The University of Chicago

Geopolitics vs. Public Health?

Determinants of U.S. Overseas COVID-19 Vaccine Donations

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August 2024

A paper submitted in partial fulfillment of the requirements
for the Master of Arts degree in the Master of Arts Program
in the Committee on International Relations

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Abstract

This thesis investigates the factors driving the U.S. decision to prioritize particular countries over others in its COVID-19 vaccine donations. The United States has claimed that it provides vaccines to countries in need. However, descriptive evidence suggests that factors other than need influence U.S. donations, as apparent in its contributions to high-income nations. The literature presents three theories to explain why the United States gives aid: response to countries' perceived needs, commitment to allies, and quid pro quo for other goals. To examine the extent to which each of these accounts for U.S. vaccine diplomacy, this thesis regresses the cumulative U.S. deliveries of vaccine doses abroad on measures of recipients' needs and their geopolitical importance to the United States. The regression results suggest that: a) the United States donated more vaccines per capita to nations with lower GDP per capita; b) countries in the Middle East and NATO members received fewer doses per capita; c) nations with significant U.S. military presence, major non-NATO allies, and those physically closer to the United States received more doses per capita. These results are robust to other confounders and alternative formulations of the dependent variable. In addition to the usual robustness checks, this thesis conducts sensitivity analyses to test its findings. The results imply that U.S. COVID-19 vaccine diplomacy manifests a dual mandate of charity and self-interest by concurrently donating to countries in need and to those that contemporaneous U.S. foreign policy values more.

Acknowledgements

I would first like to thank Professor Robert Gulotty, my thesis advisor, for his endless support and advice these past two years. He has given me insightful feedback that helped me improve my thesis methodology and structure. I also thank Professor Pinar Alakoc for her comments and encouragement. In addition, I am grateful to the participants at the 2021-22 M.A. Thesis Workshop and the 7^{th} Annual Interdisciplinary Graduate Student Academic Research Conference at the University of Chicago, especially Dr. Matthias Staisch, who served as the primary discussant for my panel. I gratefully acknowledge the financial support and feedback the Chicago Consular Corps provided me in June 2022. This thesis would not have been possible without the support of my friends and family members. I dedicate this thesis to the memory of my grandmother, Jung Dong Kim, a source of inspiration and courage for all.

Contents

1 Introduction

The United States has donated about 600 million COVID-19 vaccine doses to other countries since early 2021. President Biden characterized the United States as an "arsenal of vaccines for the world" sharing them "in service of ending the pandemic globally" to "countries in need" (United States, Office of the Press Secretary 2021a).

However, the list of U.S. vaccine recipients seems puzzling. While it includes low-income countries like Haiti, which received just under a million doses, it also contains high-income countries like Canada, which received 2.5 million doses. Indeed, the map below, depicting U.S. donations of COVID-19 vaccine doses abroad as of August 2022, shows that the United States has concentrated its donations in Latin America, the Caribbean islands, Southwest Asia, and Southeast Asia.[1] It also shows differences among nations in Sub-Saharan Africa in doses received per capita, implying that factors other than need affected U.S. donations. These points raise questions regarding factors in the U.S. decision to donate vaccines to particular countries over others.

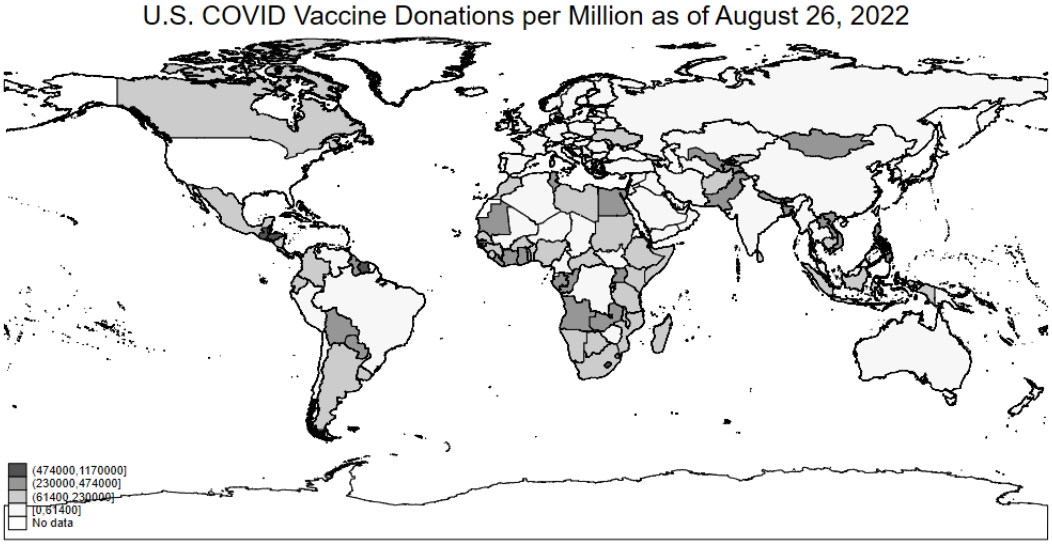

Figure 1: U.S. COVID-19 Vaccine Donations, August 2022

Three prevailing theories explain why the United States gives aid to other countries. One says the U.S. government assists countries it perceives as the most underprivileged. Another states that the U.S. government doles out aid to secure the loyalty of

1. Map generated by the Minnesota Population Center (2020)'s IPUMS World Map shape file

its allies. Finally, some point to the U.S. use of material assistance to accomplish other contemporaneous policy goals, suggesting a quid pro quo.

The results of this thesis accord with the scholarly consensus that "global health diplomacy entails potentially contradictory 'dual goals' of serving foreign policy interests and strengthening global public health" (Bengy Puyvallée and Storeng 2022: 2). The United States gives more vaccines per capita to nations with lower GDP per capita, supporting the need hypothesis. Meanwhile, the usual recipients of U.S. aid, such as Middle Eastern countries and NATO members, receive fewer doses per capita than other nations, undermining the allies and quid pro quo arguments. However, the United States sends more doses per capita to neighbors, major non-NATO allies (MNNAs), and nations with significant U.S. military presence. These results suggest that the U.S. COVID-19 vaccine distribution policy is a bifurcated means to give charity to other states while serving its self-interest.

The main results are robust to observed and unobserved confounders. This thesis conducts traditional robustness checks against the recipients' concurrent use of Russian and Chinese vaccines, shared cultural variables like common language and religion, and the Freedom House score, representing the extent of liberal democracy in recipient states. It also runs sensitivity analysis to check for the effect of unobservable confounders on existing coefficients, specifically GDP per capita and the Middle East indicator. In addition, this thesis analyzes alternative formulations of the dependent variable to check if they affect the main results. Both the robustness check and sensitivity analysis reinforce the thesis's conclusions.

This paper is organized as follows. It first connects theories on foreign aid with the state of U.S. COVID-19 vaccine donations to formulate hypotheses on U.S. vaccine diplomacy. It then presents its empirical strategy and regression analysis. Next, this thesis conducts sensitivity analysis and robustness checks on the quantitative results. It concludes with its contributions to the literature, a consideration of the underlying motives of U.S. vaccine diplomacy, and policy implications of the results for beneficiaries' trust, aid effectiveness, and the future of multilateral cooperation.

2 Literature Review

2.a Need

One view of foreign aid in the literature holds that it is distributed based on need, with no expectation of quid pro quo. This viewpoint stems from "a humanitarian desire to improve the welfare of the people of the underdeveloped areas" even when "no security advantages could be expected from it" (Banfield 1963: 37). From this perspective, one could expect donations of COVID-19 vaccines to be strictly altruistic as humanitarian aid to fight the pandemic.

The U.S. government's official statements on vaccine donations indicate a selfless concern for public health. Vice President Harris (2021), for instance, highlighted that the U.S. vaccines are "donations, free of charge, with no strings attached" because donating vaccines is "about saving lives" and "the right thing to do." Throughout its public statements, the U.S. administration has been adamant about the charitable nature of its overseas vaccine distribution. Accordingly, this thesis puts forth the following hypothesis: *the United States donates vaccines based on need.*

2.b Commitment to Allies

A different view of foreign aid regards it as a reward developed countries dole out to their allies. Alesina and Dollar (2000) find that in distributing aid, the United States generally favors what they call "UN friends," characterized by how closely those countries' voting records match the U.S. votes at the United Nations General Assembly (UNGA) (37). Since "the pattern of UN votes is strongly correlated with alliances and similarity of economic and geopolitical interest," the authors argue that donors privilege their friends over others in disbursing aid and that the votes at the General Assembly demonstrate such friendship (Alesina and Dollar 2000: 46).

Descriptive evidence on U.S. vaccine donation indicates that U.S. commitment to allies significantly determines its recipients. For example, South Korea received over one million COVID-19 vaccine doses from the United States in the summer of 2021.

The U.S. and the Korean presidents justified the donation by citing military cooperation between the two countries in a press conference:

> PRESIDENT MOON [of South Korea]: ... for the sake of the ROK-U.S. alliance, President Biden decided to provide vaccines to the servicemen in Korea as soon as the U.S. is ready. I understand there will be an announcement to be made by the U.S. side.
>
> PRESIDENT BIDEN: By the way, I – I can just prematurely make that. And we're going – there are 550,000 Korean soldiers, sailors, and airmen who closely interact with American forces in Korea. We'll provide full vaccinations for all 550,000 of those Korean forces engaging with American forces on a regular basis – both for their sake and the sake of the American forces. (United States, Office of the Press Secretary 2021b)

Based on this viewpoint, this thesis advances the following hypothesis: *the United States prioritizes its allies in COVID-19 vaccine donations.*

2.c Quid Pro Quo

Yet another view of foreign aid considers it a return for political favors. Whereas alliances are structural, codified relationships, quid pro quo focuses on contemporary policy goals. For instance, in examining the U.S. aid flow to non-permanent members of the United Nations Security Council (UNSC), Kuziemko and Werker (2006) find that a "typical developing country serving on the council can anticipate an additional $16 million from the United States," a figure that rises to $45 million during what they call "important years" (924). Based on the data, the authors infer that non-P5 members "promote another country's interests in the Security Council in exchange for development aid" (Kuziemko and Werker 2006: 907). Alesina and Dollar also consider an explanation of foreign aid motivated by quid pro quo. They find that countries in the Middle East, particularly Egypt and Israel, have received "much political and economic support" from the United States "for well known reasons having to do with the conflict" there (Alesina and Dollar 2000: 47).

Descriptive evidence suggests that the United States may have used vaccines in return for other favors. For instance, the Philippines decided to keep the Visiting Forces

Agreement (VFA) with the United States in August 2021 after receiving 3 million Moderna vaccine doses.[2] Former Filipino President Rodrigo Duterte suggested the quid pro quo nature of the transaction in a televised speech:

> I'm going to go to the airport because the United States donated 3 million — the Moderna. *Kaya ano give and take lang tayo* (We did a give and take). *So pasalamat tayo sa kanila at maibigay naman na — may naibigay na naman ako sa kanila na concession* (So let's thank them and I gave them something in concession). I consider the continuance of the Visiting Forces Agreement.... (Kabiling 2021)

Based on this viewpoint, this thesis puts forth the following hypothesis: *the United States uses COVID-19 vaccines in exchange for other favors*. The theories of need, commitment to allies, and quid pro quo will be tested empirically against the U.S. vaccine donation data in the following sections.

3 Data and Methods

3.a Issues with Measurement

This thesis details its estimation strategy after examining the relevant literature and hypotheses. Quantitative evaluation of the marginal effects of the three determinants requires precise definitions and ways to measure them, which are discussed below.

3.a.i Who seems to need COVID-19 vaccines the most?

There are multiple approaches to estimating which countries need COVID-19 vaccines the most. One way is to assess need based on current or projected case burden, a strategy that Kiernan et al. (2021) advocate. However, measuring COVID-19 cases and deaths is prone to errors. For instance, more than 100 countries do not collect data on actual deaths from COVID-19 or do not report them regularly (Adam 2022: 312). Also, in developed countries, the widespread use of at-home rapid tests has contributed to an undercounting of COVID-19 cases (Christensen et al. 2022). This thesis thus does not consider COVID-19 deaths and case data as explanatory variables.

2. The VFA allows U.S. military personnel to be stationed temporarily on foreign soil.

Another approach uses pandemic preparedness indices like the Global Health Security Index (GHS) to extrapolate the need for vaccines. Epidemiologists, however, have found them to be poor predictors of countries' pandemic preparedness in light of their performance against COVID-19. Abbey et al. (2020), for instance, find "a negative correlation between the GHS rankings" and the ranking they developed based on the countries' performance against COVID-19 (5). Likewise, the GHS Index is "not associated with standardized infection rates or standardized" infection fatality ratio of COVID-19 in data from 177 countries between 2020 and 2021 (COVID-19 National Preparedness Collaborators 2022: 1505). Pandemic preparedness indices are thus not appropriate in determining need.

Given the shortcomings of COVID-19 cases, deaths, and pandemic preparedness indices, this thesis suggests GDP per capita as a proxy for access to vaccines. This approach acknowledges the universal need for vaccines and focuses on the financial barriers less developed countries face. Since wealthier nations can acquire vaccines more readily, GDP per capita is a practical indicator of countries reliant on external support for vaccine access.

A plausible objection to this strategy is that GDP per capita may not precisely capture a state's need for COVID-19 vaccines. Indeed, some developing countries have been forced to discard donated doses as they struggle with low administration capacity, vaccine hesitancy among the population, and vaccines' short shelf-life.[3] Nevertheless, it is still a well-founded approach. For one, estimating states' unmet vaccine needs remains complex and opaque due to the shortage of high-quality data on public health in developing states. Moreover, what matters more here is how the United States *perceives* the needs of other states in giving out doses, not necessarily their actual needs, since the focus is on U.S. preferences in its vaccine donations. In this sense, GDP per capita represents an unambiguous measure that fits a lay policymaker's expectation of who needs vaccines the most.

3. For example, Nigeria faced a million expired doses in November 2021 due to these reasons (Mcallister et al. 2021).

3.a.ii Who is a U.S. ally?

Identifying U.S. allies with shared geopolitical interests remains laborious. After all, since geopolitics can mean different things under different contexts, "the geopolitical importance of a country is an unobservable variable," and "there is no unique geopolitical variable" (Reynaud and Vauday 2009: 140). Scholars such as Aklin and Kern (2019) have explored potential observable proxies for U.S. allies, using the deployment of the U.S. military "as a measure of a credible commitment" by the U.S. government to other countries (16). Aside from being visible and easy to quantify, the presence of U.S. service members acts as "a costly signal that the United States prefers the status quo and is willing to pay for it" (Aklin and Kern 2019: 18). Aklin and Kern thus claim that the presence of the U.S. military signals to others that "the United States is committed to the stability and welfare of the country" (19). Per their logic, it makes sense for the U.S. government to prioritize allies that host the U.S. military as vaccine recipients to protect the health of the U.S. service members and the host country's citizens.

Still, other scholars have tried to identify U.S. allies by extrapolating from public voting records, notably those of the United Nations General Assembly. In their investigation of the U.S. influence on World Bank policy-making, Clark and Dolan (2021) find that "when countries vote more closely than usual with the United States in the General Assembly," they are subject to "fewer domestic policy reforms" in fewer areas (37). They attribute this result to the fact that the U.S. Congress "is annually briefed on how countries vote during important votes in the UN General Assembly" and can mandate that U.S. representatives at the World Bank support or block specific World Bank projects (Clark and Dolan 2021, 48). Their approach is similar to that of Alesina and Dollar (2000) discussed in Section 2.

3.a.iii With whom does the United States exchange favors?

This thesis considers two kinds of quid pro quo recipients frequently discussed in the international relations literature: countries in the Middle East and non-permanent

members (P5) of the UNSC. The decision to include an indicator variable for Middle Eastern states follows Alesina and Dollar (2000)'s rationale. After all, the United States remains engaged in the Middle East, regardless of presidential partisan affiliation.[4] Kuziemko and Werker (2006) as well as more recent literature supports this thesis's choice to include a binary variable for non-P5 members. For example, in their study of World Bank aid, Berlin, Desai, and Olofsgård (2023) conclude that "the US government has routinely used bilateral, as well as influence over multilateral, aid to reward UNSC members that are loyal supporters of US interests" (242). Likewise, Mikulaschek (2018) finds that "EU member states that temporarily serve on the UN Security Council promote the interests of other EU member states in exchange for larger receipts from the EU budget" (496). The regression thus incorporated these two indicators.

3.b Data Sources

This thesis uses the following data sources, which include variables that can influence the U.S. decision to donate vaccines. Table 1 contains their descriptive statistics.

4. The current U.S. administration's alignment in the Middle East is debatable, however, as discussed in Section 5.

Table 1: Descriptive Statistics

	N	Mean	St. Dev.	Minimum	Maximum
Doses Received per Million	198	162646	236534	0	1165955
No. U.S. Service Members	198	795	4981	0	53732
NATO Member	198	0.15	0.35	0	1
Major Non-NATO Ally	198	0.09	0.29	0	1
Distance, km	198	8795.40	3501.02	548.40	16180.32
UN Voting Ideal Point Distance	192	2.90	0.80	0.12	4.74
Scores for Component 1	192	0	1.31	-1.91	4.67
Scores for Component 2	192	0	1.12	-1.01	8.90
GDP per Capita	192	16331	25866	224	189487
Middle Eastern Country	198	0.08	0.27	0	1
Non-P5 UNSC Member	198	0.08	0.27	0	1
Freedom House Score	196	57.63	30.76	1	100
Has Used Russian Vaccines	193	0.35	0.48	0	1
Has Used Chinese Vaccines	193	0.59	0.49	0	1
Human Development Index	188	0.72	0.15	0.39	0.96
Patents per Capita	124	0	0	0	0.01
Uses English as Primary/Official Language	194	0.30	0.46	0	1
Religion Proximity Index	184	0.15	0.13	0	0.43
Imputed GDP per Capita	196	16095	25668	224	189487

3.b.i Donated U.S. Vaccine Doses

The dataset contains data on donated U.S. vaccine doses compiled by the Kaiser Family Foundation (2022) until August 2022. The original dataset is entitled "U.S. International COVID-19 Vaccine Donations Tracker." The tracker was updated daily by the U.S. State Department and COVAX. Also, while the United States has donated vaccines directly and through COVAX, this thesis considers both bilateral donations because the U.S. administration specified recipient countries even for COVAX donations (United States, Office of the Press Secretary 2021a).

3.b.ii Number of U.S. Active-Duty Service Members Abroad

This thesis uses Siebens et al. (2021)'s 2020 data on the number of U.S. active-duty service members abroad, the most recent figure available in the dataset.

3.b.iii United Nations General Assembly Voting Records

This thesis uses the ideal voting distance between UNGA member states and the United States as calculated by Bailey, Strezhnev, and Voeten (2017). It uses the 2020 values because they represent the similarities in UNGA voting records between the UN member states and the United States right before the United States started donating vaccines in 2021.

3.b.iv Physical Distance

This paper incorporates the physical distances between entities found in Conte, Cotterlaz, and Mayer (2021)'s "Gravity" dataset. However, the Gravity dataset lacks the distances for Kosovo, Liechtenstein, Monaco, and the Holy See. This thesis thus calculated the distances between the most populous U.S. city (New York, NY) and the most populated cities of those four entities using the Distance Calculator (2022), which is how the Gravity dataset defines the distance between states. It then plugged them into the distance variable. This variable also accounts for the U.S. decision to help its neighbors first by prioritizing "Latin American and the Caribbean" countries (United States, Office of the Press Secretary 2021a).

3.b.v Regional Classification of Entities and Non-P5 Membership

This thesis follows the Stockholm International Peace Research Institute (2022)'s regional classification in its "SIPRI Military Expenditure Database." A list of Middle Eastern states according to the SIPRI classification and the non-permanent members of the UNSC in the years 2020-22 is found in Table 2.

Table 2: List of Middle Eastern and Non-P5 States (2020-22)

Middle Eastern States	Non-P5 Member States
Bahrain	Albania
Egypt	Brazil
Iran	Estonia
Iraq	Gabon
Israel	Ghana
Jordan	India
Kuwait	Ireland
Lebanon	Kenya
Oman	Mexico
Palestine	Niger
Qatar	Norway
Saudi Arabia	St. Vincent and the Grenadines
Syria	Tunisia
United Arab Emirates	United Arab Emirates
Yemen	Vietnam

3.b.vi GDP per Capita

This thesis uses the World Bank (2022)'s "GDP per Capita (Current US$)" 2019 statistics to exclude the COVID-19 pandemic's deleterious effect on world economies. Since the World Bank dataset lacks Taiwan's GDP per capita, this thesis uses the data from the Gravity dataset for Taiwan only. The World Bank dataset also lacks data on six states' 2019 GDP per capita. As one of the robustness checks, this thesis imputes some of those countries' 2019 GDP per capita values using their last available GDP per capita data. It discusses how that imputation affects the regression results in Section 5.

3.c Principal Component Analysis (PCA)

As discussed earlier, defining a U.S. ally with shared geopolitical interests is a formidable task. In addition to the two variables mentioned in section 3., this thesis assembles two more variables representing codified U.S. commitment to foreign countries: indicators for a NATO member and a major non-NATO ally.[5] While one could include all these variables in the regression, this approach would be problematic since they are inevitably correlated. Furthermore, using the most relevant variables in identifying U.S. allies would be ideal.

Principal component analysis allows one to extract the most pertinent parts of these variables to find U.S. allies. Four variables–the number of U.S. service members stationed, an indicator for NATO members, an indicator for major non-NATO allies, and UN Voting Distance–were first standardized to a mean of 0 and a standard deviation of 1. The principal component analysis generated the following four components that describe the overall variation among the four variables:

Table 3: Results of the Principal Component Analysis

Component	Eigenvalue	Proportion	Cumulative
Component 1	1.722	0.430	0.430
Component 2	1.265	0.316	0.746
Component 3	0.693	0.173	0.919
Component 4	0.323	0.081	1.000

According to Table 3, only components 1 and 2 have eigenvalues greater than 1, which are included in the regression following the Kaiser Criterion. For clarity, the five countries with the highest and the lowest Components 1 and 2 values are listed below. Tables 4 and 5 imply that Component 1 encapsulates U.S. allies—mainly NATO members—and Component 2 represents major non-NATO allies and states with sig-

5. The list of non-NATO major allies has changed since the start of the pandemic. While President Biden added Qatar and Colombia to the list in early 2022, he announced his intent to remove Afghanistan from the list in July 2022. Since Afghanistan was not off the list as of August 2022, this thesis included it as a major non-NATO ally in the regression. As for Qatar and Colombia, this thesis reruns the principal regression with them as major non-NATO allies as part of the robustness checks.

nificant U.S. military presence.[6]

Table 4: Countries with the Highest Component 1 and 2 Values

Highest in Component 1	Highest in Component 2
Germany	Japan
United Kingdom	South Korea
Japan	Germany
Italy	Bahrain
France	Kuwait

Table 5: Countries with the Lowest Component 1 and 2 Values

Lowest in Component 1	Lowest in Component 2
Nicaragua	Denmark
Cuba	Estonia
Venezuela	Lithuania
Iran	France
Syria	Czechia

The principal component analysis also generated four principal components, or eigenvectors, associated with each component. The eigenvectors' entries are arranged in the following order: number of U.S. service members, NATO member, major non-NATO ally, UN voting distance. These eigenvectors are associated with components 1 and 2, respectively: (0.293, 0.667, 0.026, -0.685); (0.618, -0.242, 0.746, 0.058). Their meanings call for an explanation. For instance, component 1 contains 0.293 of the number of U.S. service members variable and 0.667 of the NATO membership variable. One can thus discern that NATO membership plays a significant role compared to other variables in Component 1. Conversely, being a major non-NATO ally and hosting the U.S. military play a more critical role than other variables in component 2. These results agree with the pattern seen in Tables 4 and 5.

6. Japan, South Korea, and Germany host the most U.S. military personnel abroad. Bahrain hosts the U.S. Fifth Fleet, and Kuwait is the forward base for U.S. operations in the Middle East.

3.d Empirical Strategy

The following linear regression model is fit on the data.

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \beta_4 x_{4i} + \beta_5 x_{5i} + \epsilon_i$$

The unit of analysis (i) comprises the 192 member states of the United Nations sans the United States plus six territories: the Holy See, Palestine, Taiwan, Kosovo, Hong Kong, and Macao. Meanwhile, the dependent variable is the log (+1) of cumulative U.S. vaccine doses per million the entities received until August 26, 2022. This thesis considers the per capita measure instead of the raw number of doses to make the effect of population constant. This practice also aligns with the White House Fact Sheet's claim that the United States will share doses "on a per capita basis" (United States, Office of the Press Secretary 2021a). In addition, this thesis takes the log of vaccine doses because the data is heavily right-skewed, as many entities did not receive doses from the United States. This strategy follows the literature's standard practice for zero values (Aklin and Kern 2019: 19).

The regression includes six independent variables. Variables x_1 and x_2 are Components 1 and 2 from PCA and represent measures of U.S. commitment to allies. Meanwhile, variable x_3 is the 2019 log GDP per capita measuring perceived need. Concurrently, variables x_4 and x_5 take the value of 1 if a country is in the Middle East and is a rotating member of the UNSC; they represent quid pro quo. Finally, x_6 represents the distance between the country's most populous city and the most populous U.S. city (New York, NY).

4 Results

The regression results in Table 6 support the perceived need hypothesis. According to the log GDP per capita coefficient in column 5, a one percent increase in GDP per capita is associated with a 1.82% decrease in doses received per million. In other words, the United States donates more vaccines per capita to low-income countries than to high-income countries. The coefficient is also statistically significant at $\alpha = 0.001$.

Conversely, the results complicate the commitment to allies hypothesis. The coefficient of component 1 is negative and statistically significant, which means countries that tend to have a modest U.S. military presence and be NATO members receive fewer vaccines per capita than those that are not. However, the coefficient of component 2 is positive and statistically significant, which means countries with substantial U.S. military presence and that are major non-NATO allies receive more vaccines per capita than those that are not.[7]

The results also refute the quid pro quo hypothesis. Countries in the Middle East received 3.62% fewer log U.S. vaccine doses per million than other countries, and the Middle East coefficient is statistically significant. This result could reflect the diminishing emphasis on the Middle East in U.S. foreign policy pre-2023. At the same time, the non-P5 member coefficient is not statistically significant.

Meanwhile, the coefficient on log distance is negative and statistically significant. Specifically, a one percent increase in distance is associated with a 3.23% decline in doses received per million. The implications of these findings are discussed further in Section 6.

7. Note that these variables are not binary indicators of a state being a NATO member or having a significant U.S. military presence. Instead, they are components that incorporate a substantial portion of such variables. Readers should refrain from interpreting the coefficients in a dichotomous sense. A drawback of principal component analysis is that it produces coefficients that are difficult to interpret. Therefore, this thesis focuses on the signs and statistical significance of the components' coefficients.

Table 6: Log (+1) Regression

	(1)	(2)	(3)	(4)	(5)
	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million
Log Distance	-2.831***	-3.145***	-3.483***	-3.238***	-3.233***
	(0.734)	(0.764)	(0.790)	(0.802)	(0.806)
Log GDP per Capita	-2.684***	-1.944***	-2.020***	-1.821***	-1.823***
	(0.202)	(0.252)	(0.253)	(0.258)	(0.260)
Scores for Component 1		-1.627***	-1.606***	-1.817***	-1.816***
		(0.267)	(0.255)	(0.256)	(0.257)
Scores for Component 2			0.712**	0.852**	0.852**
			(0.252)	(0.260)	(0.261)
Middle Eastern Country				-3.625**	-3.623**
				(1.236)	(1.241)
Non-P5 UNSC Member					0.302
					(0.940)
Constant	56.19***	52.50***	56.19***	52.51***	52.46***
	(7.105)	(7.398)	(7.662)	(7.817)	(7.848)
Observations	192	187	187	187	187
Adjusted R^2	0.382	0.473	0.488	0.506	0.504

Standard errors in parentheses. Component 1 refers to U.S. allies, mainly NATO members. Component 2 largely represents U.S. major non-NATO allies and states with significant U.S. military presence.

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

5 Robustness Checks

This paper conducts the following robustness checks to examine whether the main results hold under different assumptions. First, this thesis uses sensitivity analysis to test an alternative argument that the United States prioritizes more democratic states in vaccine distribution. Next, this paper runs the regression with other formulations of the dependent variable, such as raw doses per capita, inverse hyperbolic sine (IHS) transformed doses per capita, and a binary indicator of receiving a vaccine dose. Finally, robustness checks with other variables that could affect the results are also conducted. Such confounders include the beneficiaries' concurrent use of Russian and Chinese vaccines and shared language and religion. Regressions are also run using HDI and patents per capita as alternative measures of need.

5.a Sensitivity Analysis

A more liberal, value-driven argument for foreign aid is promoting democracy abroad. For instance, Alesina and Dollar (2000) find a positive association between the amount of U.S. official developmental assistance (ODA) and the presence of democratic institutions in receiving states (49). Does democracy then matter in U.S. vaccine diplomacy while accounting for other factors?

A robustness check was first conducted to test this alternative explanation by adding Freedom House's Global Freedom Score (GFS) as a proxy for democracy to the regression.[8] Freedom House assigns a score between 0 and 4 on 25 indicators related to political and civil rights to 195 countries and 15 territories, which are then aggregated to the GFS from 0 ("not free") to 100 ("free") (Repucci and Slipowitz 2022: 34). This thesis uses the 2021 scores that are the latest data available and reflect the post-pandemic reality well.[9] The table below represents the robustness check results.

8. Other measures of democracy like V-Dem and Polity are not considered because they lack data on some countries like Antigua and Barbuda that have received a substantial number of U.S. doses.

9. Freedom House lists two scores for Palestine: 11 for Gaza Strip and 23 for West Bank. The average of those two scores is used as the score for Palestine.

Table 7: Log (+1) Regression with Freedom House Score

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million
Log Distance	-1.486	-2.638***	-2.615***	-2.961***	-2.896***	-2.893***
	(0.881)	(0.773)	(0.779)	(0.798)	(0.810)	(0.813)
Freedom House Score	-0.0395*	0.0187	0.0517**	0.0539***	0.0463*	0.0462*
	(0.0158)	(0.0152)	(0.0162)	(0.0161)	(0.0184)	(0.0184)
Log GDP per Capita		-2.888***	-2.284***	-2.381***	-2.218***	-2.219***
		(0.241)	(0.261)	(0.262)	(0.303)	(0.304)
Scores for Component 1			-2.041***	-2.036***	-2.095***	-2.093***
			(0.241)	(0.222)	(0.223)	(0.225)
Scores for Component 2				0.776**	0.846**	0.846**
				(0.248)	(0.260)	(0.260)
Middle Eastern Country					-2.048	-2.049
					(1.357)	(1.360)
Non-P5 UNSC Member						0.217
						(1.036)
Constant	22.78**	55.14***	47.66***	51.48***	50.06***	50.04***
	(8.306)	(7.315)	(7.448)	(7.661)	(7.776)	(7.809)
Observations	196	191	187	187	187	187
Adjusted R^2	0.030	0.380	0.509	0.528	0.531	0.529

Standard errors in parentheses

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

The coefficient for the Freedom House score fluctuates in Table 7. While negative in the first column, it becomes positive in subsequent columns: a one-unit increase in GFS is associated with either a 3.95% decline or a 5.39% increase in log doses per million received. It is also noteworthy that the coefficients of the other variables remain mostly the same as those from the Table 6 regression in their magnitude and direction: negative for GDP per capita, component 1, and distance; positive for component 2. Moreover, existing variables account for the variation in log doses received per capita better than GFS. According to the adjusted R^2 values, while the model with just GFS and log distance explains about 3.0% of the variation in the dependent variable, the fuller model with log GDP per capita and component 1 accounts for over half the variation. The only difference is that the Middle East coefficient becomes statistically insignificant. It is plausible that some unobserved confounders affect the Middle East coefficient.

A sensitivity analysis using Cinelli and Hazlett's *sensemakr* package was used to probe that question. Its coefficient and t-statistic contour plots depict the impact of any omitted variable that is once, twice, or thrice as strong as the GFS in explaining the residual variations in the Middle East and the doses received per capita variables (Cinelli and Hazlett 2020: 48). The plots (Figures 2 and 3) show that the coefficient and statistical significance of the Middle East variable fluctuate when it is subject to the influence of omitted variables. The unstable coefficient and statistical significance could indicate the current U.S. foreign policy's mixed attitude toward the Middle East pre-2023. While the Biden administration continues to engage with Middle Eastern states to contain the influence of Russia and calm rising oil prices amidst the war in Ukraine, it concurrently raises issues irritating them, such as human rights. For instance, President Biden previously vowed to hold Saudi Arabia responsible for the murder of journalist Jamal Khashoggi. However, he met the Saudi Crown Prince Mohammed bin Salman in July 2022 to persuade Saudi Arabia to increase oil production to calm rising energy prices while facing criticism that he was helping rehabilitate the Crown Prince's international image (Baker and Sanger 2022).

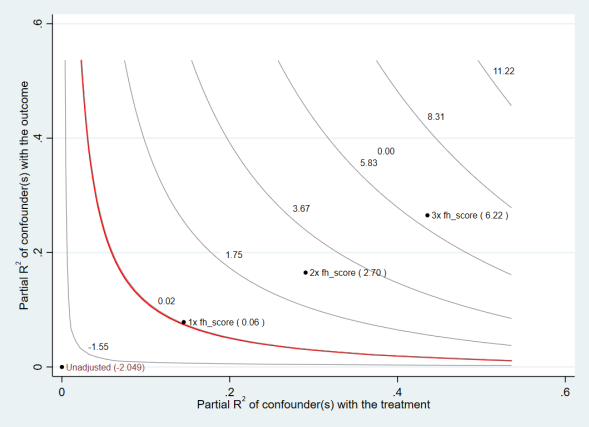

Figure 2: Coefficient Contour Plot, Middle East

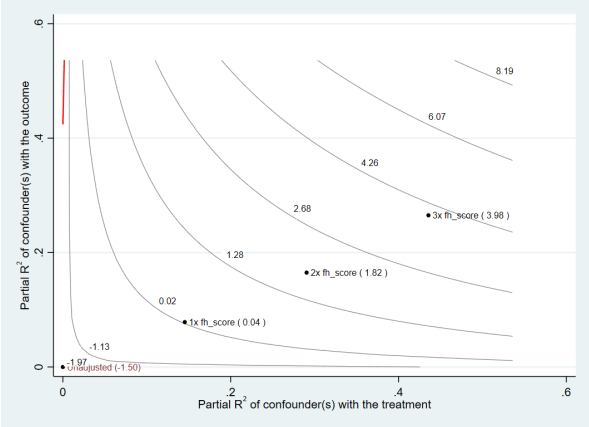

Figure 3: T-statistic Contour Plot, Middle East

Another sensitivity analysis was run to test whether omitted variable bias affects existing variables in the regression. Since the *sensemakr* package works only for binary regressors, GDP per capita is converted into an indicator variable for whether an entity has GDP per capita above the median. The contour plots show that the coefficient and the statistical significance of the binary GDP per capita variable are robust to unobserved confounders with the same or greater strength than the GFS. It is thus unlikely that other confounders could have affected the main results.

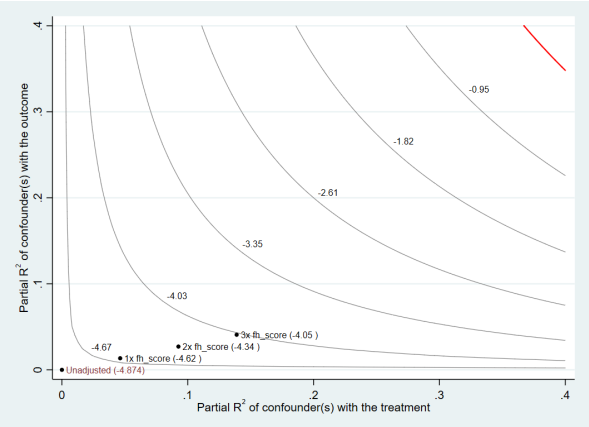

Figure 4: Coefficient Contour Plot, Binary GDP per Capita

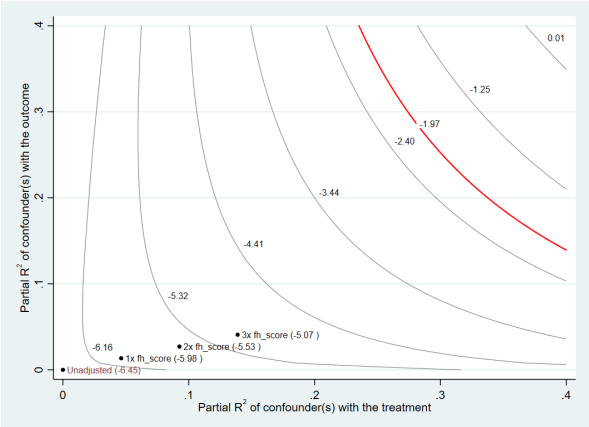

Figure 5: T-statistic Contour Plot, Binary GDP per Capita

5.b Alternative Measures of the Dependent Variable

This section examines whether alternative measures of the dependent variable (doses received) affect the main results. This thesis thus runs the main regression specification on the following formulations of the dependent variable: raw doses per capita, IHS transformed doses per capita, and a binary indicator of dose received using the linear probability model (LPM) and logit model.

5.b.i Raw Doses per Capita

A crude way of measuring the dependent variable is the raw (i.e., non-logged) number of doses per capita. Table 8 shows the results of the regressions with linear measurements of distance, GDP per capita, and doses received per million variables. In column 5, while the signs are the same as those in Table 6, the coefficient of component 2 loses statistical significance. Nonetheless, one would not attach much importance to these results because the dependent variable is highly right-skewed, which means it should be logged.

5.b.ii Inverse Hyperbolic Sine Transformed Doses per Capita

Inverse Hyperbolic Sine (IHS) transformation is an alternative to logging the variable. Table 9 shows the results of the regressions with IHS transformed distance, GDP per capita, and doses received per million variables. While it is challenging to interpret IHS-transformed coefficients, the signs and the statistical significance of the coefficients remain the same as those from Table 6.

5.b.iii Binary Doses Received: Linear Probability Model

One could also examine whether a country has received U.S. doses in investigating the correlates of U.S. vaccine aid. An indicator variable that takes the value of 1 if a country received any vaccines from the United States is thus created. The data is then fit into a linear probability model (LPM). Table 10 shows the results of the LPM regression, in which the coefficients' signs and statistical significance remain the same

as those from Table 6 regression. In interpreting these coefficients, a Middle Eastern country has a 24.1-2% less probability of receiving a U.S. vaccine than a non-Middle Eastern country. Similarly, a 1% increase in GDP per capita is associated with a 16.2% decreased likelihood of receiving a U.S. vaccine.

5.b.iv Binary Doses Received: Logit Model

Instead of LPM, one could fit the data using logistic regression. Table 11 shows the results in an odds ratio format. The signs and the statistical significance of the coefficients remain the same as those from the main regression. For instance, the odds of a Middle Eastern country receiving U.S. vaccine doses is 64.3-5% lower than that of a non-Middle Eastern country.

Table 8: Linear Regression

	(1)	(2)	(3)	(4)	(5)
	Doses Received per Million	Doses Received per Million	Doses Received per Million	Doses Received per Million	Doses Received per Million
Distance, km	-14.07*	-18.80**	-18.86**	-18.27**	-18.23**
	(6.216)	(6.423)	(6.659)	(6.593)	(6.587)
GDP per Capita	-2.599***	-1.279***	-1.281***	-1.017***	-1.019***
	(0.512)	(0.298)	(0.303)	(0.291)	(0.295)
Scores for Component 1		-68797.3***	-68822.9***	-76211.7***	-76186.9***
		(9876.7)	(9862.2)	(10160.9)	(10185.8)
Scores for Component 2			993.5	9309.5	9293.5
			(8802.2)	(7209.8)	(7260.7)
Middle Eastern Country				-183676.4***	-183659.5***
				(31273.8)	(31368.5)
Non-P5 UNSC Member					7844.1
					(56410.3)
Constant	333743.9***	353700.1***	354297.5***	357869.9***	356933.1***
	(63576.7)	(62695.8)	(64676.4)	(64407.9)	(64280.3)
Observations	192	187	187	187	187
Adjusted R^2	0.094	0.198	0.193	0.225	0.221

Standard errors in parentheses

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

Table 9: Inverse Hyperbolic Sine (IHS) Regression

	(1)	(2)	(3)	(4)	(5)
	IHS Doses Received per Million	IHS Doses Received per Million	IHS Doses Received per Million	IHS Doses Received per Million	IHS Doses Received per Million
IHS Distance	-2.976***	-3.308***	-3.667***	-3.411***	-3.406***
	(0.773)	(0.806)	(0.833)	(0.847)	(0.851)
IHS GDP per Capita	-2.839***	-2.060***	-2.141***	-1.932***	-1.935***
	(0.214)	(0.266)	(0.266)	(0.272)	(0.274)
Scores for Component 1		-1.714***	-1.691***	-1.912***	-1.911***
		(0.282)	(0.269)	(0.270)	(0.271)
Scores for Component 2			0.758**	0.904**	0.904**
			(0.269)	(0.278)	(0.278)
Middle Eastern Country				-3.793**	-3.791**
				(1.313)	(1.318)
Non-P5 UNSC Member					0.318
					(0.992)
Constant	63.30***	59.10***	63.33***	59.16***	59.12***
	(8.065)	(8.417)	(8.713)	(8.895)	(8.929)
Observations	192	187	187	187	187
Adjusted R^2	0.383	0.474	0.489	0.507	0.504

Standard errors in parentheses

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

Table 10: Linear Probability Model (LPM) Regression

	(1)	(2)	(3)	(4)	(5)
	Vaccine Received Indicator	Vaccine Received Indicator	Vaccine Received Indicator	Vaccine Received Indicator	Vaccine Received Indicator
Log Distance	-0.211***	-0.236***	-0.268***	-0.251***	-0.251***
	(0.0582)	(0.0626)	(0.0642)	(0.0657)	(0.0660)
Log GDP per Capita	-0.224***	-0.168***	-0.175***	-0.162***	-0.162***
	(0.0164)	(0.0203)	(0.0203)	(0.0208)	(0.0209)
Scores for Component 1		-0.125***	-0.123***	-0.137***	-0.137***
		(0.0218)	(0.0209)	(0.0207)	(0.0208)
Scores for Component 2			0.0661**	0.0754**	0.0754**
			(0.0243)	(0.0253)	(0.0254)
Middle Eastern Country				-0.242*	-0.241*
				(0.113)	(0.114)
Non-P5 UNSC Member					0.0233
					(0.0762)
Constant	4.462***	4.190***	4.532***	4.287***	4.284***
	(0.564)	(0.608)	(0.624)	(0.641)	(0.644)
Observations	192	187	187	187	187
Adjusted R^2	0.396	0.476	0.496	0.507	0.504

Standard errors in parentheses

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

Table 11: Logistic Regression

	(1)	(2)	(3)	(4)	(5)
	Vaccine Received Indicator	Vaccine Received Indicator	Vaccine Received Indicator	Vaccine Received Indicator	Vaccine Received Indicator
Log Distance	-1.323**	-1.587**	-1.823***	-1.785**	-1.784**
	(0.428)	(0.506)	(0.532)	(0.573)	(0.577)
Log GDP per Capita	-1.469***	-1.146***	-1.254***	-1.148***	-1.148***
	(0.235)	(0.226)	(0.253)	(0.243)	(0.243)
Scores for Component 1		-0.835***	-0.827***	-0.996***	-0.996***
		(0.225)	(0.213)	(0.252)	(0.252)
Scores for Component 2			0.517**	0.594***	0.594***
			(0.169)	(0.173)	(0.173)
Middle Eastern Country				-1.645*	-1.643*
				(0.805)	(0.806)
Non-P5 UNSC Member					0.0418
					(0.751)
Constant	25.39***	24.81***	27.90***	26.72***	26.70***
	(5.149)	(5.602)	(6.054)	(6.260)	(6.299)
Observations	192	187	187	187	187

Standard errors in parentheses

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

5.c Other Potential Confounders

This section investigates whether other potential confounders affect the main regression results. Specifically, this thesis studies the crowd-out effect of the recipient states' concurrent use of Russian and Chinese vaccines, the use of HDI and patents per capita as different measures of need, the influence of cultural factors like shared language and religion, the effect of adding Qatar and Colombia as MNNAs, and the effect of imputed GDP per capita.

5.c.i Crowd-out Effect: Use of Russian and Chinese Vaccines

One possible omitted variable is the countries' concurrent use of Russian and Chinese vaccines alongside Western vaccines. Russia and China started donating their vaccines ahead of the United States to developing states. The recipients' use of Russian and Chinese vaccines thus could have curtailed their acceptance of U.S. donations.

Indicator variables for whether a country has administered Russian or Chinese vaccines are included in the regression model, using Mathieu, Ritchie, and Ortiz-Ospina (2021)'s tabulation of types of vaccines administered in every country.[10] Table 12 shows the regression results with the two indicators included. The indicator variables have statistically insignificant coefficients; none of the existing coefficients or their statistical significance changed substantially. These outcomes imply no crowd-out effect from the countries' use of Russian or Chinese vaccines.

One may ask why there is no crowd-out effect. It is likely that as the pandemic unfolded, the countries had no choice but to accept Western donations and forego Russian and Chinese vaccines, albeit for different reasons. Chinese vaccines, such as Sinovac's CoronaVac and Sinopharm's BIBP vaccines, have been criticized for their low effectiveness against the Omicron variant (Dolgin 2022: 311). Thus, countries may have preferred to receive more effective Western vaccines. As for Russian vaccines, the Sputnik V vaccine is quite effective against the Omicron variant (Shkoda et al. 2022: 13). How-

10. The OWID data omits data on Micronesia. According to the VIPER Group COVID-19 Vaccine Development and Approvals Tracker Team (2022), Micronesia has not used Russian or Chinese vaccines. Micronesia is thus coded as having 0 for both indicators.

ever, its production has been severely hindered by the Russian invasion of Ukraine and the subsequent U.S. and European sanctions against the Russian Direct Investment Fund (RDIF) that finances the Sputnik vaccines (Webster 2022). Hence, many countries would not have been able to import Russian vaccines and have no other option but to rely on Western vaccines.

Table 12: Log (+1) Regression with Russian and Chinese Vaccines

	(1)	(2)	(3)
	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million
Log Distance	-3.108***	-3.259***	-3.265***
	(0.816)	(0.807)	(0.817)
Log GDP per Capita	-1.801***	-1.723***	-1.725***
	(0.268)	(0.272)	(0.276)
Scores for Component 1	-1.799***	-1.681***	-1.685***
	(0.262)	(0.276)	(0.277)
Scores for Component 2	0.829**	0.826**	0.829**
	(0.263)	(0.261)	(0.264)
Middle Eastern Country	-3.797**	-3.932**	-3.868**
	(1.302)	(1.252)	(1.301)
Non-P5 UNSC Member	0.192	0.194	0.234
	(0.942)	(0.922)	(0.912)
Has Used Russian Vaccines	0.192		-0.148
	(0.751)		(0.770)
Has Used Chinese Vaccines		1.157	1.202
		(0.786)	(0.808)
Constant	51.15***	51.21***	51.30***
	(8.073)	(7.846)	(8.005)
Observations	185	185	185
Adjusted R^2	0.501	0.508	0.505

Standard errors in parentheses

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

5.c.ii Alternative Measures of Need: HDI and Patents per Capita

One could conceive of a proxy for the need for vaccines as something other than GDP per capita. Two alternatives are the human development index (HDI), which summarizes national income, education level, and life expectancy, and the number of patents issued per capita, a more concrete figure than GDP per capita. Thus, HDI and the number of patents per capita instead of GDP per capita are included in the regression to test these alternative measures. The HDI figures come from the United Nations Development Programme (2021)'s 2020 Human Development Report, while the number of patents per capita comes from the World Intellectual Property Organization (2021)'s 2020 resident applications per million population data.

Table 13 shows the regression results with the two alternative measures of need. The results from the regression with HDI remain relatively the same as the main regression results: doses per capita are negatively associated with log distance, HDI, component 1, and the Middle Eastern indicator while positively related to component 2. The results from the regression with patents per capita are similar to the main results, except that the coefficient of log distance is not statistically significant. Nonetheless, one can expect such divergence in results because over 60 countries lack their patents per capita records and are thus left out of the regression.

Table 13: Log (+1) Regression with HDI and Patents

	(1)	(2)
	Log Doses Received per Million	Log Doses Received per Million
Log Distance	-2.580**	-0.924
	(0.821)	(1.524)
Human Development Index	-15.30***	
	(2.734)	
Scores for Component 1	-1.716***	-2.525***
	(0.292)	(0.268)
Scores for Component 2	0.863**	0.865**
	(0.290)	(0.323)
Middle Eastern Country	-4.667***	-6.461***
	(1.365)	(1.558)
Non-P5 UNSC Member	0.397	-0.229
	(0.944)	(1.183)
Patents per Capita		-791.1**
		(243.0)
Constant	41.76***	15.88
	(7.715)	(13.81)
Observations	186	123
Adjusted R^2	0.444	0.392

Standard errors in parentheses

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

5.c.iii Cultural Affinity: Common Language and Religion

Cultural factors could also influence aid distribution: donors may send the most aid to beneficiaries who share the same language and religion as they do. In their analysis of Western official development assistance to African states, Schraeder, Hook, and Taylor (1998) point out that the "cultural overlay of a particular colonial heritage" in areas such as national language is "recognized as theoretically playing an important role in the contemporary international relations of the African continent, particularly when one is assessing the aid policies of a former colonial power" (305). Of course, the United States did not possess as many colonies as other European states. Nonetheless, one can suspect that the United States might prioritize countries that use English as their official language for ease of communication or that share a religious make-up to appeal to the pathos of the American public. Indicators for whether a country uses English as an official language and the religion proximity index from the Gravity dataset were thus used to test this alternative explanation.[11]

Table 14 shows the results of the regression with the common language indicator (column 1), the religion proximity index (column 2), and both (column 3). The existing variables' sign, magnitude, and statistical significance in all three formulations remain similar to the main regression results. In contrast, while the coefficients of the religion variable are not statistically significant, the coefficients of the common language variable are statistically significant and positive. This result supports the convenience argument that the United States may prefer sending vaccines to Anglophone countries for accessible communication.

11. According to Conte, Cotterlaz, and Mayer (2021), the index is "obtained by adding the products of the shares of Catholics, Protestants and Muslims in the exporting and importing countries. It is bounded between 0 and 1, and is maximum if the country pair has a religion which (1) comprises a vast majority of the population, and (2) is the same in both countries" (13).

Table 14: Log (+1) Regression with Language and Religion Index

	(1)	(2)	(3)
	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million
Log Distance	-3.253***	-2.853**	-2.933***
	(0.760)	(0.882)	(0.813)
Log GDP per Capita	-1.823***	-1.798***	-1.744***
	(0.279)	(0.306)	(0.322)
Scores for Component 1	-1.736***	-1.819***	-1.737***
	(0.271)	(0.261)	(0.273)
Scores for Component 2	0.832**	0.821**	0.777**
	(0.260)	(0.255)	(0.259)
Middle Eastern Country	-3.203*	-3.582**	-3.340*
	(1.269)	(1.368)	(1.392)
Non-P5 UNSC Member	0.240	0.104	0.0239
	(0.999)	(0.923)	(1.006)
Uses English as Primary/Official Language	1.409*		1.588*
	(0.705)		(0.718)
Religion Proximity Index		2.221	0.751
		(3.233)	(3.232)
Constant	52.19***	48.68***	48.68***
	(7.574)	(8.320)	(7.853)
Observations	185	178	176
Adjusted R^2	0.505	0.499	0.502

Standard errors in parentheses

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

5.c.iv Effect of Adding Qatar and Colombia as MNNA

This sub-section examines the effect of adding Qatar and Colombia to the list of major non-NATO allies (MNNA). The MNNA variable with Qatar and Colombia included is put through principal component analysis alongside the other three variables. The PCA generated the following four components:

Table 15: New PCA Results

Component	Eigenvalue	Proportion	Cumulative
New Component 1	1.719	0.430	0.430
New Component 2	1.253	0.313	0.743
New Component 3	0.704	0.176	0.919
New Component 4	0.324	0.081	1.000

Similar to the initial PCA, only components 1 and 2 have eigenvalues greater than 1. They are thus included in the regression.

These are the eigenvectors associated with components 1 and 2, in the order of number of U.S. service members stationed, NATO member, major non-NATO ally with Qatar and Colombia), and UN voting distance: (0.283, 0.672, -0.007, -0.685); (0.626, -0.219, 0.748, 0.036). The entries of these eigenvectors are very similar to those of the original PCA. Furthermore, the coefficients in Table 16 resemble those in the main regression. Hence, adding Qatar and Colombia to the MNNA list does not alter the main results much.

Table 16: Log (+1) Regression with Qatar and Colombia as MNNA

	(1)	(2)	(3)	(4)	(5)
	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million
Log Distance	-2.831***	-3.175***	-3.458***	-3.212***	-3.208***
	(0.734)	(0.765)	(0.786)	(0.798)	(0.802)
Log GDP per Capita	-2.684***	-1.941***	-2.034***	-1.834***	-1.837***
	(0.202)	(0.251)	(0.255)	(0.259)	(0.261)
Scores for New Component 1		-1.646***	-1.612***	-1.831***	-1.830***
		(0.263)	(0.256)	(0.255)	(0.256)
Scores for New Component 2			0.636*	0.797**	0.797**
			(0.249)	(0.259)	(0.259)
Middle Eastern Country				-3.746**	-3.744**
				(1.257)	(1.262)
Non-P5 UNSC Member					0.327
					(0.941)
Constant	56.19***	52.74***	56.08***	52.40***	52.35***
	(7.105)	(7.404)	(7.647)	(7.791)	(7.820)
Observations	192	187	187	187	187
Adjusted R^2	0.382	0.476	0.487	0.506	0.504

Standard errors in parentheses

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

5.c.v Effect of Imputed GDP per Capita

This sub-section investigates the effect of imputed GDP per capita on the regression results. Six countries lack 2019 GDP per capita in the World Bank dataset: Eritrea, North Korea, South Sudan, Syria, the Holy See (Vatican), and Venezuela. They are thus dropped from the regression specification. This thesis imputes the missing figures with the latest available GDP per capita by country in the regression: Eritrea (2011), South Sudan (2015), Syria (2018), and Venezuela (2014). Unfortunately, the GDPs per capita of North Korea and the Holy See are not available in the World Bank dataset for any year. They thus remain excluded from the model.

Table 17 replicates the main table (Table 6) with the imputed GDP per capita. The existing variables' sign, magnitude, and statistical significance remain similar to the main regression results, which thus remain mostly the same whether the missing GDP per capita data points are dropped or included through imputation.

Table 17: Log (+1) Regression with Imputed GDP per Capita

	(1)	(2)	(3)	(4)	(5)
	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million	Log Doses Received per Million
Log Distance	-2.735***	-2.970***	-3.307***	-3.014***	-3.008***
	(0.737)	(0.772)	(0.797)	(0.814)	(0.817)
Log Imputed GDP per Capita	-2.576***	-1.912***	-1.989***	-1.769***	-1.772***
	(0.209)	(0.259)	(0.260)	(0.273)	(0.275)
Scores for Component 1		-1.467***	-1.444***	-1.700***	-1.699***
		(0.280)	(0.272)	(0.275)	(0.276)
Scores for Component 2			0.715**	0.875**	0.875**
			(0.258)	(0.274)	(0.274)
Middle Eastern Country				-4.192**	-4.187**
				(1.380)	(1.384)
Non-P5 UNSC Member					0.479
					(0.951)
Constant	54.24***	50.45***	54.15***	49.91***	49.85***
	(7.148)	(7.416)	(7.678)	(7.896)	(7.925)
Observations	196	191	191	191	191
Adjusted R^2	0.351	0.424	0.439	0.465	0.463

Standard errors in parentheses

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

6 Discussion and Conclusion

This thesis explored the basis for the U.S. decision to donate COVID-19 vaccines to particular countries. It summarized three prevailing theories that could account for U.S. vaccine donations: response to countries' perceived needs, commitment to allies, and quid pro quo. Results confirmed the perceived need hypothesis while qualifying the allies hypothesis and rejecting the quid pro quo hypothesis. The United States primarily donates more vaccines per capita to states with low GDP per capita. Simultaneously, it prioritizes states with sizeable U.S. military presence, major non-NATO allies, and neighbors, while passing over NATO members and Middle Eastern states. These puzzling results call for an explanation of why the U.S. government tempers its humanitarian commitment with foreign policy objectives.

The United States may be heeding the advice of the public health community in its charitable vaccine distribution abroad. Epidemiologists have called for spare vaccine doses to be allocated "to reduce the most premature deaths," not to address geopolitical aims (Bollyky, Murray, and Reiner 2021: 98). Concurrently, the Biden administration has emphasized the central role of science in guiding its COVID-19 policies, as President Biden (2021) echoed, "we know what we need to do to beat this virus: ... Follow the scientists and the science."

However, this theory does not explain why the United States simultaneously donates more vaccines to neighboring states and countries with a substantial U.S. military presence. In fact, the Biden administration may be prioritizing U.S. citizens' welfare by donating vaccines to countries where Americans are most likely to interact with foreign populations. This strategy resonates with the attitude of the U.S. public toward COVID-19 vaccine donations. In a survey of 788 respondents, Guidry et al. (2021) found that while 80.5% of respondents endorsed the United States donating vaccines to low-income countries, 58.9% also agreed that "donations should not occur until at least some threshold of domestic vaccination has taken place" (2454-2455). After all, national governments answer "above all to domestic constituencies" that want "as many vaccines as possible and as fast as possible" (Brown and Rosier 2023: 548).

This promotion of U.S. self-interest can be seen in the positive correlation between doses per capita and component 2 and the inverse correlation between doses per capita and distance. Recalling that component 2 includes states with a substantial U.S. military presence, such as South Korea, one can infer that the United States wants to protect its service members abroad from COVID-19 by vaccinating local nationals with whom they interact regularly. Similarly, the negative distance coefficient could reflect the U.S. desire to protect its citizens by vaccinating foreigners abroad who interact with Americans the most through commerce and tourism, such as Canadians, Mexicans, and people of the Caribbean island nations.

The speculation that the Biden administration heeds the epidemiologists' advice also does not explain why the United States discriminates between allies. Specifically, the question remains why the United States would contribute vaccines to MNNAs but not to NATO members, even after controlling for their national income. This may have been because the MNNA designation reflects codified, non-European U.S. geopolitical priorities that have taken precedence over European matters in recent years, at least before the Russian invasion of Ukraine in February 2022. These interests include deterring Chinese "coercion and aggression" in the Indo-Pacific and curbing Russian and Chinese vaccine diplomacy in Latin America (United States, National Security Council 2022: 5; Gramer 2021). Thus, the Biden administration's COVID-19 vaccine distribution policy exhibits both charity and self-interest.

The conclusion of this thesis aligns with the consensus of the public health literature. In their analysis of COVAX, Bengy Puyvallée and Storeng (2022) find that donors still pursued "national security, diplomatic and commercial interests through vaccine donations" while maintaining a guise of charity (11). Similarly, Fang et al. (2023) deduce from the 15 developed countries' COVID-19 vaccine donation data that "donor countries nevertheless balance humanitarian contribution against foreign policy interests" such as political and economic alignment (8).

This paper contributes to both the international relations and global public health literature. Methodologically, this thesis tests the strength of the main results using

traditional robustness checks and more innovative sensitivity analysis. Practically, it focuses on the donor behavior of the United States in the context of COVID-19 vaccines, a topic often overshadowed by the literature's focus on Chinese vaccine diplomacy (cf. Vadlamannati and Jung 2023; Lee 2023). Most crucially, this paper quantitatively examines the factors that influenced the U.S. decision to give vaccines to particular countries over others, going beyond the normative question of to whom the United States should provide vaccines that pundits have focused on so far.

This thesis points to further avenues for research. Quantitatively, the time dimension in vaccine distribution remains to be explored. In other words, states that received vaccines earlier could matter more politically to the United States than others, especially given the earlier shortage in the supply of vaccines. Qualitatively, the U.S. State Department policymakers can be interviewed or surveyed to investigate their thought processes in determining the recipient of U.S. vaccine doses.

This thesis's conclusion that the United States engages in both charity and self-interest in its vaccine distribution abroad has some critical policy implications. For one, it can affect recipient states' citizens' trust in the United States. In their experimental study of vaccine recipients in South American nations, Barham et al. (2023) elucidate such impact:

> [I]f vaccine diplomacy conveys a country's concern for global public health, effectiveness in addressing public health challenges, or support for a particular recipient country and its population – and citizens interpret the country's motivations for vaccine distribution in this light – vaccine distribution likely will then cultivate trust in the country exercising such diplomacy. ... However, if foreign citizens instead mostly perceive the vaccine-developing country's motives cynically—as serving the foreign country's strategic interests, such as by increasing foreign dependence, profit, and influence—and offered only in exchange for recipient countries adopting specific policy positions, then vaccine diplomacy transforms into coercive power, which might diminish its impact on trust. (Barham et al. 2023: 833-834)

Barham et al. (2023) find vaccine diplomacy can give rise to conflicting feelings of idealism and cynicism among recipients. Specifically, respondents were 4.3 percentage points more likely to believe that the vaccine-developing country pursued humanitarian objectives and six percentage points more likely to think it distributed vaccines "to

increase support abroad" (Barham et al. 2023: 851). The information that the United States has dual intentions could thus dampen pro-U.S. sentiment among the population by appearing hypocritical.

The dual intent of U.S. vaccine aid may also have diminished its overall effectiveness in combating COVID-19. Early in the pandemic, bioethicists advocated prioritizing countries where the distribution of vaccines would minimize the most standard expected years of life lost per dose, thus reducing "foreseeable premature deaths directly or indirectly caused by COVID-19" (Emanuel et al. 2020: 1311). However, the United States' simultaneous focus on fulfilling its geopolitical interests through its vaccine diplomacy may have saved fewer lives. Infectious disease experts also argue that the sluggish delivery of vaccines from high-income to low-income nations spurred more transmissible variants in the developing world, namely the Omicron variant (Oehler and Vega 2022: 133).

Most importantly, the U.S. engagement in both charity and self-interest in COVID-19 vaccine distribution casts an uncertain outlook on multilateral cooperation, not just against future pandemics but also in addressing impending global challenges like climate change. Brown and Rosier (2023) criticize how high-income governments undermined multilateral initiatives like COVAX by turning them into "an instrument through which to distribute their excess supplies, including to countries that they themselves designated for geopolitical reasons" (548). They attribute the high-income governments' actions to "an overwhelming concern for their national self-interest and the well-being of their citizens" in the short term (Brown and Rosier 2023: 545). However, one cannot solely fault a democratic government accountable to its electorate for prioritizing its interests above others. The policy challenge is reconciling these two objectives to achieve a net positive outcome for all.

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