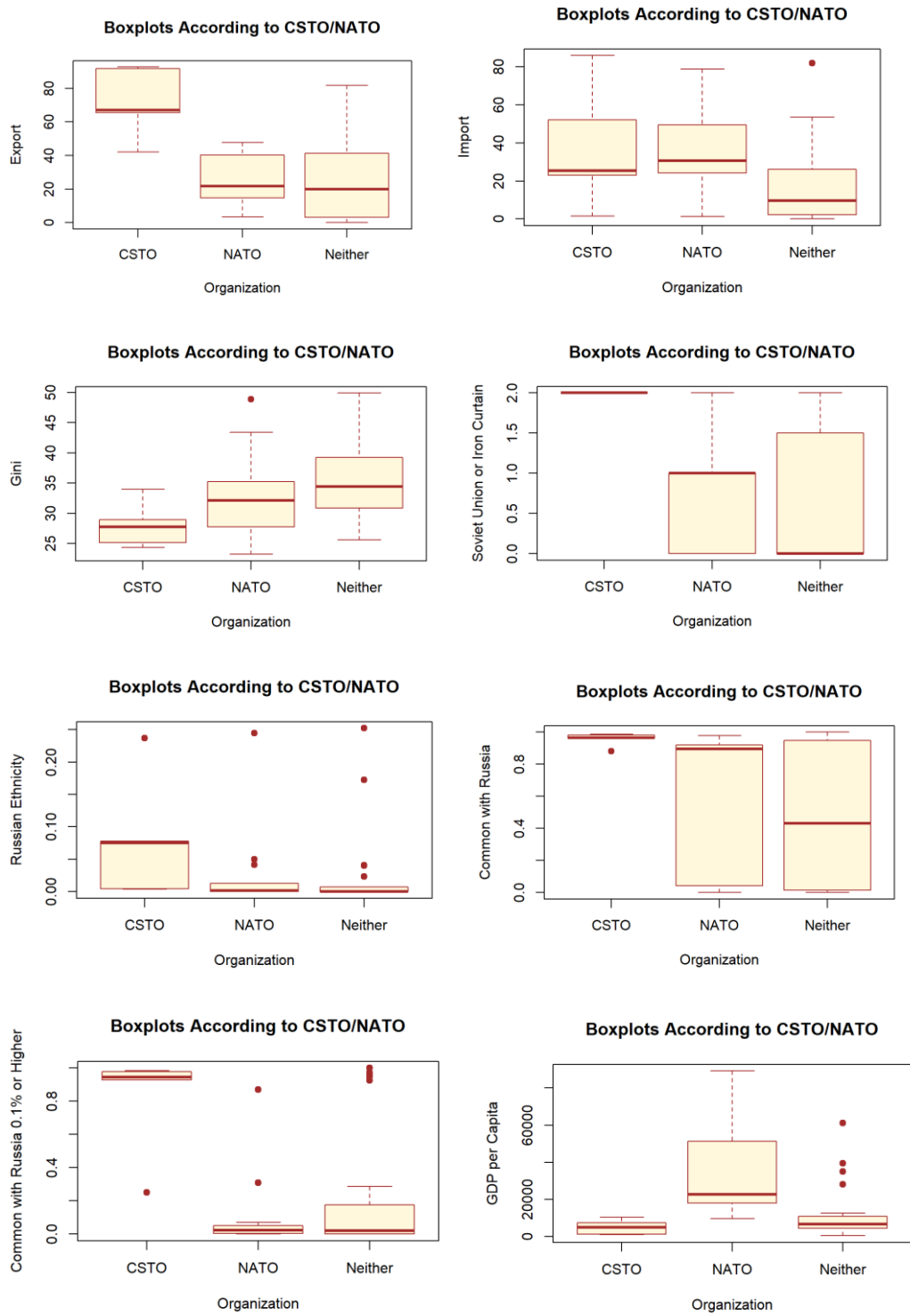


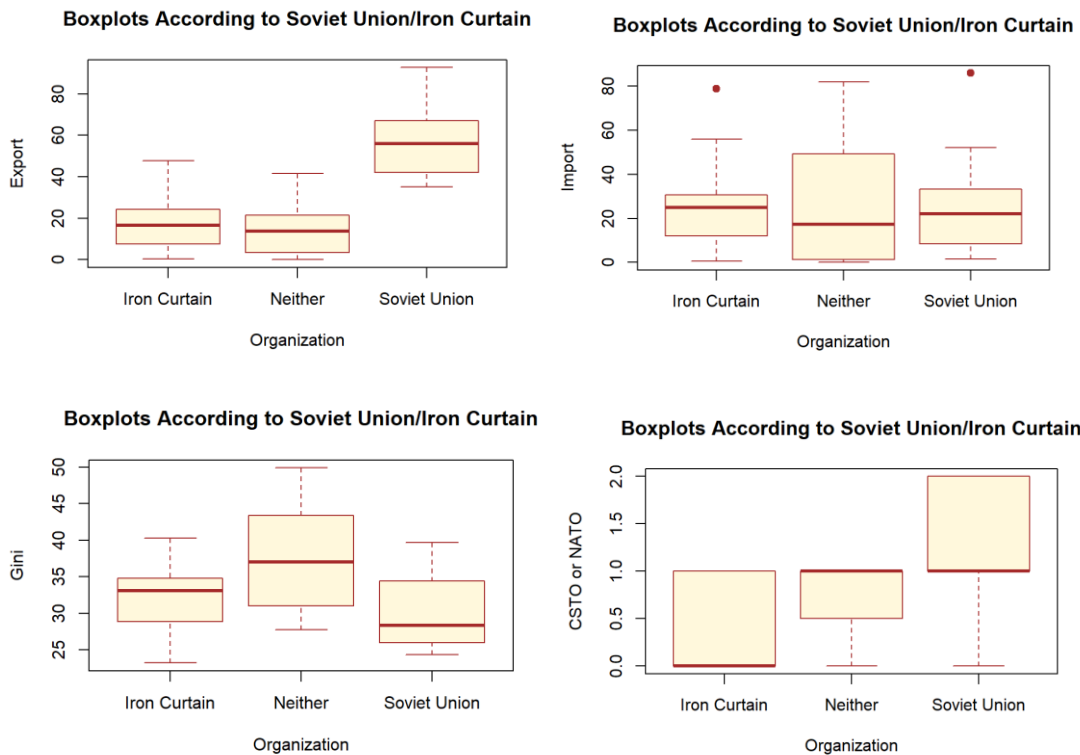
Figure 2. Boxplots by CSTO for country data variables

The Soviet Union boxplot insights showed that export trade data has a higher trade flow with countries formerly in the Soviet Union. This could be an indicator of the strong historical ties to previously being in the Soviet Union. Similarly to the CSTO comparison, the import trade data has a more even distribution across all categories.

The higher Gini scores, where wealth distribution is less so, is more prominent in the countries that were neither a part of the Soviet Union nor under the influence of the iron curtain. Perhaps there is a correlation here with capitalism versus communism.

Not surprisingly, most countries that were not a part of the Soviet Union do not have the Russian ethnicity listed in their census. However, most countries that were in the Soviet Union or under the Iron Curtain influence have similar ethnicities to Russia's ethnicities. Also not surprisingly, countries that were a part of the Soviet Union have the highest amount of similar ethnicities with Russia's ethnicities above .1%.

Former Soviet Union countries have the lowest GDP per capita. This could also correlate to having a higher Gini score (more income equality).



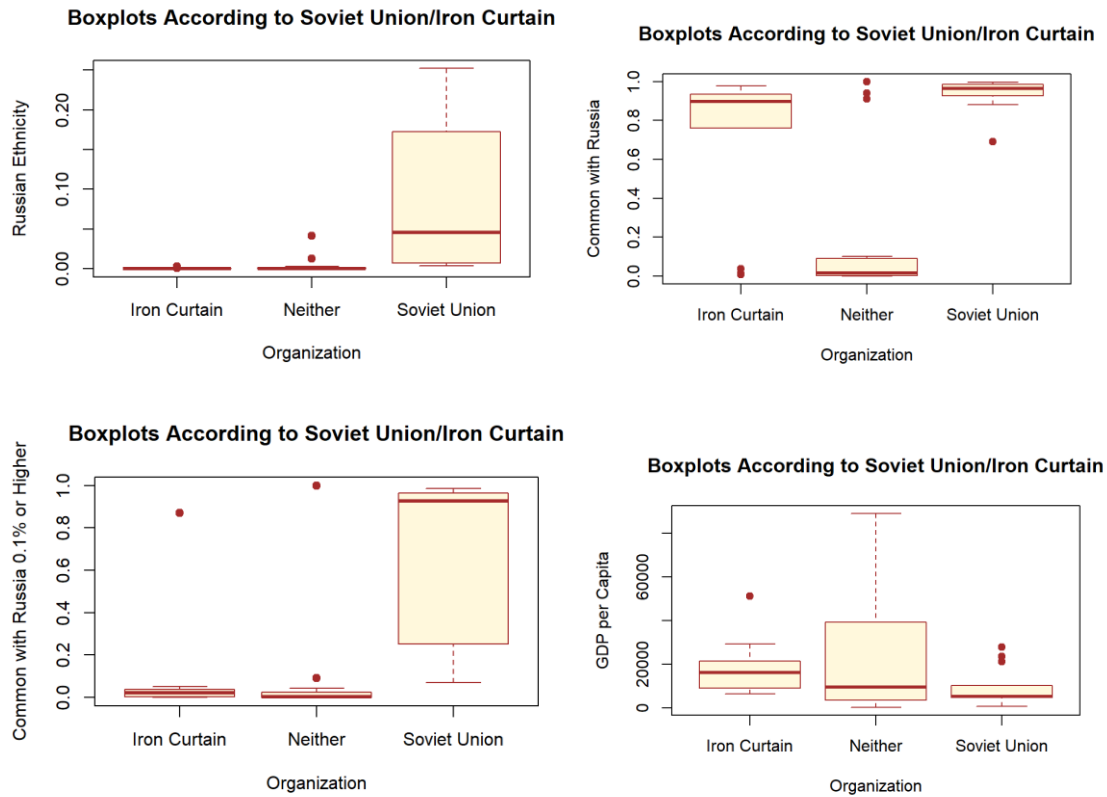


Figure 3. Boxplots by Soviet Union for country data variables

To better visualize the diplomatic ranking score, I used ArcGIS Pro to create maps of the countries and their variables.

First, I pulled in the CShapes-2 shapefile and filtered it to reflect only the 46 surrounding countries to Russia as well as Russia itself and former countries like Yugoslavia and Czechoslovakia. I then pulled in the CapstoneVariables_for_RStudios.csv files and created a Join between the CShapes and CapstoneVariables_for_RStudios.csv file using the country name. I changed the symbology to graduated colors using the variables with 10 classes.

Below are eight maps depicting the variables with the 46 countries.

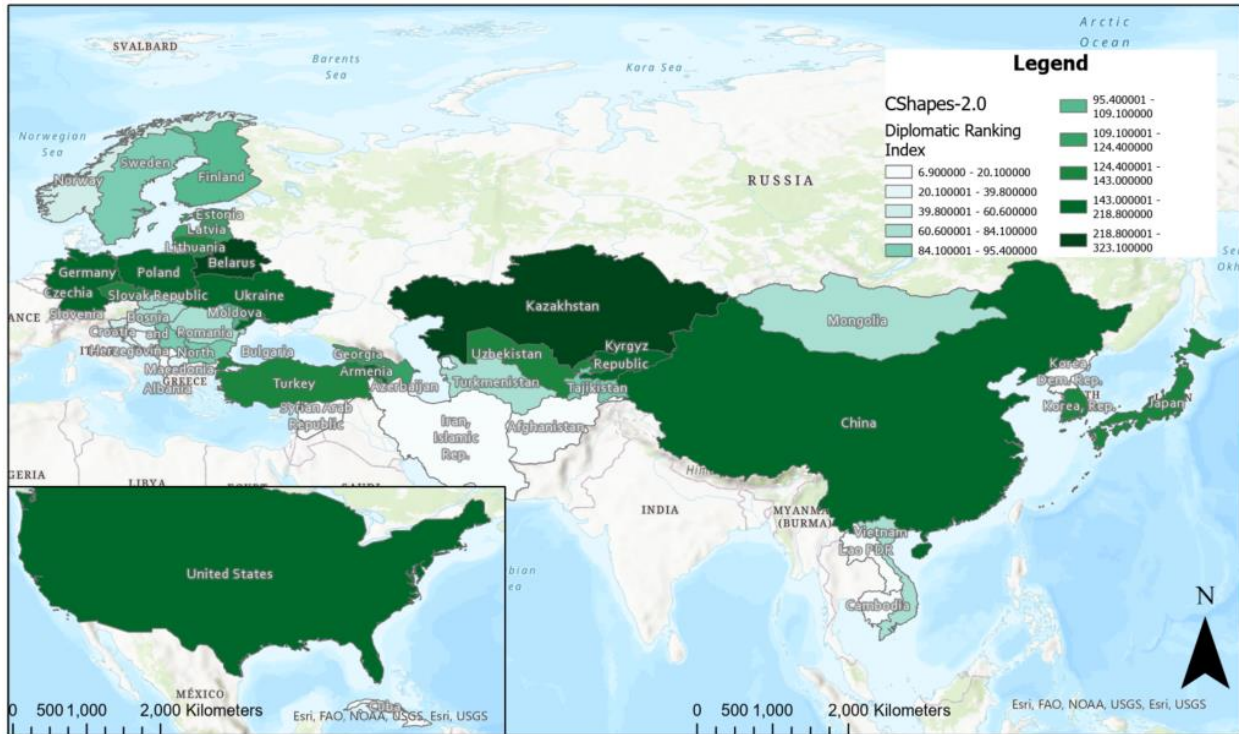


Figure 4. Map depicting the Diplomatic Ranking Index

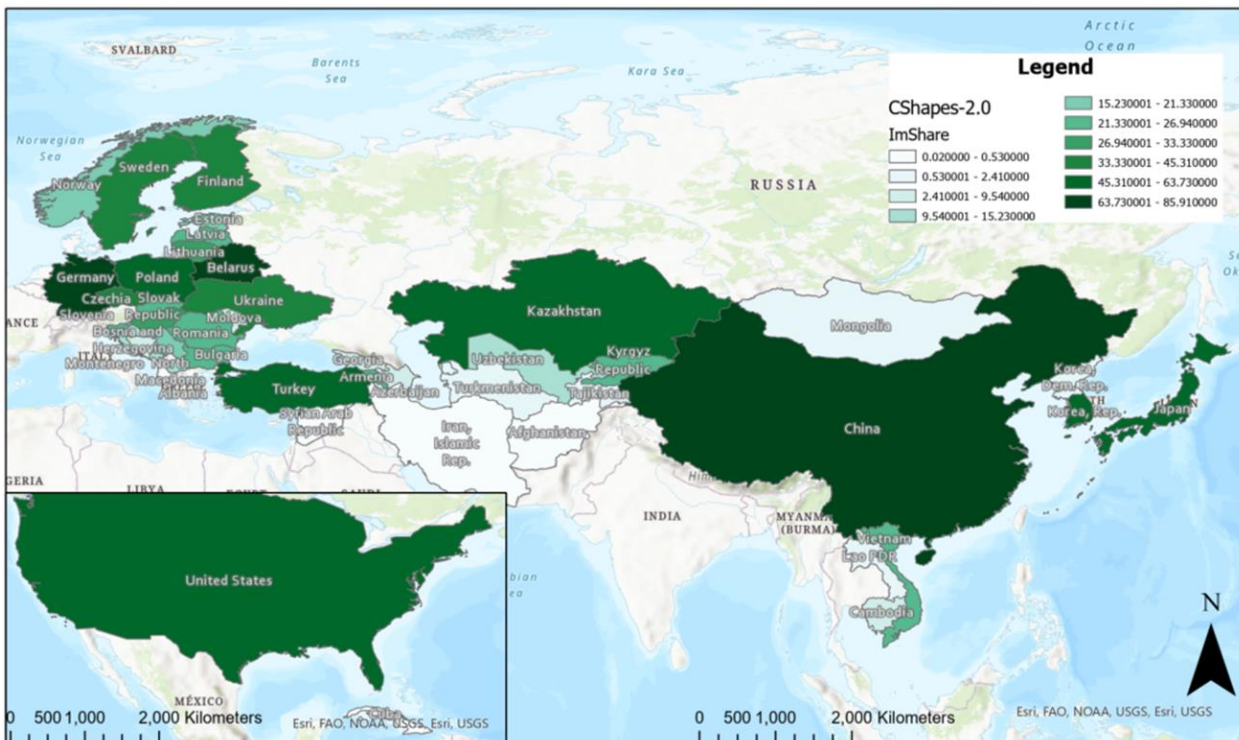


Figure 5. Map depicting the Import Shares

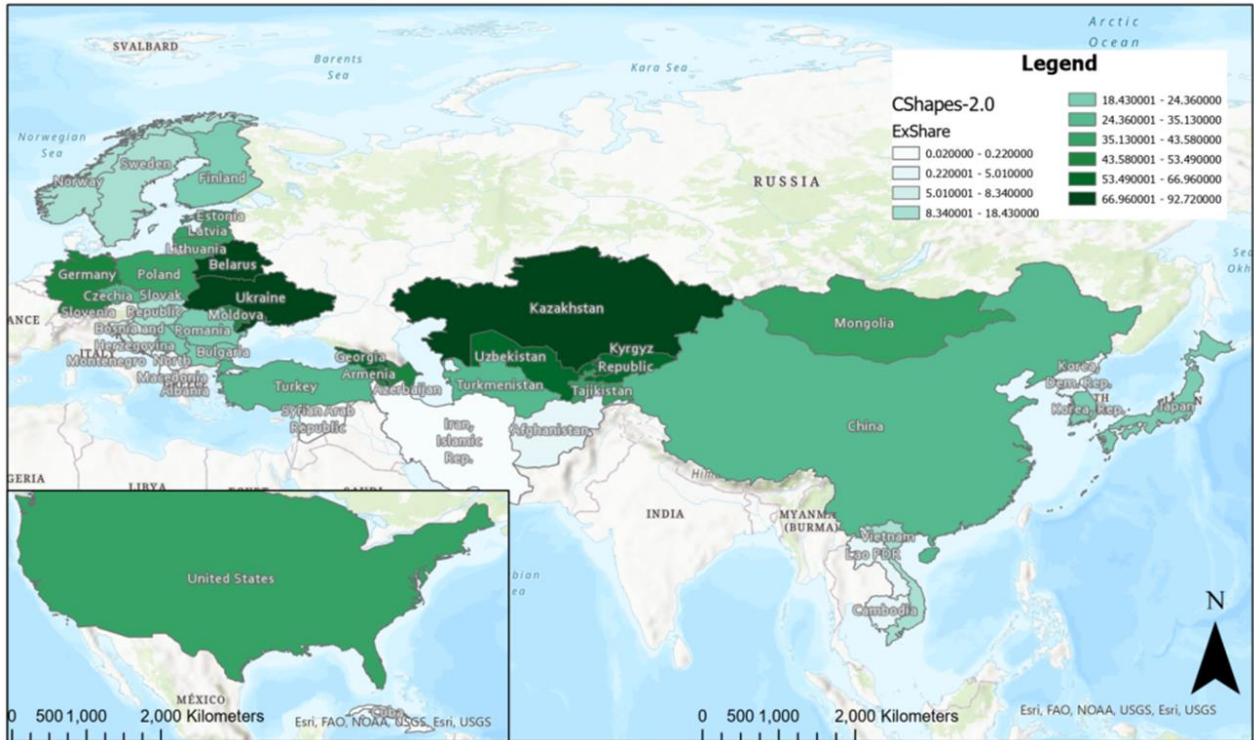


Figure 6. Map depicting the Export Shares

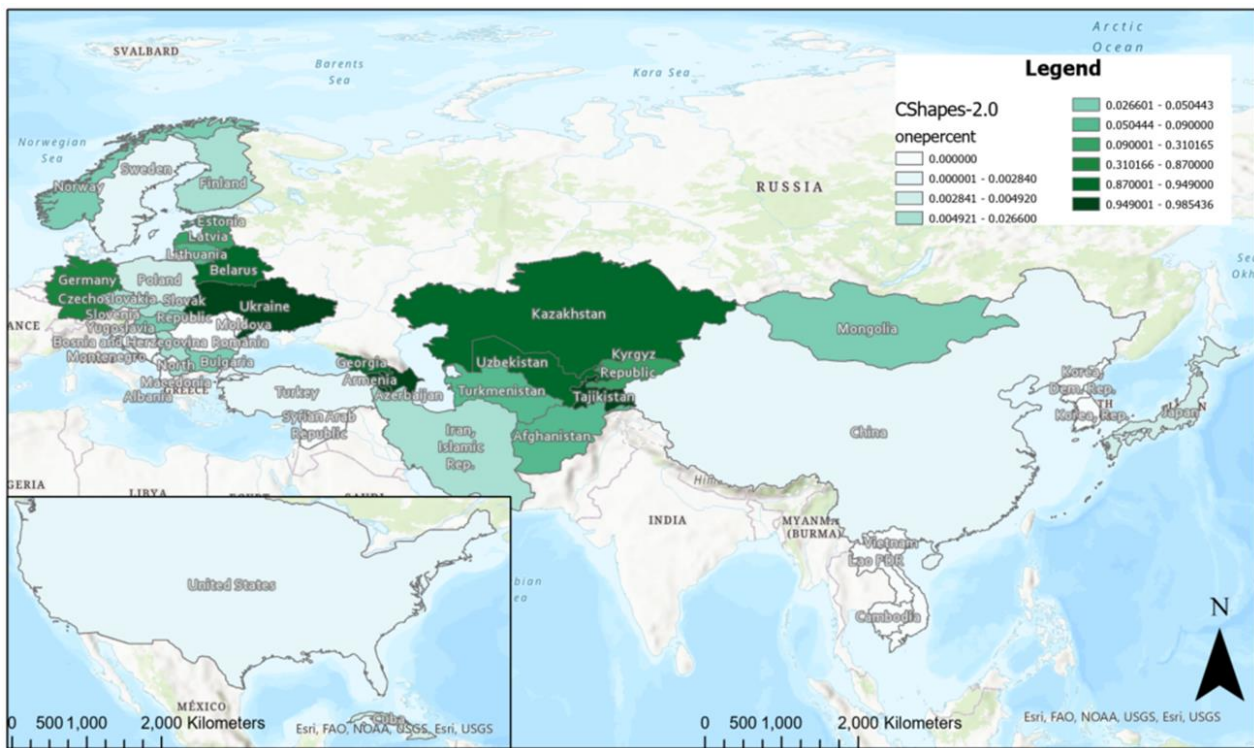


Figure 7. Map depicting the 0.1% or higher ethnicities in common with Russia.

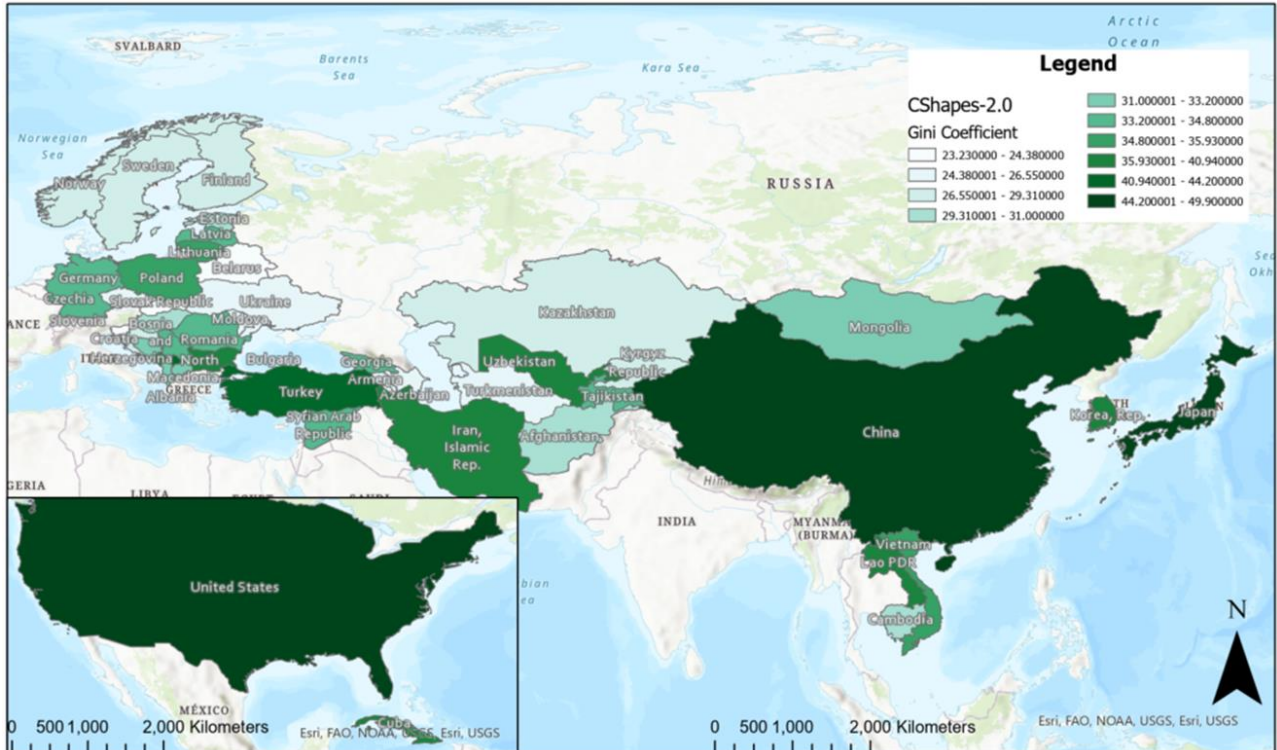


Figure 8. Map depicting income inequality.

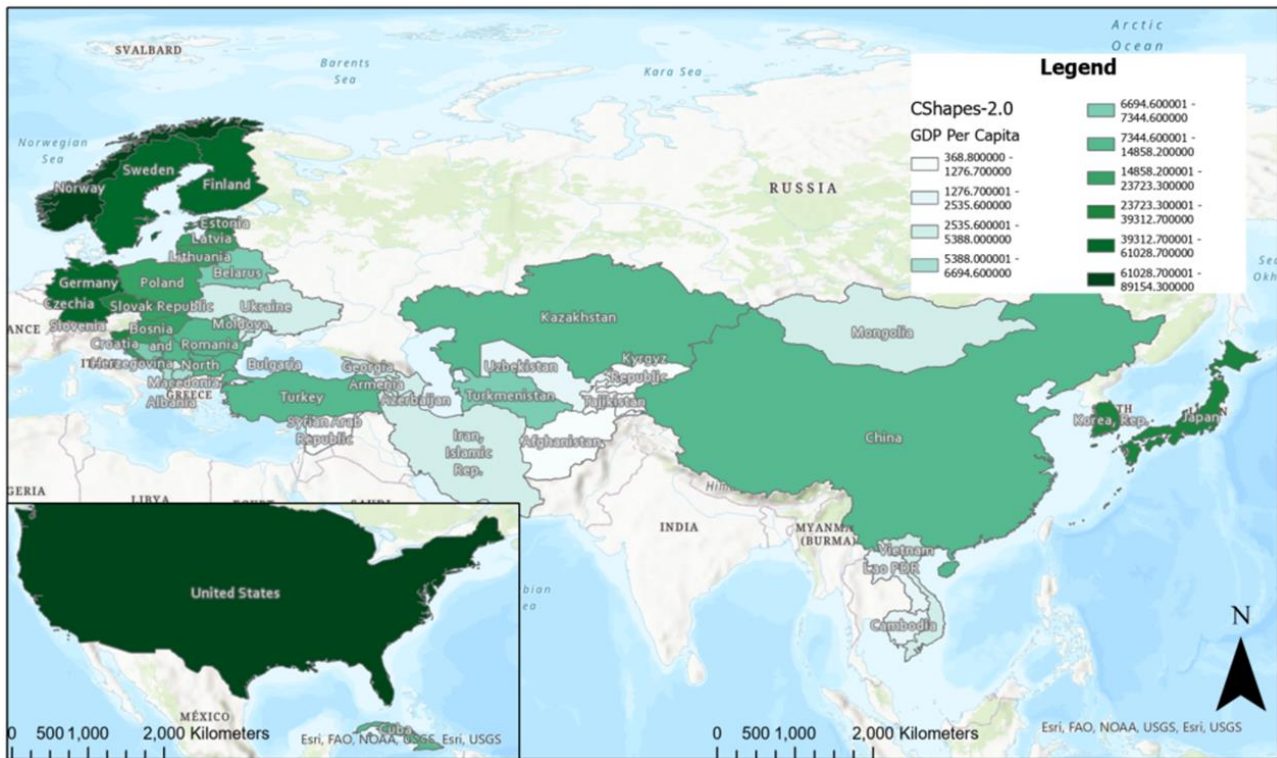


Figure 9. Map depicting the GDP per Capita.

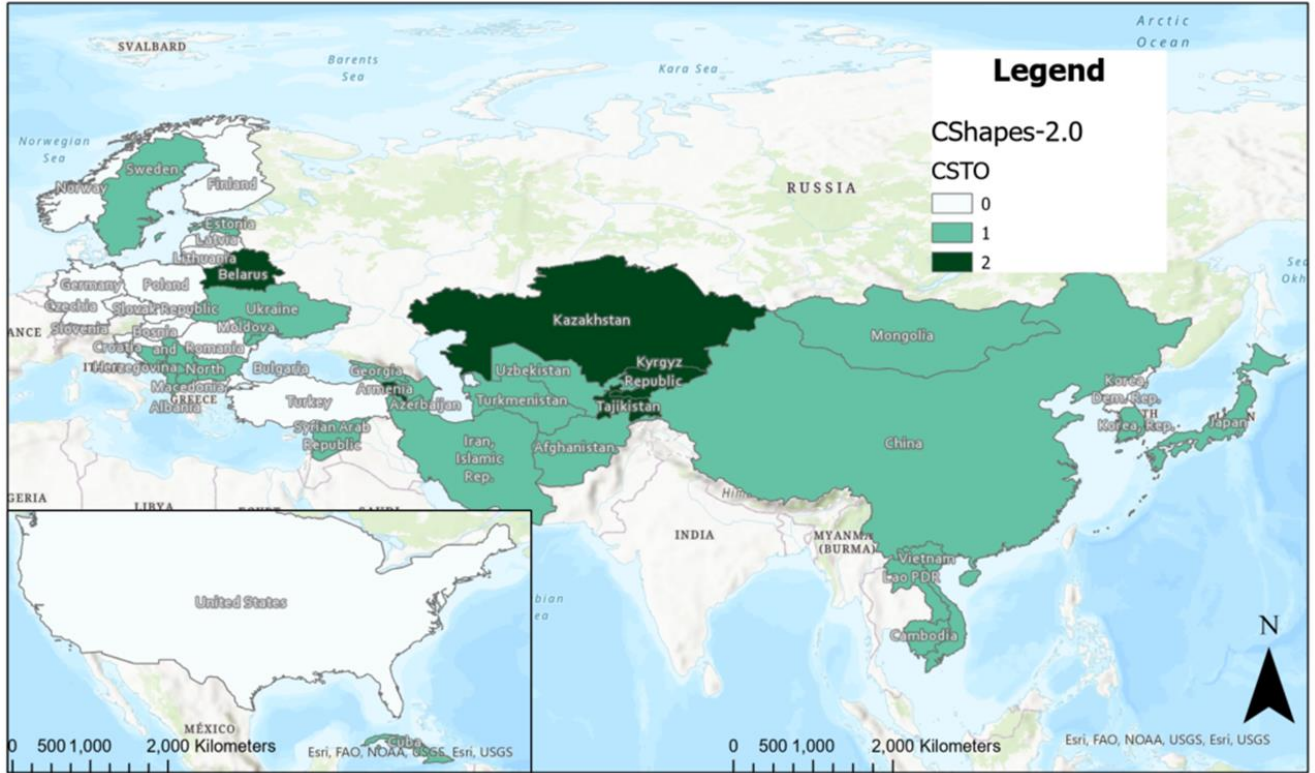


Figure 10. Map depicting CSTO (2), Neither (1), or NATO (0) membership.

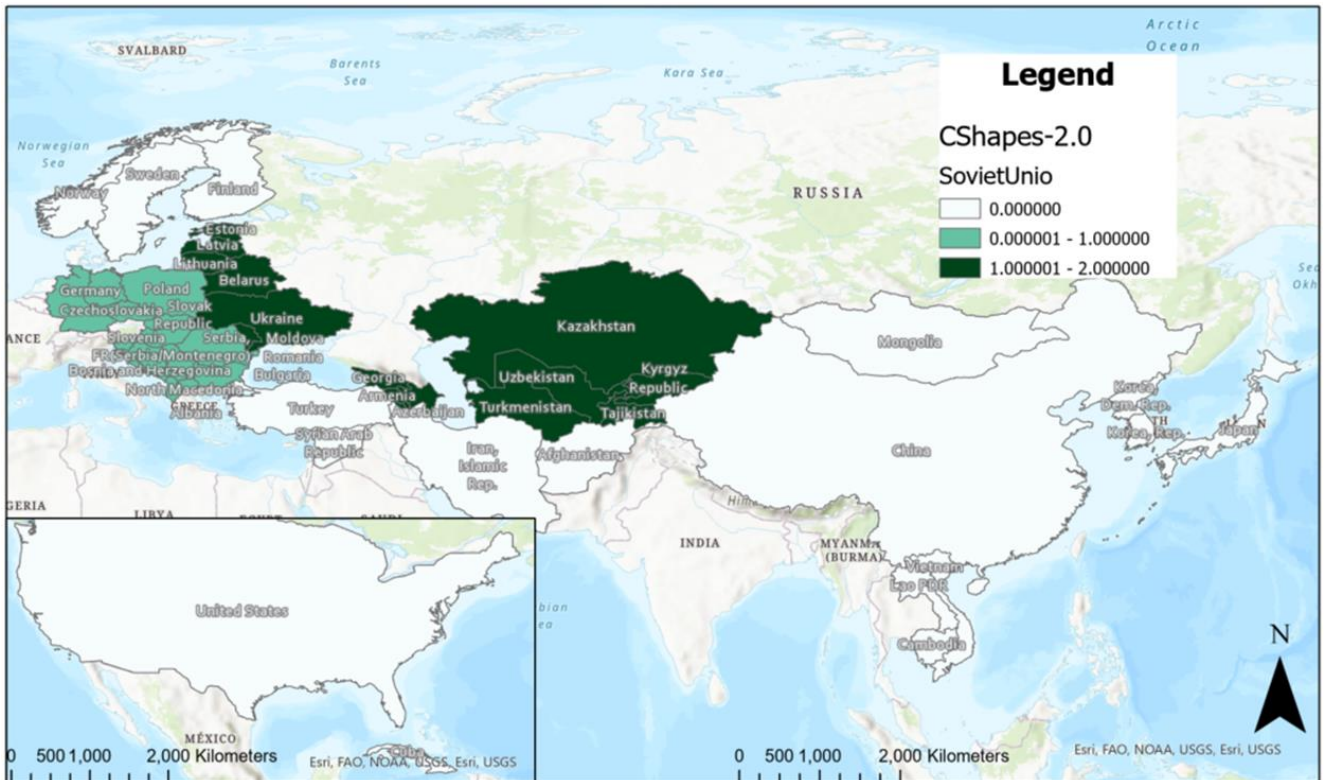


Figure 11. Map depicting the Soviet Union Countries (2), Iron Curtain influence (1), or neither (0).

SUMMARY

Before conducting the study, the assumption was that trade would more heavily be an indicator of two countries' diplomatic relations. The first indicator that this may not be true was the relationship between Russia and the United States versus their apparent positive trade relations. When looking at the import trade especially, there is a higher volume of import from the United States going into Russia which from my original hypothesis would be an indicator of positive relations.

The export map reflects more so what I would have assumed to be an indicator of positive relations as those countries closest to Russia and also known CSTO members or previous Soviet Union members have higher exports coming in from Russia.

Ethnicities common with Russia had a higher correlation with the diplomatic ranking index. It also made sense as the countries that had more ethnicities in common with Russia were closer in proximity to Russia. Countries closer to Russia would benefit more from having a positive relationship with Russia as well.

The Gini coefficient which represents the income inequality data shows a trend of countries closer to Russia having a lower Gini score indicating the distribution of wealth in being more equal. There does not seem to be a correlation between the Gini score and the diplomatic ranking, however.

GDP Per Capita also did not seem to have a strong correlation to the diplomatic ranking index. The strongest diplomatic rankings with Belarus and Kazakhstan both had lower GDPs but not the lowest. There also didn't seem to be a correlation between having a higher GDP score and a negative or positive diplomatic ranking.

All of the countries apart of the CSTO had positive diplomatic rankings however, not being in the CSTO did not seem to hinder diplomatic relations either. Even the countries apart of NATO like the United States, Germany, and Turkey still had a good diplomatic ranking score. This could also go back to the previous discussion on trade and whether it is a good indicator of diplomatic rankings. The United States, Germany, and Turkey all had high rates of importing goods into Russia which influenced their diplomatic ranking score.

Finally, previously being a part of the Soviet Union or under its influence did not seem to have much influence on the diplomatic ranking score either. There did seem to be a slight correlation to the ethnicities, however, that could also be more in part to the proximity to Russia versus being a part of the Soviet Union.

One of the biggest takeaways was the trade data. Perhaps the trade data is still a good indicator of diplomatic relations as this data was all taken pre-Ukraine and Russia war. If one of the first tactics for many countries when in disagreement is to issue trade sanctions, then a healthy trade flow would seem like a good indicator of positive diplomatic relations.

Interestingly, I would have assumed the countries apart of the CSTO would have made it into the top ten for diplomatic relations but instead Tajikistan came in at number 25 and the Kyrgyz Republic just made it into the top ten at the tenth slot.

Tobler's First law of things closer together tends to relate more than those further apart does seem to have some truth when looking at the diplomatic ranking index with the assumption that countries who

are more similar would have better relationships. With the exceptions of Mongolia, which is closer but scored lower, and the United States, which is further away but scored higher.

Ultimately, assessing the diplomatic relations between countries cannot be simply put within the confines of a few variables. The diplomatic relations and the nature of humans cannot be put into a neat mathematical equation however this study gives a good jumping-off point to assess the diplomatic relations.

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