Who Complies? When Interdependence Meets IO Independence

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Abstract

Why do some states comply with the disease outbreak reporting requirement at the World Health Organization (WHO) while others do not? Information dissemination of disease outbreaks can trigger the international community to impose trade and travel bans to states with weak linkages and provide resources to states with strong linkages. Due to such heterogeneous responses, states with high interdependence with the community comply and report, while states with low interdependence conceal the outbreaks. To induce compliance in reporting, the WHO reformed its International Health Regulations (IHR) in 2005, which grants the WHO independence to disseminate outbreak information without the consent of the outbreak country. I argue that such independence in information dissemination allows the WHO to leverage the interdependence among the states and trigger punishment on information withhold, which deters non-compliance. Using the number of Disease Outbreak News (DONs) as an indicator of state's compliance, I find that states with strong linkages to the U.S. have more DONs reports before the reform. The reform increases the number of DONs reports from states with weak linkages to the U.S.

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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

Who complies with international agreements? Scholars have been studying various mechanisms of treaty compliance (Chayes and Chayes, 1993; Downs et al., 1996; Tallberg, 2002; Dai, 2005; Simmons, 2010). However, treaty violation is still common in international agreements. Why do some states comply with international agreements while others do not? What explains the variation in compliance? More importantly, how can international institutions induce noncompliant states to comply?

This paper argues that interdependence among states determines who complies with international agreements. Specifically, states with strong linkages to the international community benefit from compliance, while states with weak linkages have to pay a high cost to comply and hence violate the agreement to avoid such cost. To induce states with weak linkages to the international community to comply, this paper argues that independence in international organization (IOs) allows the IO to leverage interdependence among states and trigger punishment from the international community, which deters noncompliance.

This paper examines the case of states' disease outbreak reporting to the World Health Organization's (WHO). According to the International Health Regulations (IHR), an agreement among the WHO's member states to deal with infectious diseases that may disrupt international trade and travel, states are required to share the disease outbreak information with the WHO upon any potential infectious disease outbreaks. However, states are often reluctant to share such information with the WHO. For example, in the case of the Severe Acute Respiratory Syndrome (SARS) outbreak in China in 2003, after the WHO was informed by its intelligence network and tried to seek confirmation about the outbreak, the

Chinese government refused to share the outbreak information with the WHO. The WHO inspector team was only allowed to investigate the disease on the site after April, three months after the first case emerged (Huang, 2004, p. 121).

One key obstacle in outbreak information sharing is that wide dissemination of such information can be costly to political leaders (Hollyer et al., 2015; Carnegie and Carson, 2020) in the form of costly responses from the international community. For example, the 1994 plague outbreak in Surat in Indian led to the suspension of agricultural exports, one of India's major exports, and caused the crash of the share value of agriculture-related financial products at the stock markets. Plague-related travel restrictions were imposed. These responses caused over $2 billion loss to the Indian economy (Kamradt-Scott, 2015, p. 110). Such radical trade and travel restrictions are no stranger to disease outbreaks in human history because of their low costs and high popularity among the domestic audience (Kenwick and Simmons, 2020; Worsnop, 2017a,b). Anticipating the costly responses, states have strong incentives to breach the reporting requirement in the IHR (Worsnop, 2019).

As a response to such noncompliance, the WHO reformed the IHR in 2005, which grants the WHO Director-General independence to disseminate the outbreak information based on nonofficial information. Before the reform, the WHO must obtain the consent from the disease outbreak country before disseminating the outbreak information to the international community. Hence, the reform gives the WHO the discretion over whether to use information spread to trigger the international community's responses to disease outbreaks.

I propose a simple model to demonstrate how interdependence and IO independence interacts with each other to influence states' compliance in information sharing. To begin with, the disease outbreak in one country negatively affects the international community through linkages among states, which may take the form of political alliance, economic integration, and geographic distance. To reduce the negative impact of diseases, the community can provide resources to mitigate disease severity and to impose trade and travel bans to keep the virus out of its territory. As bans can disrupt economic and political activities in the outbreak states, the community may suffer from its own bans if closely linked to the outbreak state. Therefore, the community is likely to provide more resources and impose fewer bans when the outbreak state is closely linked.

Without independence, the WHO cannot disseminate information without states' consent. States are able to withhold the outbreak information as they wish. For states with weak linkages to the international community, they expect to face strong bans and few resources upon outbreak information dissemination. Hence, they do not comply with the reporting requirement in the IHR. On the contrary, states with strong linkages to the community are forthcoming about the outbreak information with the WHO, as they expect to receive lots of resources and few bans from the community and can benefit from information dissemination. Therefore, before the IHR reform, the stronger the linkage with the international community, the more compliant states are in outbreak information sharing with the WHO.

With independence, the WHO has the discretion to disseminate information to trigger responses from the international community. For states with weak linkages, the reform means that these states are faced with the threat of strong bans, which serves as ex post costs on information withhold (Fearon, 1997) and deters noncompliance. For states with strong linkage, as they are compliant even without the threat from information dissemination, they comply with the reporting requirement as before. Therefore, the reform increases compliance in information sharing from states with weak linkages to the international community.

To empirically examine the argument, I use the number of Disease Outbreak News (DONs) to measure compliance. I use ideal point distance to the U.S. based on the voting records at the United Nations General Assembly (UNGA), imports from the U.S. and number of seats on direct flights to the U.S. to measure the linkage to the international community, under the assumption that the U.S. and its allies have the greatest influence in the international arena and can be a good representative of the international community. Using a difference-in-differences specification, I find that states more closely linked to the U.S. have more DONs reports before the IHR reform. However, after the reform, the number of reports increased for states with weaker linkages. The political linkage plays a more important role than the economic linkage, while the geographic linkage does not produce a consistent pattern. As a placebo test, I use the number of outbreak events as the dependent variable. The previous pattern disappears, consolidating the argument that the disease outbreak reporting process is highly politicized.

This paper adds to two pieces of literature. First, it speaks to the literature on the role of information in compliance (Simmons, 2010; Kelley and Simmons, 2019; Koliev et al., 2020). Existing reserach show that information can induce compliance through mechanisms of domestic politics (Dai, 2005; Johns and Rosendorff, 2009), bureaucratic responses (Bisbee et al., 2019), and transnational pressures or third-party enforcement (Milgrom et al., 1990; Johns, 2012). This paper adds to this literature by specifying the scope conditions for the third-party enforcement mechanism: interdependence, defined as mutual senstitivity in payoffs (Keohane and Nye, 1973), determines the degree of enforcement from third-party actors. Given that information dissemination specifically induces compliance from non-allies of the U.S., this paper suggests that independence in IO can enhance U.S. power in IOs.

Second, this paper contributes to an under-studied field of the politics of international public health. Existing studies show how information dissemination can trigger radical responses (Worsnop, 2017b) and the domestic politics in bans impositions (Worsnop, 2017a; Kenwick and Simmons, 2020), which explains why states conceal disease outbreaks (Kamradt-Scott, 2015; Worsnop, 2019). This paper incorporates their insights and examines the institutional design of international public health responses. This paper also demonstrates the heterogeneity in the disease outbreak reporting process.

2 A Model of Disease Outbreak Reporting

2.1 Setup

The model features three actors: the leader of disease outbreak country (L), the agency or the WHO (A), and the international community or the US (C).

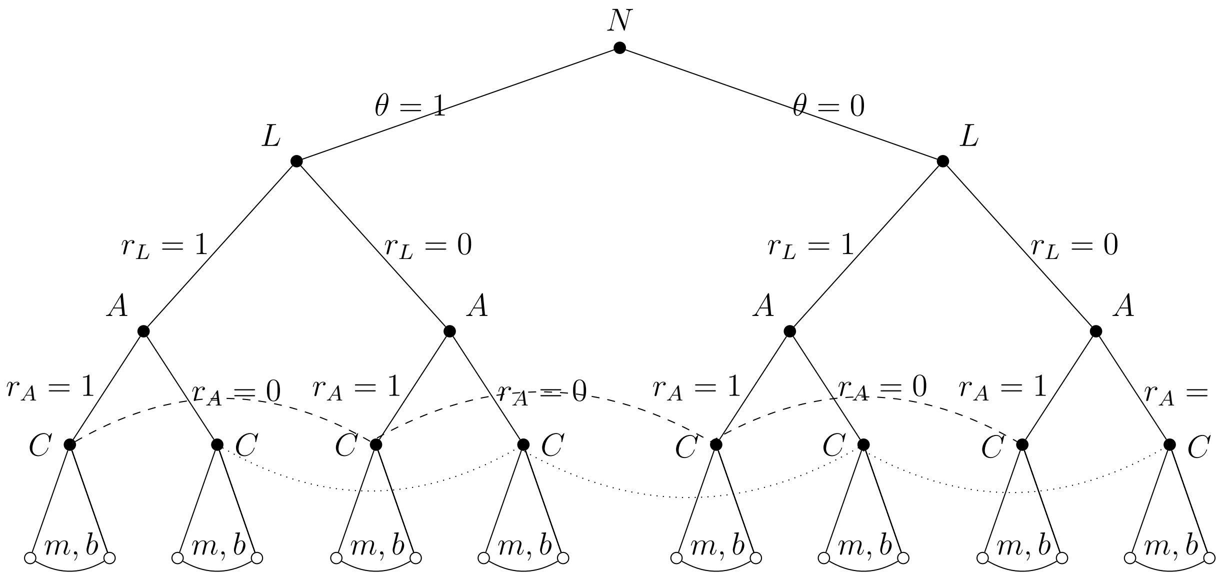

Figure 1: Sequence of the Game

The sequence of the game is shown in Figure 1.[1] First, Nature (N) picks the severity of disease $\theta \in \{0, 1\}$ with $Pr(\theta = 1) = \psi$. $\theta = 1$ indicates that the disease has the potential of international transmission and may lead to radical measures like trade and travel restrictions from C.[2] Second, after observing θ, L decides whether to preemptively disapprove A of reporting the disease to C: $r_L \in \{0, 1\}$, with 1 indicating approval and 0 otherwise. Third, observing θ and r_L, A decides whether to report to C that the disease is of concern: $r_A \in \{0, 1\}$, in which $r_A = 1$ indicates that $\theta = 1$. I assume that A can observe θ because of its expertise. This assumption allows us to focus on the institutional design

[1] The dash lines indicate the information set.

[2] I assume that ψ is a relatively small number, suggesting that severe diseases are rare events. I choose a binary disease type because it allows us to focus on a binary response from L and A, while a continuous disease type may distract the focus to how much information is communicated at the equilibrium.

aspect of the interaction and abstract away from the informational contents in A's message. Lastly, only observing r_A, C provides resources $m \in [0,1]$ to L for disease remediation and imposes trade and travel bans $b \in [0,1]$ to prevent the disease from spreading to its territory.

In terms of their payoffs, L's utility function is shown below:

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

. L pays a cost for the disease outbreak, which is mitigated by C's resource provision m: $\theta(1-m)$. L also suffers from C's bans: bq, in which b is the intensity of the ban, and q is how costly the ban is to L and represents the overtime change in the degree of globalization.

C's utility contains three components, which is shown below:

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

. First, C pays a direct cost for disease damage, which is mitigated by the resource remediation m and the measures to restrict the interaction with L b. Second, C incurs an indirect cost of disease outbreak, the magnitude of which depends on the linkage to L. α is the linkage parameter. Specifically, the first part $\theta(1-m-b)$ captures the indirect costs related to the disease outbreak in L's territory. For example, due to the prevalence of fragmented production, temporary shutdown of firms in L can disrupt the routine operation of firms in the supply chain. If the linkage between L and C is strong, such disruption can hurt certain firms in C and impose political pressure on C's political leaders. The second part bq captures the indirect costs as a result of the disruption from the bans impose by C. Third, C pays a cost for disease remediation $k_m(m)$ and ban impositions $k_b(b)$. The cost functions take the following form:

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

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

, in which γm^2 and λb^2 represent the material costs of resources and bans, while $\varepsilon_m \mathbb{1}\{m > 0\}$ and $\varepsilon_b \mathbb{1}\{b > 0\}$) are the administrave costs once any resources or bans are provided.[3]

The goal of A is to control the disease spread. The following equation summarizes A's utility function:

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

. When C provides more resources and imposes more bans, the disease will be better constrained. The institutional design imposes further costs to A. The parameter p indicates the size of the costs if A reports the disease outbreak to C without L's approval. The larger p is, the less independence A has.

2.2 Solution

To solve the game,[4] we start by analyzing C's optimization problem. After taking the first-order condition, we can obtain $m = \dfrac{\theta(1+\alpha)}{2\gamma}$ and $b = \begin{cases} \dfrac{\theta - \alpha q}{2\lambda} & \alpha \leq \theta/q \\ 0 & \alpha > \theta/q \end{cases}$, from which we know that C tends to provide more resources to L and impose fewer bans on L when C is more closely linked to L.

Knowing C's decision rule, we now turn to the decision of A, who is faced with two situations. First, we analyze the situation where A does not need to pay any overriding costs, which happens when L has incentives to tell the truth about the disease outbreak. The situation is similar to a cheap-talk game between L and C: only when L and C's preferences are aligned enough will L tell the truth. We can obtain $\alpha \geq \alpha^* = \dfrac{\gamma q - \lambda}{\gamma q^2 + \lambda}$, above which L has incentive to tell the truth about θ. Under this circumstance, L follows a

[3]The inclusion of the administrative costs is to induce a corner solution in C's equilibrium strategy, for which I assume that ε_m and ε_b have lower bonds. Specifically, $\varepsilon_m \geq \dfrac{(\alpha^*+1)^2\psi}{4\gamma} + \alpha^*(1-\psi)$ and $\varepsilon_m + \varepsilon_b \geq \dfrac{(1+q)^2\psi^2}{4\gamma q^2} + \dfrac{(1-\psi)^2}{4\lambda} + \dfrac{1-\psi}{q}$. Without this specification, C will choose a small amount of m and b when there is no sign of disease outbreak, which is not consistent with the observation in the real world.

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

separating equilibrium $r_L = \begin{cases} 1 & \theta = 1 \\ 0 & \theta = 0 \end{cases}$, which is the same for A: $r_A = \begin{cases} 1 & \theta = 1 \\ 0 & \theta = 0 \end{cases}$. Second, when $\alpha < \alpha^*$, L will preemptively disapprove A of reporting to C. Hence, A needs to balance the tradeoff between the disease relief provided by C if it disseminates the information and the overriding costs for ignoring L's disapproval. Only when the disease relief can provide enough disease control will A be willing to incur the overriding costs. Thus, we can obtain $p \leq \frac{1}{2}[\gamma+\lambda-\alpha(\gamma q-\lambda)]$, below which A disseminates information regardless of L's disapproval.

Now we can move to L's choice. First, when $\alpha \leq \alpha^{**} = \dfrac{\gamma+\lambda-2p}{\gamma q-\lambda}$, L refrains from restricting A's reporting if she anticipates that A will override. Hence, L with $\alpha \leq \alpha^{**}$ follows a separating equilibrium and complies with the agreement. Second, when $\alpha \geq \alpha^*$, L has incentives to tell the truth and follows a separating equilibrium as well. Lastly, when $\alpha^{**} < \alpha < \alpha^*$, L has incentives to restrict A's reporting, and A cannot benefit from overriding L. Hence, L with $\alpha^{**} < \alpha < \alpha^*$ follows a pooling equilibrium and does not comply.

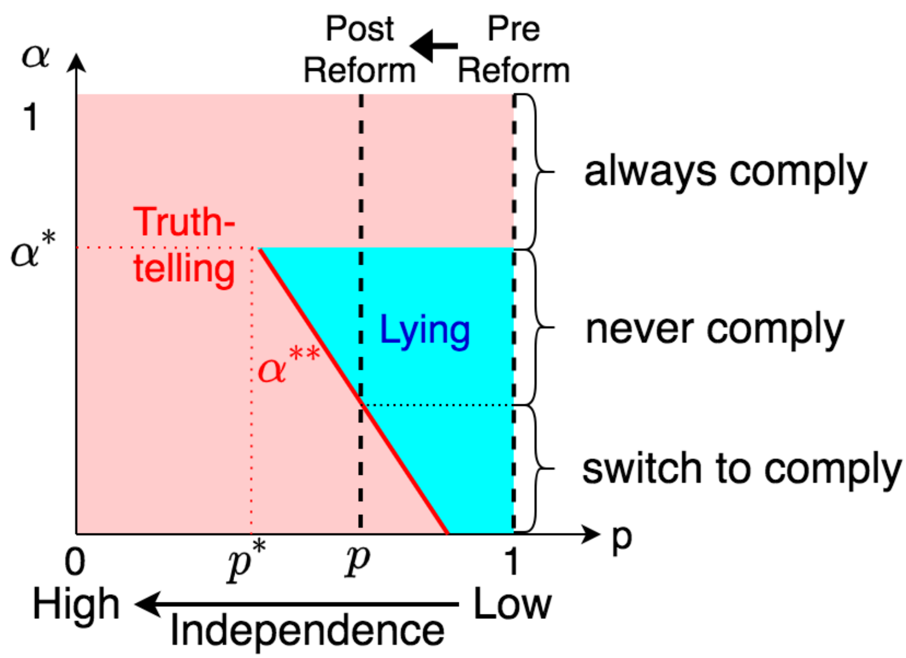

Figure 2: Range of p and α to Sustain the Separating Equilibrium

Figure 2 illustrates how L's equilibrium strategy varies with p. The pink area indicates the range of α and p that support the separating equilibrium, while the blue area is where L follows the pooling equilibrium. The red line shows how the threshold α^{**} changes as p varies.[5] The dashed black line on the right indicates the situation before the reform, where A has a large overriding cost $p = 1$. Hence, only L with $\alpha > \alpha^*$ complies, and the rest of the states lies. The reform moves the line to the left where $p < 1$. Under this circumstance, L with $\alpha \leq \alpha^{**}$ switch from the pooling equilibrium to the separating equilibrium, while the rest of the state remains the same as the pre-reform situation.

The following proposition formally illustrates the equilibria of the model.

Proposition 1 *Let* $b^* = \begin{cases} \dfrac{1-\alpha q}{2\lambda} & \textit{if } \alpha \leq 1/q \\ 0 & \textit{if } \alpha > 1/q \end{cases}$. *For the combination of* α *and* p *located in the pink area in Figure 2. L approves the outbreak information dissemination* $r_L = \begin{cases} 0 & \textit{if } \theta = 0 \\ 1 & \textit{if } \theta = 1 \end{cases}$, *A report the truth about the disease* $r_A = \begin{cases} 0 & \textit{if } \theta = 0 \\ 1 & \textit{if } \theta = 1 \end{cases}$. *C provides resources* $m = \begin{cases} 0 & \textit{if } r_A = 0 \\ \dfrac{1+\alpha}{2\gamma} & \textit{if } r_A = 1 \end{cases}$, *imposes bans* $b = \begin{cases} 0 & \textit{if } r_A = 0 \\ b^* & \textit{if } r_A = 1 \end{cases}$, *and forms its belief* $Pr(\theta = 1 | r_A = 0) = 0$ *and* $Pr(\theta = 1 | r_A = 1) = 1$.

For the combination of α *and* p *located in the blue area, L disapproves the outbreak information dissemination* $r_L = 0$. *A does not report the outbreak* $r_A = 0$. *C gives* $m = b = 0$ *and forms its belief* $Pr(\theta = 1|r_A = 0) = \psi$ *and* $Pr(\theta = 1|r_A = 1) = 1$, *in which* $\psi = Pr(\theta = 1)$.

2.3 Testable Hypotheses

To intuitively demonstrate how the players' behaviors vary with the degree of independence, Figure 3 and Figure 4 demonstrate L and C's strategies under the case of zero independence and complete independence. Figure 3 shows L's strategies. When A has no independence,

[5] p^* is the point where $\alpha^* = \alpha^{**}$. When $p < p^*$, $\alpha^{**} > \alpha^*$.

only states whose linkage to C is large enough tells the truth about the disease type. The rest of the states remain silent at a disease outbreak. However, when A has complete independence to disseminate information, all states tell the truth about the disease type.

Figure 4 illustrates C's strategy. The left panel shows the case without independence, and the right panel shows the case with complete independence. The thick dotted and solid lines represent the magnitude of resources and ban C provides at the equilibrium respectively. Without independence, C only reacts to the disease outbreak in states that are closely linked to it. With independence, C also reacts to disease outbreaks in states with less linkage to it. Also, C tends to impose stronger bans and provide fewer resources to these states. This suggests that giving the agency more independence may have distributive consequences. States with less linkage to C fare worse as the agency becomes more independent.

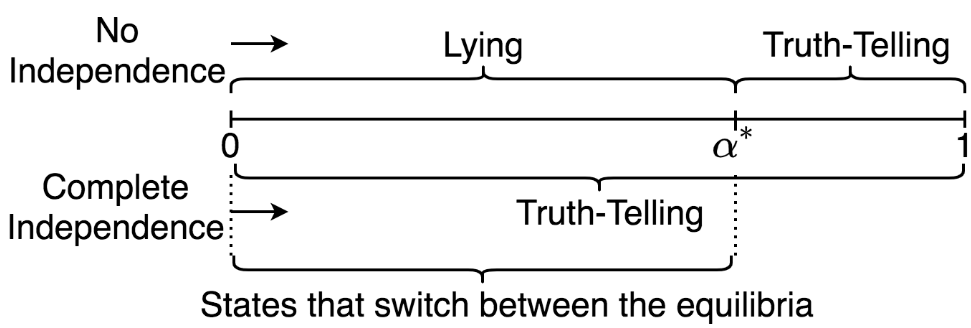

Figure 3: L's Strategy: Comparison Between $p = 1$ an $p = 0$

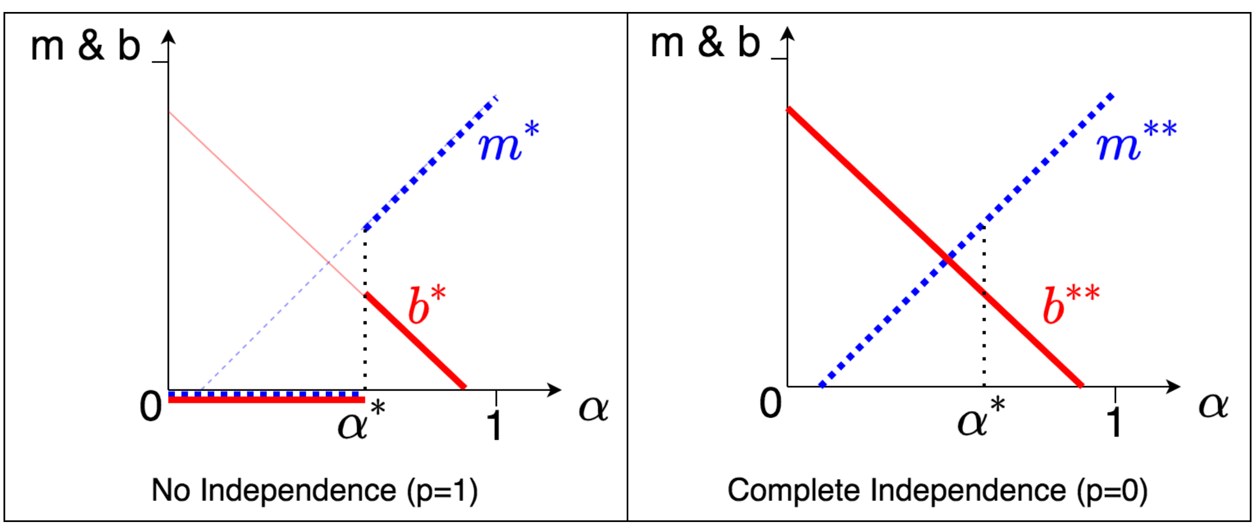

Figure 4: C's Strategy: Comparison Between $p = 1$ and $p = 0$

The model can generate the following testable hypotheses:

Hypothesis 1 *Without independence, states with a stronger linkage to C are more compliant in revealing the presence of disease outbreaks.*

Hypothesis 2 *Independence increases compliance in revealing the presence of disease outbreaks from states with a weaker linkage to C.*

3 Background

This section briefly introduces the organizational structure of the WHO and the history of the IHR reform that allows us to observe an increase in the level of independence in the institution. This section also presents the cases of the SARS outbreak in 2003 and the Kivu Ebola Outbreak in 2018 to demonstrate the role and the strategic consideration of the WHO in disease outbreak control.

3.1 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.

In terms of the organizational structure, the WHO is composed of three organs. First, governed by 194 member states, the World Health Assembly (WHA) is the decision-making body. It meets annually in May and votes on the policy goals and the proposed budget for the next year. Second, the Executive Board (EB) carries out the decisions and policies of the WHA, provides advice to the WHA, and facilitates its work. The EB is composed of 34 representatives of the member states. They are elected by the WHA for three-year terms and cannot be elected consecutively.[6] The third organ is the secretariat, the bureaucratic body of the WHO. The secretariat is headed by the director-general who is nominated by the EB and elected by the WHA for a five-year term and can be reelected.

Headquartered in Geneva, Switzerland, the WHO has six regional offices, namely in Africa, Europe, South-East Asia, East Mediterranean, Western Pacific, and the Americas, to satisfy the special needs of different areas and facilitate quick response to public health emergencies.

As for the financial resources of the institution, the WHO has two primary components of revenue (Kaiser Family Foundation, 2020). The first component is the assessed contributions, which are set amounts expected to be paid by member state governments, scaled by income and population. Assessed contributions are often used to cover general expenses and program activities. The second 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.[7] Only 3.9% of all voluntary contributions are fully unconditional and subject to the WHO's full discretion, suggesting the low enforcement capacity the institution has.

3.2 History of International Health Regulations (IHR) 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 disruption to trade and commerce. The recognized diseases under this framework were chosen particularly for their disruption to international trade,

[6]This suggests that each member state can at most be on the EB every other term.

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

such as typhus, cholera, plague, yellow fever, smallpox, and relapsing fever. Without significant adjustments overtime, ISR was renamed in 1969 as International Health Regulations, but the reform only removed typhus and relapsing fever from the disease list without much substantive revision. 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 member states' incentive to reform the IHR. At the WHA in 1995, member states voted to revise and update the IHR. However, it took ten years to complete the revision due to various reasons.[8] It was until the outbreak of the Severe Acute Respiratory Syndrome (SARS) in 2003 that alerted the international community to the inadequacy in the existing IHR framework and the urgency to complete the revision.

There are two substantive changes in the IHR (2005). First, the change in the outbreak verification process allows the WHO to report and act based on non-governmental sources of information if the disease outbreak country fails to cooperate. To be more specific, a great amount of the non-government sources of information comes from the Global Public Health Intelligence Network (GPHIN), a system established in 1997 that monitors internet media of different languages to detect potential events that are of public health concern. 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". With the old IHR framework, WHO had no such authority to act on nongovernmental reports until it received official notification from the affected member state. In this sense, the fact that the Chinese government concealed the outbreak and withheld the information regarding the degree of transmission from the WHO is a crucial trigger that

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

motivates the reform to give the institution more independence in information dissemination.

Second, the reform grants the director-general the unilateral authority to declare a Public Health Emergency of International Concern (PHEIC). As such declaration disrupts international trade and travel and intervenes the national sovereignty, it attracted much resistance from the member states and delayed the completion of the IHR revision for another year. The solution to such disagreement is to introduce more flexibility in the declaration process, which maintains the stability of the agreement (Rosendorff, 2005). Specifically, the IHR (2005) 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. The Emergency Committee creates introduces flexibility by giving the outbreak states some control over the declaration of the PHEIC. Finally, the revised IHR framework was unanimously approved by the Inter-Governmental Working Group (IGWG) and was passed by member states on the 58th WHA. It was in effect on 15 June 2007.[9]

3.3 The WHO's Role in Disease Outbreak Control

I present two case studies to demonstrate what role the WHO plays in controlling the disease outbreak. The first case shows how the Chinese government interacted with the WHO in the SARS outbreak in 2003, which illustrates how the WHO can use the travel advisory as a threat to induce compliance. The second case explores why the PHEIC declaration in the Kivu Ebola Outbreak in 2018 was so late. It shows how the WHO strategically made the declaration decision based on the risk of the disease spread, which is proxied by the linkage parameter in the model.

[9]Despite the prolonged process of negotiation, this paper treats the year 2005 as the starting point of the agreement, under the assumption that there exists some consensus among the member states that override is possible.

3.3.1 The WHO's Advisory Capacity During the SARS Outbreak in 2003

On November 27, 2002, the WHO received one of its earliest alerts from the GPHIN about a potential influenza outbreak in southern China. When the secretariat issued a formal request for further information, the Chinese government dismissed the request. After a series of news reports by Hong Kong media about an epidemic of atypical pneumonia, the WHO issued a second formal request for information on February 10, 2003. The Chinese government confirmed the outbreak, which involved 305 individuals and 5 deaths, and stressed that the outbreak was under control. Out of respect for the assurance, the WHO responded by closely monitoring the situation, but it continuously received reports from Hong Kong, Singapore, and Hanoi about hospital staff contracting atypical pneumonia. Until February 28 when Carlo Urbani, a WHO epidemiologist working in Vietnam, reported his suspicion about an ongoing new contagion did the WHO start to intensify the epidemiological intelligence gathering. On March 12, the secretariat issued the first global alert (Kamradt-Scott, 2015, p. 89-90).

Since then, the WHO issued various recommendations and policy advice to contain the disease in real-time, among which the WHO secretariat "intentionally utilized the international media and the Internet to broadcast a range of travel recommendations specifically addressing individuals and their behavior" (Kamradt-Scott, 2015, p. 93). Due to the Chinese government's rejection of the WHO's request to send a team to the site, the WHO was uncertain about the adequacy of measures to control the disease and the rate of transmission. On April 2, the WHO issued the first travel warning against Guangdong province of China. In contrast, as one of the cities where several earliest SARS cases took place, Hanoi was not on the list because of the Vietnamese government's forceful and rapid responses.

It was until April 9 were the WHO experts finally allowed to inspect military hospitals in Beijing (Huang, 2004, p. 121). However, the Chinese government tried to conceal the degree of transmission by transferring patients to hotels when the WHO officials visited the two military hospitals (Pomfret, 2003). This poses an interesting contrast to the situation in Shanghai, one of the most international and developed cities in China. In fear of the huge economic losses due to the travel advisory, the central government invited the WHO's investigative team to assess the disease control measures in Shanghai, which prevented the extension of the travel advisory to the city (Kamradt-Scott, 2015, p. 96).

In this process, the WHO plays an important role in disease containment in three aspects. First, powered by its intelligence network, the WHO is responsible for information collection and verification. Second, despite its low capacity in resource provision to mitigate disease severity, the WHO provides various technical support for its member states, including coordinating research efforts and information sharing among competing research institutes, and issuance of detailed technical guidance to inform the states of the best practice of disease control, and so on.

Lastly, the WHO monitors and evaluates states' disease control efforts. It strategically uses its advisory capacity to trigger the response of the international community. For one thing, the travel advisory restricts disease spread if the outbreak is severe. For another, the travel advisory pulls the trigger of international reaction if the outbreak state is reluctant to cooperate. This aspect of travel advisory gives the WHO strong power in inducing cooperation from its member states despite the limited resources the institution has.

3.3.2 The Delayed PHEIC Declaration in the Kivu Ebola Outbreak in 2018

The WHO uses its advisory capacity strategically. In the case of the Kivu Ebola outbreak in the Democratic Republic of the Congo (DRC) in 2018, the WHO's PHEIC declaration lagged behind the declaration of an outbreak by the DRC Ministry of Health more than 10 months.[10] During these ten months, The WHO Emergency Committee convened three times in October 2018, April 2019, and June 2019. Even after the international spread of the virus to Uganda in June, the committee still advised against a PHEIC declaration, claiming that

[10] This was just two years after the previous Ebola outbreak ended, which led to 28,616 cases of infection and 11,310 deaths. Hence, there is no reason to believe that the delay is due to the low capacity the WHO has as in the previous massive outbreak.

the outbreak failed to meet the criteria of a PHEIC and that the declaration would bring no additional benefits to control the disease and would trigger unnecessary trade and travel measures that harm efforts to manage the outbreak (Fidler, 2019, p. 289).

The PHEIC declaration on July 17 finally ended the increasing tension over the declaration (Klain and Lucey, 2019).[11] What changed from June to July is the identification of a case of a man who traveled from the epicenter of the outbreak in the DRC to Goma, a city of the DRC with an international airport and a highly mobile population of 2 million located near the DRC's eastern border with Rwanda.

This case sheds light on two important aspects of the WHO's information dissemination function: deterrence and disease control. First, the declaration allows the WHO to indirectly impose ex post cost on noncompliance. We can see that the WHO knows well the consequence of the PHEIC declaration and makes the decision based on whether the declaration can produce the intended result. For states like the DRC, the WHO expected few resources but strong bans, which would give the institution strong leverage to push the state to cooperate. Meanwhile, as the DRC Ministry of Health has already been in close contact with the WHO, there is no need for the WHO to trigger the international response, which may explain the late declaration.

Second, the final PHEIC declaration sheds light on the disease control function of the declaration. As the DRC is a relatively distant country to other powerful states, it poses a relatively small threat to the security of these countries and makes the outbreak less urgent, which is in sharp contrast to the fast PHEIC declaration of the Zika outbreak in Brazil in 2016 (Patterson, 2016). However, with the case in Goma, the risk for the disease to spread across continents was largely increased. Given how the virus was spread to the U.S. and other western countries through international travel in the case of the western African Ebola outbreak in 2014, the case in Goma made a PHEIC declaration urgent at this particular

[11] Despite all the controversies over the late PHEIC declaration, the Centers for Disease Control and Prevention (CDC) issued an endorsement for the WHO's declaration the next day after the WHO's declaration (CDC, 2020).

moment to limit the disease spread.

In summary, these two case studies demonstrate the deterrence effect of the WHO's information dissemination function. In the SARS outbreak case, the WHO could not alert the international community about the outbreak at an early stage due to the lack of independence. Once it started its information dissemination function, the WHO could impose a credible threat and successfully induced cooperation from the Chinese government in Shanghai. In the case of the Kivu Ebola Outbreak, the delayed declaration of the PHEIC shows that declarations can be unnecessary when the state is cooperative. What triggered the declaration is the increase in the linkage between the outbreak state and the community as the virus spread, which had an impact on the community's response and indirectly affected the WHO's consideration.

4 Data

To systematically examine the hypotheses, this section introduces the variable construction for states' compliance and the explanatory variables. It then presents the identification strategy.

4.1 Disease Outbreak News (DONs)

To measure states' compliance to the reporting requirement in the IHR (2005), 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[12], 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 disease information verification process in the WHO, the selective nature of the DONs reports allows us to measure compliance based on the number of reports. Figure

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

A.5 illustrates the data generating process of each report (Grein et al., 2000). Based on the GPHIN and other information sources, the system generates some reports of the potential events that might be of concern. Every day in the morning, a team at the WHO headquarter gathers together and evaluates the importance of the events. Once an event is deemed important, an outbreak verification team will seek verification from the disease outbreak country. Only upon the receipt of official confirmation will the WHO post a report on the DONs webpage. In other words, when a state refuses to confirm the outbreak, we will not see the report in the data set. Thus, the number of DONs reports can be a good indicator to capture states' level of compliance before the reform in 2005.[13]

With some variation in the contents overtime, 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.[14] The left panel of Figure 5 summarizes the overtime change in the number of reports. The spike in 2003 reflects the outbreak of the SARS, while the spike in 2014 reflects the outbreak of Ebola and Middle East respiratory syndrome coronavirus (MERS). 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),[15] a platform mainly used by health professionals and educators for infectious disease diagnosis and reference purposes 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

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

[14] To code the disease outbreak countries in each report, I use the regular expression 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 through the contents to verify that the identified countries are disease outbreak countries. 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.

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

reports varies.

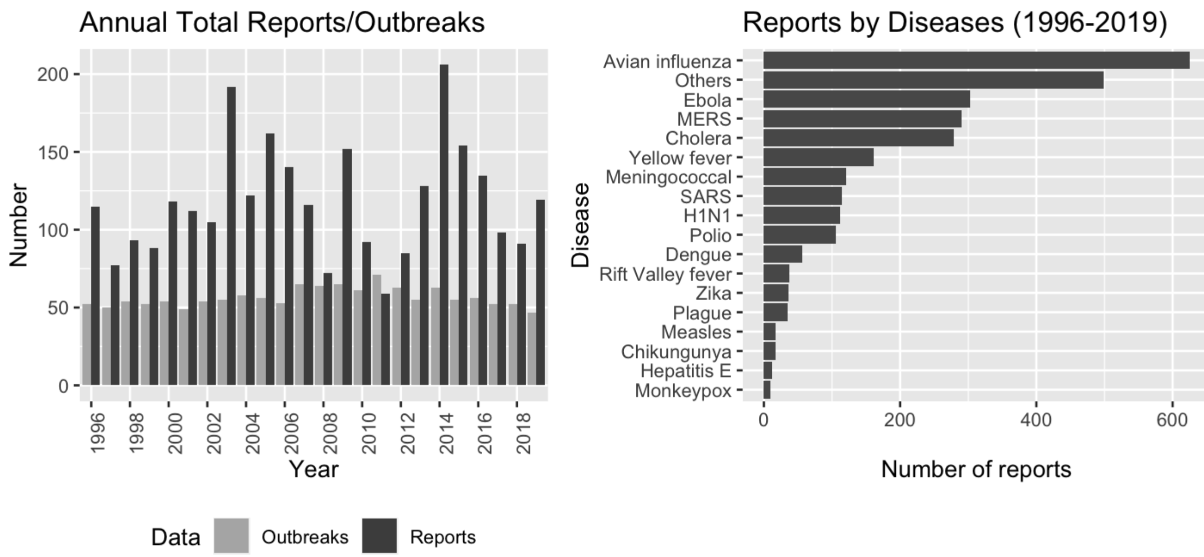

Figure 5: Number of Reports Overtime and Major Disease Types in DONs

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.[16] As 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 Linkage Proximity with the U.S.

To measure the linkage proximity with the U.S., this paper constructs three variables for political, economic, and geographic linkage respectively. First, I use the ideal point estimates ($IdealDistance_{it}$) based on the voting records at the United Nations General Assembly (UNGA) (Bailey et al., 2017) to measure the political linkage. This measure accounts for the agenda change overtime at the UNGA and allows for the inter-temporal comparison of

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

alignment. Thus, it is an improvement to the measurement based on disagreement vote share. I take the absolute difference of the ideal point estimate between a country and the U.S. to measure the political alignment. The larger the magnitude, the weaker the linkage is.[17] Second, I use the total imports from the U.S. to measure the economic linkage. With the fragmented mode of production, the disruption in economic activities due to disease outbreaks can have an immediate impact on the supply chains and affect the interest of states with strong trade connections. I use the imports from the U.S. to capture the potential damage the U.S. may suffer from a foreign country's disease outbreak. I will also examine the linkage based on total trade volume with the U.S. and total exports to the U.S. Third, to measure the geographic linkage, I use the number of seats on direct flights to the U.S.[18] because it captures the capacity of population movement and reflects the geographic linkage in the age of extensive international travel.

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

Table 1: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Median	Max
N. of DONs reports	2,922	2.163	7.485	0	0	75
Ideal Point distance with US	2,922	2.884	0.846	5.175	3.091	0.114
log(1+total trade volume with US)	2,922	20.756	3.161	0.000	20.919	27.225
log(1+total imports from US)	2,922	19.834	3.071	0.000	19.848	26.467
log(1+total exports to US)	2,922	19.758	3.831	0.000	20.090	26.910
log(1+seats on direct flights to US)	2,922	6.669	6.615	0.000	5.849	17.342
Polity IV	2,922	3.624	6.294	−10	6	10
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(1+population)	2,922	16.163	1.523	12.792	16.118	21.034
IMF participation	2,922	0.332	0.471	0	0	1
Openness	2,922	0.545	0.421	0.000	0.485	3.454
N. of desease outbreaks (GIDEON)	2,922	1.743	2.662	0	1	24

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

[18]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.

4.3 Regression Specification

To examine whether independence in IO can induce compliance, this paper relies on the IHR reform as the source of variation in independence in the IO. I employ the difference-in-differences (DID) specification with the IHR reform as the treatment and explore the variation in a country's linkage to 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 degree of linkage to the U.S. Hence, the intuition of this identification strategy is to compare the difference in compliance between groups that are more sensitive 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 compliance from states with a loose linkage to the U.S., the identified effect is a conservative estimate of the effect of independence on compliance. The identification assumption is that the trend in the relationship between the linkage to the U.S. and the number of DONs reports is the same in the absence of the reform. The regression equation is shown below:

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

, where i, r, and t indicate the country, regional office, and year respectively. The dependent variable is the number of DONs report ($DONs\ Report_{it}$) in the logarithmic term. $Linkage_{it}$ represents three measures of linkage with the U.S.: $IdealDistance_{it}$, $Imports_{it}$, and $Seats_{it}$. The coefficient β_1 identifies the relationship between linkage with the U.S. and the compliance before the IHR reform, which is expected to be positive if Hypothesis 1 holds. $Post_t$ is a dummy variable indicating the post-reform period. The coefficient β_2 of the interaction term $Linakge_{it} * Post_t$ identifies the causal effect of the increased degree of independence on compliance, which is expected to be negative according to Hypothesis 2.[19]

One threat to this identification strategy is the bias from omitted variables that covary with the linkage 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 overtime 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 overtime change in the six regional offices that each country is assigned to. For example, since the regional office plays a critical role in disease verification on the spot, 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. This term addresses 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 ($Openness_{it}$), which is measured as the total import and export volume over total GDP. As infectious diseases are disruptive to international trade, countries with greater openness are less willing to disclose their outbreak information. Hence, we should expect $Openness_{it}$ to reduce the number of DONs reports.

Second, I control for a country's involvement in other international organizations. I control for whether a country is a member of the United Nations Security Council (UNSC) ($UNSCmember_{it}$). 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

[19] As the ideal point distance measure has an opposite sign to the linkage variable, I will flip the sign of the measure to make the coefficient estimates have consistent signs.

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 ($IMFparticipation_{it}$). 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 ($PolityIV_{it}$) to account for the fact that democracies have stronger domestic sources of mechanism to induce compliance (Dai, 2005). I also control for GDP per capita ($GDPpc_{it}$) and population size (POP_{it}) to account for the general conditions. The summary statistics of these control variables are in Table 1.[20] All the independent variables are lagged for one year to avoid simultaneous bias.

5 Results

Table 2 reports the baseline results. Column (1), (3), (5), and (7) examine how the linkage to the U.S. affects the number of DONs reports, while Column (2), (4), (6), and (8) test the first two hypotheses of the paper. None of the linkage variables has a significant impact on the number of reports. However, linkage plays an important role once we take into consideration the IHR reform. For the political linkage, one standard deviation increase in the ideal point proximity with the U.S. leads to about 6 to 8% increase in DONs reports before the reform (Row 1). After the IHR reform, one standard deviation further away from the U.S.'s ideal point estimate significantly increases the number of DONs reports by about 18% (Row 2). The economic linkage exhibits a similar pattern, but the effect is not statistically significant. Fewer imports from the U.S. do not reduce the DONs reports before the reform (Row 3), but they do increase the number of DONs reports after the reform (Row 4), which is consistent with Hypothesis 2. However, the geographic linkage does not display

[20] Table A.6 presents the data sources of these variables.

a consistent pattern as the model predicts. More seats on direct flights to the U.S. reduce the number of DONs reports, and the IHR reform seems to impose a negligible impact on DONs reports. Column (8) includes all three of the linkage variables. The results with the political linkage still hold, and the results with the economic linkage become more significant, while the geographic linkage still exhibits an inconsistent pattern. To further explore the economic linkage, I replicate the results in Column (4) with the economic linkage measured as total trade volume with the U.S. and exports to the U.S. in Table A.1. The impact of economic linkage is mainly driven by imports from the U.S.

One potential threat to the findings in Table 2 is that the results could be driven by the actual disease severity instead of states' compliance because the linkage variables can be correlated with numerous factors that influence how much resources a country invests in public health facilities and hence how likely a country suffers from disease outbreaks. To address this concern, I implement a placebo test using the disease severity as the dependent variable. If the DONs reports only reflect the actual severity of disease outbreaks, we should observe a similar pattern as Table 2 shows. However, if the pattern disappears, it suggests that the disease outbreak reporting process is politicized. To measure disease severity, I use the number of disease outbreak events collected from GIDEON ($Outbreaks_{it}$).[21]

Table 3 reports the results. For the political and economic linkages, the coefficients of the interaction terms flip the signs and become statistically insignificant. The geographic linkage shows an opposite pattern to the model prediction: stronger geographic linkage reduces the disease outbreaks before the reform, but it significantly alleviates the negative correlation after the reform. Table 3 does not support for the concern that the pattern in Table 2 is driven by disease severity. Instead, it shed light on the political considerations underlying the disease outbreak reporting process.[22]

[21] 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.

[22] As the number of disease outbreak events is a post-treatment control, I do not control for it in the baseline setting. However, as is shown in Table A.2, the baseline results still hold after controlling for this variable.

Table 2: Economic and Political Links and Disease Outbreak Report

	Dependent variable: log(1 + DONs reports)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ideal point proximity with US	−0.074	0.094					−0.077	0.073
	(0.090)	(0.105)					(0.090)	(0.101)
Ideal point proximity * Post2005		−0.314**						−0.289**
		(0.125)						(0.129)
Total imports from US			−0.007	−0.003			−0.008	0.082*
			(0.013)	(0.014)			(0.013)	(0.045)
Total imports from US * Post2005				−0.052*				−0.051*
				(0.028)				(0.026)
Seats on Direct Flight to US					−0.011	−0.008	−0.011*	−0.016*
					(0.007)	(0.009)	(0.007)	(0.009)
Seats on Direct Flight * Post2005						−0.007		0.011
						(0.010)		(0.010)
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	2,922	2,922	2,922	2,922	2,922	2,922	2,922	2,922
R^2	0.651	0.653	0.650	0.651	0.651	0.651	0.651	0.654
Adjusted R^2	0.567	0.569	0.567	0.568	0.567	0.567	0.567	0.570

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

Table 3: Economic and Political Links and Disease Outbreak Events

	Dependent variable:							
	log(1 + number of disease outbreaks) (GIDEON)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ideal point proximity with US	0.027	−0.008					0.026	0.013
	(0.061)	(0.069)					(0.061)	(0.072)
Ideal point proximity * Post2005		0.066						0.032
		(0.063)						(0.072)
Total imports from US			−0.017*	−0.018*			−0.017*	−0.004
			(0.009)	(0.009)			(0.009)	(0.027)
Total imports from US * Post2005				0.009				−0.024
				(0.015)				(0.019)
Seats on Direct Flight to US					−0.003	−0.011*	−0.003	−0.013*
					(0.005)	(0.006)	(0.005)	(0.007)
Seats on Direct Flight * Post2005						0.016**		0.020**
						(0.006)		(0.008)
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	2,922	2,922	2,922	2,922	2,922	2,922	2,922	2,922
R^2	0.749	0.749	0.749	0.749	0.749	0.750	0.749	0.750
Adjusted R^2	0.689	0.689	0.689	0.689	0.689	0.690	0.689	0.690

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

Standard error clustered at the country level in parentheses.

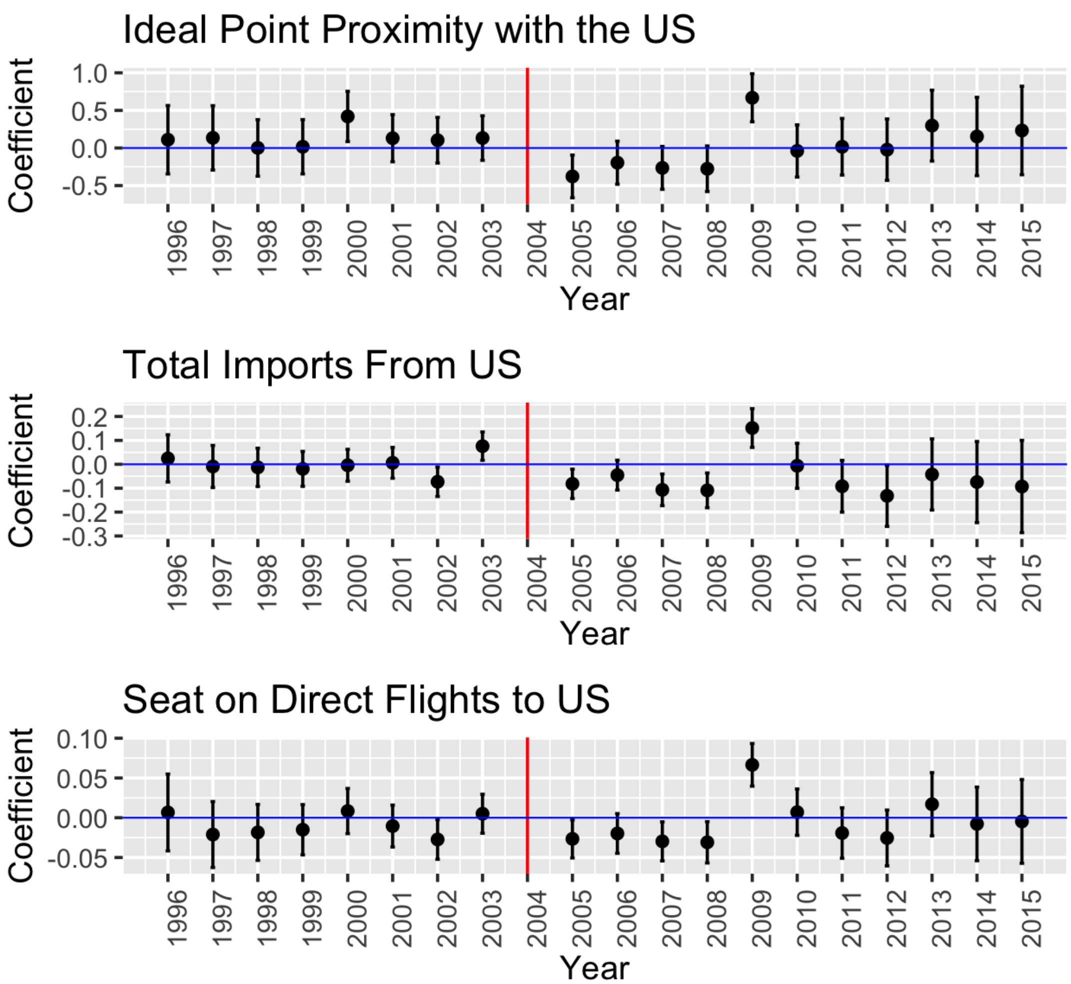

Figure 6: Pre-trend Analysis

To test the parallel trend assumption, Figure 6 presents the coefficient estimates of a vector of year dummies interacted with the three linkage variables. For the political and economic linkage, there does not seem to be a pre-trend before the reform: the coefficients of the linkage variable are mostly non-negative and statistically insignificant before 2004. As the negotiation over the IHR reform started in 2005, the reports from states with a weaker linkage started to increase until 2009. The two big spikes in 2009 are likely due to the H1N1 pandemic, which started in Mexico and was later spread to the U.S. As the disease is more likely to spread to states with a closer linkage to the U.S., the significantly positive coefficients reflect this tendency well. For the geographic linkage, there does not exist any significant changes before and after 2004, and the only spike is also due to the H1N1 pandemic in 2009, which is consistent with the null results in Table 3.

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' behavior. Table A.3 examines the heterogeneous effect of the IHR reform on regime types and finds that the reform increases democracies' number of DONs of reports 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 level, 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.4 shows that transparency has no effect on the number of DONs reports, and 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, the results still hold.[23]

One last concern about the finding is the sample selection in the DONs report. Diseases of less severity might be less likely to enter the dataset. When the diseases are less sensitive, states are more likely to comply. If states with weaker linkage to the U.S. are more willing to comply in less sensitive cases to fulfill the IHR requirement, the coefficient of the interaction term will be biased upwards. Given the negative sign of the interaction term, this type of sample selection will not affect the main findings of the paper.

To conclude, the empirical evidence is consistent with the theoretical expectations. There is a weak pattern that states with strong linkages to the U.S. reported more than those

[23]The results are shown in Table A.5.

with weak linkages did before the reform. In contrast, states with weak political linkages experienced an increase in DONs reports after the reform.

6 Conclusion

Who complies with international agreements? This paper argues that states with strong linkages to the international community complies, but IO independence allows the IO to trigger punishment through interdependence among states and induces states with weak linakges to comply.

This paper examines the case of states' disease outbreak reporting to the WHO. As disease outbreak information can trigger the international community to impose trade and travel bans, the outbreak state has incentives to conceal the outbreak. This paper shows that by giving the WHO independence to disseminate outbreak information to the international community, the WHO can trigger responses from the community, which serves as ex post cost on information withhold and deters noncompliance. More importantly, this paper shows that the scope of such third-party enforcement mechanism depends on the outbreak state's linkage to the community, defined as the sensitivity of the community's payoff to the outbreak state's payoff (Keohane and Nye, 1973). Stronger linkage means that the community is likely to provide more resources for disease mitigation and impose fewer bans to keep the virus out of its border. With that, when the WHO has independence to disseminate outbreak information, it can trigger strong bans for states with weak linkage to the community, which effectively deters their noncompliance.

The empirical results support the argument: states with weak linkages to the U.S. tend to have fewer DONs reports before the reform, indicating their low compliance rate; after the reform, the number of reports increased for these states. This pattern disappears when the number of disease outbreak events is the dependent variable, suggesting that the disease outbreak reporting process is politicized.

Several remaining issues are worth discussion. First, why did countries with weak linkage to the U.S. agree to the IHR reform? Given the breadth and depth tradeoff in IOs (Downs et al., 1996; Rosendorff, 2005), we should expect states with weak linkages to the U.S. to have incentives to withdraw from the WHO, as the IHR reform forces these states to change their behavior and to cooperate more. There could be two reasons why this did not happen. The first reason is reciprocity. Given the risk of future infectious diseases in other countries, states with weak linkages to the U.S. expect other countries to share information with the WHO, the long-term benefits of which may cancel out the short-term costs of compliance. The second reason is the lack of exit option of the WHO. 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 due to the IHR reform, states with weak linkages choose to stay even though the IHR reform requires more cooperation from them.

Second, what does the finding of this paper tell us about the Covid outbreak? One salient issue is the Trump administration's announcement to withdraw from the WHO with the claim that the WHO is "China-centric" (Shear and Jacobs, 2020). On the contrary, this paper suggests that the IHR reform has required China to be more cooperative in information sharing, which is what actually happened during the Covid outbreak (Horton, 2020). More significantly, this paper shows how the U.S. power is enhanced by independence in IO, which may explain why the Biden administration rejoins the WHO immediately after his term starts.

Third, how generalizable is the finding? We know that collective action problem has always been an obstacle to the enforcement of international cooperation (Johns, 2019). This paper shows that interdependence among states drives the third-party enforcement, which can be context-specific. However, using interdependence as leverage is not unique. For example, in the case of international standard harmonization, whether a state decides to pay the costs and switch its own standards to accomodate international standards depends on the existing standards structure and how dependent this state is on international trade. The development of global value chains can be another important source of interdependence. Future research may expand the contents of interdependence to understand how interdependence contributes to international cooperation.

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A Appendix

A.1 Solution to the Model

For C, FOC:

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

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

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

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

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 $\theta = 1$, $m = m^* = \dfrac{1+\alpha}{2\gamma}$ and $b = b^* = \dfrac{1-\alpha q}{2\lambda}$.

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 has incentives to allow A to disseminate information, A does not suffer from the overriding costs and only transmits a message from L to C. Similar to a cheap-talk game between L and C, we need to find the threshold for L to approve A's information dissemination.

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

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

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

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

Plug in m^* and b^*, we get $\alpha \geq \dfrac{\gamma q - \lambda}{\gamma q^2 + \lambda} = \alpha^*$ and $\mu = 0$.

Here, we assume that $q > \frac{\lambda}{\gamma}$, meaning that the C's bans can impose large enough costs to L.

- 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 $\mu = \psi$, in which $\psi = Pr(\theta = 1)$.

- 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 for 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, which has a flavor of the signaling game.

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

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

We got $\alpha \leq \frac{\gamma + \lambda - 2p}{\gamma q - \lambda} = \alpha^{**}$, in which we assume that $q > \frac{\lambda}{\gamma}$.

- 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 $\mu = \psi$, in which $\psi = Pr(\theta = 1)$.

- 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.

Compare $\alpha^* = \frac{\gamma q - \lambda}{\gamma q^2 + \lambda}$ and $\alpha^{**} = \frac{\gamma + \lambda - 2p}{\gamma q - \lambda}$

- When $p \geq p^* = \frac{\lambda\gamma(q+1)^2}{2(\gamma q - \lambda)}$, $\alpha^* \geq \alpha^{**}$
- When $p < p^* = \frac{\lambda\gamma(q+1)^2}{2(\gamma q - \lambda)}$, $\alpha^* < \alpha^{**}$

Therefore, we know that when $\alpha \geq \alpha^*$ and $\alpha \leq \alpha^{**}$, A will disseminate the information no matter whether L approves it or not. When $\alpha \geq \alpha^*$, $r_L = 1$. When $\alpha \leq \alpha^{**}$, as L's utility is the same no matter whether L approves or not, L approves.

The pink area in Figure A.1 shows the range of p and α that supports the existence of the separating equilibrium where states comply. The red line indicates the size of α^{**} as a function of p. There are three main takeaways from the figure.

- If A does not have large enough independence (aka. the overriding cost cannot be too large), there will not be more compliance at the equilibrium.
- Perfect independence is not necessary for perfect compliance.
- States with small α are most likely to comply after the reform.

Now, we need to go back to C's decision. When $r_A = 1$, C believes that $\theta = 1$ and chooses $m = m^* = \frac{1+\alpha}{2\gamma}$ and $b = b^* = \begin{cases} \frac{1-\alpha q}{2\lambda} & \alpha \leq 1/q \\ 0 & \alpha > 1/q \end{cases}$. When $r_A = 0$, C needs to make

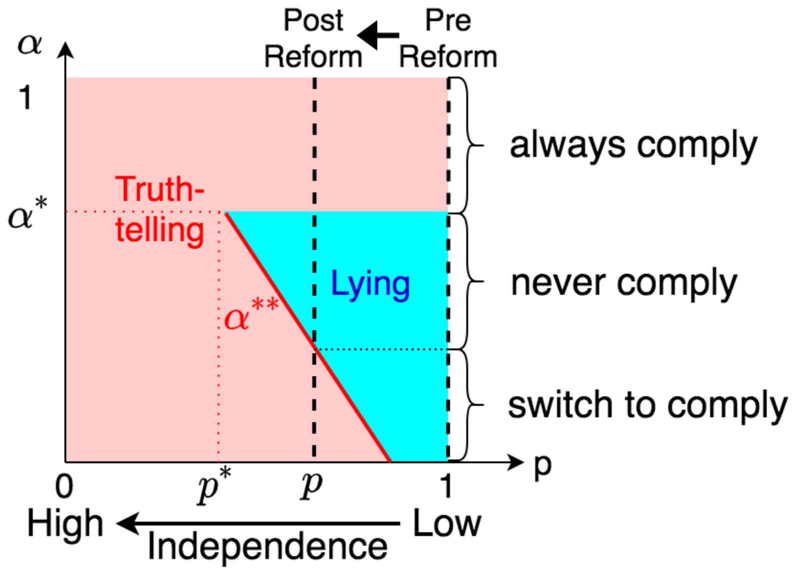

Figure A.1: Range of p and α to Sustain the Separating Equilibrium

a decision based on its belief about the probability that $\theta = 1$: ψ.

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

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

When ψ is very close to 0, $EU_C(m > 0, b > 0) < EU_C(m = 0, b = 0)$. C will choose $m = b = 0$ when $r_A = 0$.

A.1.3 Summary of Equilibria

Let $b^* = \begin{cases} \dfrac{\theta - \alpha q}{2\lambda} & \alpha \leq \theta/q \\ 0 & \alpha > \theta/q \end{cases}$, $\alpha^* = \dfrac{\gamma q - \lambda}{\gamma q^2 + \lambda}$ and $\alpha^{**} = \dfrac{\gamma + \lambda - 2p}{\gamma q - \lambda}$.

- For the combination of α and p located in the pink area in Figure A.1, $r_L = \begin{cases} 0 & \theta = 0 \\ 1 & \theta = 1 \end{cases}$, $r_A = \begin{cases} 0 & \theta = 0 \\ 1 & \theta = 1 \end{cases}$, $m = \begin{cases} 0 & r_A = 0 \\ \dfrac{1+\alpha}{2\gamma} & r_A = 1 \end{cases}$, $b = \begin{cases} 0 & r_A = 0 \\ b^* & r_A = 1 \end{cases}$, and C forms its belief $Pr(r_A = 0|\theta = 1) = 0$ and $Pr(r_A = 0|\theta = 0) = 1$.

- For the combination of α and p located outside the pink area, $r_L = 0$, $r_A = 0$, $m = b = 0$, and C forms its belief $Pr(r_L = 0|\theta = 1) = \psi$ and $Pr(r_L = 0|\theta = 0) = 1$, in which $\psi = Pr(\theta = 1)$.

A.2 Figures and Tables

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

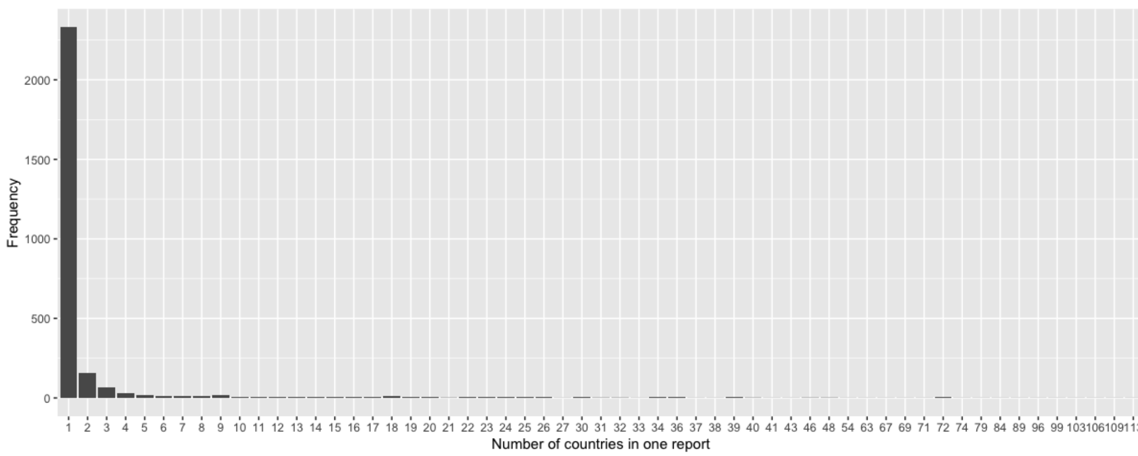

Figure A.3: Share of Countries Being Covered by DONs (1996-2019)

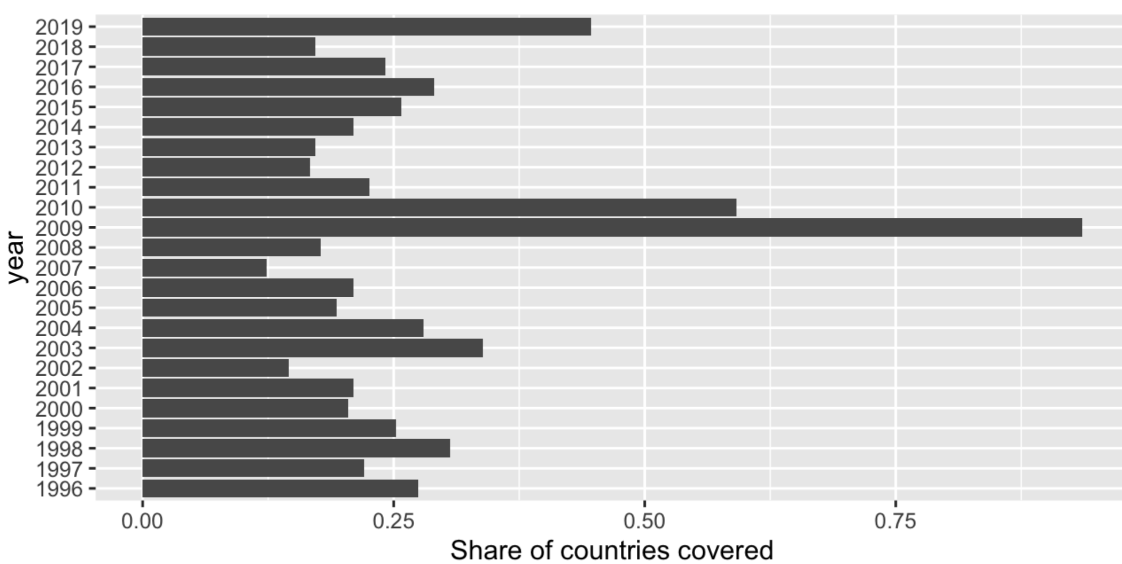

Figure A.4: Most Frequently Reported Countries: Pre 2005 vs. Post 2005

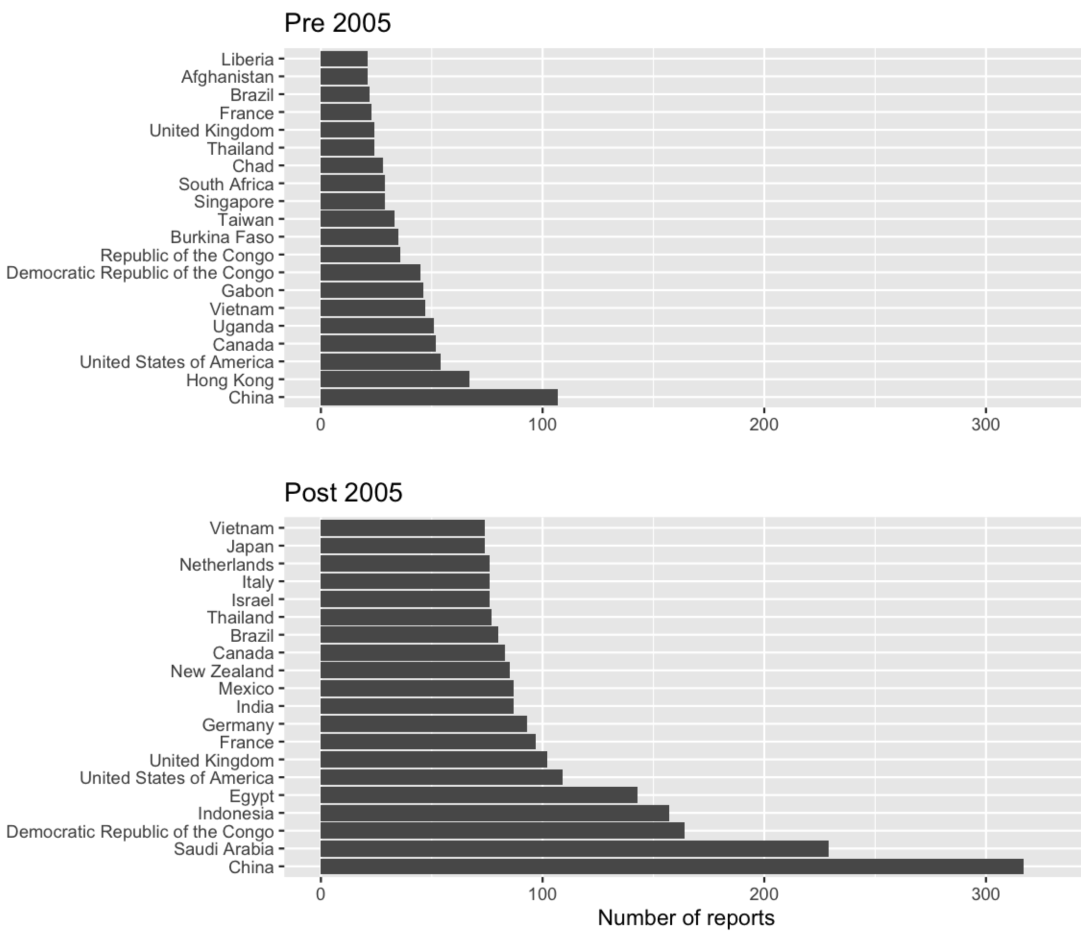

Figure A.5: Disease Information Verification System

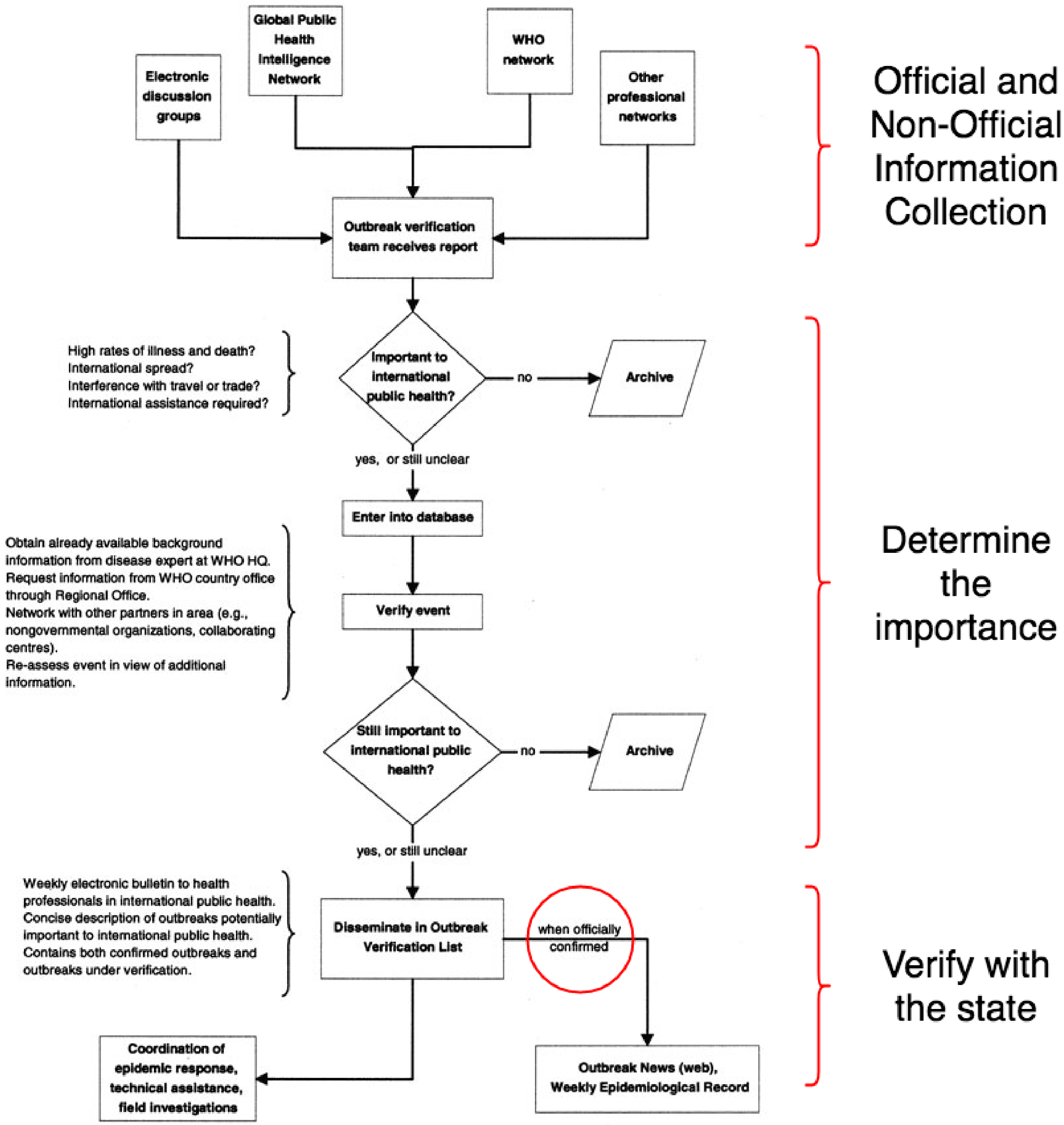

Figure A.6: Interface of GIDEON Informatics

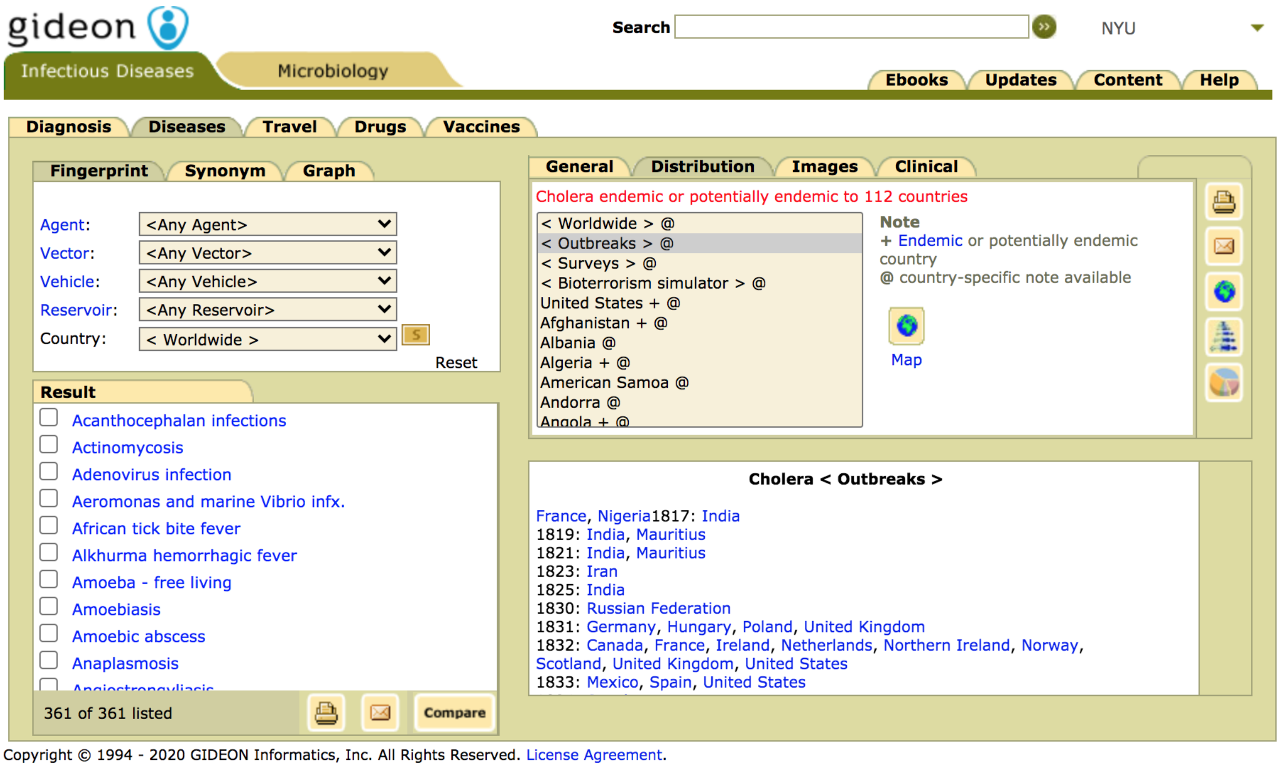

Table A.1: Trade Volume with the US and Disease Outbreak Report

	Dependent variable:					
	log(1 + DONs reports)					
	(1)	(2)	(3)	(4)	(5)	(6)
Total trade volume with US	−0.020	−0.016				
	(0.013)	(0.013)				
Total trade volume with US * Post2005		−0.053*				
		(0.028)				
Total exports to US			−0.011	−0.001		
			(0.010)	(0.012)		
Total exports to US * Post2005				−0.026		
				(0.018)		
Total imports from US					−0.007	−0.003
					(0.013)	(0.014)
Total imports from US * Post2005						−0.052*
						(0.028)
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	2,922	2,922	2,922	2,922	2,922	2,922
R^2	0.651	0.652	0.651	0.651	0.650	0.651
Adjusted R^2	0.567	0.568	0.567	0.567	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.2: Controlling for Disease Outbreak Events

	Dependent variable: log(1 + DONs reports)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ideal point proximity with US	−0.077	0.095					−0.080	0.071
	(0.089)	(0.103)					(0.089)	(0.100)
Ideal point proximity * Post2005		−0.323***						−0.293**
		(0.123)						(0.128)
Total imports from US			−0.005	−0.001			−0.006	0.082*
			(0.013)	(0.014)			(0.013)	(0.044)
Total imports from US * Post2005				−0.053*				−0.048*
				(0.028)				(0.026)
Seats on Direct Flight to US					−0.011	−0.006	−0.011	−0.015*
					(0.007)	(0.009)	(0.007)	(0.009)
Seats on Direct Flight * Post2005						−0.009		0.009
						(0.010)		(0.010)
N. of diseases (GIDEON)	0.123***	0.125***	0.122***	0.123***	0.122***	0.124***	0.122***	0.123***
	(0.035)	(0.034)	(0.035)	(0.034)	(0.034)	(0.035)	(0.034)	(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	2,922	2,922	2,922	2,922	2,922	2,922	2,922	2,922
R^2	0.653	0.655	0.653	0.654	0.653	0.654	0.654	0.657
Adjusted R^2	0.570	0.572	0.570	0.571	0.570	0.570	0.570	0.573

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

Table A.3: Alternative Explanation: Regime Type

	Dependent variable:			
	log(1 + DONs reports)			
	(1)	(2)	(3)	(4)
Ideal point proximity with US			−0.077	0.122
			(0.090)	(0.105)
Ideal point proximity * Post2005				−0.380***
				(0.142)
Total imports from US			−0.008	0.077*
			(0.013)	(0.045)
Total imports from US * Post2005				−0.052**
				(0.024)
Seats on Direct Flight to US			−0.011*	−0.015*
			(0.007)	(0.008)
Seats on Direct Flight * Post2005				0.008
				(0.010)
Polity IV	0.005	0.003	0.005	−0.006
	(0.011)	(0.011)	(0.010)	(0.012)
Polity IV * Post2005		0.005		0.021*
		(0.009)		(0.011)
Control	Y	Y	Y	Y
State FE	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y
Observations	2,922	2,922	2,922	2,922
R^2	0.650	0.651	0.651	0.655
Adjusted R^2	0.567	0.567	0.567	0.571

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

Table A.4: Alternative Explanation: Transparency

	Dependent variable:			
	log(1 + DONs reports)			
	(1)	(2)	(3)	(4)
Ideal point proximity with US			−0.128	0.067
			(0.115)	(0.127)
Ideal point proximity * Post2005				-0.436^{***}
				(0.158)
Total imports from US			0.009	0.105
			(0.020)	(0.072)
Total imports from US * Post2005				-0.113^{***}
				(0.036)
Seats on Direct Flight to US			−0.007	-0.018^{*}
			(0.009)	(0.010)
Seats on Direct Flight * Post2005				0.030^{**}
				(0.015)
HRV Transparency Index	−0.007	0.018	−0.008	0.008
	(0.039)	(0.040)	(0.039)	(0.040)
HRV Transparency Index * Post2005		−0.035		0.022
		(0.024)		(0.032)
Control	Y	Y	Y	Y
State FE	Y	Y	Y	Y
Office-Year FE	Y	Y	Y	Y
State-specific time trend	Y	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y	Y
Observations	1,858	1,858	1,858	1,858
R^2	0.714	0.714	0.714	0.720
Adjusted R^2	0.623	0.623	0.623	0.629

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

Table A.5: Exclude China and Saudi Arabia from the Sample

	Dependent variable:		
	log(1 + DONs reports)		
	Exclude China	Exclude Saudi Arabia	Exclude Both
	(1)	(2)	(3)
Ideal point proximity with US	0.073	0.087	0.088
	(0.106)	(0.101)	(0.105)
Ideal point proximity * Post2005	-0.316^{**}	-0.287^{**}	-0.314^{**}
	(0.131)	(0.129)	(0.130)
Total imports from US	0.082^{*}	0.078^{*}	0.078^{*}
	(0.045)	(0.045)	(0.045)
Total imports from US * Post2005	-0.044^{*}	-0.050^{*}	-0.043
	(0.026)	(0.026)	(0.026)
Seats on Direct Flight to US	-0.017^{*}	-0.019^{**}	-0.019^{**}
	(0.009)	(0.008)	(0.009)
Seats on Direct Flight * Post2005	0.012	0.013	0.014
	(0.010)	(0.010)	(0.010)
Control	Y	Y	Y
State FE	Y	Y	Y
Office-Year FE	Y	Y	Y
State-specific time trend	Y	Y	Y
State-specific quadratic time trend	Y	Y	Y
Observations	2,902	2,902	2,882
R^2	0.648	0.652	0.645
Adjusted R^2	0.562	0.567	0.558

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

Table A.6: 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 flight 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)	