

Trading Secrets: Disclosure Dilemmas in International Trade

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Abstract

How do international institutions help states cooperate? Scholars have long argued that these organizations solve information problems by increasing transparency; however, we introduce a distinct information problem – the disclosure dilemma – that they can solve using secrecy instead. Focusing on the domain of international trade, we claim that states often refrain from sharing sensitive economic information even though it can be critical for settling trade disputes. However, we demonstrate that IOs such as the World Trade Organization, if properly designed, can ameliorate this problem by receiving and protecting such information. After formalizing our theory, we assess our hypotheses using new data on information-sharing with the institution. We show that key reforms to safeguard confidential information increased the provision of this information and boosted trade cooperation, especially in industries that rely on such information. We conclude by discussing how solving this pervasive issue puts international institutions in tension with the normative goals of international transparency and accountability.

Keywords: international cooperation, international institutions, international relations, information, trade, WTO

In a recent trade dispute between South Korea and the EU over shipbuilding, the EU demanded information about South Korea's cost breakdowns, claiming that this was necessary to fairly adjudicate the case. However, South Korea refused to relinquish the data, asserting that doing so could help its firms' rivals and put them at a competitive disadvantage.¹ The EU could not ascertain whether South Korea made this claim to avoid producing evidence of its wrongdoing or because the information was, in fact, confidential.

We argue that these "disclosure dilemmas" – cooperation problems caused by a state or firm's unwillingness to divulge confidential information – are common in domains across international relations. For example, to enforce nonproliferation norms states must share intelligence about nuclear activities; to prosecute war crimes states must disclose relevant evidence; and to resolve civil conflict states must communicate sensitive facts about belligerents actions and intentions. However, worries about revealing intelligence capabilities or other secrets can keep states or other actors from doing so, and without this proof, their claims lack credibility. The resulting paucity of information can make it impossible to determine whether states are in compliance with their commitments, hampering efforts to enforce international norms and laws.

While these dilemmas represent a broad class of problems, we focus on their application to international trade due to the importance and salience of this domain and for reasons of empirical tractability. Indeed, many trade disputes involve proprietary data whose revelation can implicate trade secrets, details about specific transactions, or intellectual property. In such cases, parties commonly hesitate to supply materials that are necessary to fairly resolve a trade dispute; in fact, we document dozens of World Trade Organization (WTO) cases in which this occurred, and still others likely are never adjudicated. Observers cannot discern whether these details are kept hidden because it is truly confidential or because disclosing it would reveal the actor's guilt, and without this information, trade disagreements often cannot be resolved. States and firms may even refuse to pursue a dispute or engage in trade cooperation in the first place if they anticipate that sensitive information will either prevent a dispute's resolution if it is not disclosed, or will reveal trade secrets

¹See Barnard, Bruce. "EU poised to file complaint with WTO over South Korean shipbuilding practices." *Journal of Commerce*. October 3, 2000.

or other sensitive material if it is disclosed.

However, we posit that this impediment to international cooperation can be resolved by properly equipped international institutions. In contrast to the large literature arguing that a key purpose of these organizations is to *disseminate* compliance information (e.g. [Keohane \(1984\)](#)), we show that when sensitive details are involved, IOs can boost cooperation by *protecting* such information. Sharing confidential information with an IO limits access to it, while still allowing it to be communicated to the relevant parties. The outcome – reducing uncertainty through the provision of information – is the same, but in our account, IOs do so by withholding key facts and details rather than releasing them.

In the trade context in particular, extant scholarship argues that the WTO primarily improves trade cooperation by verifying a state's (non)compliance with international trade rules and laws and then publicizing that information ([Maggi, 1999](#)). Since the WTO has no discovery powers, this role relies on states to submit evidence of violations, after which the institution adjudicates the case.² The WTO often works in exactly this manner, as states provide information to the WTO's dispute settlement body, and it then determines whether violations occurred. However, we argue that when information is *sensitive*, this story often breaks down, as states typically refuse to provide materials that can undermine their firms' market competitiveness. In such a case, the WTO may not be able to tell whether the disputant refuses to supply information because it is guilty, or because the information is sensitive, and the dispute cannot be fairly adjudicated. However, if the institution can guarantee that competitors and other interested parties will not discover the confidential information, states may provide it and the case can go forward. To serve this function, an IO such as the WTO requires two important capabilities: reliable security and the expertise to judge the validity of a state's claims in a relatively unbiased manner. We demonstrate that once the WTO obtained a high level of both capabilities, international trade cooperation increased.

To make our argument, we develop a formal model of trade negotiations conducted in industries featuring sensitive information. The model shows that trade is inefficiently low in the absence of

²Disclosure dilemmas could be solved by providing the WTO with such powers, but states typically resist these impingements on their sovereignty.

an IO that can protect confidential data due to the potential harm that revealing this material would cause to firms' market competitiveness. However, a properly designed IO can mitigate this problem, leading relevant parties to divulge information and raising trade to socially optimal levels. The model yields several empirical implications, which we test with new data on information provision to the WTO and case studies analyses using the universe of WTO disputes. We also rely on 20 expert interviews with WTO officials, U.S. trade policy officials, and legal experts to further assess our mechanism. We show that the improved handling of confidential material following the Boeing-Airbus trade dispute increased the amount of such information submitted to the WTO and boosted trade, particularly in industries where this kind of information is relevant.

The Dilemma of Confidential Information

The under-provision and uneven distribution of information is widely recognized as an impediment to cooperation, as it permits states to avoid detection when they violate their agreements. Compliant states then fear that noncompliant states will exploit them, preventing them from cooperating in the first place.³ In contrast, when infractions are widely known, this behavior can be punished, and potential violators are frequently deterred.⁴ Indeed, the literature about international institutions has embraced this notion to such an extent that the critical role of "compliance information to facilitate compliance with international agreements," has become "a centerpiece of neoliberal institutionalism" (Dai, 2002, 409).

However, we argue that when compliance information is sensitive, this account is incomplete because it does not take into consideration the negative externalities associated with sharing it. Following Grando (2009, 276), we define confidential information as "non-public business or proprietary information and government information which is not accessible to the public." In the realm

³See Keohane (1984); Axelrod and Keohane (1985); Milgrom, North et al. (1990); Mitchell (1998); Koremenos, Lipson and Snidal (2001); Dai (2002); Lindley (2004); Carrubba (2005); Voeten (2005); Thompson (2006); Lindley (2007); Guzman (2008).

⁴There may be drawbacks to information sharing about multilateral diplomacy (Stasavage, 2004; Hafner-Burton, Steinert-Threlkeld and Victor, 2016b), multilateral monitoring (Marquardt, 2007; Lindley, 2007), and domestic items (Finel and Lord, 1999; Florini, 2002; Lord, 2012).

of international trade, this typically involves firm-level data that would be useful to potential competitors, or a government's classified materials.⁵ While some figures, such as the cost of lending on the open market, can be ascertained from the public domain, other issues of fact and intentionality are only available from confidential material. For example, disputes in which one side alleges that a government has unfairly subsidized an industry tend to pivot on whether that government's programs provided market advantages to domestic producers. Demonstrating that a state bought a product, provided incentives, or secured financing at below-market prices is tough to assess without sensitive data (Kreier, 2005, 54) because "the explanations and analysis in the confidential documents are more detailed, and provide more informative statements as to the authorities' reasoning and the factual basis therefor, than the conclusory statements found in the documents forming the basis of [the] review."⁶

Firms tend to care deeply about safeguarding this type of information. A recent survey in the EU demonstrated that firms most value their secret "commercial bids and contracts," followed by their "customer or supplier lists and related data," and then their "financial information and business planning," all of which could be revealed in a trade dispute (European Commission, 2013, 122). 74% of the firms surveyed said that these secrets were of medium or high importance, particularly for large firms, and mainly for strategic reasons. Indeed, the majority of firms indicated that the revelation of these details could lead to a "loss of sales/clients/contracts" (European Commission, 2013, 126). The survey concluded that "a stronger protection of trade secrets might result in greater sharing of information" (European Commission, 2013, 125).

The problem is that when such information is released, firms' competitors may learn about proprietary trade secrets or other material that could jeopardize the firms' market positions, or even reveal state secrets if the firm is linked to the government. Thus, absent confidentiality protections,

⁵The general confidentiality of pre-panel consultations, a panel's deliberations, interim panel reports, and other larger processes are related but distinct issues. A panel may adopt procedures that open parts of their proceedings to third party states or the public at large while also deciding to protect specific data and documents that disputants designate as confidential.

⁶WT/DS122/R 57. We describe cases subsequently in which access to sensitive firm-level information helped to shed light on lost profits and preferential contractual terms while sensitive government-level documents demonstrated what data was used when imposing countervailing duties.

“some members may choose not to produce confidential information, preferring instead to suffer the consequences of their non-compliance, which may be less costly than the damage that would ensue from public disclosure of the information” (Grando, 2009, 280). However, if a party to a dispute states that it refuses to share materials due to their confidentiality, it is difficult for trading partners to ascertain whether these claims are true or whether revealing the information would demonstrate the disputant’s guilt. As a result, such assertions can “become (or be perceived to be) an excuse not to provide information which would disfavour the party in question” (Grando, 2009, 279). States’ reluctance to provide confidential information, and their incentives to misrepresent why they refuse to do so, can therefore render disagreements unresolvable, and states that anticipate these difficulties often hesitate to invest in trade cooperation in the first place.⁷

IOs can Solve the Dilemma

We argue that international institutions can be designed to mitigate disclosure dilemmas and thereby improve international cooperation, by facilitating the sharing of sensitive information without necessitating its wide dissemination. In the economic realm, IOs obtain confidential macroeconomic or firm-specific data and combine it with other sources and their own expertise, while avoiding its disclosure to markets, states, or other actors. The institutions then reveal their conclusions to the international community, which are credible because the IOs have seen and validated the sensitive data. IOs can perform this function when they are designed to safeguard such information through, for example, document classifications systems and other security measures, and policies regarding how bureaucrats handle such information. IOs must also be able to credibly assess the veracity of sensitive information using their technical expertise and relative political neutrality; otherwise, states may not trust their conclusions.

This view of IOs both extends and revises traditional theories of IOs, which typically assume that states provide information about infractions, and do not account for their frequent refusals to

⁷Interviews with trade officials. Conducted 5/1/17.

reveal information for reasons other than avoiding a guilty verdict. For example, some scholars conceptualize IOs as “biased experts” (Krishna and Morgan, 2001) or “advocates” (Dewatripont and Tirole, 1999) which possess information, but have incentives to misrepresent it to the international community. Others view IOs as “mediators” which seek to promote cooperation between feuding parties, and which face conflicting incentives over whether to report violations of agreements (Kydd, 2006; Lindley, 2007; Mattes and Savun, 2010). Some also argue that IOs must have access to “an exogenous source of information” in order to be believed (Fey and Ramsay, 2010). In contrast, in our account, parties to a dispute can prove their own guilt or innocence, but doing so requires revealing secrets, which can be verified and safeguarded by the IO. The IO then reports its conclusions truthfully since a scope condition for our theory is that the IO is relatively politically neutral.

More broadly, international courts are typically conceptualized as bodies that provide “a guarantee for the right to negotiate, a common standard for evaluating outcomes, the option for several countries to join a dispute, and incentives for states to change a policy found to violate trade rules” (Davis, 2006), rather than protectors of confidential data. While the difficulty of proving secret information without “giving the secret away” has been recognized in domestic contexts (Metcalf, 1999),⁸ the problem is even more intractable in an anarchic international setting due to the involvement of governments, national security, and international economic competition. As a result, a role for confidential information has often been explicitly rejected in international institutions.⁹ Thus, while confidential information now plays a key role in many international settings (Chesterman, 2005), this role has not been explicitly theorized by scholars.¹⁰

In the case of the WTO in particular, this role is distinct from – but in many ways builds on – previous scholarly examinations of the institution, which claim that it serves several purposes. For instance, it may solve a terms-of-trade prisoners’ dilemma whereby states have an incentive to

⁸This often results in spotty enforcement (Putnam, 2016).

⁹For example, for years intelligence was a “dirty word” at the United Nations (Dorn, 2005).

¹⁰On organizational secrecy more broadly, see Geser (1992); Gibson (2014). On the risks of leaks see Pozen (2013); Sagar (2016). On IOs’ ability to validate policy proposals, see Voeten (2005); Thompson (2006); Chapman (2007).

defect from their trade agreements to gain a terms-of trade advantage (Bagwell and Staiger, 1999), prevent states from exercising coercive diplomacy (Carnegie, 2014), allow states to coordinate and reduce transaction costs (Keohane, 1984), permit states to build reputations for compliance (Büthe and Milner, 2008; Maggi, 1999; Mansfield and Pevehouse, 2008), and give states domestic political cover for adhering to their agreements (Allee and Huth, 2006). However, the vast majority of these accounts rest on the WTO's ability to "verify and publicize violations" so that other governments can learn about them and punish violators accordingly (Maggi, 1999). To do so, the WTO relies on information provided by states, as it has no discovery powers of its own. When such information is readily provided, these standard functions apply. However, we show that many instances occur in which governments fail to provide the information required to adjudicate a case. As a seminal piece in this literature shows, this is not a problem as long as: 1) the WTO can publicize these procedural violations and 2) disputants have no reason to withhold information other than to evade punishment (Maggi, 1999). Yet we demonstrate that this second condition does not hold when such information is sensitive, as disputants seek to avoid divulging confidential business information that can help firms' market competitors. As a result, interested parties cannot discern whether the accused parties did so to avoid being found guilty or to protect their market competitiveness.¹¹

We argue that the WTO can mitigate these dilemmas by safeguarding confidential information, a capability that improved most dramatically after the 2004 Boeing-Airbus case, which we detail subsequently. At the WTO's establishment in 1995, it relied on Article 18.2 of the Dispute Settlement Understanding which states, "Written submissions to the panel or the Appellate Body shall be treated as confidential, but shall be made available to the parties to the dispute."¹² Articles in

¹¹While previous research has noted the potential significance of confidential information in global governance more generally (Keohane, 2006; Grigorescu, 2007; Stone, 2011) and in other economic areas like investment arbitration (Hafner-Burton, Steinert-Threlkeld and Victor, 2016a), we are unaware of any systematic theories or tests that address the role of confidential information disclosures during trade disputes.

¹²The text of the article further clarifies that "Members shall treat as confidential information submitted by another Member to the panel or the Appellate Body which that Member has designated as confidential" but that "Nothing in this Understanding shall preclude a party to a dispute from disclosing statements of its own positions to the public." In addition to Article 18, also relevant is Article VII.1 of the Rules of Conduct for the DSU specifically covering panel members and WTO secretariat staff, which states, "Each covered person shall at all times maintain the confidentiality of dispute settlement deliberations and proceedings together with any information identified by a party as confidential" (Steinbach, 2013, 4-5).

specific agreements on subsidies and antidumping echo this language.¹³ However, textual references “do not themselves establish procedures to ensure the protection of such information but are just, in many cases, a declaration of principles” (Steinbach, 2013). Without specific protections for especially sensitive information, these details appear in “the wide and un-monitored diffusion of panel submissions,” as the normal distribution of this material involves sharing sensitive information with member-state delegations which often include “the lawyers for affected private parties or even employees of the parties themselves” (Kreier, 2005, 55).¹⁴

Firms and governments thus have demanded better protections for their confidential information, but since the WTO lacks dedicated practices for securely handling this information, each dispute uses “working procedures dealing with the individual confidentiality needs of the parties to the dispute” Steinbach (2013, 29). In practice, this means that sensitive and confidential information enters panel or appellate body proceedings only when a) additional protective procedures are requested by at least one disputant, b) the panel agrees that such procedures are merited and adopts them as part of its procedures, and c) members supply such information given those procedures. Such measures include redactions from publicly circulated documents such as panel and appellate body reports, the use of “approved persons” lists restricting which personnel from delegations can access documents, limitations on the location(s) at which sensitive documents can be stored and viewed, the creation of legal liability by requiring individual non-disclosure agreements, and the regulation of the physical handling of documentation (Kreier, 2005, 55-6).¹⁵ However, disputants often doubted the efficacy of these measures, leading firms to often choose not share information, or even litigate the case.¹⁶ A key turning point was the Boeing-Airbus case, which involved such a high volume of sensitive information that a variety of new procedures were developed to handle it.

¹³“The provisions of Articles 12.2, 12.3, 12.4 and 12.8 Subsidies Agreement are identical with or, at least, similar to the already mentioned provisions of the Antidumping Agreement. The Safeguard Agreement is less detailed, but also requires the protection of confidential information” (Ehlermann, 2002, 626).

¹⁴Delegations of states directly involved in the dispute are guaranteed access. In addition, delegations of third party participating states are also given access to all submitted material unless specific procedures are adopted.

¹⁵Examples of the last measure include no photocopying, the use of secure computer systems, and the destruction of documents at the conclusion of the proceedings.

¹⁶Interview 17.

The treatment of such information became more routine and the WTO demonstrated that it could successfully keep even the most sensitive information secret, increasing confidence in the institution. We detail this case more extensively subsequently, and exploit this change overtime in our empirical analysis.

A Theory of Trade Cooperation

We build from these observations to develop a theory of how the WTO can benefit its members by resolving disclosure dilemmas. Our central theoretical claim is that IOs like the WTO can ease disclosure dilemmas that arise when sensitive, private information is relevant to the compliance process by receiving, evaluating, and protecting it. In general, cases involving alleged trade discrimination often require sensitive facts – the price of inputs, the cost of credit, the terms of government support for domestic producers – about which governments have more information than the market and the WTO itself. When governments refuse to provide this information, the dispute may be difficult to resolve. By protecting sensitive information, the WTO allows states to supply it with less worry that it will be revealed more broadly, and the dispute can be adjudicated. To flesh out our logic and to derive testable hypotheses, we model these dynamics formally.

Model Setup

The model features two players, the home country H and the foreign country F . At the beginning of the game, H decides whether to trade with F . If H chooses not to do so, the game ends and the payoff for both countries is $(0,0)$. If H chooses to trade with F , F then decides whether to trade with H . If F chooses not to trade with H , the game ends and the payoff for both countries is again $(0,0)$. If F decides to trade with H , trade between the two countries begins.

Next, F decides whether to compete fairly with H in the market, or to secretly subsidize its firms (i.e. cheat) in order to export its products below cost to H . Doing so would allow it to drive

out competition and capture the market.¹⁷

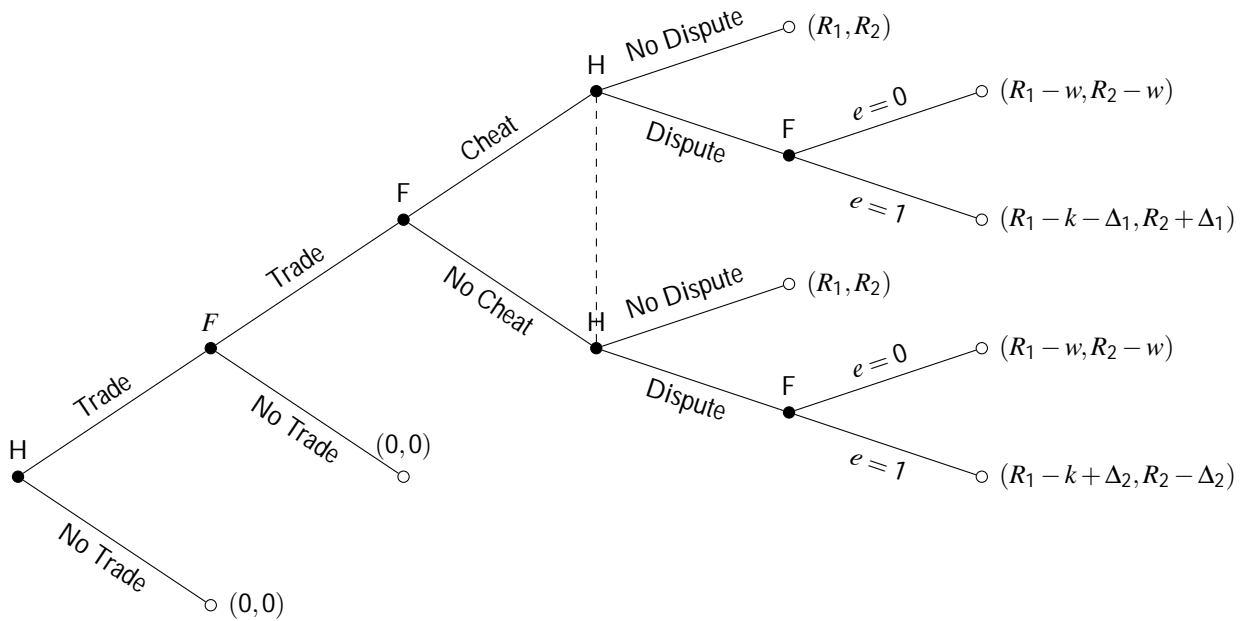
Denote the trade outcome as R_i , where $i = 1$ for F and $i = 2$ for H . The trade outcome can be decomposed into two parts: $R_i = Q_i + e_i$, where Q_i is the deterministic part and e_i is a random productivity shock. If F chooses not to cheat, denote $[Q_1, Q_2] = [q_{11}, q_{12}]$; if F cheats, $[Q_1, Q_2] = [q_{21}, q_{22}]$. $e_i, i = 1, 2$ follows a normal distribution $N(0, \sigma^2)$ and the shocks in the two countries are independent of each other. We specify $q_{21} > q_{11} > 0$ and $q_{22} < q_{12}$, so that F has an incentive to cheat, and F 's cheating harms H . We also stipulate that $q_{21} - q_{11} < q_{12} - q_{22}$ so that it is socially optimal for both countries to compete fairly.

Because H observes a noisy trade outcome, it cannot perfectly distinguish whether F cheated. H can either accept the current outcome $[R_1, R_2]$ (denoted ND), or it can dispute the outcome (denoted D). F then decides whether to show sensitive evidence that demonstrates whether it cheated or not at cost k . If F does not reveal its evidence ($e = 0$), the dispute cannot be properly adjudicated and both lose w as trade cooperation breaks down. If F reveals its evidence ($e = 1$) and it demonstrates that F cheated, F transfers Δ_1 to H . If F displays its evidence and it demonstrates that F did not cheat, H transfers Δ_2 to F . We assume that $k > \Delta_1 > \Delta_2$ because if it were not highly costly to reveal information, F would always admit to cheating and would simply compensate H . Further, the compensation paid if F cheated is greater than the compensation paid if H falsely accuses F of doing so since the former causes a greater loss to H than the latter does to F .

¹⁷Since H immediately observes F 's import taxes, no ambiguity exists about whether F cheats in this area. We therefore analyze export subsidies as a policy that F can strategically manipulate, though others could be modeled as well. To simplify, we assume that H does not cheat, though in a richer game with symmetry between the two parties, an export subsidy could also represent a choice variable for H .

Term	Description	Range
R_i	Trade outcome	$\in \mathbb{R}^+$
Q_i	Deterministic part of trade outcome	$\in \mathbb{R}^+$
q_{1i}	Deterministic part if F does not cheat	$\in \mathbb{R}^+$
q_{2i}	Deterministic part if F cheats	$\in \mathbb{R}^+$
e_i	Random productivity shock	$\in \mathbb{R}^+$
k	Cost of revealing evidence	$\in \mathbb{R}^+$
Δ_1	F 's transfer to H if evidence reveals cheating	$\in \mathbb{R}^+$
Δ_2	H 's transfer to F if F is falsely accused of cheating	$\in \mathbb{R}^+$

Table 1: Definitions of variables used in formal model.



Solving the Model

We look for subgame perfect Nash equilibria using backward induction. We explain the intuition behind the equilibria here and relegate the proofs to the supplemental appendix due to space constraints.

Consider two scenarios: First, if H and F trade, but F cheats and H files a dispute, F chooses $e = 0$ if and only if $R_1 - w > R_1 - k - \Delta_1$, or equivalently, if $w < k + \Delta_1$. In other words, if the loss that results from H freezing trade with F is smaller than the loss that occurs when F presents sensitive information to H and must compensate H , F decides not to reveal its information. Second,

if H and F trade but F does not cheat, yet H raises a dispute, F chooses $e = 0$ if and only if $R_1 - w > R_1 - k + \Delta_2$, or equivalently, $w < k - \Delta_2$. In other words, if the loss that results from a breakdown in trade cooperation is smaller than the loss that occurs when F discloses sensitive information showing its innocence and receives compensation from H , F decides not to disclose information.

In our context, the cost of revealing sensitive information depends on how well the WTO can protect both parties' information in a dispute. As the WTO becomes better able to do so, k decreases so that, holding w and the dispute transfer (Δ_1, Δ_2) constant, F becomes more likely to disclose its information. Further, as k decreases, F 's strategy changes from definitely cheating to cheating with some probability, H 's expected payoff increases. H is therefore more likely to trade with F at the beginning of the game. Suppose that trade between H and F in a given sector is composed of products for which trade involves different amounts of confidential information. In the aggregate, as k decreases, products that were previously not traded due to the need for F to protect its sensitive information are now traded, so that the trade flow in the sector increases.

Formally, as shown in the Supplemental Appendix, when $k > w + \Delta_2$, F never reveals information conditional on H raising a dispute, as $k > w + \Delta_2$ indicates that $R_1 - w > R_1 - k + \Delta_2$ and $R_1 - w > R_1 - k - \Delta_1$. However, when $w + \Delta_2 \geq k > w - \Delta_1$, F discloses information if F does not cheat as $w + \Delta_2 \geq k > w - \Delta_1$ indicates that $R_1 - w < R_1 - k + \Delta_2$ and $R_1 - w > R_1 - k - \Delta_1$. Further, when $w - \Delta_1 \geq k$, F always provides information conditional on H raising a dispute, as $w - \Delta_1 \geq k$ indicates that $R_1 - w < R_1 - k + \Delta_2$ and $R_1 - w < R_1 - k - \Delta_1$. The model shows that when k decreases, we move from the first scenario to the third, and the equilibrium moves from no trade to trade. Therefore, we arrive at the following two hypotheses:

Hypothesis 1. *Conditional on H bringing a dispute against F , F becomes more likely to disclose information as k decreases, ceteris paribus.*

Hypothesis 2. *As k decreases, overall bilateral trade increases.*

We can translate these theoretical expectations into empirically testable hypotheses. First, F only faces a cost of disclosing information if compliance information is sensitive. If, for example, compliance information is readily observable – such as whether a state is implementing a higher-than-agreed-upon tariff – F need not pay to submit it and $k = 0$. When F must reveal cost, pricing, or other information in order to allow the case to be adjudicated, however, its strategic interests can be compromised if other firms or governments obtain the information. Thus, whether compliance information is sensitive represents a key parameter in our theoretical framework.

However, even when information is sensitive, F may not face a high k if an IO exists that can protect it. When an IO can do so, F can demonstrate its innocence without worrying that other firms and market actors will obtain the information and compromise its market position. F can then reveal its information to the IO, and engage in trade with H . This logic is summarized in Table 2.

Table 2: Summary of Predictions

	IO Unable to Protect Info	IO Able to Protect Info
No Sensitive Info	Info Sharing Trade Cooperation	Info Sharing Trade Cooperation
Sensitive Info	Info Withholding Cooperation Breakdown	Info Sharing Trade Cooperation

Empirical Analysis

We assess our model’s predictions empirically using a mixture of qualitative and quantitative methods. In particular, we adopt a case study approach to evaluate whether the WTO’s ability to protect information led to more sharing of sensitive material, and use statistical analyses to analyze whether these reforms also resulted in increased trade. Both tests, but particularly the case study analyses, are informed by interviews we conducted with 20 experts using a convenience sample that includes current and former officials from the WTO Secretariat, the U.S. Commerce Department, the office

of the U.S. Trade Representative, trade associations, lawyers who represent clients at the WTO, and industry representatives.¹⁸ We reference these interviews in our case study analyses by number to protect the identities of our interviewees, which allowed them to speak more freely than they would have otherwise.

In both analyses, we operationalize whether the WTO is able to safeguard information using an indicator of the post-2004 period, since 2005 represented the formation of a panel to adjudicate the Boeing-Airbus case, which brought a wide range of new protections for sensitive information as detailed in the case study presented below. Many of our interviewees, along with our secondary sources, emphasized that this was a turning point for the WTO, after which firms and governments became more confident in the institutions's ability to protect their secrets. Thus, their willingness to provide information to the institution should have increased following the establishment of these measures, along with trade cooperation in general.

Testing Hypothesis 1

We assess our first hypothesis using new data that we collected from all WTO disputes that have resulted in a panel report. Ongoing or settled disputes are therefore excluded, as it is impossible to code our key independent and dependent variables in these cases since settled disputes remain confidential and ongoing disputes are not resolved. Out of all 518 cases that have been brought to the WTO, there are 215 that fit these criteria.

Our dependent variable is an indicator of whether either party to a given dispute withheld information from the panel. To code this, we relied on a combination of primary sources including panel reports and other documents produced by the WTO, secondary sources, and expert interviews. If a country held information back, it could have been either due to its sensitivity or to hide the disputant's guilt. However, our model shows that after the WTO could protect confidential information, a country's claim that it is withholding information due to its sensitivity lost its credi-

¹⁸We attempted to reach all WTO officials for whom we were able to locate contact information, and interviewed those who would agree to do so.

bility, so we expect fewer instances of information withholding after the reforms regardless of the country's true motivation for withholding it. However, measurement error is possible due to the difficulty of detecting the absence of information, for two reasons. First, if states anticipate that they will suppress information, they might seek to settle the dispute instead. Second, even if a panel is established, we may simply fail to detect the government's reticence to provide the information. Yet in both cases, this is likely to work against our results, resulting in an understatement of the true effect. If governments settle in instances where they would otherwise withhold information if it went to trial, we expect them to do so in the pre-reform period. Indeed, we can check whether firms are more likely to settle cases that likely involve sensitive information more frequently before the reforms are enacted, and we find that they are. These results are reported in the Supplemental Appendix due to space constraints. Further, our interviewees may not remember earlier cases as well, and it may be more difficult to locate secondary sources about such cases. Thus we likely under-count instances of information under-provision primarily from the pre-reform period.

We have two key independent variables. One is an indicator of the post-2004 period, as discussed previously. The second is a measure of how much sensitive information was involved in a given case. Since this can be difficult to observe, we use four different measures, finding similar results using each. Due to space constraints, we present the results using the first measure here, and relegate the findings from the other tests to the Supplemental Appendix. For our baseline results, we count cases in which confidentiality provisions were requested by one of the parties. States likely do so when they anticipate that they will need to reveal confidential information, so we count all instances of requests, rather than only the adoption of such measures. However, states may not bother to request these provisions if they do not expect the panel to enact them, so this method may undercount instances in which sensitive information was involved.

For robustness, we use three alternative ways to measure this variable: first, we code the degree to which words indicating information sensitivity came up in the panel report including: price, cost, bid, contract, list, data, financed, planning. To do so, we preprocessed the WTO panel reports and used lemmatization on each word, after which we computed the number of occurrences and the

frequency by dividing the number by the length of the document.¹⁹ An advantage of this method is that it is continuous, so that it provides an indication of how much confidential information was likely involved. Second, we used an indicator of whether a given case was classified by the WTO as an antidumping or subsidies dispute, since our interviews indicated that these are the areas in which confidential information arises most frequently due to the relevance of pricing and cost information that is not publicly available. However, this is a relatively rough measure; since it does not capture any aspects of the production process, it may not capture all cases accurately. Third, we use the R&D intensity of the industry, where greater intensity indicates that more sensitive and proprietary information is likely involved. We measure this using data from the OECD. Specifically, we rely on R&D expenditure data and divide it by gross output for a given industry. An advantage of using this measure is that, like our second measure, it is continuous. However, the data are not available for all countries in the sample.

Results

Our results strongly support our first hypothesis. We did not find any cases that did not involve sensitive information but information was withheld anyway. This makes sense since if information was not sensitive, parties could not credibly claim to withhold it for reasons other than a desire to avoid a guilty verdict. Moreover, among cases that involved sensitive information, all but one instance of withholding took place prior to the Boeing-Airbus case in 2005. The single case in which a party withheld information that occurred in the post-reform period happened concurrently with the Boeing-Airbus case, and the panel drew adverse inferences from it, meaning that it determined that withholding information for confidentiality reasons was not legitimate and likely indicated guilt.

Table 3 summarizes our findings, listing a separate entry for each case before and after the WTO's reforms. It codes our key independent variables – an indicator of whether the case was adjudicated after the WTO's reforms and an indicator of whether information was withheld – and

¹⁹We repeated this exercise using words that indicate that the WTO plans to protect this information: limited, locked, approved person, sealed, secure, access, stand-alone, closed. We also used words that indicate secrecy: secret, sensitive, HSBI, BCI, XXX, confidential. We obtained similar results.

provides additional details about cases in which information was withheld. As can be seen from the table, in contrast to the one instance of information withholding out of the 17 cases involving sensitive information that occurred after the WTO's reforms, we find that 13 out of the 25 cases prior to the reforms featured information withholding. Thus, prior to reforms, withholding occurred in 6% of sensitive information cases, while it occurred in 52% of these cases beforehand, a difference which is statistically significant.

In many of the cases prior to 2005, the panel expressed its concern about information withholding. For example, after the U.S. suppressed materials from the panel in U.S.-Wheat Gluten, the panel noted that such behavior represented a "serious systemic issue." It further stated, "Having access to the requested information would have facilitated our objective assessment of the facts of this case, and of the matter before us. We recall the view expressed by a previous panel and the Appellate Body that the WTO dispute settlement system cannot function optimally if relevant information is withheld from a panel."²⁰ Relatedly, after a leaked interim panel report in EC Approval and Marketing of Biotech Products, the panel worried about its effect on the willingness of private parties to make available business confidential information that may be crucial to the resolution of a dispute.²¹ Panels expressed similar concerns in a variety of other disputes as well, as detailed extensively in the Supplemental Appendix.

²⁰Panel Report in US *D* Wheat Gluten, WT/DS166/R

²¹See Panel Reports, EC - Approval and Marketing of Biotech Products (2006), para. 6.3, footnote 170.

Table 3: Summary of Cases Involving Sensitive Information

Dispute	Post-Reform?	Information Withheld?	Details	
			Information Withheld?	Details
Australia – Salmon	No	Unclear		Panel says Australia provided some requested info
EC – Bananas (US)	No	Yes		US denied access to its confidential information
Brazil – Aircraft	No	Yes		See Canada – Aircraft
Indonesia – Autos	No	Yes		U.S. would not provide sensitive info; leak occurred
Canada – Aircraft	No	Yes		Canada refused to provide sensitive business info – said panel could not protect
Korea – Alcoholic Beverages	No	No		
Canada – Dairy	No	Yes		Withheld after panel would not adopt confidentiality proceedings
United States – Upland Cotton	No	Yes		US used substitute farm numbers to protect farms
Thailand – H-Beams	No	Yes		Thailand submits inconsistent, scrubbed, opaque confidential documents; WTO can't determine
Australia – Automotive Leather II	No	No		
Argentina – Textiles and Apparel	No	Yes		Customs documents had been redacted
US – Lead and Bismuth II	No	Yes		US says can't share based on duty to protect firm
Argentina–Hides and Leather	No	No		
Guatemala–Cement II	No	No		
US – Wheat Gluten	No	Yes		
US – Lamb	No	Yes		US withheld info collected by ITC
Egypt – Steel Rebar	No	No		US provides scrubbed, indexed information
Canada – Aircraft Credits and Guarantees	No	Yes		
EC – Export Subsidies on Sugar	No	Unclear		Leaked confidential info
US – Oil Country Tubular Goods Sunset Reviews	No	No		
US – Line Pipe	No	Yes		US would not show complete confidential record
Korea – Commercial Vessels	No	No		
Canada – Wheat Exports and Grain Imports	No	No		
US – Gambling	No	Unclear		
EC – Approval and Marketing of Biotech Products	Yes	Unclear		Leak Leak
Korea – Certain Paper	Yes	No		
EC and certain member States – Large Civil Aircraft	Yes	No		
Mexico – Steel Pipes and Tubes	Yes	No		
Turkey – Rice	Yes	Yes		Turkey would not provide sensitive info; panel rejects justification
Japan – DRAMs (Korea)	Yes	No		
EC – Salmon (Norway)	Yes	No		
Mexico – Olive Oil	Yes	No		
US – Large Civil Aircraft	Yes	No		
Thailand – Cigarettes (Philippines)	Yes	No		
US – Anti-Dumping and Countervailing Duties (China)	Yes	No		
Philippines – Taxes on Distilled Spirits	Yes	No		
EC – Fasteners (China)	Yes	No		
EU – Footwear (China)	Yes	No		
China – GOES	Yes	No		
China – X-Ray Equipment	Yes	No		
China – Boiler Products	Yes	No		
China – Autos (US)	Yes	No		

Notes: The table summarizes the coding of each of our cases. The double horizontal line divides cases that began prior to the WTO's reforms from those that began afterward.

To explore the mechanism driving these decisions, we also include a more detailed analysis of each case listed above. In each case, we find that fears of leaked or compromised information drove decisions to withhold information, but that these justifications largely disappeared once the WTO demonstrated its ability to protect information in the Boeing-Airbus case. Due to space constraints, we include only two cases in full in the main text, which are disputes over aircraft subsidies. We include one from the pre-reform period and one from the post-reform period for comparison. Since the Boeing-Airbus case is critical to our story, we include it in the main text along with another aircraft case. However, the remaining cases are presented in the Supplemental Appendix. Further, because we do not find any instances of information withholding in any of the non-sensitive cases, we include full case studies for the sensitive cases only, and examine how information withholding changes in the pre versus post reform period. For each case, we provide a brief overview, then explain the sensitive information that was involved in the case and how the WTO sought to protect it. We then document whether the country held back information and if so, what its rationale was. Finally, we detail the panel's reaction to the withholding, if it occurred.

We find that in the Canada-Aircraft case, a variety of sensitive information was important to the panel, but Canada would not provide it due to concerns about its firms' competitors obtaining it. If firms worried about this, they might not apply for funds from Canada in the first place, and trade would suffer. In contrast, the WTO put extreme protections in place during the Boeing-Airbus case, and the parties to the dispute revealed considerable confidential data and details, which greatly assisted the panel in adjudicating it.

Case Study: Canada-Aircraft

In 1998, Brazil brought a case – known as Canada-Aircraft DS 70 – to the WTO in which it alleged that the Canadian government had illegally provided financial support to its domestic civil aircraft industry. Brazil claimed that Canada gave these subsidies in particular to promote the exports of its aircraft through the Technology Partnership Canada (TPC) Program, which made loans that could be repaid through royalties that were assessed on sales of the product. Canada asserted that

whether the loans constituted a "benefit" should depend on both the government's cost of capital and a commercial benchmark.²² In 1999, the panel decided that some of Canada's policies were not in compliance with its agreements, but did not find that it was providing export subsidies. Canada then appealed the decision, and the Appellate Body upheld the panel's findings.

A variety of sensitive information pertained to this case, particularly documents "concerning the \$87 million subsidy to Bombardier." Canada was especially worried that Embraer representatives in Brazil would see any disclosed information even with the additional confidentiality provisions²³ because this information was "of extreme sensitivity." The WTO adopted some provisions to safeguard this information, adopting "Business Confidential Information" procedures which included defining who could view the information, requiring viewers to sign non-disclosure declarations, redacting some information from panel reports, and limiting the number of copies or requiring that some information could only be held in Geneva.²⁴ The Appellate Body did not adopt additional procedures beyond those that the panel adopted.²⁵

However, Canada contended that it could not reveal information to the WTO because Article 18.2 of the DSU (reviewed previously) and these special procedures "did not afford sufficient protection" for its information.²⁶ Canada believed that a "neutral third party" such as the WTO Secretariat should be entrusted with its sensitive information, but instead the materials would be safeguarded by Brazil. The problem, according to Canada, was that Brazil "may have an immediate and commercial interest in these materials"²⁷ and thus should not be provided with them. If Brazil could easily access Canada's secrets in this manner, Canada worried that providing the information would lead to additional suits filed to learn secrets from Canada's "tax files, banking and financial records, regulatory proceedings and a host of other governmental activities" in an

²²https://www.wto.org/english/tratop_e/dispu_e/cases_e/1pagesum_e/ds70sum_e.pdf.

²³70R, 33

²⁴Ibid, 55-6.

²⁵See AB report.

²⁶Ibid 198.

²⁷Ibid, 38.

"endless intrusion."²⁸ Furthermore, if businesses believed that their information would be compromised, they might not apply for government funds or participate in the government program in the first place.²⁹ Canada claimed that many of the affected private parties had "already expressed reluctance in supplying information, or additional information, concerning their business plans, and such reluctance, if it were to continue, would have a serious deleterious impact on the functioning of the TPC programme"³⁰

Canada thus provided heavily redacted information regarding the specific subsidy, and refused to supply documents that the Panel requested including "Project Summary Forms, and the memoranda and other documents supporting the recommendations and decisions to provide these contributions"³¹ Canada stated that "the protection of confidential proprietary business information is a new and significant challenge to the WTO dispute settlement process, in which the Panel must balance two competing interests."³² Furthermore, if the information were released, Canada could have been vulnerable to "civil and criminal sanctions." Since the WTO would not sanction Brazil should a breach occur, Canada would be responsible under its domestic laws.³³

However, Brazil argued that Canada's information had "been redacted to such an extreme degree that it contribute[d] nothing to the Panel's understanding of the programs and issues involved." Brazil claimed that "in other instances, Canada ha[d] selectively provided particular pages, lines or figures from various documents, claiming that these extracts support its defense,"³⁴ and made similar arguments in the remedy phase.³⁵ The Panel agreed, stating that "the Business Confidential documents submitted by Canada" were "not sufficient" to prove its case.³⁶ Thus, the Appellate

²⁸70R, 24.

²⁹Ibid, 259.

³⁰Ibid, 116.

³¹Ibid, 226.

³²70R, 35.

³³Ibid, 180.

³⁴70R 32

³⁵WT/DS70/RW, 54.

³⁶Ibid, 226.

Body rejected Canada's argument that it did not have to provide the requested information (Grando, 2009, 9200). It "regrett[ed] Canada's refusal to provide the requested information" and noted that it could draw adverse inferences as a result, though it decided not to do so.³⁷ The Appellate Body noted that such refusals have "the potential to undermine the functioning of the dispute settlement system. The continued viability of that system depends, in substantial measure, on the willingness of panels to take all steps open to them to induce the parties to the dispute to comply with their duty to provide information deemed necessary for dispute settlement."³⁸

Case Study: Boeing-Airbus

In 2004, the United States alleged that the European Communities, Germany, France, the UK, and Spain were illegally subsidizing Airbus through a variety of grants, loans, and other kinds of assistance. The WTO agreed that it had obtained billions of dollars worth of subsidized financing, and in 2016 determined that the EU still had not come into compliance. However, the EU also claimed that Boeing had been unfairly subsidized by about \$9 billion. The WTO initially ruled that Boeing had received illegal subsidies, but reversed the decision after it was appealed.³⁹

A large amount of sensitive information was involved in this case, for several reasons. First, Boeing and Airbus are two of the largest exporters, so there were hundreds of billions of dollars at stake; if the confidential information were revealed, it would have a huge financial impact. Second, many parties were involved, and the interests of each country and company had to be protected. Third, the investment cycle for airlines is long, so the sensitive information would be relevant far into the future. Confidentiality issues thus arose for many kinds of relevant information. For example, the airlines did not want their customers to learn about price discrimination, and they sought to hide recurring cost information from competitors since they could reverse engineer it, deterring the airlines' abilities to invest in new products. Pricing and cost details were also very confidential; pricing information tended to be specific to a particular sale and cost information

³⁷Ibid 199.

³⁸WT/DS70/AB/R.

³⁹See https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds316_e.htm.

included development costs. Further, the airlines wanted to protect their spending profiles for development, such as the cost of suppliers.⁴⁰ However, the WTO required this information to “identify the nature of the government’s subsidy and then trace the discount this created to the final price of the produced good. This can be very tricky and requires large paper trail. It is especially hard with complex civil aviation, where it involves a very complicated production process, complex financial architecture; banks in multiple countries, buyers, sellers, and subsidiaries.”⁴¹ Moreover, the EU alleged that the U.S.’s military contracts subsidized its civilian manufacture, so extremely confidential information from U.S. military procurement contracts became relevant as well.⁴²

A particularly contentious issue requiring confidential data revolved around whether the EU provided Airbus with launch aid. Governments provide such assistance since it is very expensive to build planes. The payment is contingent, as it is only repaid if a plane is certified and sold, so the government bears the same risk as if it were an equity holder. The number of units sold is unknown so the fee they pay is similar to paying back a loan. The U.S. needed to show that the launch aid provided a benefit to Airbus, so a market benchmark, or the rate of return an investor would have demanded, was required. But to do so, it was necessary know what Airbus actually paid, which is confidential. Boeing also had to show that the subsidization had a consequence in terms of sales, to demonstrate that the subsidies displaced Boeing, which necessitated a comparison of price information that is not public.⁴³ Thus, markets, aircraft pricing, sales campaigns and other details of confidential contracts were demanded. The parties to the case claimed that if this information were released it could be “severely prejudicial” to the manufacturer, its customers, and suppliers.⁴⁴

In response, the WTO developed new, extreme measures to protect this information. Submissions were made public on the website with a delay, sensitive information was redacted from panel reports and only shared within the delegation, there were limits on the number of paper copies cre-

⁴⁰Interview 32.

⁴¹Interview 26.

⁴²Interview 23.

⁴³Interview 18.

⁴⁴https://www.wto.org/english/tratop_e/dispu_e/cases_e/1pagesum_e/ds316sum_e.pdf.

ated, information was sent by encrypted email and stored on a laptop whose internet connectivity was disabled, documents were hand delivered to corporate headquarters and could not be carried out of the room at the WTO, and third parties could not view information designated BCI (except for Brazil).⁴⁵ These precautions also evolved from temporary, improvised measures into routine ones. For example, parties initially used a small, locked room for sensitive information storage which only two people had access to. However, this was then upgraded to a designated space in the WTO's basement which "symbolize[d] the shift from ad hoc to permanent use of the information. It was quite a conscious decision."⁴⁶ They also "created HSBI – a whole new category of information – and an HSBI annex for the panel reports with HSBI info that wasn't available to anyone but the parties. It was an extraordinary level of protection."⁴⁷ Information was thus protected to such a degree that in the public reports of the case, "at key moments you have no idea what the panel's reasoning is because the critical info is just not there."⁴⁸ Our interviewees indicated that "by and large the system worked really well. There was no indication of a breach of the confidentiality procedures. Long term too, the case lasted 12-13 years and there were no breaches. The two parties by and large played by the rules."⁴⁹

As a result, with the potential exception of some recurring cost information, the parties to the dispute shared the information that was requested of them. While the "parties would not engage and exchange that information if it was talked about publicly,"⁵⁰ they were able to do so under the circumstances. The case thus set the precedent that the WTO could protect even the most confidential of information, and it "earned the trust of its members."⁵¹ Indeed, a key player in the dispute told us that the case "shows the way that trust is built,"⁵² and the institution can now

⁴⁵Interviews 32 and 23.

⁴⁶Interview 26.

⁴⁷Interview 23.

⁴⁸Interview 23.

⁴⁹Interview 32.

⁵⁰Interview 32.

⁵¹Interview 32.

⁵²Interview 26.

“copy the procedures going forward. If [the interviewee] brought a case today, [he] would get [his] hands on the working procedures of Boeing-Airbus.” Other interviewees believed that following this case, the WTO no longer needed to adopt reforms to protect confidential information.⁵³ Many believed that these procedures vastly improved the workings of the WTO because there cannot exist “meaningful subsidy rules without confidence in confidentiality.”⁵⁴

Testing Hypothesis 2

We next test whether the enactment of confidentiality provisions increased trade. As we discuss in the theoretical model, IOs need reliable information protection in order to ease disclosure dilemmas; otherwise, member-states may be deterred from submitting sensitive materials or may be “deterred from bringing cases by the fear that their own business secrets will be revealed” (Kreier, 2005, 53). Further, as Grando (2009, 279) observes, private firms that perceive a lack of reliable information protection at the WTO “will be deterred from providing sensitive information to their governments up front.” Even if member-states are willing to share information with the WTO, firms may resist giving up “proprietary or commercially sensitive information unless they have sufficient assurance that the confidentiality of the information will be maintained” (Prost, 2005, 279). If states and firms know that confidential materials will not be protected, they are likely to trade at lower levels than they otherwise would, since disputes could either release their information or reduce the value of their investments in their trading relationship if they prove intractable.

To test this hypothesis, we first ascertain whether the Boeing-Airbus case described previously increased trade between WTO members, before looking more specifically at the mechanism. Our data range from 1948-2009 and come from Liu (2009), and the unit of analysis is the dyad-year. The dependent variable is the natural log of imports of a given country in a dyad from its partner in a particular year and comes from the IMF’s “Direction of Trade Statistics.” We use OLS along with robust standard errors clustered by dyad.

⁵³Interview 18.

⁵⁴Interview 23.

To measure whether confidentiality reforms had been enacted at the WTO, we use an indicator of the post-2004 period, labeled *Reforms*. Since the Boeing-Airbus case should only have increased trade for WTO members, we interact this variable with an indicator of whether both states in a dyad are WTO members – *Both in WTO*. Since the dispute settlement system is only available to country pairs that are both WTO members, we include *One in WTO* but do not interact it with *Reforms*. We also control for the standard set of variables typically included in gravity models, including the logged *GDP* and *GDP per capita* of each country, whether one state in a dyad is a *current colony* or a *current colonizer* of the other, whether the states are jointly members of a *PTA* or *currency union*, whether one receives *GSP* treatment from the other. We use year and dyad fixed effects in the baseline model, which are robust to many kinds of endogeneity and misspecification. While this allows for comparability with other empirical work on the WTO and is a reasonable starting point, we also run a variety of alternative specifications, discussed subsequently.

The results shown in Table 4 demonstrate that trade increased significantly after the WTO's reforms for WTO members. The coefficient on WTO membership in the pre-reform period is 1.364, and is statistically significant, indicating that the WTO increased trade by 291% during this time.⁵⁵ However, during the post-reform period the coefficient is 1.727 and is also statistically significant, indicating that after the reforms, the WTO increased trade by 462%. Since the interaction term, *Both in WTO X Reforms*, is positive and significant, there exists a significant difference between the WTO's effect in the pre-reform period and the post-reform period.

We also run a variety of robustness checks on our results. First, since the WTO might be qualitatively different than the GATT, we rerun the results beginning in 1995, which marked the creation of the WTO. Second, we use time-varying fixed effects to capture additional sources of unobserved heterogeneity. Third, we use the EK Tobit model to capture zero trade flows. Fourth, because WTO membership might be endogenous, we investigate our hypothesis by testing whether the effect of the WTO is greater in the post-reform period *among states that were already WTO members* at the time the reforms were enacted. To do so, we use a sample of states that were WTO

⁵⁵Calculated using $e^{1.364} - 1$.

members in 1995, the year the GATT became the WTO, and examine the effect beginning five years before the reforms were enacted.⁵⁶ We also ensure that the results are not driven by the particular specification or covariate profile by including a variety of additional control variables and dropping outliers, as detailed in the appendix.

While these findings are consistent with our hypotheses, we cannot rule out the possibility that other factors drive them. We thus subject our data to a more difficult test. In particular, we expect our results to be especially strong for industries that are likely to require the release of confidential information in a trade dispute. Specifically, we argue that industries with higher research and development intensities benefitted disproportionately from the confidentiality reforms. High research and development intensities indicate that considerable proprietary information is necessary for producing a particular product, which firms might wish to withhold in a dispute, and which could be resolved by the WTO's reforms. We thus use the industry-country-year as the unit of analysis, with industry and country-year fixed effects, and interact a measure of research and development expenditures with reforms.

The dependent variable divides R&D expenditure by gross output for a given industry to obtain R&D intensity, which comes from the OECD. In our baseline specification, we use an indicator of whether an observation is above the mean value of this variable. In our robustness checks, we also use a continuous version of this variable. Since this measure is only available for 20 countries from 2000-2009, all of the countries in the sample were WTO members for the duration of the sample period. We therefore do not interact our independent variables with WTO membership as we did before. In our baseline specification, we use industry and country-year fixed effects. We also control for a variety of industry-level characteristics including intermediate inputs, value added, and labor costs.

Table 5 provides strong support for our contention that reforms to the WTO boosted trade most in industries that are most likely to require the revelation of sensitive information in a trade dispute. In the pre-reform period, having a higher R&D intensity increased trade by 1.756, while in the post-

⁵⁶None of these states exited the WTO during the sample period.

reform period, having a higher intensity did so by 19.772. Both terms are statistically significant, as is the interaction term, indicating that the difference between the two is also significant. These results are also robust to the specifications described previously, as shown in the appendix.

Conclusion

The question of whether and how international organizations can improve cooperation between member states is central to international relations. In the trade domain, disclosure problems arise frequently because states often cannot cooperate without revealing sensitive information. In the absence of an international body that can safeguard such material, this leads to cooperation failures since disputants prefer not to share such data, and other parties are unable to discern whether this is due to confidentiality concerns or because the information would demonstrate guilt. This paper introduces the issue of such sensitive information in the resolution of trade disputes and describes the effects on such issues on international trade. In particular, it argues that the WTO represents a solution to disclosure dilemmas, as it can protect sensitive information and thereby improve compliance and the willingness to trade. To derive testable predictions, we developed a formal model that analyzes trade cooperation both with and without an IO capable of protecting sensitive information. We then evaluated our hypotheses empirically and, using new data, found that 1) more confidential information was disclosed when the WTO was better able to protect it and 2) WTO members benefitted from the institution most after confidentiality provisions were enacted, particularly in affected industries.

In addition to the scholarly implications highlighted previously, this paper's findings have both normative and policy implications. In particular, our research sheds light on a normative tension that arises when international institutions handle sensitive information: investment by international organizations in infrastructure and protocols designed to protect confidential information run counter to calls for transparency and accountability. While international relations scholars have long argued that international organizations best facilitate cooperation by eliminating barriers to

information-sharing, we argue that improved cooperation in the presence of sensitive information often necessitates a capacity for secrecy. Therefore, mitigating disclosure dilemmas could potentially undermine efforts to increase democratic governance. Our findings thus suggest that when sensitive information is present, achieving accountability and transparency may be more challenging and complicated than it would otherwise appear.

From a policy standpoint, our findings suggest that international cooperation will benefit from the continued use and strengthening of confidential information procedures at the WTO and, beyond the trade arena, in many other IOs. Indeed, although we evaluate our theory in the trade domain, it applies broadly in the international arena, as IOs in a variety of domains now possess the ability to safeguard sensitive information. For example, the International Atomic Energy Agency collects and vets third party compliance information; the Organization for the Prohibition of Chemical Weapons protects information regarding chemical industries; and the International Monetary Fund safeguards financial sector data.⁵⁷ However, our argument does not apply to all IOs, as some provide primarily social functions or do not regulate areas in which sensitive information is important for governance. Other IOs could ameliorate these dilemmas but do not either because states have not enabled them to do so or for other political or technical reasons. Theorizing and substantiating this phenomenon helps to provide a richer framework for thinking about these aspects of global governance and determining when transparency or secrecy would be more effective.

⁵⁷See, respectively, [Carnegie and Carson \(2017\)](#), Article VIII of the Chemical Weapons Convention; and the Articles of Agreement of the International Monetary Fund, Article V, Section 2(B), "Confidentiality Protocol - Protection Of Sensitive Information In The Financial Sector Assessment Program".

Both in WTO X Reforms	0.363***
	0.058
Both in WTO	1.364***
	0.073
One in WTO	0.728***
	0.062
WTO Era	-17.262***
	0.476
Log(GDP) _i	1.838***
	0.099
Log(GDP) _j	1.957***
	0.103
Log(GDPPC) _i	-0.563***
	0.096
Log(GDPPC) _j	-0.696***
	0.099
Current Colony	0.469
	0.590
Current Colonizer	-0.472
	0.820
PTA	0.414***
	0.068
GSP _j	0.443***
	0.084
GSP _i	0.402***
	0.084
Currency Union	0.598***
	0.152
Constant	-29.436***
	1.283
R-Squared	0.704
N	1020182

Table 4: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Table displays the effect of reforms to the WTO on trade among WTO members relative to non-members. Robust standard errors clustered by dyad.

ReformsXRDIIntensity	18.016***
	5.910
RDIntensity	1.756***
	0.458
Labor Costs	-3.770***
	1.280
Intermediate Inputs	10.690***
	5.550
Capital Stock	-2.227
	8.270
Constant	22.723**
	0.081
R-Squared	0.413
N	1160

Table 5: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Table displays the effect of reforms to the WTO on industry-level trade among 20 WTO members. Robust standard errors clustered by industry.

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Model Proofs

Senario 1: $w + \Delta_2 < k$

If $w + \Delta_2 < k$, F conceals information when H raises a dispute, regardless of whether F cheated or not. The WTO then cannot tell whether F is guilty and refuses to show evidence to avoid punishment, or whether it is innocent but does not reveal information due to the high cost of doing so.

Anticipating F 's actions at the end of the game, H chooses not to raise a dispute because in a dispute, F always refuses to disclose information, triggering a trade freeze and leading to the loss of w . It is therefore better for H to accept the current outcome R_2 instead of $R_2 - w$. Once the countries begin to trade, F expects that H will accept any outcome without raising a dispute; thus, F cheats since the expected payoff from cheating, q_{21} , is greater than expected payoff from not cheating, q_{11} . F is willing to trade with H initially because $q_{21} > 0$. At the beginning of the game, however, if $q_{22} < 0$, H will not trade with F , since it knows that F will cheat and trade will then cease.

In sum, when the cost associated with disclosing information in a dispute is high for F , F always cheats. The more loss H endures when F cheats, the less likely H is to agree to trade with F at the beginning of the game. Notice that extremely high values of k also harm F ; since H will not trade with F because it knows that F will cheat and a trade freeze will occur, F loses at least q_{11} .

When H will choose not to raise a dispute, F decides to cheat and H 's expected payoff is q_{22} . If $q_{22} < 0$, H will not trade at the beginning of the game. However, trade will occur when $q_{22} \geq 0$, as the expected payoffs for F and H respectively are $[q_{21}, q_{22}]$. We therefore have the following proposition:

Proposition 1. *When $w + \Delta_2 < k$, there exists a unique pure strategy subgame perfect Nash equilibrium. If $q_{22} < 0$, H and F do not trade. If $q_{22} \geq 0$, H and F trade, F cheats, and H does not raise a dispute. If H were to raise a dispute, F would conceal its information.*

Senario 2: $w - \Delta_1 < k \leq w + \Delta_2$

If F cheats and H raises a dispute, the payoff of revealing information $R_1 - k - \Delta_1$ is smaller than that of concealing information $R_1 - w$, so F chooses $e = 0$. If F does not cheat and H raises a dispute, the payoff of revealing information $R_1 - k + \Delta_2$ is greater than that of concealing information $R_1 - w_2$, so F chooses $e = 1$. In other words, F discloses information when F is innocent and conceals information otherwise. Thus, if H raises a dispute, it either loses w because F refuses to show its evidence and H freezes trade, or it suffers a loss of Δ_2 because H has wronged F . Therefore, H accepts the trade outcome R_2 and chooses not to raise a dispute. Since no dispute will be raised, F cheats, as the expected payoff from cheating is q_{21} , which is greater than the expected payoff from not cheating, q_{11} . F is therefore willing to trade with H , while H is willing to trade with F if and only if $q_{22} \geq 0$. Therefore, if $q_{22} < 0$, H will not trade at the start of the game, while if $q_{22} > 0$, trade occurs between the two countries and the expected payoffs for F and H respectively are $[q_{21}, q_{22}]$.

Proposition 2. *When $w - \Delta_1 < k \leq w + \Delta_2$, there exists a unique pure strategy subgame perfect equilibrium. If $q_{22} < 0$, no trade occurs between H and F . H trades with F if $q_{22} \geq 0$ and does not raise a dispute. F then trades with H and cheats. Conditional on facing a dispute with H , F conceals its information if it cheated and discloses its information if it is innocent.*

Senario 3: $k \leq w - \Delta_1$

Since the cost of disclosing sensitive information is low under this scenario, F reveals its information in a dispute. We first show that no pure strategy Nash equilibrium exists.

In all pure strategy Nash equilibria in this scenario, once trade begins between the two countries, the following subgame is equivalent to the following static game:

		H	
		Dispute	No dispute
F	Cheat	$q_{21} - k - \Delta_1, q_{22} + \Delta_1$	q_{21}, q_{22}
	No cheat	$q_{11} - k + \Delta_2, q_{12} - \Delta_2$	q_{11}, q_{12}

If F cheats, H 's best response is to raise a dispute. Assuming that $q_{21} - q_{11} < \Delta_1 + \Delta_2$, F therefore does not always cheat. Similarly, one can easily show that no equilibrium exists in which F never cheats. Therefore, once the countries begin to trade, the only possible equilibrium is one in which F cheats with probability $0 < p_c < 1$.

H knows F 's strategy but cannot perfectly distinguish whether F cheated, as it only observes the trade outcome $[R_1, R_2]$ which represents a noisy proxy for F 's choice. If H fails to raise a dispute when F cheats or if it raises a dispute when F does not cheat, H loses utility. Therefore, H calculates the probability that F cheated ex post. Denote the probability with which H believes that F cheated as m_c . Then

$$m_c(R_1, R_2, p_c | S, Q) = \frac{Pr(R_1, R_2 | cheating) p_c}{Pr(R_1, R_2 | cheating) p_c + Pr(R_1, R_2 | no cheating) (1 - p_c)} \quad (1)$$

where $Q = \begin{bmatrix} q_{11} & q_{12} \\ q_{21} & q_{22} \end{bmatrix}$ summarizes the deterministic part of trade payoff.

The expected payoff from raising a dispute is $m_c(R_2 + \Delta_1) + (1 - m_c)(R_2 - \Delta_2)$, while the expected payoff from not raising a dispute is R_2 . Therefore, H raises a dispute if and only if $m_c(R_2 + \Delta_1) + (1 - m_c)(R_2 - \Delta_2) \geq R_2$, or equivalently, $m_c(R_1, R_2, p_c | S, Q) \geq \frac{\Delta_2}{\Delta_1 + \Delta_2}$. Hence, H 's best response after observing $[R_1, R_2]$ is to raise a dispute if and only if $m_c(R_1, R_2, p_c | S, Q) \geq \frac{\Delta_2}{\Delta_1 + \Delta_2}$.

Equation (1) can be further simplified:

$$\begin{aligned} m_c(R_1, R_2, p_c | S, Q) &= \frac{f(R_1 - q_{21})f(R_2 - q_{22})p_c}{f(R_1 - q_{21})f(R_2 - q_{22})p_c + f(R_1 - q_{11})f(R_2 - q_{12})(1 - p_c)} \\ &= \frac{1}{1 + \frac{f(R_1 - q_{11})f(R_2 - q_{12})(1 - p_c)}{f(R_1 - q_{21})f(R_2 - q_{22})p_c}} \end{aligned}$$

where $f(\cdot)$ is the probability density function of the normal distribution $N(0, S^2)$. Thus, the condition under which H raises a dispute is:

$$\begin{aligned}
m_c(R_1, R_2, p_c | S, Q) &\geq \frac{\Delta_2}{\Delta_1 + \Delta_2} \Leftrightarrow \frac{\Delta_1}{\Delta_2} \frac{p_c}{1 - p_c} \geq \frac{f(R_1 - q_{11})f(R_2 - q_{12})}{f(R_1 - q_{21})f(R_2 - q_{22})} \\
&\Leftrightarrow \frac{\Delta_1}{\Delta_2} \frac{p_c}{1 - p_c} \geq \frac{\exp[-(R_1 - q_{11})^2/2S^2 - (R_2 - q_{12})^2/2S^2]}{\exp[-(R_1 - q_{21})^2/2S^2 - (R_2 - q_{22})^2/2S^2]} \\
&\Leftrightarrow 2S^2 \ln\left(\frac{\Delta_1}{\Delta_2} \frac{p_c}{1 - p_c}\right) \geq [(R_1 - q_{21})^2 - (R_1 - q_{11})^2] + [(R_2 - q_{22})^2 - (R_2 - q_{12})^2] \\
&\Leftrightarrow S^2 \ln\left(\frac{\Delta_1}{\Delta_2} \frac{p_c}{1 - p_c}\right) \geq (q_{11} - q_{21})(R_1 - \frac{q_{11} + q_{21}}{2}) + (q_{12} - q_{22})(R_2 - \frac{q_{12} + q_{22}}{2}). \quad (2)
\end{aligned}$$

If F chooses to cheat, $[R_1, R_2] = [q_{21} + e_1, q_{22} + e_2]$. F 's expected payoff from cheating given the condition under which H raises a dispute, (2), is:

$$\begin{aligned}
E_C &= \int_{[e_1, e_2] \in \text{set } A} (q_{21} + e_2 - k - \Delta_1) g(e_1, e_2) de_1 de_2 + \int_{[e_1, e_2] \notin \text{set } A} (q_{21} + e_2) g(e_1, e_2) de_1 de_2 \\
E_C &= q_{21} - (k + \Delta_1) \int_{[e_1, e_2] \in \text{set } A} g(e_1, e_2) de_1 de_2
\end{aligned}$$

where $g(\cdot)$ is the probability density function for the bivariate normal distribution of e_1 and e_2 . $\text{set } A$ is the set of $[e_1, e_2]$ such that $S^2 \ln\left(\frac{\Delta_1}{\Delta_2} \frac{p_c}{1 - p_c}\right) \geq (q_{11} - q_{21})(e_1 + \frac{q_{21} - q_{11}}{2}) + (q_{12} - q_{22})(e_2 + \frac{q_{22} - q_{12}}{2})$. F 's expected payoff is the probability that it raises a dispute times its payoff after the dispute, plus the probability that it does not raise a dispute times its resulting payoff.

Thus, if F does not cheat, $[R_1, R_2] = [q_{11} + e_1, q_{12} + e_2]$. F 's expected payoff from not cheating is:

$$E_{NC} = \int_{[e_1, e_2] \in \text{set } B} (q_{11} + e_1 - k + \Delta_2) g(e_1, e_2) de_1 de_2 + \int_{[e_1, e_2] \notin \text{set } B} (q_{11} + e_1) g(e_1, e_2) de_1 de_2$$

$$E_{NC} = q_{11} + (\Delta_2 - k) \int_{[e_1, e_2] \in \text{set } B} g(e_1, e_2) de_1 de_2.$$

set B is the set of $[e_1, e_2]$ such that $s^2 \ln(\frac{\Delta_1}{\Delta_2} \frac{p_c}{1-p_c}) \geq (q_{11} - q_{21})(e_1 + \frac{q_{11}-q_{21}}{2}) + (q_{12} - q_{22})(e_2 + \frac{q_{12}-q_{22}}{2})$. Again, F 's expected payoff is the probability that F raises a dispute times its payoff after the dispute plus the probability that it does not raise a dispute times its payoff from not doing so.

H 's mixed strategy guarantees that F 's expected payoff from cheating equals the expected payoff from not cheating. Therefore, p_c is the implicit solution from the following equation:

$$(\Delta_2 - k) \int_{[e_1, e_2] \in \text{set } B} g(e_1, e_2) de_1 de_2 + (k + \Delta_1) \int_{[e_1, e_2] \in \text{set } A} g(e_1, e_2) de_1 de_2 = q_{21} - q_{11}. \quad (3)$$

Denote $q_1 = q_{21} - q_{11}$, $q_2 = q_{12} - q_{22}$ and $q_3 = s^2 \ln(\frac{\Delta_1}{\Delta_2}) + \ln(\frac{p_c}{1-p_c})$. Equation (3) can be rewritten as:

$$(\Delta_2 - k) \int_{e_1} F\left(\frac{q_1}{q_2} e_1 + \frac{q_3}{q_2} - \frac{q_1^2}{2q_2} - \frac{q_2}{2}\right) f(e_1) de_1 + (k + \Delta_1) \int_{e_1} F\left(\frac{q_1}{q_2} e_1 + \frac{q_3}{q_2} + \frac{q_1^2}{2q_2} + \frac{q_2}{2}\right) f(e_1) de_1 = q_1 \quad (4)$$

where F is the cumulative density function of the normal distribution $N(0, s^2)$. No explicit solution exists for p_c in equation (4). However, as k decreases, q_3 increases, which indicates that the probability that F cheats increases. Intuitively, k affects the cost of having a dispute. If F becomes more likely to cheat, it increases the probability that H will raise a dispute, which increases the likelihood that it will lose k . As k decreases, ceteris paribus, F becomes less afraid of triggering a dispute, thus increasing the probability that it will cheat. In other words, as the WTO provides better information protection, the fraction of cases in which one party cheated that feature confidential information increases.

The proof is shown below.

Proof. Rewrite (4) in the following way:

$$\begin{aligned} \Delta_2 \int_{e_1} F\left(\frac{q_1}{q_2}e_1 + \frac{q_3}{q_2} - \frac{q_1^2}{2q_2} - \frac{q_2}{2}\right)f(e_1)de_1 + \Delta_1 \int_{e_1} F\left(\frac{q_1}{q_2}e_1 + \frac{q_3}{q_2} + \frac{q_1^2}{2q_2} + \frac{q_2}{2}\right)f(e_1)de_1 \\ + k \int_{e_1} [F\left(\frac{q_1}{q_2}e_1 + \frac{q_3}{q_2} + \frac{q_1^2}{2q_2} + \frac{q_2}{2}\right) - F\left(\frac{q_1}{q_2}e_1 + \frac{q_3}{q_2} - \frac{q_1^2}{2q_2} - \frac{q_2}{2}\right)]f(e_1)de_1 = q_1 \end{aligned}$$

Since $k \int_{e_1} [F\left(\frac{q_1}{q_2}e_1 + \frac{q_3}{q_2} + \frac{q_1^2}{2q_2} + \frac{q_2}{2}\right) - F\left(\frac{q_1}{q_2}e_1 + \frac{q_3}{q_2} - \frac{q_1^2}{2q_2} - \frac{q_2}{2}\right)]f(e_1)de_1$ is positive, holding all other parameters constant, a decrease in k lowers the value of left hand side of the equation. Thus, q_3 increases, which increases the value of p_c .

□

F 's expected payoff is E_c , which is less than q_{21} , and H 's expected payoff is greater than q_{22} .⁵⁸ Therefore, the smaller the cost of disclosing information, the more likely H is to trade with F at the beginning of the game.

Proposition 3. *When $k \leq w - \Delta_1$, H trades with F if the expected payoff is greater than 0. This condition is easier to achieve than when $k > w - \Delta_1$ since F 's expected payoff is higher. If H and F trade with each other at the beginning of the game, F cheats with probability p_c (solved in (4)). H raises a dispute if (2) is satisfied, after which F discloses its information.*

⁵⁸This property holds when k is close to 0.