Empowered by Information: Disease Outbreak Reporting at the World Health Organization

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Abstract

International organizations (IOs) can use information dissemination to induce deeper cooperation from states. I investigate the role of the World Health Organization (WHO) in facilitating states' cooperation with the outbreak reporting. States may be reluctant to share outbreak information to avoid border restrictions imposed by the international community. After the Severe Acute Respiratory Syndrome outbreak, the WHO was authorized by the International Health Regulations reform to disseminate outbreak information without states' consent. When states' attempts to conceal outbreaks lead to border restrictions triggered by the WHO's information dissemination, previously uncooperative states become more forthcoming with outbreaks. This is especially true for those facing stronger restrictive measures. Using Disease Outbreak News to measure state cooperation, I find that the reform increased the reporting by states isolated from the U.S. and its allies. Such heterogeneity suggests that delegating information authority to neutral IOs may enhance the influence of powerful countries.

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"It is wrong to be any 'country-centric.' I am sure we are not China-centric. The truth is, if we are going to be blamed, it is right to blame us for being U.S.-centric."

Dr. Tedros Adhanom Ghebreyesus, Director-General of the WHO

1 Introduction

Can international organizations (IOs) facilitate cooperation from states? IOs are generally equipped with expertise but limited material resources to enforce cooperation. This is well illustrated during the Covid outbreak. Despite its expertise in public health, the World Health Organization's (WHO) advice against trade and travel restrictions is frequently ignored by states (Maxmen, 2021), leading to uncoordinated efforts in managing the Covid outbreak (Rauhala, 2020). With a $1.2 billion budget at its discretion, which is equivalent to only one-sixth of the total discretionary budget at the Centers for Disease Control and Prevention (CDC) of the U.S.,[1] the WHO is constrained by the limited options in its toolbox. Can institutional arrangements empower the WHO in facilitating deeper cooperation from states than what its material resources permit?

I argue that the authority over information dissemination to its members empowers the WHO. States may be reluctant to share outbreak information with the WHO in fear of the costly trade and travel restrictions imposed by the international community (Hollyer et al., 2015; Worsnop, 2019; Carnegie and Carson, 2020), leading to delayed responses to outbreaks and an even larger scale of damage. For example, in 2003, during the Severe Acute Respiratory Syndrome (SARS) outbreak, the Chinese government barred the WHO experts from accessing the origin site of illness to avoid the potential border restrictions (Altman and Bradsher, 2003). To prevent such disease concealment, the WHO reformed the International Health Regulations (IHR), an agreement among all member states of the WHO

[1] The calculation is based on the 2019 data in the WHO's Programme Budget Web Portal and the Office of Financial Resources report at the CDC.

to address global health security. One of the key changes in the reform is that it delegates the WHO the authority to disseminate outbreak information to its members without waiting for the outbreak state to confirm first. As such, states anticipate to face border restrictions even if they attempt to conceal diseases. Those who might have been reluctant to disclose do so now more frequently, which is especially true for states who tend to face stronger border restrictions updon disease outbreaks. This explains why the Chinese government proactively reported atypical cases of pneumonia to the WHO at the end of 2019 (Horton, 2020), two months before the WHO declared the Covid-19 outbreak a global pandemic.

I develop a formal model to investigate the impact of the IHR reform on the strategic incentives of states to share or withhold information on disease outbreaks. With a high degree of interdependence in the global system, an outbreak in one country may both directly spread to other countries and indirectly disrupt their political and economic activities (Antràs et al., 2023). To minimize the negative impact of an outbreak, the international community provides resources to mitigate the outbreak and imposes border restrictions to shut the virus out of its territory. When the outbreak state is deeply integrated with the international community, border restrictions become less favorable than resource provision because disruptions caused by trade and travel bans may backfire. As such, states deeply integrated with the international community tend to receive more resources and face fewer restrictions upon a disease outbreak.

Equipped with expertise in public health, the WHO can detect the presence of disease outbreaks but is constrained by its information authority. Before the IHR reform, the WHO cannot unilaterally disseminate the outbreak information to its members. States with shallow integration with the community can successfully conceal the outbreak to avoid those costly restrictions, while states with deep integration with the community proactively report outbreaks to the WHO to benefit from the material support provided by the international community. Hence, before the IHR reform, states less integrated with the international community are more likely to conceal than those with deeper integration.

After the IHR reform, those previously uncooperative states anticipate that the WHO may use information disseminated to trigger costly restrictions ex post and hence become more forthcoming with outbreaks. Therefore, the IHR reform increases the reporting by states with shallow integration with the international community.

To test these implication of the model, I use a difference-in-differences specification where I use the IHR reform as the treatment of the institutional change and explore the variation in state integration with the international community. I use the number of Disease Outbreak News (DONs) as a proxy for state cooperation with disease outbreak reporting. This is because of the outbreak verification procedure at the WHO (Grein et al., 2000), where only reports confirmed by the outbreak country can appear on the DONs webpage, the most frequently visited webpage on the WHO website.

I take three steps to operationalize state integration with the international community. First, I treat the U.S. as the center of the international community and measure a state's integration with the U.S. based on a set of political, economic, and geographic variables. I find that the reform reduced the gap in reporting between states with deep integration with the U.S. and those with shallow integration, signifying the increased reporting from those previously uncooperative states.

Second, I examine state integration with different major powers in the world. The analyses reveal that the increase in reporting is specific to countries with shallow integration with the U.S. and its allies, not those with shallow integration with other major powers, such as China and Russia. As the IHR reform induces more cooperation from countries not integrated with major western powers, such heterogeneity reveals that delegating more authority over information to IOs may not mitigate the political influence of powerful states but rather exacerbate it. Lastly, I consider state integration with the world and find that the increase is specific to state interdependence with the world rather than dependence on the world.

I make three contributions. First, I speak to the literature on state compliance with their obligations under international treaties. The dominant view is that agreements must be self-enforcing if they cannot be enforced by a third party (Simmons, 2010), which implies that IOs without enforcement capacity do not have constraining power over states. Hence, compliance comes from states' self-selection into institutions where they have already been willing to cooperate even without the treaty (Downs et al., 1996; von Stein, 2005). I show that even without its own enforcement capacity, IOs can use information dissemination to trigger outbreak responses from the international community, which deters disease concealment by states and induce deeper cooperation.

Second, the heterogeneous effect of the IHR reform reveals a new mechanism of the indirect influence of powerful actors over IOs (Stone, 2011; Dreher et al., 2019; Vreeland, 2019; Carnegie and Carson, 2019; Clark and Dolan, 2020). Previous studies show that the U.S. can influence the IOs through indirect channels, such as an exchange between the formal and informal power (Stone, 2011), institutional secrecy (Carnegie and Carson, 2019), and bureaucrats' internalization of the U.S.'s preferences (Clark and Dolan, 2020). With interdependence triggering heterogeneous outbreak responses, the IHR reform has more constraining power over states less integrated with the U.S. and its allies. Such heterogeneity suggests that the existing structure of interdependence in the international system is another mechanism of the indirect influence that powerful actors have over IOs. In addition, contrary to our traditional understanding that delegation to neutral IOs reduces the influence of main sharesholders (Abbott and Snidal, 1998; Hawkins et al., 2006), I show that more information authority in IOs may enhance the influence of these powerful actors.

Lastly, I contribute to the understudied literature on global health governance. Existing studies focus on homogeneous responses, such as how information dissemination triggers radical responses (Worsnop, 2017b; Worsnop et al., 2022) and the domestic politics of border restrictions (Worsnop, 2017a; Kenwick and Simmons, 2020), which explain why states conceal disease outbreaks (Kamradt-Scott, 2015; Worsnop, 2019). Incorporating their insights, I examine the institutional design in infectious disease surveillance and reveal the heterogeneous impact of the IHR reform on state cooperation with the reporting of disease outbreaks.

2 Background

2.1 World Health Organization

Established in 1948, the WHO functions as one of the specialized agencies of the United Nations and the coordinating authority on international public health. It is responsible for monitoring public health risks, coordinating responses to health emergencies, and providing technical and material assistance to combat disease outbreaks. The WHO also sets international health standards and guidelines and collects data on global health issues.

Despite the numerous responsibilities to fulfill, the WHO has limited resources to enforce cooperation. It has two primary components of revenues (Kaiser Family Foundation, 2020). One is the assessed contributions, which are set amounts expected to be paid by member state governments, scaled by income and population. Accounting for less than 20% of the total budget, assessed contributions are often used to cover general expenses and program activities. The other component is voluntary contributions, including other funds provided by member states, private organizations, and individuals. 90% of the voluntary contributions are earmarked by donors for certain activities. For example, as the biggest non-state donor, the Bill & Melinda Gates Foundation accounts for more than 10% of total voluntary contributions to the WHO, 60.59% of which are specified for polio eradication from 2018 to 2019.[2] Only 3.9% of all voluntary contributions are fully unconditional and subject to the WHO's discretion. Compared to the $7.4 billion discretionary budget[3] for the CDC of the U.S., the WHO has only about 20% of its $6 billion total budget at its discretion.

[2]The data is obtained from the WHO's Programme Budget Web Portal (http://open.who.int/2018-19/home).

[3]The number is based on the FY 2019 budget obtained from: https://www.cdc.gov/funding/documents/fy2019/fy-2019-ofr-snapshot-508.pdf

2.2 History of the International Health Regulations Reform

The International Health Regulations (IHR) is an agreement among 196 countries to work together for global health security. It was originally named the International Sanitary Regulations (ISR) and was first adopted on 25 May 1951 to prevent the international spread of diseases while minimizing disruptions to trade and commerce. The recognized diseases under this framework were chosen particularly for their disruption to international trade, such as typhus, cholera, plague, yellow fever, smallpox, and relapsing fever. Without significant adjustments over time, ISR was renamed in 1969 as IHR. Despite its long presence, the IHR had been "viewed as ineffective and insipid, were openly derided, and were frequently ignored" (Kamradt-Scott, 2015, p. 101).

In the early 1990s, a series of disease outbreaks, such as the reappearance of cholera in Latin America in 1991, the outbreak of plague in India in 1994, and the Ebola outbreak in Zaire in 1995 (Kamradt-Scott, 2015, p. 106), motivated states to reform the IHR. At the WHA in 1995, states voted to revise and update the IHR. However, it took ten years to complete the revision due to various reasons.[4] It was until the SARS outbreak in 2003 that alerted the international community about the insufficiency of the existing IHR framework and the urgency to finish the revision.

The IHR reform is generally regarded as revolutionary due to its intervention in states' sovereignty. There are two substantive changes in the IHR reform (2005). First, the IHR reform authorized the WHO to report and act based on non-governmental sources of information if the disease outbreak country fails to cooperate. Paragraph 3 of Article 10 in IHR (2005) specifies that WHO "shall offer to collaborate with the State Party" in on-site assessments, and paragraph 4 states that WHO may share the disease outbreak information with other States Parties "when justified by the magnitude of the public health risk". Since 1997, the WHO has established an electronic public health early warning system called the

[4] The reasons include technical problems in syndromic reporting, the lack of enthusiasm from member states, the interruption from the 2001 terrorist attacks, and so on.

Global Public Health Intelligence Network (GPHIN) in collaboration with Canada's Public Health Agency. The GPHIN monitors internet media of different languages to detect potential events that are of public health concern, which is one of the most important sources of non-governmental information. However, before the IHR reform, the WHO did not have the authority to act on the information detected from the GPHIN until it obtained official confirmation from the affected state.

Second, the reform grants the director-general the unilateral authority to declare a Public Health Emergency of International Concern (PHEIC). Such a declaration may trigger restrictive measures from other states and intervenes in national sovereignty. It attracted resistance from member states and delayed the completion of the IHR revision for another year. As a compromise, the reform incorporated more control by the outbreak state in the declaration process, which pushed through the reform efforts. Specifically, the IHR reform requires the director-general to convene an Emergency Committee composed of a group of technical experts with at least one expert being nominated by the disease outbreak country. This gives the outbreak states some control over the PHEIC declaration.[5]

The revised IHR framework was unanimously approved by the Inter-Governmental Working Group (IGWG) at the 58th WHA and has been in effect since 15 June 2007.[6]

3 A Model of Disease Outbreak Reporting

I develop a model to demonstrate how the authority of information dissemination at the WHO affects states' incentive to share or withhold information on disease outbreaks. We are particularly interested in the early stage of disease outbreaks where timely reporting

[5] This paper focuses on the first aspect of the IHR reform because the PHEIC declaration follows a different procedure. There are seven PHEIC declarations: the H1N1 outbreak in 2009, the Polio outbreak in 2014, the Ebola outbreak in West Africa in 2014, the Zika outbreak in 2016, the Ebola outbreak in the Democratic Republic of the Congo in 2016, the Covid outbreak in 2020, and the Monkeypox outbreak in 2022.

[6] Despite the prolonged process of negotiation, I treat the year 2005 as the starting point of the agreement because the SARS outbreak has revealed to the international community the possibility for the WHO to disseminate information without states' consent.

by the outbreak state is crucial for the control of outbreaks. The model features three actors: the leader of the disease outbreak country (L), the agency or the WHO (A), and the international community (C).

3.1 Sequence

Here is the sequence of the model:

1. Nature determines that the outbreak is severe with probability ψ: $Pr(\theta = 1) = \psi$.
2. L decides whether to report the outbreak to A ($r_L = 1$) or not ($r_L = 0$).
3. A decides whether to disseminate the outbreak information to C ($r_A = 1$) or not ($r_A = 0$).
4. C provides resources $m \in [0, 1]$ to L for disease mitigation and imposes trade and travel bans $b \in [0, 1]$ to prevent the disease from entering its territory.

3.2 Payoffs

Knowing that C may respond to an outbreak by providing resources and imposing bans, Leader L decides whether to allow A to report the outbreak to C. L's utility function is as follows:

$$U_L(r_L) = -\underbrace{\theta(1-m)}_{\text{Disease damage}} - \underbrace{b}_{\text{Costs from ban}}$$

First, when there is an outbreak, L suffers from the damage caused by the outbreak, while the resources provided by C can mitigate L's costs of outbreak damage. Second, since C may impose restrictive measures, L also suffers from the disruption caused by the bans.

As an agency specializing in public health, A aims to control the disease's spread. Its utility function is as follows:

$$U_A(r_A) = \underbrace{-\theta(1-m-b)}_{\text{Disease control goal}} - \underbrace{p\mathbb{1}\{r_L \neq r_A\}}_{\text{Overriding costs}}$$

Given its limited resources, what A can do to control the outbreak is to use information dissemination to trigger outbreak responses by the international community. Since both resources and bans have a constraining effect on disease spread, the achievement of A's disease control goal depends on the magnitudes of resources m and bans b.[7] However, as information dissemination without states' consent is regarded as an intervention in states' sovereignty, A incurs an overriding cost if it reports outbreaks to C without L's approval. The parameter of interest is $p \in [0, 1]$, which captures the level of information dissemination authority that the institutional design grants to A. As such, we may use a decrease in p to represent the IHR reform, which grants the WHO greater authority over information dissemination.

Suffering from the outbreak spillovers, C uses resource provision and ban imposition to minimize the outbreak damage, which is represented in the following utility function:

$$U_C(m, b) = -\underbrace{\theta(1-m-b)}_{\text{Disease damage}} - \underbrace{\alpha(\theta(1-m)+b)}_{\text{Damage due to linkage}} - \underbrace{(k_m(m)+k_b(b))}_{\text{Costs for resource and ban}}$$

First, the outbreak causes direct damages to C if the outbreak spreads outside of L's territory. By giving resources and imposing bans, C can reduce the direct damages of the outbreak. Second, with interdependence in political and economic activities among states, the disruption by an outbreak in one country may lead to disruption in other countries if they have deep integration with each other (Antràs et al., 2023). For example, due to the prevalence of fragmented production, the temporary shutdown of firms in L can disrupt the operations of firms in the same supply chain in other countries. Conceptualizing interde-

[7] To simply the math, I assume that resources and bans have an additive effect on disease control.

pendence as the mutual sensitivity in payoff structures, I assume that C internalizes the utility of L when considering the indirect damage of the outbreak. To measure how strong C is affected by the disruption in L's territory, I use the parameter $\alpha \in [0, 1]$ to capture L's integration with C, which is the key parameter of interest in this model.

Lastly, C incurs costs of resource provision and ban imposition which are represented in the following cost functions respectively:

$$k_m(m) = \gamma m^2 + \varepsilon_m \mathbb{1}\{m > 0\}$$

$$k_b(b) = \lambda b^2 + \varepsilon_b \mathbb{1}\{b > 0\})$$

γm^2 and λb^2 correspond to the material costs of resources and bans,[8] while $\varepsilon_m \mathbb{1}\{m > 0\}$ and $\varepsilon_b \mathbb{1}\{b > 0\})$ are the administrative costs once any resources or bans are provided.[9]

3.3 Information Set

The model focuses on the early stage of a disease outbreak. I assume that both L and A observe θ, while C does not. First, the direct interaction with early cases of the disease makes L more informed about the severity of an outbreak. Second, I assume that A's expertise in public health surveillance allows it to observe the outbreak. This assumption focuses our attention on the institutional role of information dissemination and abstracts away from the informational component in A's message.[10] Lastly, I assume that C cannot observe θ and

[8] I assume that $\gamma > \lambda$. This is consistent with the argument that ban imposition is less costly than resource provision and is a more domestically attractive option for political leaders (Kenwick and Simmons, 2020).

[9] To ensure a corner solution in C's equilibrium strategy, I include these administrative costs with certain constraints. $\varepsilon_m + \varepsilon_b \leq \frac{(1+\alpha)^2}{4\gamma} + \frac{(1-\alpha)^2}{4\lambda}$ ensures that C's outbreak responses are not deterred by high administrative costs, and $\varepsilon_m \geq \frac{(1+\alpha)^2\psi^2}{4\gamma}$ ensures that C does not choose a small amount of m and b when there is no sign of disease outbreak. The calculation of these constraints is in Appendix A.1.

[10] To model the circumstances where the WHO does not have the complete knowledge about disease outbreaks, we can include a parameter of a probability that WHO observes the true value of θ. However, adding this parameter would not change the qualitative predction of the model. As such, we assume that the WHO has complete information about the outbreak to simplify the model.

can only make its decision based on L and A's actions. All the other parameters are public information to all three actors.

3.4 Equilibria

The equilibrium concept is weak Perfect Bayesian Equilibrium. The following proposition summarizes the equilibria of the model.[11]

Proposition 1 *Let* $\alpha^* = \frac{\gamma - \lambda}{\gamma + \lambda}$ *and* $\alpha^{**} = \frac{\gamma + \lambda - 2\gamma\lambda p}{\gamma - \lambda}$.

L's reporting strategy is $r_L = \begin{cases} \theta & \text{if } \alpha \geq \alpha^* \text{ or } \alpha \leq \alpha^{**} \\ 0 & \text{otherwise} \end{cases}$.

A's reporting strategy is $r_A = r_L$.

C provides resources $m^* = \begin{cases} \frac{1+\alpha}{2\gamma} & \text{if } r_A = 1 \\ 0 & \text{otherwise} \end{cases}$ *and imposes bans* $b^* = \begin{cases} \frac{1-\alpha}{2\lambda} & \text{if } r_A = 1 \\ 0 & \text{otherwise} \end{cases}$.

C forms its belief about the outbreak severity $Pr(\theta = 1|r_A = 1) = 1$ *and* $Pr(\theta = 1|r_A = 0) = \psi$*, where* $\psi = Pr(\theta = 1)$.

From the equilibria, we can see that C's responses to outbreaks depend on its integration with L. As L's integration with C deepens, C is likely to provide more resources and impose fewer restrictive measures.[12] This result is crucial for our understanding of the decisions by L and A.

Figure 1 illustrates L's reporting strategy with different levels of integration depth with C and information authority in A. The light grey area represents the proactive reporting by L,

[11] The solution to the game is in Appendix A.1.

[12] This is a key assumption of the model. The Covid-19 pandemic provides a good empirical setting to examine this assumption because it allows us to examine the border restriction patterns of all countries, while most disease outbreaks create a selective disease environment, making the inference difficult. Based on the pattern of border restriction imposition at the dyadic level between 2020 to 2021, I find that deeper integration between the dyad decreases the probability of border restrictions (Figure A.1). The result is mainly driven by political alignment measured by the UNGA voting similarity between the dyad and the geographic proximity measured by the distance between the captial cities. More details of this test can be found in Appendix A.2.

which contains two different situations. First, when L is deeply integrated with C ($\alpha \geq \alpha^*$), L anticipates receiving a large number of resources and facing few restrictive measures once C becomes aware of the outbreak. As such, L benefits from A's dissemination of the outbreak information and proactively report the outbreak to A. Second, when L is isolated from C ($\alpha \leq \alpha^*$ and $\alpha \leq \alpha^{**}$), L knows that information dissemination can only lead to strong bans and few resources and wants to conceal the outbreak. However, since A knows that C's restrictive measures are strong enough to contain the outbreak within L's territory, A is willing to override A's reluctance in disclosure and make C aware of the outbreak. Foreseeing strong restrictive measures ex post, L becomes cooperative with the outbreak reporting.[13]

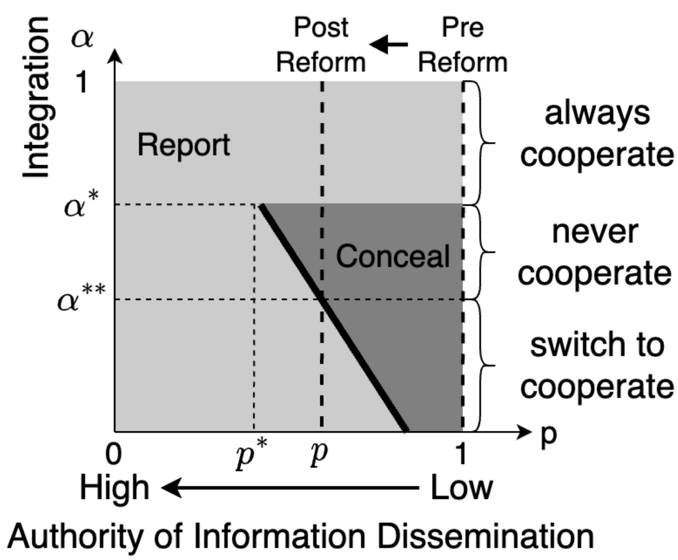

Figure 1: L's Reporting Strategy

The dark grey area in Figure 1 indicates the situation where L conceals the outbreak. When L does not have deep enough integration with C ($\alpha < \alpha^*$), L does not benefit from the information dissemination and has incentives to withhold the outbreak information.

[13]In this case, L is indifferent between reporting and concealing. I assume that there exists a benefit of proactive reporting, which allows states to control what information goes into a report. Another simple way to break the balance is to allow L to randomize, which does not change the qualitative prediction of the model. A more realistic approach is to make the disease paramter θ continous. This allows C to adjust the outbreak responses according to the posterior belief about the outbreak severity. When observing L conceals and A reports, C infers that the outbreak is very severe so that A is willing to incur the overriding cost. As such, the bans are stronger when L conceals and A overrides, which breaks the indifference in L's utility. As this approach may greatly complicate the model without adding insights other than the third-party enforcement mechanism, I keep the simple approach to preserve the model parsimony.

Meanwhile, as L's integration with C is not deep enough ($\alpha > \alpha^{**}$), C's responses to the outbreak are moderate. In A's calculation, it is not worth incurring the overriding costs only to generate a limited effect in outbreak containment. As such, L can successfully conceal the outbreak without the concern of A's information dissemination.

To understand how changes in A's information authority affect L's reporting strategy, the two vertical dashed lines in Figure 1 illustrate a decrease in the value of p, which corresponds to an increase in A's information authority. Moving the vertical dashed line towards the left, we start to see more proactive reporting from L most isolated from C first. As A is granted even greater information authority, we expect more proactive reporting by L with moderate but still relatively shallow integration with C. These changes in L's reporting strategy suggest that delegating more authority of information dissemination to A is most effective in inducing cooperation from L that are most isolated from C.

3.5 Hypothesis

To understand the effect of the IHR reform on the outbreak reporting, I examine the movement of p from 1 to 0, which corresponds to the change from no information authority to complete information authority.[14]

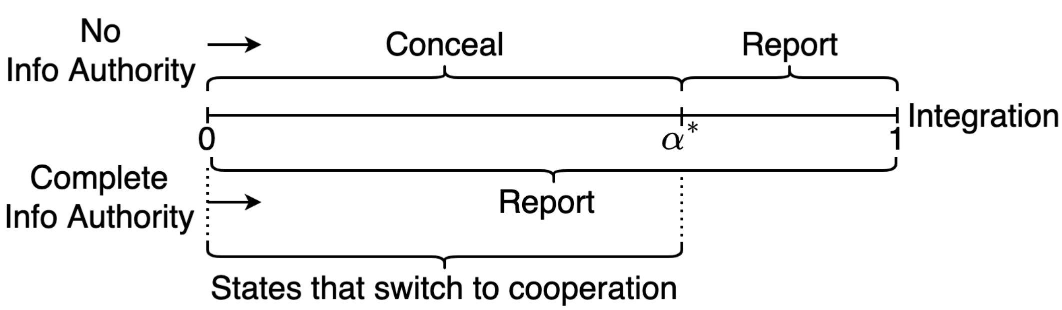

Figure 2: L's Strategy: Comparison Between $p = 1$ an $p = 0$

As Figure 2 shows, before the IHR reform when the WHO cannot unilaterally disseminate

[14] As it is difficult to empirically evaluate how much information authority is delegated to the WHO after the IHR reform, I examine the two most extreme cases of no information authority and complete information authority. Despite the simplification, this comparison captures the model prediction that the IHR reform is most capable of inducing cooperation from states that are least integrated with the global system.

the outbreak information, only states with deep enough integration with the international community report the outbreak. This explains the concealment efforts by the Chinese government during the SARS outbreak in 2003 (Huang, 2004). After the IHR reform allows the WHO to disseminate the outbreak information at its own discretion, those who would otherwise be reluctant to disclose become more forthcoming with the outbreaks, which explains the timely reporting by the Chinese government during the Covid outbreak in 2020 (Horton, 2020).

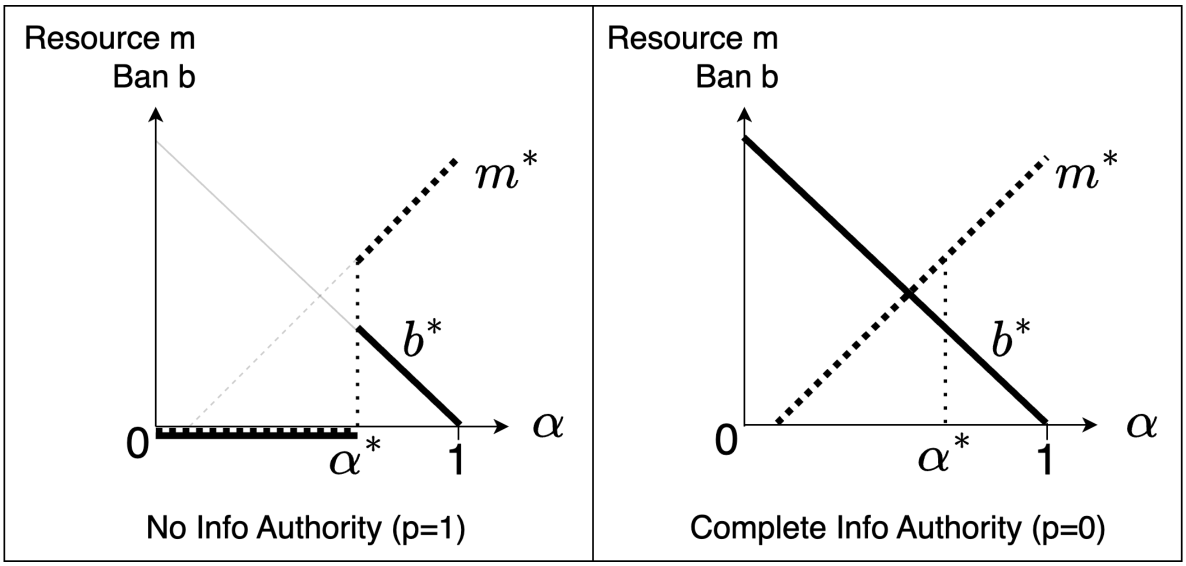

Figure 3: C's Strategy: Comparison Between $p = 1$ and $p = 0$

Figure 3 illustrates the community's outbreak responses under these two extreme scenarios, where the WHO has zero and complete authority of information dissemination. The dotted and solid lines correspond to the magnitude of resources and border restrictions respectively in the equilibrium. The left panel shows the pre-reform world, which is characterized by high resources and low bans for integrated countries only. For isolated countries, as a result of their disease concealment, they do not face the costly bans and limited resources before the reform. In the post-reform world in the right panel, the international community is responsive to disease outbreaks in all countries, but their additional reactions are dominated by restrictive measures with limited resource provision for isolated states.

This comparison provides us with a comprehensive picture of the IHR reform. Arguably, the IHR reform is effective in facilitating cooperation with the reporting of disease outbreaks. However, such benefits come at the cost of stronger restrictive measures, which may disrupt the efficient allocation of medical resources to contain the outbreak.

In the following sections, I describe the empirical test on the following hypothesis:

Hypothesis 1 *The IHR reform induced more outbreak reporting by shallowly integrated states, which would otherwise be reluctant to disclose.*

4 Data

4.1 Disease Outbreak News (DONs)

To measure state cooperation with outbreak reporting, I construct a variable based on the number of disease outbreak news a country has every year. I obtain the data from the WHO's Disease Outbreak News (DONs) webpage[15], which is the most frequently accessed webpage on the WHO website and is a platform where the WHO disseminates officially confirmed information about disease outbreaks of international importance. Because of the outbreak verification process in the WHO, we can use the number of DONs reports to measure cooperation.

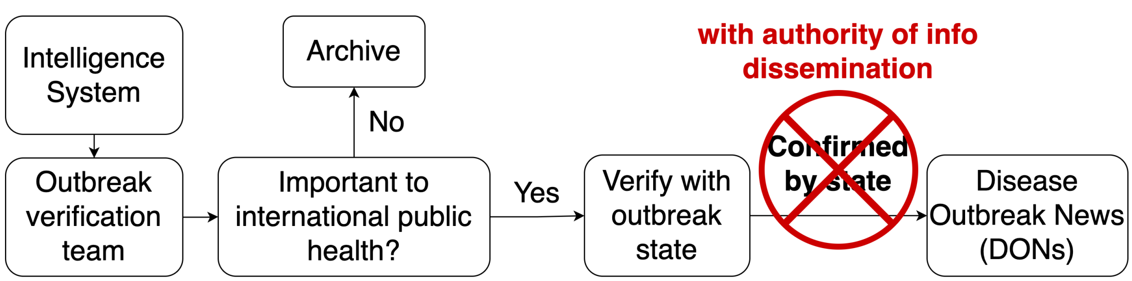

Figure 4: Disease Outbreak Verification System

Figure 4 illustrates the data-generating process of each report on the DONs website (Grein et al., 2000). Based on the GPHIN and other information sources, the system generates

[15] Website: https://www.who.int/csr/don/en/

reports of events that might be of concern. Every day in the morning, a team at the WHO headquarters evaluates the importance of the events. Once an event is deemed important, the outbreak verification team will seek verification from the disease outbreak country. Only upon the receipt of the official confirmation can the WHO post a report on the DONs webpage. In other words, if a state were not cooperative with the confirmation, we would not see the report in the data set.[16] After the reform, the WHO does not need to receive a confirmation by the state to post a report, which recovers a set of reports by previously uncooperative states. Due to this selection process, the number of DONs reports can be a good indicator to capture states' cooperation with the reporting of outbreaks before the reform.[17]

With variations in the contents over time, all reports in the DONs include basic information such as the reporter, disease type, region of the outbreak, and the number of cases. After scraping the website, I obtained a dataset of 2874 reports covering dates from 1996 to May 14, 2020.[18] The left panel of Figure 5 summarizes the over-time change in the number of reports. The spike in 2003 reflects the SARS outbreak, while the spike in 2014 reflects the Ebola outbreak in West Africa and the Middle East respiratory syndrome coronavirus (MERS) outbreak. The right panel shows the most frequently reported disease types.

I also collect the disease outbreak event data from a third-party source: the Global Infectious Diseases and Epidemiology Online Network (GIDEON),[19] a platform mainly used by health professionals and educators for infectious disease diagnosis and reference purposes

[16] For the SARS outbreak, the first DONs report is on February 11, 2003, while the first atypical pneumonia case was reported in Guangdong in China on November 16, 2002. The delayed reporting suggests that had China cooperated with the reporting, a set of reports would have appeared in the data set.

[17] One potential concern with this measure is that the number of reports reflects the agency's information dissemination r_A instead of the state's cooperation r_L. However, as the model shows, $r_A = r_L$ in equilibrium, suggesting that the number of reports can indirectly represent states' cooperation.

[18] To code the disease outbreak countries in each report, I use regular expressions to identify the country name from the headline. For reports that do not identify country names in headlines, I first use the same regular expressions to identify the country names from the report content. Then, I read the contents to verify that the identified countries are the ones that experienced outbreaks. Figure A.2 shows the histogram of the number of countries in each report. Figure A.3 presents the coverage of countries over time. Figure A.4 shows the most frequently reported countries before 2005 and after 2005.

[19] Website: https://www.gideononline.com/. Figure A.6 shows the interface of this database.

in hospitals and universities. Due to its functional nature, the GIDEON dataset provides a relatively less politicized source of the severity of disease outbreaks. We can see from the left panel of Figure 5 that the number of outbreaks is stable over time, while the number of reports varies.

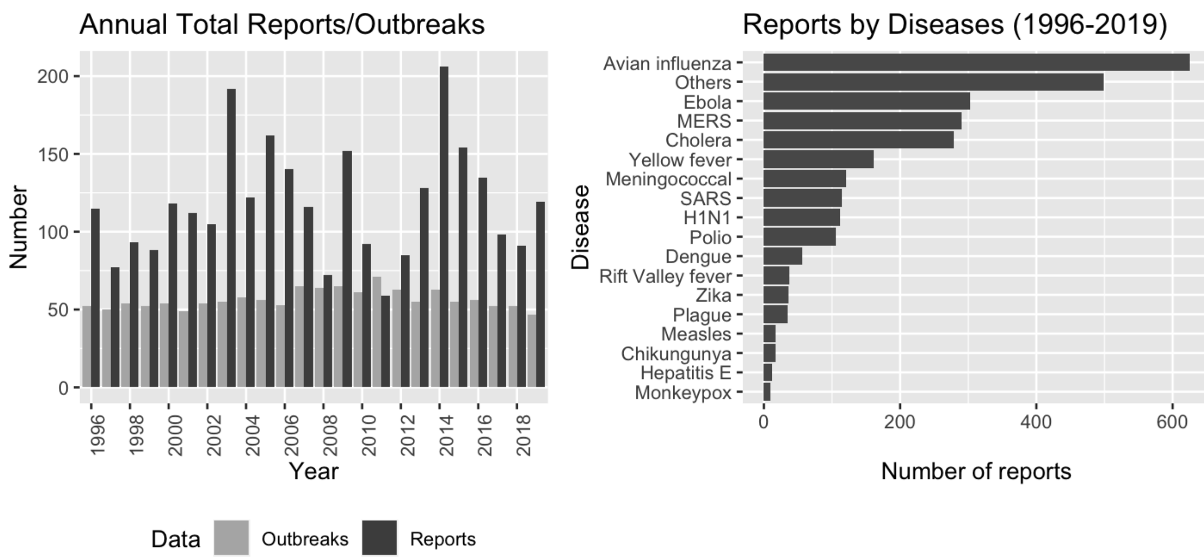

Figure 5: Number of Reports Overtime and Major Disease Types in DONs

To transform the report dataset into a country-year panel, I sum the reports by country and year and balance the panel by coding the missing country-year entries as zero. The final dataset covers 152 countries in the period from 1996 to 2015.[20] As is shown in Table 1, each country has on average 2 reports every year. The maximum number of reports a country receives in a year is 75, which corresponds to the reports on SARS for China in 2003. 69.3% of the country-year pairs have zero reports.

4.2 Integration with International Community

I use a state's integration with the U.S. to measure integration with the international community. Since the U.S. and its allies are the biggest shareholders of the WHO, have great

[20] The reduction in the number of countries and years is due to the availability of the linkage measures and other control variables.

influence in international organizations (Copelovitch, 2010; Dreher et al., 2009b; Stone, 2008, 2011), and are major aid providers, treating the U.S. as the representative of the international community can be a good summary of the international community's responses to disease outbreaks. I construct an integration index based on the political, economic, and geographic integration. First, I use the ideal point estimates based on the voting records at the United Nations General Assembly (UNGA) (Bailey et al., 2017) to measure the political integration.[21] I use the absolute difference of the ideal point estimate between a country and the U.S. to measure political integration. The larger the magnitude, the shallower the integration is.[22] Second, I use the total imports from the U.S. to measure economic integration. Third, to measure the geographic integration, I use the number of seats on direct flights to the U.S.[23] because it captures the capacity of population movement and reflects the geographic integration in the age of massive international travel. To create the Z-score index, I first standardized these three integration dimensions and take the average of the standardized integration scores.[24]

The summary statistics of these three variables are shown in Table 1.

4.3 Regression Specification

I employ the difference-in-differences (DID) specification with the IHR reform as the treatment and explore the variation in the depth of state integration with the U.S. Unlike the standard DID approach, where the control group is not treated and serves as the counterfactual, the treatment in this paper affects all countries but the magnitude of influence varies with the depth of integration with the U.S. Hence, the intuition of this identification strategy is to compare the difference in cooperation between groups that are more sensi-

[21]This measure accounts for the agenda change over time at the UNGA and allows for the inter-temporal comparison of alignment. Thus, it is an improvement to the measurement based on disagreement vote share.

[22]In the regression below, I take the negative value of the ideal point distance to harmonize the signs of the coefficients of different integration variables.

[23]The data is obtained from the U.S. Department of Transportation website: https://www.transportation.gov/policy/aviation-policy/us-international-air-passenger-and-freight-statistics-report.

[24]The results are robust using the first dimension of the principal component analysis (PCA) index.

Table 1: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Median	Max
Outcomes						
N. of DONs reports	2,922	2.163	7.485	0	0	75
N. of DONs reports (travel)	2,922	0.828	3.508	0	0	67
N. of DONs reports (the rest)	2,922	1.334	6.601	0	0	73
N. of outbreak events (GIDEON)	2,922	1.743	2.662	0	1	24
Integration (all standardized)						
Integration index (Z-score)	2,922	−0.052	0.958	−2.649	−0.287	3.088
Ideal point proximity to US	2,922	−0.052	0.958	−2.649	−0.287	3.088
Imports from US	2,922	0.198	0.734	−4.541	0.201	1.783
Seats on direct flights to US	2,922	0.143	1.020	−0.885	0.016	1.788
IGO portfolio similarity with US	2,902	0.038	0.970	−1.959	−0.062	2.041
GVC integration with US	2,612	0.138	0.966	−1.791	0.132	2.420
Total trade with world	2,922	0.172	0.886	−1.914	0.469	1.071
GVC integration with world	2,845	0.048	1.021	−2.890	0.184	1.591
Openness	2,922	0.063	1.003	−1.237	−0.080	7.000
KOF globalization index	2,922	0.061	1.009	−2.183	−0.006	2.169
Other controls						
Polity IV	2,922	3.624	6.294	−10	6	10
HRV transparency index	2,922	0.389	0.965	−0.901	1.105	1.126
UNSC membership	2,922	0.094	0.292	0	0	1
log(1+GDP per capita)	2,922	8.296	1.512	5.218	8.216	11.425
log(total population)	2,922	16.163	1.523	12.792	16.118	21.034
IMF participation	2,922	0.332	0.471	0	0	1

tive to the treatment with the groups that are less sensitive and to identify the differences between these two groups. By assuming that the treatment has a one-directional impact on all groups, meaning that the IHR reform does not reduce the level of cooperation from states with deep integration with the U.S., the identified effect is a conservative estimate of the effect of the IHR reform on state cooperation. The identification assumption is that the trend in the relationship between the depth of integration with the U.S. and the number of DONs reports is the same in the absence of the reform. The regression equation is shown below:

$$log(1 + DONs\ Report_{irt}) = \alpha_t + \gamma_i + \delta_{rt} + \lambda_{it} + \beta_1 Integration_{i,t-1} + \beta_2 Integration_{i,t-1} * Post_t + X_{i,t-1}\Gamma + \varepsilon_{idt}$$

where i, r, and t indicate the country, regional office, and year respectively. The dependent variable is the number of DONs reports in the logarithm. $Integration_{i,t-1}$ represents the integration index based on states' political, economic, and geographic integration with the U.S. The coefficient β_1 identifies the difference in DONs reports between integrated and isolated states before the IHR reform. Ideally, β_1 may inform us of who conceals outbreaks before the IHR reform. However, due to the difficulty to control for the disease environment, it is empirically challenging to make inference about state cooperation from β_1. As the global disease burden is unequally distributed around the world, more DONs reports do not reflect states' cooperation without accounting for the time-varying disease environment. In addition, we cannot use the observed disease incidents to proxy for the disease environment as this variable is endogeneous to states' reporting decisions.

The coefficient of interest is β_2, which corresponds to the interaction term $Integration_{i,t-1} * Post_t$. $Post_t$ is a dummy variable indicating the post-reform period. β_2 identifies the causal effect of the authority of information dissemination on state cooperation with outbreak reporting, which is interpreted as the difference in the gap of reporting between integrated states and isolated states before and after the reform. As we expect the isolated states to increase their reporting after the reform, β_2 is expected to be negative to capture the shrinkage in the gap.

One potential threat to this identification strategy is the bias from omitted variables that covary with the integration index and the DONs reports. To address this concern, I control for year fixed effects α_t, country fixed effects γ_i, and regional office-year fixed effects δ_{rt}. To be more specific, α_t accounts for the over-time change in the WHO's DONs reporting strategy that is not specific to any country. γ_i accounts for the time-invariant country-specific characteristics, such as the geographic conditions that are sensitive to the influence of infectious diseases. δ_{rt} controls for the over-time change in the six regional offices that each country is assigned to. For example, since the regional office plays a critical role in on-site disease verification, the leadership change in a specific regional office may affect the reporting pattern for all countries in this region. Lastly, λ_{it} represents the country-specific time trend and the country-specific quadratic time trend. These terms address the potential spurious correlation issue due to the long time span. The inclusion of the quadratic term captures the nonlinear trend due to the reform.

In addition to the above specifications, I control for a vector of country-year-specific control variables X_{it}. First, as infectious diseases have a close relationship with international trade and travel, I control for the openness of the economy, which is measured as the total import and export volume over the total GDP. As infectious diseases are disruptive to international trade, countries with greater openness are less willing to disclose their outbreak information. Hence, states with greater openness should have fewer DONs reports.

Second, I control for a country's engagement in other international organizations. I control for whether a country is a member of the United Nations Security Council (UNSC). Previous research shows that being on the UNSC creates space for vote-buying (Dreher et al., 2019), which generates not only preferential treatment from the International Monetary Fund (IMF) (Dreher et al., 2009a) and the World Bank (Dreher et al., 2009b) but also pernicious consequences on economic growth and press freedom (Bueno de Mesquita and Smith, 2010). Hence, UNSC membership reduces a country's incentive to obtain support from the WHO in dealing with a disease outbreak and may harm cooperation in the public health arena. In addition, I control for whether a country participated in any IMF programs. Stubbs et al. (2017) argue that IMF conditionality reduces the fiscal space for investment in health systems, which may undermine the ability to cope with infectious disease outbreaks (Kentikelenis et al., 2015). The amount of DONs reports may increase as a result of the low capacity to deal with the outbreak.

Lastly, I control for the regime type to account for the fact that democracies have a stronger domestic mechanism to induce compliance (Dai, 2005). I also control for GDP per capita and population size to account for the general conditions. The summary statistics of these control variables is in Table 1.[25] All the independent variables are lagged for one year to avoid simultaneity bias.

5 Results

5.1 Baseline Results

Table 2 reports the baseline results. Columns (1) only controls for the basic set of controls, including state fixed effects, year fixed effects, and state-specific time trends. Columns (2) adds the set of control variables mentioned in the previous section. Columns (3) includes the regional office-year fixed effects and state-specific quadratic time trend. Across all these specifications, we find statistically significant negative coefficient estimates for the interaction term between integration with the U.S. and the post-reform indicator. This suggests that after the IHR reform, states less integrated with the US increased their reporting, which shrinks their gap in reporting with those integrated states.

To examine which dimension of integration drives the results in Table 2, the first column of Figure 6 shows the coefficient estimates of the political, economic, and geographic integration using the specification in Column (3) in Table 2. We can see that the results with political integration with the U.S. are most consistent with the second hypotheses.

5.2 Placebo Test

One potential threat to the above results is that the pattern could be driven by the actual disease severity rather than state cooperation with outbreak reporting. The integration index might correlate with other factors that influence how much resources a country invests

[25] Table A.15 presents the data sources of these variables.

Table 2: Integration with US and Disease Outbreak Reports/Events

	Dependent variable:					
	log(1 + DONs reports)			log(1 + Outbreak Events)		
	(1)	(2)	(3)	(4)	(5)	(6)
Integration with US	−0.009	−0.002	0.093	−0.038	−0.020	0.001
	(0.064)	(0.066)	(0.094)	(0.050)	(0.049)	(0.062)
Integration with US * Post2005	−0.158**	−0.182***	−0.317***	0.035	0.036	0.053
	(0.065)	(0.065)	(0.111)	(0.036)	(0.036)	(0.055)
State FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	N	N
State-specific time trend	Y	Y	Y	Y	Y	Y
Control	N	Y	Y	N	Y	Y
Office-Year FE	N	N	Y	N	N	Y
State-specific quadratic time trend	N	N	Y	N	N	Y
Observations	2,922	2,845	2,845	2,922	2,845	2,845
R^2	0.487	0.496	0.657	0.711	0.711	0.749
Adjusted R^2	0.424	0.432	0.570	0.675	0.674	0.685

Note: *p<0.1; **p<0.05; ***p<0.01
Standard error clustered at the country level in parentheses.

in public health facilities and hence how likely a country experiences disease outbreaks. To address this concern, I conduct a placebo test using the number of outbreak events as the dependent variable. If the DONs reports reflect the actual severity of disease outbreaks, we should observe a similar pattern as the first three columns in Table 2 show.

Using the number of outbreak events from the GIDEON database as the dependent variable,[26] the last three columns in Table 2 presents the result. The previous pattern disappears. The IHR reforms increased the number of outbreak events for states more deeply integrated with the U.S. These results suggest that the disease outbreak reporting process might be politicized.[27] The second column in Figure 6 shows the placebo test using the breakdown of the integration index.

[26] Although the GIDEON database covers the number of cases for each outbreak, there is a serious missing data issue, making it difficult to verify the actual level of severity. As a compromise, I use the number of outbreaks to capture the baseline severity of disease outbreaks.

[27] As the number of diseases outbreak events is a post-treatment control, I do not control for it in the baseline setting. However, as is shown in Table A.6, the baseline results still hold after controlling for this variable.

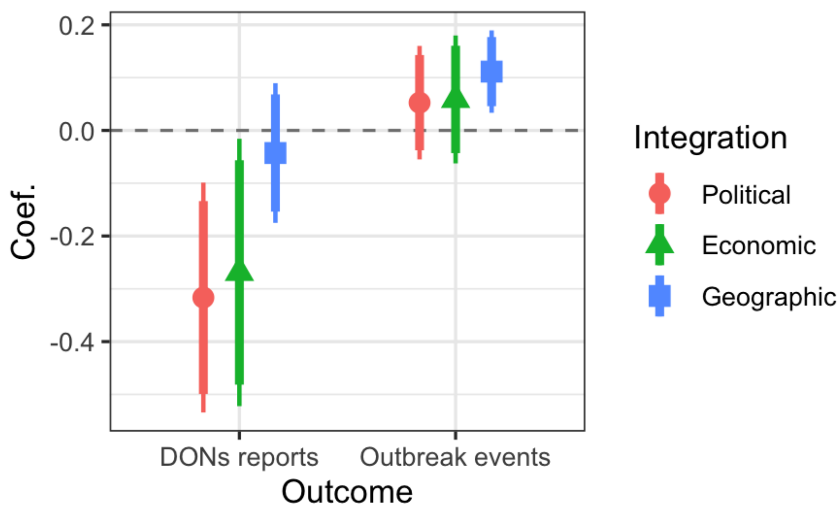

Figure 6: Which Dimensions of Integration Matters?

5.3 Mechanism Check

To further examine the mechanism of the argument, I explore the variation of disease types in DONs reports. The model shows that the international community can provide the third-party enforcement, which empowers the WHO. As such, we expect to see changes in states' reporting patterns in outbreaks that can potentially trigger the community's responses. Diseases with high transmissibility may receive more radical responses, while whether vaccines are available may also affect how concerned the international community is with the outbreak. Hence, we expect to see states' reporting patterns to be consistent with the model prediction for outbreaks with high transmissibility or without a vaccine.

However, the empirical challenge is the lack of a measurement to capture these features of different diseases. As a compromise, I use the list of diseases published on the Traveler's Health webpage on the CDC website,[28] which aims to provide citizens with information about specific diseases that are relevant to travel. I use the term travel-related diseases to indicate the diseases listed on this webpage. After categorizing the disease in each DONs report into travel-related diseases and the rest of diseases, I aggregate the reports to the

[28] Website: https://wwwnc.cdc.gov/travel/diseases

country-year level. The summary statistics of these two variables are shown in Table 1. If the third-party enforcement mechanism is correct, we expect to see more reporting from isolated countries only for travel related diseases and not for the rest of diseases.

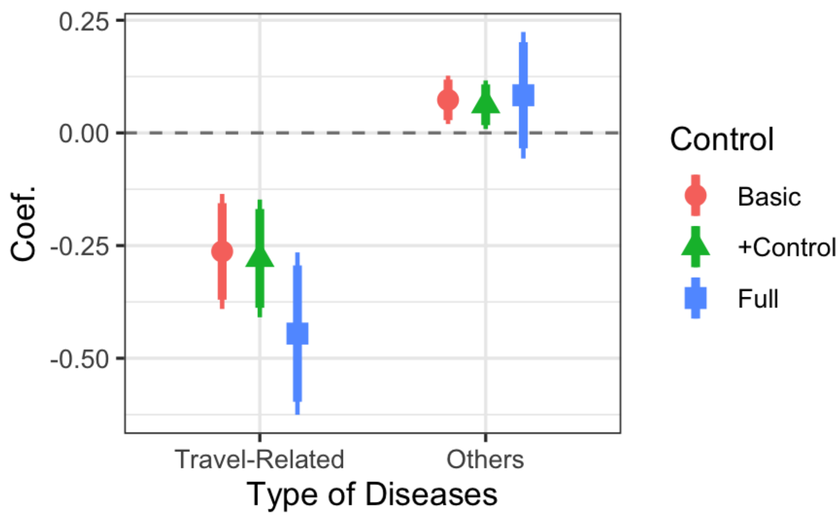

Figure 7: Mechanism Check

Figure 7 shows the results with two different sets of DONs reports as the dependent variable. The first column shows the coefficient estimate of the interaction term β_2 using DONs reports on travel-related diseases. We see that the coefficient estimates are significantly negative and become stronger as we include more controls. In addition, we do not see a similar pattern for other types of diseases. Instead, we find that the gap in reporting on other diseases increased between integrated and isolated states. These results suggest that the deterrent effect of the WHO's information dissemination depends on the presence of the third-party enforcement mechanism. For the rest of the paper, I use DONs reports on travel-related diseases as the dependent variable as this outcome is a more precise test of the model.

5.4 Pre-Trend Analysis and Robustness Checks

To test the parallel trend assumption, Figure 8 presents the coefficient estimates of a vector of year dummies interacted with the integration index. As the negotiation over the IHR reform started in 2005, I use the year 2004 as the reference group. The results show that before the IHR reform, deeper integration insignificantly increased DONs reports,[29] indicating the absence of the pre-trend. Immediately after the reform, we see that the reports from states less integrated with the U.S. started to increase until 2010.[30]

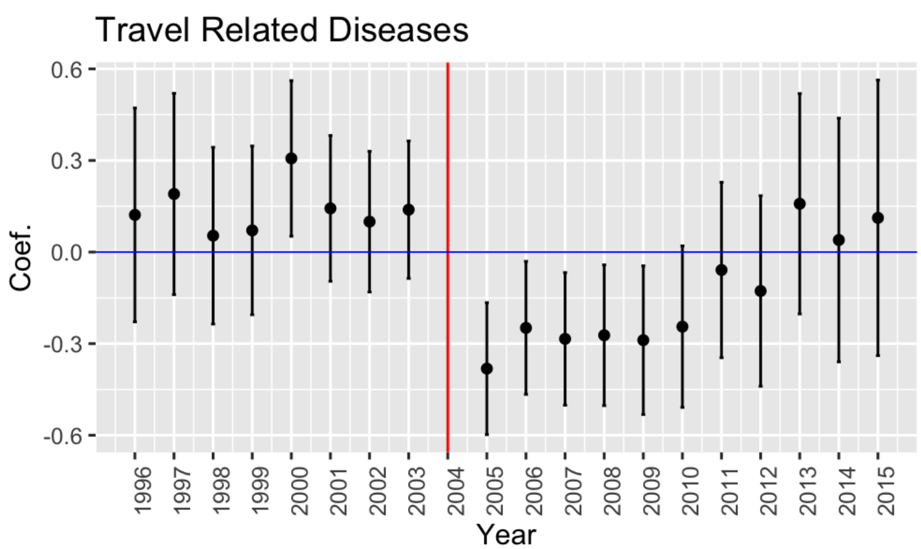

Figure 8: Pre-trend Analysis

I conduct the following robustness checks. First, one alternative explanation is that the IHR reform may have a heterogeneous effect on different regime types. As democracies are more cooperative (Mansfield et al., 2002) and have a stronger domestic enforcement mechanism of compliance (Dai, 2005), the reform may have a greater impact on autocrats'

[29]The spike in 2000 is mainly driven by the ebola outbreak in Uganda, which is politically distant from the US.

[30]There are two potential explanations for why the effect dissipated. One explanation could be that the H1N1 outbreak in 2009 and 2010, which was originated in Mexico and had a big exposure in the U.S. and countries closely integrated with it, crowded out the health capacities dealing with other outbreaks. Another explanation could be that states learned over time that the WHO would not easily override due to its need to work with the outbreak country government to investigate the outbreaks. As such, states adjust their reporting decisions accordingly. Despite the potential adjustment due to the learning mechanism, we still observe about six years' impact of the IHR reform on states' reporting behaviors.

behavior. Table A.7 examines the heterogeneous effect of the IHR reform on regime types and finds that the reform increases the number of DONs of reports in democracies after the reform, which is inconsistent with the model prediction. Still, the baseline results become stronger after controlling for the heterogeneous effect of democracy. Second, the transparency level may affect how states respond to the IHR reform. As the reform may have a ceiling effect on states with high transparency levels, the reform may increase the reporting by states with a relatively low transparency level. Using the HRV transparency index (Hollyer et al., 2014), Table A.8 shows that states with low transparency conceal disease before the reform but become more forthcoming after the reform. Meanwhile, the baseline results still hold after controlling for transparency. Lastly, to make sure the results are not driven by the outbreak of MERS in Saudi Arabia and other outbreaks in China, I exclude Saudi Arabia and China, both separately and altogether, from the regression, and the results still hold.[31]

5.5 Is this about the U.S.?

So far, we have only examined a state's integration with the U.S., but the U.S. may not be a good representative of the international community. As such, I expand the center of the international community to other powerful states in the international arena. The first group is the western powerful countries, such as the U.K., France, and Germany. The second group is other major powers, such as China and Russia. For the political dimension, I use a state's integration with these countries based on the ideal point similarity based on the UNGA voting records and the inter-governmental organization (IGO) portfolio similarity (Voeten, 2021). The former captures a state's ideological similarity with these powerful states, while the latter is a behavior measure and captures the shared commitment to international cooperation among states (Copelovitch and Powers, 2021). For the economic dimension, I use the dyadic global value chain (GVC) integration collected from the UNCTAD-Eora Global Value Chain Database (Casella et al., 2019) to measure a state's integration with the globally

[31] The results are shown in Table A.9.

fragmented production process. This measure captures how much value a country added to the production chain.

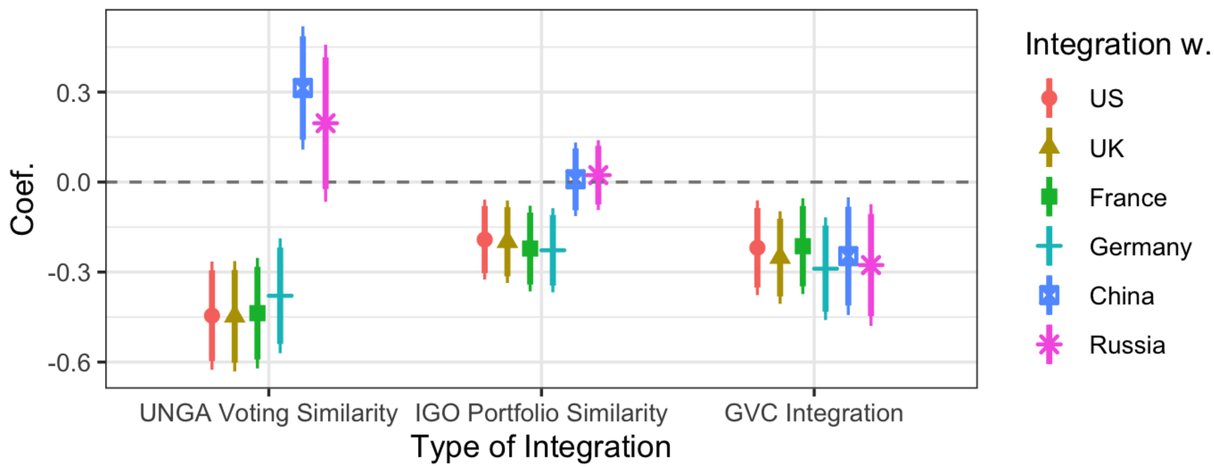

Figure 9: Integration with Powerful Countries

Figure 9 shows the coefficient estimates based on the regression specification in Column (3) in Table 2 using DONs reports related to travel as the dependent variable. For the political dimension, the results with the UNGA voting similarity and the IGO portfolio similarity both show that the increase in reporting induced by the IHR reform is specific to states less integrated with the U.S. and its allies, not those less integrated with China and Russia. These results suggest that the IHR reform has greater constraining power over states that are politically distant from the U.S. and its allies, signifying an indirect form of influence that powerful states have over the WHO. This also suggests that delegating more information authority to IOs may enhance the influence of powerful states, which is contrary to the conventional wisdom that IO independence reduces the influence of powerful actors (Abbott and Snidal, 1998; Hawkins et al., 2006).

For the economic dimension, since all these six countries are highly integrated into GVCs, the IHR reform increased the outbreak reporting by states who are not integrated with all these six countries. This suggests that the IHR reform has greater constraining power over states economically isolated from the international system.

Lastly, I conduct a similar test using different measures of integration with the world. I consider states' dependence on world economy measured by total trade volume and openness. I also examine a state's interdependence with the global system, which is measured by GVC integration with the world, and the KOF globalization index (Gygli et al., 2019). Figure 10 presents the results. We do not find a pattern that supports the model prediction when using economic dependence—such as total trade and openness—as the measure of integration. However, for interdependence measures like GVC integration and globalization, we do find that states with low interdependence become more forthcoming after the reform, revealing the important role of interdependence in shaping the heterogeneous outbreak responses.

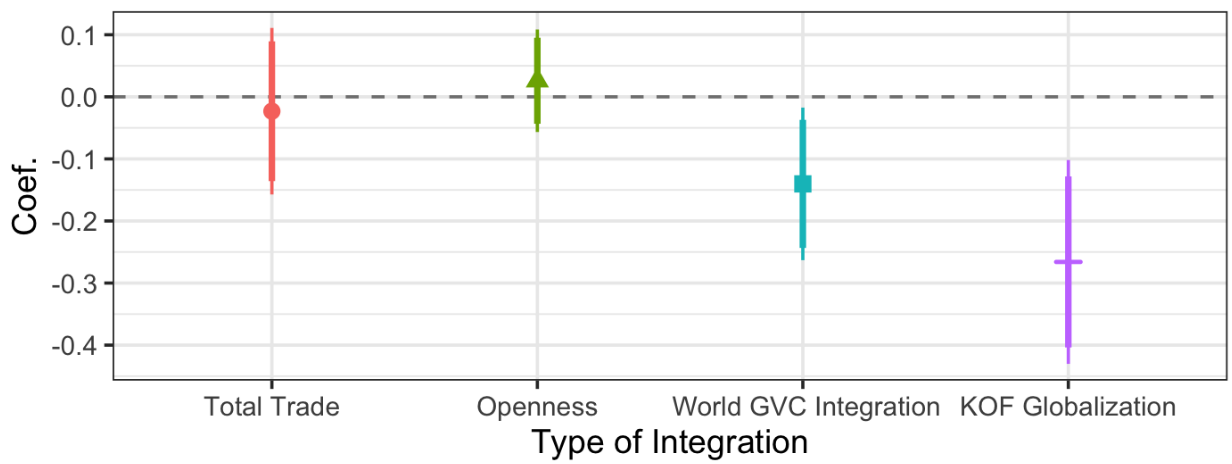

Figure 10: Integration with the World

6 Conclusion

Can IOs facilitate deeper cooperation from their members? I provide an institutional answer and show that the authority over information dissemination to their members empowers IOs to facilitate deeper cooperation from states.

I examine the role of the WHO in facilitating state cooperation with the reporting of outbreaks. As information dissemination of disease outbreaks may trigger trade and travel bans imposed by the international community, the outbreak state has incentives to conceal the outbreak. Once authorized to disseminate outbreak information to the international community, the WHO can leverage responses from the community, which serves as ex-post cost on information withhold and deters noncompliance. More importantly, such enforcement depends on the depth of integration that the outbreak state has with the international community. Deeper integration means that the international community is better off providing resources than imposing border restrictions. As such, the WHO can trigger strong restrictions on states less integrated with the international community, which effectively deters their attempt to conceal outbreaks.

The empirical results support the argument. Before the IHR reform, states less integrated with the U.S. had fewer outbreak reports, confirming the presence of outbreak concealment. The IHR reform increased the reporting from states with shallow integration with the U.S. In addition, the increase in cooperation is specific to countries less integrated with the U.S. and its allies, suggesting that the existing interdependence structure determines the scope of cooperation that information dissemination allows the IO to facilitate.

Given the difficulty in delegating more power to multilateral IOs (Hawkins et al., 2006), why did countries less integrated with the U.S. and its allies agree to the IHR reform? As the IHR reform forces these states to change their behavior and cooperate more, these states may have incentives to withdraw from the WHO. Two reasons might explain why the withdrawal did not happen. The first reason is reciprocity. Given the risk of future disease outbreaks in other countries, states with shallow integration with the U.S. expect other countries to share information with the WHO, which generates long-term benefits of control over outbreaks from outside and may make up for the short-term costs of cooperation. The second reason is the lack of exit options. In addition to its role in infectious disease surveillance, the WHO also plays an important role in the harmonization of medical standards and health-related research. As the overall benefits from being a member of the WHO may still exceed the costs of the changes in the IHR reform, isolated states choose to stay even though the IHR reform requires more cooperation from them.

Despite these optimistic findings, deeper cooperation comes at a cost of greater politicization at the WHO. The political dimension of the heterogeneous effects of the IHR reform may generate tensions among states with different ideologies in the WHO, which makes the WHO —a technical IO with a neutral stance—an arena where powerful states aim to shape the international order in their favor. This may explain why the WHO is faced with increasing criticism for its collaboration with the Chinese government during the Covid outbreak. An understanding of such political tension created by the IHR reform will be crucial for the next round of the IHR reform and the negotiation over a pandemic treaty at the WHO in the post-Covid era.

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A Appendix

A.1 Solution to the Model

For C, FOC:

$$Im = \frac{dU_C(m,b)}{dm} = \theta + \alpha\theta - 2\gamma m = 0$$

$$Ib = \frac{dU_C(m,b)}{db} = \theta - \alpha q - 2\lambda b = 0$$

$$m = \frac{\theta(1+\alpha)}{2\gamma}$$

$$b = \frac{\theta - \alpha}{2\lambda}$$

Therefore, m is increasing in α, and b is decreasing in α.
When C believes that $\theta = 0$, $m = b = 0$.
When C believes that $\theta = 1$, $m = m^* = \frac{1+\alpha}{2\gamma}$ and $b = b^* = \frac{1-\alpha}{2\lambda}$.

Knowing how C behaves, we now turn to A's decision-making process, which includes two situations.

A.1.1 A Does Not Incur the Overriding Cost

When L allows A to disseminate information, A does not incur the overriding cost and only transmits a message from L to C.

- Separating equilibrium: $r_L = \begin{cases} 1 & \theta = 1 \\ 0 & \theta = 0 \end{cases}$

$$\begin{cases} E(r_L = 1|\theta = 1) \geq E(r_L = 0|\theta = 1) \\ E(r_L = 1|\theta = 0) \leq E(r_L = 0|\theta = 0) \end{cases}$$

$$\begin{cases} -(1-m^*) - b^* \geq \mu(-(1-m^*) - b^*) + (1-\mu)(-1) \\ -b^* \leq \mu(-b^*) + (1-\mu)0 \end{cases}$$

Simplify the equations, we have $(1-\mu)(m^* - b^*) > 0$.

Plug in m^* and b^*, we get $\alpha \geq \frac{\gamma - \lambda}{\gamma + \lambda} = \alpha^*$ and $\mu = 0$.

- Pooling equilibrium: $r_L = 0$

$$\begin{cases} E(r_L = 1|\theta = 1) \leq E(r_L = 0|\theta = 1) \\ E(r_L = 1|\theta = 0) \leq E(r_L = 0|\theta = 0) \end{cases}$$

In this case, $\alpha < \alpha^*$ and $\mu = \psi$, where $\psi = Pr(\theta = 1)$.

- Pooling equilibrium $r_L = 1$ does not exist.
- Separating equilibrium $r_L = \begin{cases} 0 & \theta = 1 \\ 1 & \theta = 0 \end{cases}$ does not exist.

Therefore, we obtain that when $\alpha \geq \alpha^*$, A does not incur any overriding costs and can simply act based on what is the best for the disease control: $r_A = \begin{cases} 1 & \theta = 1 \\ 0 & \theta = 0 \end{cases}$.

A.1.2 A Incurs the Overriding Cost

When $\alpha < \alpha^*$, L will not allow A to disseminate the information. A has to balance the tradeoff between the disease relief provided by C if it disseminates the information and the overriding costs of ignoring L's disapproval. Only when A's report can induce enough m and b to contain the disease will A be willing to suffer the overriding cost p.

When $\theta = 0$, $r_L = 0$. A does not need m or b: $r_A = 0$. Thus, when $r_A = 1$, C can infer that $\theta = 1$.

- Separating equilibrium: $r_A = \begin{cases} 1 & \theta = 1 \\ 0 & \theta = 0 \end{cases}$

$$\begin{cases} E(r_A = 1|\theta = 1) \geq E(r_A = 0|\theta = 1) \\ E(r_A = 1|\theta = 0) \leq E(r_A = 0|\theta = 0) \end{cases}$$

$$\begin{cases} -(1 - m^* - b^*) - p \geq \mu[-(1 - m^* - b^*)] + (1 - \mu)(-1) \\ -p \leq \mu(0) + (1 - \mu)0 \end{cases}$$

After simplifying the equations, we get $(m^* + b^*)(1 - \mu) \geq p$

Based on Bayes' rule, $\mu = \dfrac{0 * \psi}{0 * \psi + 1 * (1 - \psi)} = 0$

After plugging m^* and b^*, we have

$$\frac{1 + \alpha}{2\gamma} + \frac{1 - \alpha}{2\lambda} \geq p$$

We got $\alpha \leq \dfrac{\gamma + \lambda - 2\gamma\lambda p}{\gamma - \lambda} = \alpha^{**}$.

- Pooling equilibrium: $r_A = 0$

$$\begin{cases} E(r_A = 1|\theta = 1) \leq E(r_A = 0|\theta = 1) \\ E(r_A = 1|\theta = 0) \leq E(r_A = 0|\theta = 0) \end{cases}$$

In this case, $\alpha > \alpha^{**}$ and $\mu = \psi$, where $\psi = Pr(\theta = 1)$.

- Pooling equilibrium $r_A = 1$ does not exist.

- Separating equilibrium $r_A = \begin{cases} 0 & \theta = 1 \\ 1 & \theta = 0 \end{cases}$ does not exist.

Therefore, we know that when $\alpha \geq \alpha^*$ and $\alpha \leq \alpha^{**}$, A disseminates the information. When $\alpha \geq \alpha^*$, $r_L = 1$. When $\alpha \leq \alpha^{**}$, A's information dissemination leads to the same utility to L regardless of L approval, L approves.

Now, we go back to C's decision. When $r_A = 1$, C believes that $\theta = 1$ and chooses $m = m^* = \dfrac{1+\alpha}{2\gamma}$ and $b = b^* = \dfrac{1-\alpha}{2\lambda}$. To make sure that C's outbreak responses are not deterred by the administrative costs, we need $EU_C(m^*, b^*) \geq EU_C(m = 0, b = 0)$ when $r_A = 1$, which generates $\varepsilon_m + \varepsilon_b \leq \dfrac{(1+\alpha)^2}{4\gamma} + \dfrac{(1-\alpha)^2}{4\lambda}$.

When $r_A = 0$, C makes the decision based on its belief about the probability that $\theta = 1$.

$$\begin{aligned} EU_C(m > 0, b > 0) &= \psi[-1 + m + b - \alpha(1 - m + b) - \gamma m^2 - \lambda b^2 - \varepsilon_m - \varepsilon_b] \\ &\quad + (1-\psi)[-\alpha b - \gamma m^2 - \lambda b^2 - \varepsilon_m - \varepsilon_b] \\ &= \psi[-(1+\alpha) + (1+\alpha)m + \alpha b] - (\alpha b + \gamma m^2 + \lambda b^2 + \varepsilon_m + \varepsilon_b) \end{aligned}$$

FOC w.r.t m and b respectively, we get $m^{**} = \dfrac{1+\alpha}{2\gamma}\psi$ and $b^{**} = 0$. Hence,

$$EU_C(m^{**}, b^{**}) = -(1+\alpha)\psi + \frac{(1+\alpha)^2\psi^2}{4\gamma} - \varepsilon_m$$

$$EU_C(m = 0, b = 0) = -\psi(1+\alpha)$$

To make sure that $EU_C(m^{**}, b^{**}) \leq EU_C(m = 0, b = 0)$, we have $\varepsilon_m \geq \dfrac{(1+\alpha)^2\psi^2}{4\gamma}$. This ensures that when ψ is a very small number, C chooses $m = b = 0$ rather than impose a small number of resources or bans.

A.2 How Does Integration Shape Border Restrictions?

One of the key propositions in the model is that a country's integration level with the international community determines the amount of resources and bans this country faces upon disease outbreaks, which is illustrated in Figure 3. This section examines whether shallower integration increases ban imposition empirically.[32]

Covid-19 pandemic provides a unique empirical environment to examine the proposition from the ban imposition perspective. First, since every country experienced Covid-19 cases between 2020 to 2021, this allows us to have a relatively similar benchmark for disease environment. In contrast, when only a subset of countries experience cases of an disease outbreak, we can only examine ban imposition on these countries as the target, which may bias the results when only a certain group of countries select into the outbreak. Second, given the massive amount of Covid-19 policies, multiple institutions or research groups invested great efforts in data collection on Covid-related policies.[33] For other disease outbreaks, there does not exist as comprehensive data sources to examine the proposition.

Among all the data sets on Covid-related policies, I use the COVID Border Accountability Project (COBAP) (Shiraef et al., 2021) for the following reasons. First, COBAP is directly related to border restrictions, while other data sets contain domestic policies and may increase the probability of coding errors if the coder mixes domestic policies with international ones.[34] COBAP has two categories of border restrictions: complete closure and partial closure. Complete closure refers to policies where all newcomers are banned from all ports of entry—air, land, and sea—with limited exceptions. Partial closure restricts access of specific groups of people based on their citizenship, travel history, visa application, or types of border entry, such as air, land, or sea.

Second, COBAP dataset has relatively clear information of the target of border restrictions. This allows me to create a directed dyad dataset to examine how the integration level between a dyad affects border restrictions.

To code the variable of border restriction, I take a conservative approach and create a binary variable of whether the initiator country has imposed a certain type of border restriction on the target country in the period of 2020 and 2021. Although the COBAP dataset contains information of the start and end dates of a policy, there are coding errors and missing data issues with the end dates of a policy. In addition, when there is a policy change, it is not so clear how to quantify the change. Hence, a binary variable of the existence of a certain type of border restriction can tolerate these data concerns and reduce the measurement problem in the dataset.

There are 4 different types of border restrictions. First, border closure refers to the re-

[32]It is emipirically difficult to examine the resource aspect of the proposition due to the fact that a good proportion of global health responses take the form of military aid (Michaud et al., 2019), making it impossible to measure the amount of aid given to the target country.

[33]The available data sources include COVID Border accountability Project (https://covidborderaccountability.org/), CoronaNet (https://www.coronanet-project.org/index.html), WHO's Public health and social measures (PHSMs) dataset (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/phsm), Citizenship, Migration and Mobility in a Pandemic (CMMP) (https://cadmus.eui.eu/handle/1814/68359), ACAPS (https://www.acaps.org/), among others.

[34]This is the case for CoronaNet dataset.

strictions on travel through a specified land, sea, or air border. Second, visa-based ban refers to restrictions on new visa applications. Third, citizenship-based ban refers to bans against foreign nationals from a specified country. Lastly, travel-based restricitons ban travelers who have recently travelled through or from a specified country. In the regression analysis, I first diffentiate these different types of restrictions and then create two aggregate level of measures of border resctrictions. The first is the total number of these 4 types of restrictions. The second is a binary variable indicating whether there exists at least one of these types of restrictions. Since complete closure is bans against all kinds of borders, once a country initated complete closure, I code all dyads with this initiator as having border closure in the forms of air, land, and sea.[35]

The sample of the analysis is a cross-sectional directed dyad in the period between 2020 and 2021. The key independent variable is an integration z-score index calculated based on the average of standardized index in three dimensions. To measure political integration, I use the difference in the ideal point estimates based on UNGA voting records between the dyad. To measure economic integration, I use the total trade volume between the dyad. To measure geographic integration, I use the geographic distance between the capital cities of the dyad.

To account for characteristics that may affect both the integration level between the dyad and the border restrictions, I control for the gap in GDP per capital, population, and policy IV between the dyad, and whether the dyad has contingent territory. I also control for initiator fixed effects and target fixed effects to control for the domestic conditions of the initiator and target countries, such as disease severity of both the initiator and target countries, political conditions that lead to more radical responses, and so on. The standard errors are clustered at the initiator and target levels.

Table A.1 shows the results of the analysis. Column (1) to (6) are the results with a specific type of border restriction. The dependent variable in Column (7) and (8) are the total number of different types of border restrictions and whether there is at least type of border restrictions. We can see that greater integration between the dyad reduces the probabiliby of border restrictions, especially for the citizenship bans.

Table A.2, A.3, and A.4 shows the results with political integration, economic integration, and geographic integration respectively. We can see that the results are mostly driven by political alignment and geographic proximity. Greater trade volume between the dyad seems to increase the probability of border restrictions, but the results are not significant.

Overall, these results provide support for the proposition that greater integration reduces the probability of border restrictions.

[35]The results are robust removing complete closures.

Figure A.1: Integration and Border Restrictions

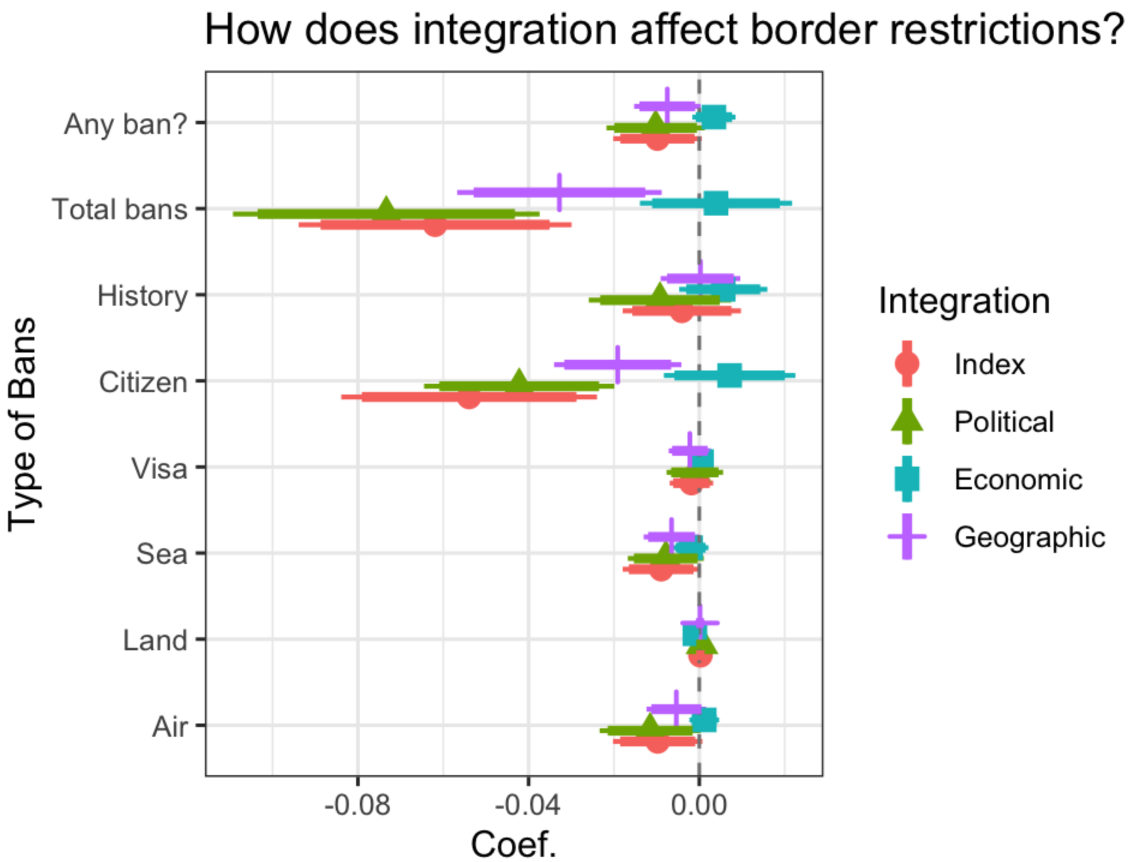

Table A.1: Integration and Border Restrictions

	Dependent variable:							
	Air	Land	Sea	Visa	Citizen	History	Total	Ban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Integration (Z-Score)	−0.016*	0.0004	−0.015*	−0.003	−0.091***	−0.007	−0.104***	−0.017*
	(0.009)	(0.001)	(0.008)	(0.004)	(0.026)	(0.012)	(0.027)	(0.009)
Control	Y	Y	Y	Y	Y	Y	Y	Y
Initiator FE	Y	Y	Y	Y	Y	Y	Y	Y
Target FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	21,584	21,584	21,584	21,584	21,584	21,584	21,584	21,584
R^2	0.927	0.992	0.977	0.977	0.691	0.492	0.933	0.759
Adjusted R^2	0.926	0.992	0.976	0.976	0.686	0.485	0.932	0.755

Note: *p<0.1; **p<0.05; ***p<0.01
Standard error clustered at the target and initiator level in parentheses.

Table A.2: Political Integration and Border Restrictions

	Dependent variable:							
	Air	Land	Sea	Visa	Citizen	History	Total	Ban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Political alignment	−0.012*	0.001	−0.008*	−0.001	−0.042***	−0.009	−0.073***	−0.010*
	(0.006)	(0.001)	(0.005)	(0.003)	(0.011)	(0.009)	(0.018)	(0.006)
Control	Y	Y	Y	Y	Y	Y	Y	Y
Initiator FE	Y	Y	Y	Y	Y	Y	Y	Y
Target FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	21,584	21,584	21,584	21,584	21,584	21,584	21,584	21,584
R^2	0.927	0.992	0.976	0.977	0.694	0.493	0.934	0.759
Adjusted R^2	0.926	0.992	0.976	0.976	0.689	0.486	0.933	0.756

Note: *p<0.1; **p<0.05; ***p<0.01
Standard error clustered at the target and initiator level in parentheses.

Table A.3: Economic Integration and Border Restrictions

	Dependent variable:							
	Air	Land	Sea	Visa	Citizen	History	Total	Ban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total trade volume	0.001	−0.001*	−0.002	0.001	0.007	0.006	0.004	0.003
	(0.002)	(0.001)	(0.002)	(0.001)	(0.008)	(0.005)	(0.009)	(0.003)
Control	Y	Y	Y	Y	Y	Y	Y	Y
Initiator FE	Y	Y	Y	Y	Y	Y	Y	Y
Target FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	21,584	21,584	21,584	21,584	21,584	21,584	21,584	21,584
R^2	0.927	0.992	0.976	0.977	0.684	0.492	0.932	0.757
Adjusted R^2	0.926	0.992	0.976	0.976	0.679	0.485	0.931	0.754

Note: *p<0.1; **p<0.05; ***p<0.01
Standard error clustered at the target and initiator level in parentheses.

Table A.4: Geographic Integration and Border Restrictions

	Dependent variable:							
	Air	Land	Sea	Visa	Citizen	History	Total	Ban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Geographic proximity	−0.005	0.0002	−0.007*	−0.002	−0.019**	0.0003	−0.033***	−0.007*
	(0.004)	(0.001)	(0.003)	(0.003)	(0.008)	(0.005)	(0.012)	(0.004)
Control	Y	Y	Y	Y	Y	Y	Y	Y
Initiator FE	Y	Y	Y	Y	Y	Y	Y	Y
Target FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	21,584	21,584	21,584	21,584	21,584	21,584	21,584	21,584
R^2	0.927	0.992	0.976	0.977	0.684	0.492	0.932	0.758
Adjusted R^2	0.926	0.992	0.976	0.976	0.679	0.485	0.931	0.755

Note: *p<0.1; **p<0.05; ***p<0.01
Standard error clustered at the target and initiator level in parentheses.

A.3 Figures and Tables

Figure A.2: Number of Countries of Disease Outbreak in One Report

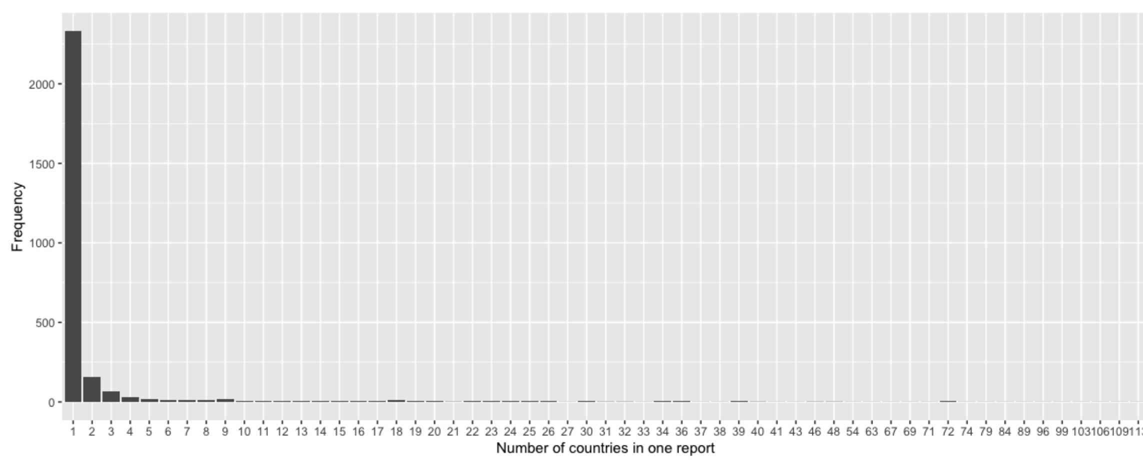

Figure A.3: Share of Countries Being Covered by DONs (1996-2019)

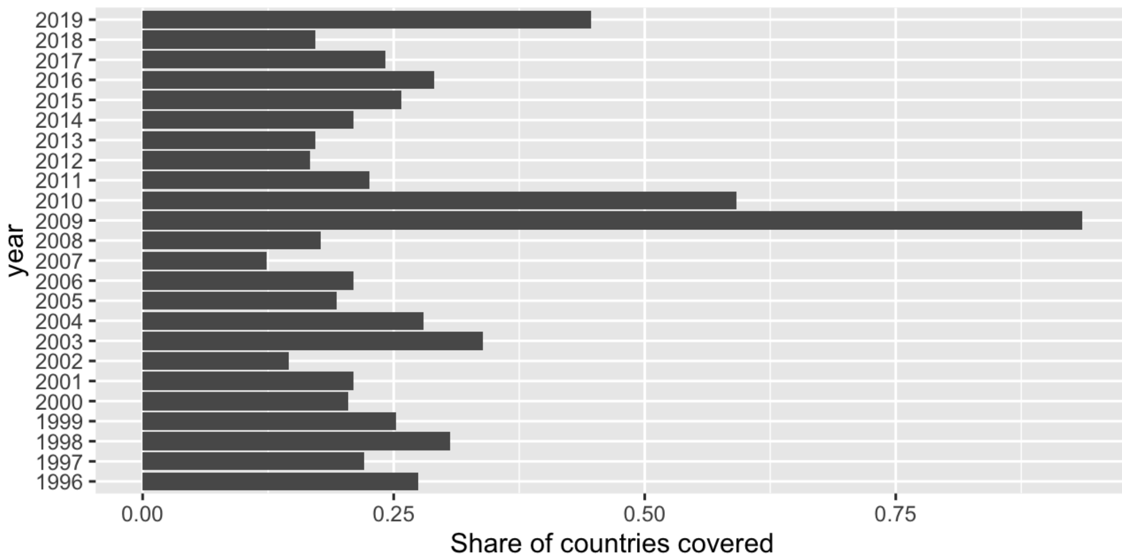

Figure A.4: Most Frequently Reported Countries: Pre 2005 vs. Post 2005

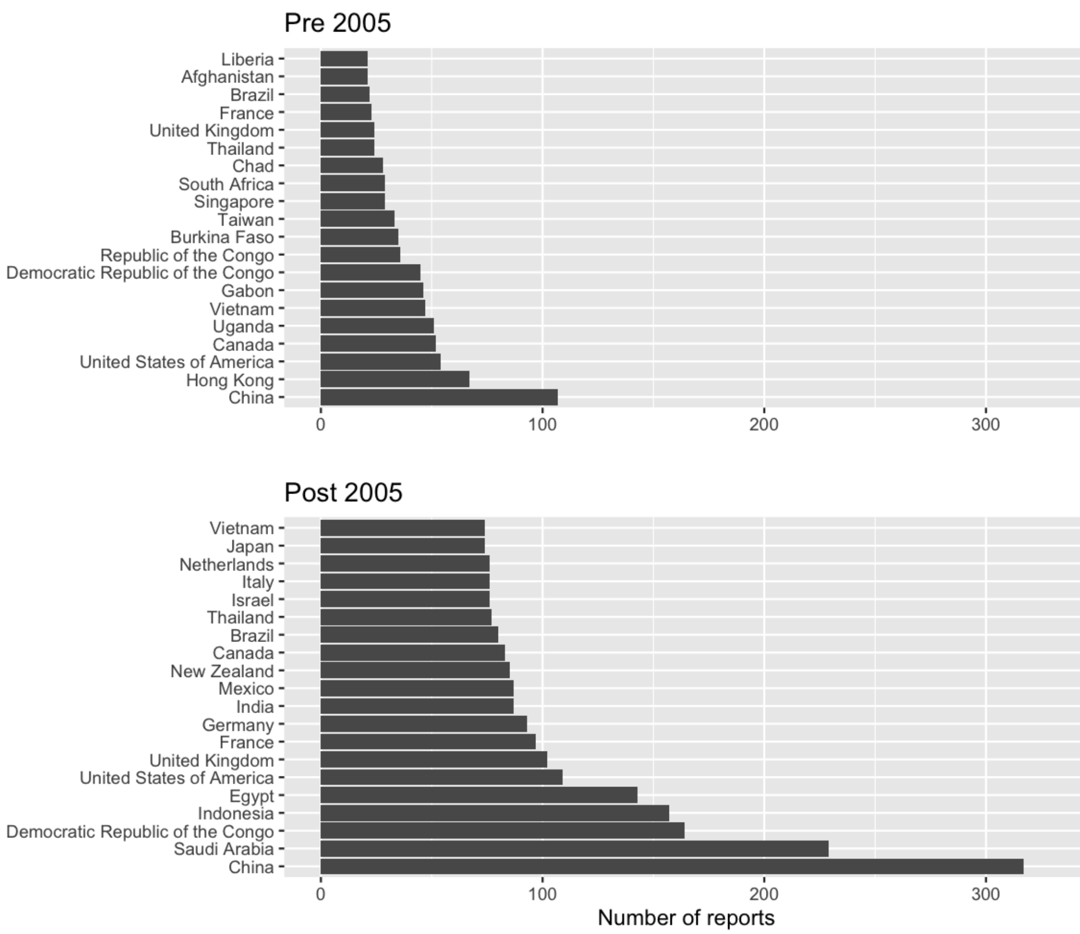

Figure A.5: Disease Information Verification System

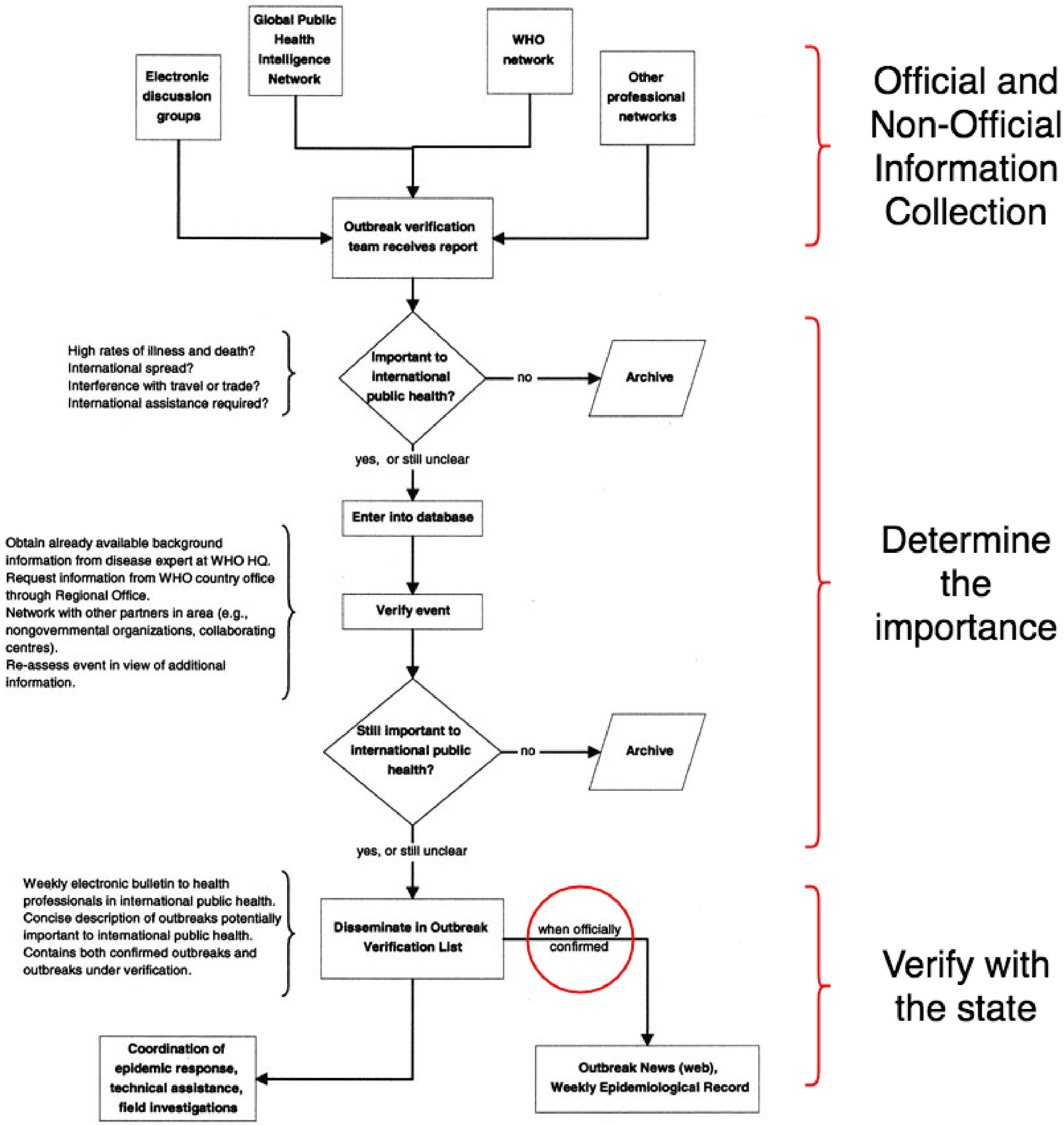

Figure A.6: Interface of GIDEON Informatics

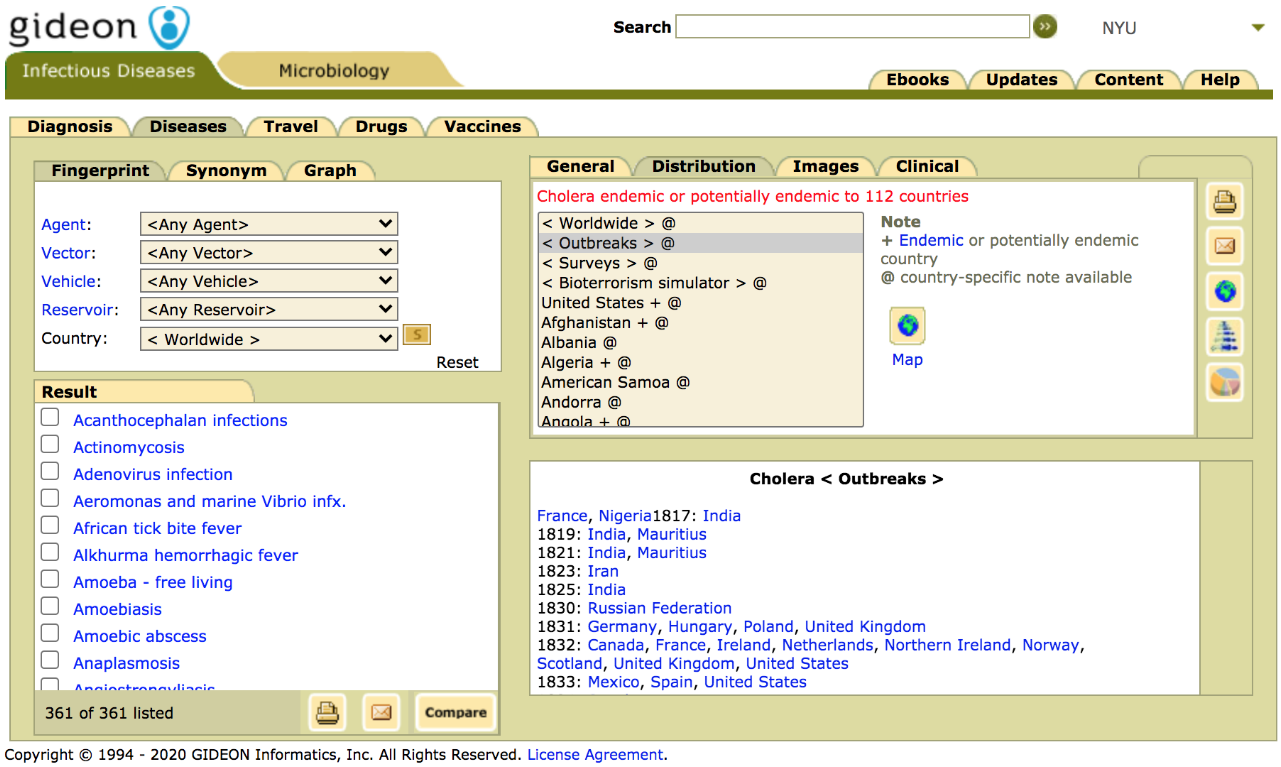

Table A.5: Trade Volume with the US and Disease Outbreak Report

	Dependent variable:					
	log(1 + DONs reports)					
	(1)	(2)	(3)	(4)	(5)	(6)
Total trade volume with US	−0.023*	−0.019				
	(0.013)	(0.013)				
Total trade volume with US * Post2005		−0.069**				
		(0.032)				
Total exports to US			−0.014	−0.001		
			(0.010)	(0.013)		
Total exports to US * Post2005				−0.033*		
				(0.020)		
Total imports from US					−0.010	−0.006
					(0.013)	(0.014)
Total imports from US * Post2005						−0.065**
						(0.031)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y
Observations	2,845	2,845	2,845	2,845	2,845	2,845
R^2	0.655	0.657	0.655	0.656	0.655	0.656
Adjusted R^2	0.568	0.570	0.568	0.568	0.567	0.569

Note: *p<0.1; **p<0.05; ***p<0.01
Standard error clustered at the country level in parentheses.

Table A.6: Controlling for Disease Outbreak Events

	Dependent variable:							
	log(1 + DONs reports)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ideal point proximity with US	−0.089	0.105					−0.093	0.072
	(0.091)	(0.106)					(0.091)	(0.101)
Ideal point proximity * Post2005		-0.366^{***}						-0.326^{**}
		(0.125)						(0.129)
Total imports from US			−0.008	−0.004			−0.010	0.095^{*}
			(0.013)	(0.014)			(0.013)	(0.048)
Total imports from US * Post2005				-0.067^{**}				-0.065^{**}
				(0.031)				(0.030)
Seats on Direct Flight to US					-0.012^{*}	−0.007	-0.012^{*}	-0.017^{*}
					(0.007)	(0.009)	(0.007)	(0.009)
Seats on Direct Flight * Post2005						−0.010		0.011
						(0.010)		(0.011)
N. of diseases (GIDEON)	0.117^{***}	0.119^{***}	0.116^{***}	0.118^{***}	0.116^{***}	0.119^{***}	0.116^{***}	0.116^{***}
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.036)	(0.035)	(0.035)
Control	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y	Y	Y
Observations	2,845	2,845	2,845	2,845	2,845	2,845	2,845	2,845
R^2	0.657	0.660	0.657	0.658	0.657	0.657	0.657	0.662
Adjusted R^2	0.570	0.573	0.570	0.572	0.571	0.571	0.570	0.575

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$
Standard error clustered at the country level in parentheses.

Table A.7: Alternative Explanation: Regime Type

	Dependent variable:					
	log(1 + DONs reports) (Travel-Related)					
	(1)	(2)	(3)	(4)	(5)	(6)
Linkage with US (Z-score)			−0.045	0.227**		
			(0.078)	(0.092)		
Linkage with US (Z-score) * Post2005				−0.504***		
				(0.111)		
Linkage with US (PCA)					−0.138**	−0.024
					(0.066)	(0.096)
Linkage with US (PCA) * Post2005						−0.252***
						(0.080)
Standardized Polity IV	0.053	0.060	0.084	0.028	0.082	0.046
	(0.061)	(0.065)	(0.060)	(0.065)	(0.058)	(0.064)
Standardized Polity IV * Post2005		−0.017		0.119*		0.055
		(0.058)		(0.065)		(0.059)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y
Observations	2,954	2,954	2,922	2,922	2,922	2,922
R^2	0.480	0.480	0.484	0.495	0.485	0.491
Adjusted R^2	0.353	0.352	0.355	0.368	0.356	0.362

Note: *p<0.1; **p<0.05; ***p<0.01
Standard error clustered at the country level in parentheses.

Table A.8: Alternative Explanation: Transparency

	Dependent variable:					
	log(1 + DONs reports) (Travel-Related)					
	(1)	(2)	(3)	(4)	(5)	(6)
Linkage with US (Z-score)			−0.048	0.173*		
			(0.078)	(0.088)		
Linkage with US (Z-score) * Post2005				−0.413***		
				(0.094)		
Linkage with US (PCA)					−0.139**	−0.033
					(0.065)	(0.098)
Linkage with US (PCA) * Post2005						−0.231***
						(0.083)
Standardized HRV	0.168**	0.315***	−0.073	−0.004	−0.072	−0.036
	(0.079)	(0.100)	(0.052)	(0.079)	(0.052)	(0.077)
Standardized HRV * Post2005		−0.102*		−0.030		0.008
		(0.056)		(0.058)		(0.060)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y
Observations	2,954	2,954	2,922	2,922	2,922	2,922
R^2	0.649	0.649	0.484	0.494	0.485	0.490
Adjusted R^2	0.562	0.562	0.355	0.366	0.356	0.362

Note: *p<0.1; **p<0.05; ***p<0.01
Standard error clustered at the country level in parentheses.

Table A.9: Exclude China and Saudi Arabia from the Sample

	Dependent variable:					
	log(1 + DONs reports) (Travel-Related)					
	Exclude China		Exclude Saudi Arabia		Exclude Both	
	(1)	(2)	(3)	(4)	(5)	(6)
Linkage with US (Z-score)	0.167*		0.190**		0.175**	
	(0.089)		(0.087)		(0.088)	
Linkage with US (Z-score) * Post2005	−0.423***		−0.416***		−0.416***	
	(0.091)		(0.090)		(0.090)	
Linkage with US (PCA)		−0.036		−0.056		−0.060
		(0.098)		(0.094)		(0.095)
Linkage with US (PCA) * Post2005		−0.226***		−0.216***		−0.212***
		(0.076)		(0.076)		(0.076)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y
Observations	2,902	2,902	2,902	2,902	2,882	2,882
R^2	0.474	0.471	0.486	0.482	0.465	0.461
Adjusted R^2	0.342	0.338	0.356	0.352	0.330	0.325

Note: *p<0.1; **p<0.05; ***p<0.01

Standard error clustered at the country level in parentheses.

Table A.10: Economic and Political Links and Disease Outbreak Report

	Dependent variable: log(1 + DONs reports)											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
US Poli Linkaage	−0.085	0.105										
	(0.092)	(0.107)										
US Poli Linkaage * Post2005		−0.359***										
		(0.126)										
UK Poli Linkaage			−0.064	0.125								
			(0.091)	(0.108)								
UK Poli Linkaage * Post2005				−0.365***								
				(0.130)								
FR Poli Linkaage					−0.075	0.103						
					(0.092)	(0.106)						
FR Poli Linkaage * Post2005						−0.339***						
						(0.129)						
DEU Poli Linkaage							−0.004	0.136				
							(0.103)	(0.119)				
DEU Poli Linkaage * Post2005								−0.286**				
								(0.128)				
CN Poli Linkaage									0.098	−0.084		
									(0.081)	(0.108)		
CN Poli Linkaage * Post2005										0.358**		
										(0.151)		
RUS Poli Linkaage											−0.099	−0.115
											(0.088)	(0.097)
RUS Poli Linkaage * Post2005												0.022
												(0.143)
Control	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	2,845	2,845	2,845	2,845	2,845	2,845	2,845	2,845	2,845	2,845	2,845	2,845
R^2	0.655	0.657	0.656	0.659	0.655	0.657	0.654	0.656	0.648	0.651	0.654	0.655
Adjusted R^2	0.568	0.570	0.570	0.573	0.568	0.571	0.567	0.568	0.559	0.563	0.567	0.568

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$
Standard error clustered at the country level in parentheses.

Table A.11: Interdependence with US and Disease Outbreak Report

	Dependent variable:										
	log(1 + DONs reports)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11
IGO Similarity with US	0.056	0.122									
	(0.265)	(0.276)									
IGO Similarity w. US * Post2005		−0.159**									
		(0.074)									
IGO Similarity with UK			−0.025	0.069							
			(0.212)	(0.229)							
IGO Similarity w. UK * Post2005				−0.185**							
				(0.081)							
IGO Similarity with France					−0.056	0.043					
					(0.280)	(0.290)					
IGO Similarity w. France * Post2005						−0.204**					
						(0.085)					
IGO Similarity with Germany							0.103	0.191			
							(0.259)	(0.271)			
IGO Similarity w. Germany * Post2005								−0.203**			
								(0.084)			
IGO Similarity with China									−0.061	−0.077	
									(0.158)	(0.160)	
IGO Similarity w. China * Post2005										0.038	
										(0.062)	
IGO Similarity with Russia											0.07
											(0.10
IGO Similarity w. Russia * Post2005											
Control	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	2,855	2,855	2,855	2,855	2,855	2,855	2,855	2,855	2,855	2,855	2,85
R^2	0.652	0.654	0.654	0.656	0.653	0.655	0.652	0.654	0.646	0.646	0.65
Adjusted R^2	0.566	0.567	0.568	0.570	0.566	0.569	0.565	0.568	0.558	0.558	0.56

Note: *p<0.1; **p<0.0
Standard error clustered at the country level in

Table A.12: Interdependence with US and Disease Outbreak Report

	Dependent variable:										
	log(1 + DONs reports)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(
Treaty similarity with US	−0.010	0.010									
	(0.063)	(0.062)									
Treaty similarity w. US * Post2005		−0.104									
		(0.110)									
Treaty similarity with UK			−0.084	−0.001							
			(0.076)	(0.075)							
Treaty similarity w. UK * Post2005				−0.367***							
				(0.097)							
Treaty similarity with France					−0.041	0.028					
					(0.062)	(0.061)					
Treaty similarity w. France * Post2005						−0.395***					
						(0.102)					
Treaty similarity with Germany							−0.074	0.049			
							(0.088)	(0.086)			
Treaty similarity w. Germany * Post2005								−0.444***			
								(0.102)			
Treaty similarity with China									−0.067	−0.040	
									(0.060)	(0.057)	
Treaty similarity w. China * Post2005										−0.103	
										(0.102)	
Treaty similarity with Russia											−(
											(0
Treaty similarity w. Russia * Post2005											
Control	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Office-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
State-specific time trend	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Observations	2,001	2,001	2,001	2,001	2,001	2,001	1,929	1,929	2,001	2,001	2
R^2	0.721	0.721	0.723	0.729	0.722	0.727	0.723	0.730	0.718	0.718	0
Adjusted R^2	0.621	0.621	0.624	0.631	0.622	0.630	0.621	0.631	0.617	0.617	0

Note: *p<0.1; **

Standard error clustered at the country le

Table A.13: Interdependence with US and Disease Outbreak Report

	Dependent variable:										
	log(1 + DONs reports)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(1
GVC integration with US	−0.039	−0.051									
	(0.284)	(0.290)									
GVC integration w. US * Post2005		−0.175*									
		(0.089)									
GVC integration with UK			−0.681	−0.393							
			(0.481)	(0.503)							
GVC integration w. UK * Post2005				−0.227**							
				(0.094)							
GVC integration with France					−0.701	−0.364					
					(0.475)	(0.479)					
GVC integration w. France * Post2005						−0.201**					
						(0.094)					
GVC integration with Germany							0.161	0.513			
							(0.596)	(0.626)			
GVC integration w. Germany * Post2005								−0.254**			
								(0.103)			
GVC integration with China									−0.264	−0.264	
									(0.365)	(0.374)	
GVC integration w. China * Post2005										−0.205*	
										(0.114)	
GVC integration with Russia											−0
											(0.
GVC integration w. Russia * Post2005											
Control	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Office-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
State-specific time trend	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Observations	2,642	2,642	2,642	2,642	2,642	2,642	2,642	2,642	2,642	2,642	2,
R^2	0.674	0.675	0.676	0.678	0.674	0.676	0.673	0.676	0.667	0.669	0.
Adjusted R^2	0.590	0.592	0.593	0.596	0.591	0.593	0.590	0.593	0.582	0.584	0.

Note: *p<0.1; **p

Standard error clustered at the country leve

Table A.14: Economic and Political Links and Disease Outbreak Report

	Dependent variable:					
	log(1 + DONs reports)					
	(1)	(2)	(3)	(4)	(5)	(6)
Total trade volume	−0.030	−0.023				
	(0.051)	(0.053)				
Total trade volume * Post2005		−0.017				
		(0.057)				
GVC integration			1.042*	1.471**		
			(0.545)	(0.621)		
GVC integration * Post2005				−0.106		
				(0.068)		
Openness					−0.052	−0.047
					(0.032)	(0.036)
Openness * Post2005						−0.012
						(0.051)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y	Y	Y
Observations	2,895	2,895	2,895	2,895	2,895	2,895
R^2	0.652	0.652	0.652	0.653	0.652	0.652
Adjusted R^2	0.566	0.566	0.566	0.567	0.566	0.566

Note: *p<0.1; **p<0.05; ***p<0.01
Standard error clustered at the country level in parentheses.

Table A.15: Data Sources

Variable	Source	Notes
Dependent Variable		
Disease Outbreak News Report	WHO DONs	
Disease outbreak events	Global Infectious Diseases and Epidemiology Online Network (GIDEON)	
Independent Variable		
Ideal point estimate (UNGA)	Bailey et al. (2017)	
Trade volume with the US	UN Comtrade	
Seats on direct flights to the US	U.S. Department of Transportation	
Control Variable		
UNSC Membership	Dreher et al. (2009a)	
GDP per capita	World Bank WDI Database	
Total population	World Bank WDI Database	
Polity IV	Center for Systemic Peace	
Openness (Total import and export over GDP)	UN Comtrade	
IMF participation	Replication file from Clark and Dolan (2020)	
HRV Transparency Index	Hollyer et al. (2014)	