

The design of enforcement: Collective action and the enforcement of international law

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Abstract

International organizations (IOs) play a vital role in enforcing international law. I argue that collective-action problems and the design of legal-standing rules drive decisions about whether to enforce international law. When cooperation generates concentrated benefits—such as compensation for the expropriation of foreign investment—transnational standing can work well because the cost and benefit of enforcement are both fully internalized by the litigant. However, when cooperation generates diffuse benefits—like a cleaner environment—individuals and even governments have the incentive to free ride on enforcement, avoiding the cost of litigation in the hopes that another actor will step up. In such circumstances, supranational standing is necessary to uphold international law. Finally, hybrid regimes, which contain multiple forms of enforcement, are most needed when an IO has members that vary in their ability to enforce, or regulates issue areas that vary in their diffuseness.

Keywords

Enforcement; international courts; international law; international organizations

1. Introduction

International organizations (IOs) play a vital role in enforcing international law by adjudicating disputes between states (Abbott et al., 2000; Johns, 2015). Almost all IOs have dispute-settlement procedures, which create institutionalized ways to

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challenge state behavior. Yet, these procedures vary greatly on the matter of legal standing—namely, who is allowed to challenge possible legal violations? While scholars of international law have catalogued variation in these standing rules, few have asked: how do standing rules affect the enforcement of international law?

Most IOs rely upon *international enforcement*—states have legal standing to file complaints about possible legal violations. For example, the World Trade Organization (WTO) relies on its member-states to identify possible violations and file disputes. The WTO itself cannot sue its member-states. In contrast, sometimes states allow other actors to enforce international rules. Under *supranational enforcement*, states grant an IO the standing to challenge possible legal violations. One example is the International Criminal Court (ICC). While cases can be referred to the Court in various ways, neither individual victims nor the ICC's member-states can file lawsuits. The ICC Prosecutor is responsible for all investigations and prosecutions, so the ICC itself chooses which cases to pursue. Under *transnational enforcement*, states give private actors—including individuals, firms, and interest groups—the standing to enforce international rules (Johns, 2018). For example, bilateral investment treaties usually allow international arbitration of disputes, but these arbitral bodies rely upon firms and individual investors to challenge possible legal violations (Allee and Peinhardt, 2010, 2011). Finally, some international regimes, like the European Union (EU), use a *hybrid* of these designs, giving multiple kinds of actors standing to enforce international rules. Through various complex procedures, the EU allows private actors, member-states, and EU bodies to file lawsuits at the European Court of Justice.

I argue that the enforcement of international law via litigation is driven by the underlying nature of legal violations and the design of legal standing. Any actor that challenges a possible legal violation must pay a private litigation cost. Sometimes enforcement generates a highly concentrated benefit, ensuring that a litigant fully internalizes the cost and benefit of enforcement. For example, when firms use investment treaties to file arbitration cases against a foreign government, they seek financial compensation for alleged treaty violations. In contrast, sometimes enforcement generates a highly diffuse benefit, such as environmental protection. While all potential litigants benefit from a cleaner environment, each has incentive to free ride on the efforts of others, shirking on enforcement in the hopes that someone else will and letting someone else pay the cost of litigation.

I use a formal model to show that collective-action problems affect decisions about whether to enforce international law. I examine how *diffuseness*—the distribution of enforcement benefits across actors—affects decisions by strategic actors about whether to challenge possible violations of international rules. I show that diffuseness produces two competing effects. On the one hand, cases that produce more diffuse benefits have more potential litigants, each of whom has incentive to enforce. This suggests that diffuseness might increase the likelihood of enforcement. On the other hand, cases that produce more diffuse benefits induce free riding: each potential litigant will be less likely to challenge a possible legal violation in the hope that another actor steps in and bears the litigation cost. This suggests that diffuseness might decrease the likelihood of enforcement. Diffuseness, therefore, has a

mixed effect on collective behavior—the likelihood that someone provides enforcement. I argue that when litigation is relatively cheap, increasing the number of potential litigants outweighs the temptation to free ride, meaning that the overall effect of diffuseness is to increase the probability of enforcement. However, when litigation is relatively costly, the free riding problem becomes more severe and outweighs the effect of having more potential litigants, meaning that the overall effect of diffuseness is to decrease the probability of enforcement. The impact of diffuseness is conditional: collective outcomes are shaped by the combination of diffuseness and the relative magnitude of litigation costs.

By identifying who has authority to bring legal challenges, standing rules shape the enforcement of international law. My argument suggests that transnational enforcement—in which private actors can challenge legal violations—maximizes enforcement when litigation generates highly concentrated benefits at a relatively low cost. In contrast, supranational enforcement—in which a centralized IO can enforce rules—can best enforce international law when litigation generates highly diffuse benefits at a relatively high litigation cost. The traditional mode of international enforcement by states maximizes enforcement when the diffuseness of benefits and the relative costs of enforcement lie between these two extremes. Finally, my argument suggests that hybrid enforcement—in which multiple types of actors can enforce—is best suited to regimes in which either there is variation in either the diffuseness of benefits or the relative cost of enforcement. Hybrid regimes, therefore, should be most beneficial in providing enforcement when these regimes either involve multiple issue areas that vary in the diffuseness of their benefits, or govern states that differ significantly in their political or economic development.

More broadly, my argument supports those scholars who see commonalities between domestic and international legal institutions (Staton and Moore, 2011). In their study of US Congressional delegation, McCubbins and Schwartz (1984) famously distinguished between ‘police patrols’ and ‘fire alarms’. Police patrols are akin to supranational enforcement because they require a government agency (or IO) to seek out non-compliant behavior. Fire alarms, like transnational enforcement, rely upon individual actors that are directly involved in a dispute to trigger the enforcement process. McCubbins and Schwartz (1984) argue that going after legal violations in a centralized fashion can require an impractically large and expensive bureaucracy. Carrubba (2005) and Carrubba and Gabel (2014) argue that similar dynamics are at work in the EU. My model extends these arguments to focus on the variety of enforcement options that are available across multiple issue areas at the international level.

2. The design of enforcement

International relations scholars have long viewed the enforcement of international cooperation as a public good, building on the insights in Olson (1965). For example, Olson and Zeckhauser (1966) argued that incentives to free ride plagued the North Atlantic Treaty Organization and collective security within the United Nations (UN). In the 1970s, hegemonic stability theorists proposed that

international cooperation relies upon a hegemonic actor who can provide the public good of cooperation (Gilligan and Johns, 2012; Kindleberger, 1973). And then in the 1980s, early regime theorists, like Axelrod and Keohane (1985) and Oye (1985), argued that it is more difficult for states to solve collaboration problems (i.e. Prisoners' Dilemmas) as the number of states increases because of difficulties related to monitoring and reciprocal punishment.

In the early 2000s, two major scholarly movements emphasized the importance of institutional design and legalization in shaping international behavior.¹ Scholars in these movements initially crafted broad theoretical arguments about the role of law and institutional design in international politics. Yet, almost all of the subsequent research has been empirically driven and narrowly focused on explaining variation within individual issue areas and/or institutions.² Large, yet isolated, literatures have developed on the rational design of trade agreements, dispute settlement at the WTO, investment arbitration, human rights agreements, humanitarian law, and state responsibility.³ These literatures have yielded great insight into their specific issue areas, yet their narrow focus has hindered our ability to understand broad conceptual issues that cut across many areas of international politics. This article attempts to remedy this limitation by examining how variation across issue areas helps us to understand the enforcement of international law.

The diffuseness of enforcement benefits varies dramatically across issue areas. In investment arbitration, successful foreign investors usually receive private rewards from litigation that offset the cost of enforcement. Successful challenges usually cause host-governments to pay investors substantial compensation (Maurer, 2013; Wellhausen, 2016). However, these arbitration cases rarely generate benefits for other foreign investors. Investment arbitration often involves firm-specific contracts and treatment, and hinges on the interpretation of firm-specific contracts with the host-government. Arbitrators have been slowly building a body of case law, but international investment law does not formally allow *stare decisis* or precedent (Schill, 2014). Investors can invoke prior judgments in their legal arguments, but they cannot avoid litigation costs by simply asking a tribunal to directly apply a prior award to their case. Investment arbitration accordingly provides large, highly concentrated rewards to successful investors, but little benefit for others.

In contrast, sometimes enforcement generates a highly diffuse benefit for all actors that favor international cooperation. For example, the growth of human rights law shows that most governments and transnational actors believe that governments must respect basic individual rights. By making a government liable for human rights violations, the international community upholds its commitment to individual rights. In addition to punishing governments, many human rights IOs, like the Inter-American Court of Human Rights (IACHR), require that violators change their domestic laws to prevent future human rights violations, creating a highly diffuse benefit. Similarly, the enforcement of EU environmental rules provides a collective benefit to all EU members (and non-members, too).

Of course, enforcement is never a purely private or public good. Even if enforcement generates mostly private rewards, all actors that favor compliance with international law benefit from enforcement if it deters future legal violations. For

example, even though investment arbitration generates a private reward, all foreign investors benefit if arbitration deters future expropriation. Similarly, enforcement that yields largely public benefits can also provide some private rewards. For example, individuals who prevail at the IACHR usually receive compensation. Nevertheless, there is variation in the ratio of public versus private benefits from enforcement. Overall, human rights and environmental litigation generates more diffuse benefits than investment arbitration.

The relative cost of enforcement also varies exogenously across both actors and issue areas. International lawsuits require specialized legal expertise that is costly for all litigants, yet litigants vary in their ability to pay these costs for reasons that are exogenous to the legal dispute. For example, states often pay millions of dollars to litigate international trade disputes, causing many to argue that the WTO is fundamentally biased against developing states, which have fewer resources to challenge trade violations (Bown, 2009; Davis and Bermeo, 2009). Weak states also fear the political cost of challenging a strong state at the WTO when they are vulnerable to trade retaliation and/or dependent on foreign aid (Bown, 2005; Johns and Pelc, 2016). Similarly, investment arbitration imposes sizable costs on firms and individuals that challenge a foreign state. In the *Loewen* case against the US—one of the earliest and most famous North American Free Trade Agreement (NAFTA) investment cases—a Canadian firm argued that it was treated unfairly by a US court, effectively forcing the firm to pay a large settlement.⁴ The firm filed an arbitration case against the US, but years of costly litigation ultimately forced the firm to declare bankruptcy before the NAFTA tribunal ruled on the case. In her recent analysis of public investment arbitration, Wellhausen (2016) finds that foreign investors demand, on average, US\$884m in damages, and a prior analysis by Franck (2011) finds that average reported investment litigation costs are 10% of the value of the award, suggesting that foreign investors often pay tens of millions of dollars for enforcement. Not surprisingly, this affects which investors actually file cases. In their recent analysis of investment disputes, Van Harten and Malysheuski (2016) find that most investment cases are filed by companies with annual revenues of over US\$1b.

Relative costs also affect non-economic disputes. Courts like the European Court of Human Rights (ECHR) and the IACHR have arguably flourished in large part because most of their member-states have relatively high levels of economic development and well-functioning democratic institutions. Individuals who use the ECHR and IACHR do not fear government retaliation, and member-state transparency ensures that it is relatively easy to collect evidence of legal violations. In contrast, human rights victims in poor Darfur, the Democratic Republic of the Congo, and other conflict zones are often coerced by their abusers and cannot afford to seek international justice. Additionally, the practical details of mounting lawsuits—such as interviewing witnesses and collecting forensic evidence—are often insurmountable for individual private actors in conflict zones.⁵ Under these scenarios, it is difficult (if not impossible) for these human rights victims to enforce their rights: the relative cost of litigation is simply too high. As discussed in the following, one way to ameliorate this impact is to endogenously lower litigation costs

by providing legal assistance to victims. Another tactic that is explored here is to take account of the relatively high exogenous cost of litigation by adjusting an institution's standing rules.

Both the diffuseness of benefits and the relative cost of enforcement affect the decisions of strategic actors about when to uphold international law. Consider trade law enforcement at the WTO as a baseline example. When a trade law violation affects only one state, that state fully internalizes both the cost and benefit of enforcement. All else equal, a state will be more likely to enforce when the relative cost of doing so is lower. However, the affected state need not consider the strategic behavior of others when others are not harmed by the violation. In contrast, when a trade law affects many states, the benefit of enforcement is spread out. Any state that files a WTO dispute must pay a private cost to provide a public benefit. This mismatch between the cost and benefit of enforcement mean that states must carefully consider the strategic behavior of other affected states. When a dispute generates relatively diffuse benefits, possible litigants face a collective-action problem (Olson, 1965). Even though strategic actors may value the enforcement of international law, they are not necessarily willing and able to pay the cost of this enforcement, especially if they believe that someone else might provide enforcement. Strategic actors, therefore, have incentives to free ride on the effort of others: rather than challenging a possible legal violation, they will be tempted to wait and see if someone else steps up. Johns and Pelc (2018) provide evidence that such free riding affects the filing of WTO disputes. They find that cases with a highly diffuse effect challenge policies that have been in effect for longer than cases with a highly concentrated effect. This suggests that states have more incentive to delay filing challenges of more diffuse legal violations.

While diffuseness induces free riding at the individual level, its impact on the collective outcome—whether someone provides enforcement—is mixed. When enforcement creates more diffuse benefits, it increases the number of actors who benefit from enforcement, expanding the pool of possible litigants. For example, investment disputes provide a concentrated benefit, meaning that there is little incentive to free ride, but only one firm that may be willing to enforce. In contrast, environmental regimes provide diffuse benefits, meaning that many individuals and special interest groups may be eager to benefit from upholding environmental laws, even though each of these actors has incentive to free ride. The overall impact of diffuseness on the collective outcome is determined by which of these effects—free riding versus more potential litigants—is strongest. My analysis, therefore, complements Bliss and Nalebuff (1984), which considers a model in which a group relies upon an individual to provide a public good. While each individual has incentive to free ride on the efforts of others, the free rider problem can be overcome under some circumstances if the group grows sufficiently large. Namely, the distribution of costs of providing the public good must be such that the added benefit of having an additional individual who can provide outweighs the collective effect of all other individuals being less likely to provide.

However, unlike Bliss and Nalebuff (1984), I show that the strength of the two competing effects of free riding versus more potential litigants is determined by the

relative cost of enforcement. When the litigation cost is relatively small, the positive effect of having more potential litigants outweighs the negative effect of free riding. Under these circumstances, diffuseness increases the probability of enforcement. However, when the litigation cost is relatively high, the negative effect of free riding outweighs the positive effect from more potential litigants, so diffuseness decreases the probability of enforcement.

Additionally, I ask: which type of standing rules—international, supranational, or transnational—yields the most enforcement of international rules? The effectiveness of standing rules in promoting enforcement should depend on two key factors: the diffuseness of cooperative benefits and the relative cost of enforcement. When the benefits of cooperation are highly concentrated, there is no collective-action problem. In such situations, enforcement will be maximized under transnational standing. Allowing individuals, firms, and interest groups to enforce international law allows states to avoid the political and economic costs of enforcement without generating severe collective-action problems. Relatively ad hoc institutions, like investment arbitral tribunals, can create effective remedies for individuals. Of course, states lose the power to serve as a gatekeeper over litigation, but this effect is most likely to be outweighed when the benefits of cooperation are highly concentrated at the sub-national level.

When the benefits of cooperation are more diffuse, individuals, firms, and interest groups have more incentive to free ride on the efforts of others. Holding the relative cost of enforcement constant, this should lead to less enforcement. Under these circumstances, a state is better able to enforce rules than private actors since it internalizes the impact of a policy on all of its citizens. States must now bear the cost of enforcement, but they can reduce the free riding problem that is faced by private actors. Of course, states can never fully escape the collective-action problem themselves. When enforcement occurs at the international level, states are tempted to free ride on the efforts of other states. As the benefits of enforcement are more diffuse, the collective-action problem amongst states also becomes more severe. When the benefits of enforcement are extremely diffuse, supranational standing yields more enforcement since an IO internalizes the impact of a violation across its member-states and has authority to challenge violations. States must still bear a share of the cost of enforcement, but they ensure that there is not under-provision of enforcement.

All else equal, my formal model suggests that transnational standing is most effective when enforcement yields highly concentrated benefits. As the benefits of enforcement become more diffuse, we should expect international enforcement to be more effective in upholding international law. And when cooperative regimes generate extremely diffuse benefits (like the criminal prosecution of war crimes), we should expect that supranational enforcement by an IO (like the ICC) will be most effective.

My argument also implies that the relative cost of enforcement affects which institutional design is most effective at generating enforcement. All else equal, I find that transnational enforcement is optimal when litigation costs are relatively low

because the positive effect of expanding the set of actors who can enforce outweighs the negative effect of free riding. As the relative cost of enforcement increases, free riding becomes more severe, meaning that international enforcement is optimal when litigation costs are relatively moderate. Finally, supranational enforcement is most effective when litigation costs are relatively high. These effects imply that the design of enforcement may vary even within a specific issue area. As described above, regional human rights institutions have been relatively successful in Europe and Latin America because individuals within those societies can bear the litigation costs, meaning that transnational enforcement can yield relatively high levels of enforcement. However, transnational institutions will be of little help to individuals who live in poverty or in conflict zones. These victims rely upon the international community as a whole, particularly the ICC Prosecutor, to hold leaders accountable for their actions. Supranational enforcement may be necessary when the cost of enforcement is relatively large.

The varying impact of diffuseness and relative costs on institutional design suggest that hybrid regimes—in which there are multiple modes of enforcement—may be needed to promote cooperation in regimes with high variation in diffuseness or relative cost. For example, the EU regulates an immense number of diverse issue areas. Some of these areas, like trademarks, generate highly concentrated (and even firm-specific) benefits, suggesting that transnational enforcement can be effective. Other areas, like environmental regulation, generate highly diffuse benefits for all EU members, suggesting that supranational enforcement may be most effective. In between these two extremes, some issue areas generate moderately diffuse benefits, such as the regulation of national state aid policies, suggesting an important role for international enforcement. Similarly, the UN's human rights treaty-based bodies oversee the behavior of states that vary dramatically in their level of economic development and domestic institutions. Individuals living in rich and democratic states, like France, can more easily pay for enforcement than individuals living in poor and autocratic states, like the Central African Republic. Transnational enforcement may be possible for some, but impossible for others, suggesting the need for multiple modes of enforcement. In such scenarios, enforcement will be highest if the IO uses its enforcement resources for supranational enforcement on those cases that generate diffuse benefits at a high cost, and allows private actors to pursue cases that generate concentrated benefits at a low cost. States can then provide enforcement for cases that lie between these two extremes.

My argument does not require that we assume that actors are greedy and opportunistic, seeking to receive financial benefits from the effort of others. Human rights victims and their families rarely appear to be motivated by financial rewards—they seek justice. Yet, they face the same strategic problem as actors that want to enforce international rules for trade, the environment, and other issue areas. The theory of collective action applies not only to the opportunistic behavior of profit-seeking firms, but also to global justice, such as the protection of human rights.

3. Theoretical argument

I present an infinite-horizon game with discrete time periods ($t = 1, 2, \dots$). In this model, a set of n players have been harmed by a possible violation of an international rule. I refer to this possible violation as the defendant's 'policy'. Under international enforcement, the players are states that wish to uphold international cooperation. Under transnational enforcement, the players are private actors—such as firms, individuals, and interest groups. Finally, if we assume that there is only one player ($n = 1$), then the model represents supranational enforcement by an IO that internalizes the full impact of enforcement on its members. I denote the total benefit of enforcement by $T > 0$, and assume that the individual benefit of enforcement for a given player i is $\tau_i > 0$.

To identify the impact of diffuseness, I must make an assumption about the distribution of the individual benefits of enforcement. If increasing diffuseness simply entailed giving new individual benefits to new players, then increasing diffuseness would be equivalent to increasing the overall benefits of enforcement. We would not be able to isolate the impact of diffuseness. Therefore, I wish to examine changes in the distribution of benefits while holding the total benefit, T , constant. To simplify my analysis, I assume that $\tau_i = \frac{T}{n}$. In the most extreme scenario, the benefits of enforcement are so concentrated that only one player has incentive to enforce ($n = 1$). As these benefits become more diffuse, the total benefit of enforcement is shared by more strategic actors. Diffuseness reduces each individual's incentive to enforce, but also increases the number of players with some incentive to enforce. Therefore, I isolate the impact of diffuseness, independent of the total benefit of enforcement.

To avoid reliance of the equilibrium behavior on mixed strategies and indifference condition, the model includes strategic uncertainty about each player's individual willingness to enforce, which is represented by her type. In each period t , Nature chooses the type of each player i for that period, which I denote by α_{it} . This type is player i 's private information. I assume that each player's type is independently and identically distributed according to the uniform distribution, $\alpha_{it} \sim U[0, A]$ with large $A > 0$. This type can represent stochastic economic or political pressure on the individual to enforce (Johns and Rosendorff, 2009). If player i does not challenge the policy in period t , it receives the payoff $-\alpha_{it}\tau_i$, which can be interpreted as player i 's political or economic cost from failing to enforce in period t . Therefore, parameter α_{it} represents the unit cost of failing to enforce, and the magnitude of the overall cost depends on a player's individual benefit from enforcement, τ_i .

After observing its type, each player simultaneously decides whether to enforce the underlying international rule at an international body. Since different international bodies use different terminology for their dispute-settlement processes, I refer generally to player choices about whether to 'file a dispute' that triggers 'litigation'. If a player files a dispute, it must pay a litigation cost $k > 0$. This is not a one-time decision: if no player files a dispute in period t , then all players can file in the next period, $t + 1$. If no player ever files, then the game continues forever, meaning that

the defendant's policy remains in effect in every period. However, if at least one player files, then the dispute goes to an international body—such as an arbitral body, court, dispute-settlement panel, etc.—and the strategic interactions in my model end.

Since my focus is on decisions about whether to enforce, and not the enforcement process itself, I model the interactions in the international body in reduced form. I don't assume that every challenge is successful—sometimes the international body may decide that the defendant has not violated an international rule. Each player's ex-ante assessment of the benefit of filing a dispute is shaped by its expectations about how the dispute process will unfold. Some legal violations might be more easily challenged than others, and some institutions might be better able to channel disputes into actual changes in the defendant's behavior. Rather than making assumptions about how the dispute process works, I define a parameter $r > 0$ that I refer to as the expected *common reward* of litigation. If someone files the case, every player receives the payoff $r\tau_i$ in future periods. Higher values of r , therefore, represent better cases, stronger institutions, etc., while lower values of r represent the opposite. Even if a player files a dispute with highly diffuse benefits, the complainant can still sometimes gain an expected *individual benefit*, $b \geq 0$. Namely, I assume that a player that files receives an additional $b\tau_i$ payoff in all future periods. Because infinite-horizon models require complex notation that will be of little interest to the general reader, I specify the utility functions (which are discounted streams of payoffs) in the Appendix 1. I solve the model for its symmetric weak perfect Bayesian equilibrium.⁶

Proposition 1. *When players are relatively impatient, there exists a symmetric weak perfect Bayesian equilibrium in which each player adopts a cutpoint strategy: conditional on reaching period t , high types will file a dispute and low types will not file.*

Given the model's structure, I must constrain the discount factor to identify a reasonable equilibrium. To understand why, suppose that the players are extremely patient (δ is large). Then, an infinite stream of minuscule expected individual benefits will outweigh the one-period litigation cost, and all players will immediately file a dispute. This behavior is substantively implausible. More plausible behavior occurs when players are relatively impatient (δ is small) because the one-period litigation cost deters some types from filing.

Rather than examining all of the comparative statics of the model, I focus on my key interest, which is the impact of diffuseness on the likelihood of enforcement. My first main result reflects the free riding incentives that are inherent in my model framework:

Proposition 2. *As the benefit of enforcement grows more diffuse, each player becomes less likely to file a dispute.*

The benefit of enforcement becomes more diffuse when the total benefit is spread across more players. In my model, this is equivalent to increasing the

number of players. Therefore, greater diffuseness reduces the individual benefit from enforcement, $\tau_i = \frac{T}{n}$. This effect, in turn, reduces the magnitude of both the per-period payoff from not filing, $-\alpha_{it}\tau_i$, and the per period benefits of filing, $r\tau_i$ and $b\tau_i$. These effects reduce each player's stake in the dispute, making each player less willing to pay the litigation cost. While every player still expects to benefit from litigation, there is a free rider problem. Each player is less willing to file, both because her own benefit from enforcement has decreased and because she hopes that someone else will pay the litigation cost.

However, the presence of a free rider problem does not necessarily mean that there will be less overall enforcement of international rules. After all, because diffuseness increases the number of players that benefit from enforcement, it also increases the number of actors who may be willing to file a dispute. Even if each individual player wants to free ride, having more possible litigants can increase the overall probability that *someone* challenges a possible violation. Which effect dominates—free riding versus more potential litigants—depends on the size of the enforcement cost, k :

Proposition 3. *As the benefit of enforcement grows more diffuse: the likelihood of enforcement increases when k is small; and the likelihood of enforcement decreases when k is large.*

In Figure 1(a), the x-axis represents the size of the litigation cost, and the y-axis represents the probability that at least one player enforces by filling a dispute in a given period.⁷ The thick line shows the probability of enforcement if one player benefits from enforcement. The thin line shows the probability of enforcement when there is low diffuseness: two players benefit. At the threshold value k , changing the level of diffusion has no impact on the overall probability of enforcement. If the litigation cost is small ($k < k$), then the free rider problem is not very severe. So, the marginal effect of having more potential litigants outweighs the marginal effect of free riding: more diffuseness increases the probability of enforcement. However, as litigation becomes more costly, the temptation to free ride grows larger and ultimately outweighs the marginal effect of having an additional potential litigant. So, for high litigation costs ($k > k$), more diffuseness decreases not only the individual probability that each player files, but also the overall probability that someone files.

As diffuseness grows even larger, the free rider problem becomes exacerbated even more:

Proposition 4. *As the benefit of enforcement grows more diffuse, the free rider problem becomes more severe.*

Figure 1(b) adds a dashed line to show the equilibrium probability of enforcement when the benefit from enforcement is more diffuse. In this simple example, I assume that four players benefit from enforcement. The logic from Figure 1(a) still holds when we consider a change from low diffuseness to high diffuseness. Now the

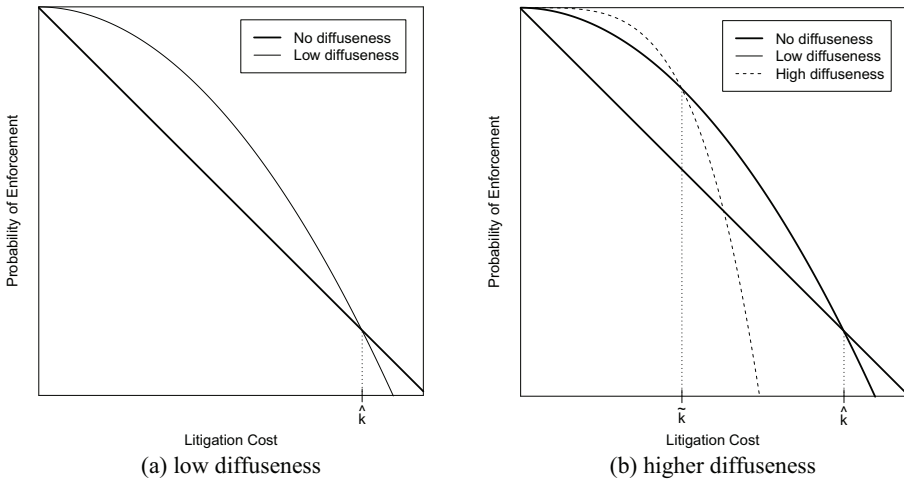


Figure 1. Impact of diffuseness.

Note: figures were created in R from simulations of equilibrium behavior.

threshold value—the point at which the increase from low to high diffuseness has no effect on the probability that someone challenges—is \tilde{k} . For small costs ($k < \tilde{k}$), moving from low to high diffuseness increases enforcement because diffuseness creates more potential litigants; but for large costs ($k > \tilde{k}$), the increase in diffuseness decreases enforcement because of free riding.

The negative impact of free riding outweighs the positive impact of more potential litigants when the litigation cost is high, so we can compare the two threshold values (k and \tilde{k}) to understand the severity of the free rider problem. As diffuseness increases, the associated threshold value decreases (i.e. $\tilde{k} < k$), meaning that diffuseness decreases enforcement for a larger range of parameter values (values of k). The free rider problem becomes more severe as diffuseness increases.

How robust are my findings? In my model, diffuseness has two effects. First, more diffuseness increases the number of potential litigants. This effect alone will make each player less likely to file, which is standard behavior under public goods arguments. Second, because I control for the total benefit of enforcement, diffuseness affects the distribution of enforcement benefits: controlling for the total benefits, more diffusion means that each individual player receives a lower benefit. This element is not part of standard collective-action arguments, which assume that a public good is non-rivalrous. If I instead assume that the individual benefit from enforcement does not change as diffuseness increases, diffuseness would increase (rather than control for) the total benefit of enforcement. As shown in the online supplementary material, this scenario would lead to the same results about individual behavior: each individual player will be less likely to file as diffusion increases. However, since increasing diffusion also increases the total benefits from enforcement, the overall likelihood of enforcement will increase as diffuseness increases. Thus, my formal results are driven not only by free riding, but also by the

distribution of enforcement benefits across a population. Other parameters in the model can be interpreted as elements of institutional design.⁸ I show in the online supplementary material that either reducing the litigation cost (k) or increasing the individual benefits of litigation (b) generates more enforcement. This suggests that states have multiple ways of trying to ameliorate the impact of diffuseness. Namely, states can try to boost enforcement by reducing barriers to litigation or increasing private awards for successful enforcers.

4. Implications for institutional design

What institutional design generates the most enforcement of international law? Standing rules do not change the underlying diffuseness of the benefits of enforcement; they change how these benefits are aggregated to affect decision-making. As a simple example, suppose that the defendant's policy is a trade barrier that affects four exporting firms. Additionally, suppose that two of these firms are located in state A, and the other two are located in state B. Consider Figure 2, which replicates the equilibrium behavior in Figure 1(b). Under transnational enforcement, individual firms would have standing to challenge the barrier, meaning that the total benefits of enforcement would be divided over four potential firm litigants. Therefore, the dashed line, which shows strategic behavior when there are four players, represents the outcome of transnational enforcement. Under international enforcement, states would have standing, so the total benefits of enforcement would be divided between two potential state litigants (each of which internalizes the impact of its two firms). Accordingly, the thin solid line, which shows strategic behavior when there are two players, represents the outcome of international enforcement. Finally, under supranational enforcement, a single IO would internalize the impact of the trade barrier on all four firms across the two states. The thick solid line, which shows optimal behavior when there is only one player, represents the outcome of supranational enforcement. Figure 2 shows that transnational enforcement will yield the most enforcement when litigation costs are low ($k < \tilde{k}$). But when litigation costs are high ($k > \tilde{k}$), supranational enforcement yields the most enforcement because the negative effect of free riding outweighs the positive effect of having more potential litigants. International enforcement is optimal when relative litigation costs are moderate ($\tilde{k} < k < k$).

It is not possible to derive a clear formal result about the optimal institutional design without making extreme assumptions about the distribution of enforcement benefits across multiple units of analysis (such as assuming that each of two states contains two firms) and without making assumptions about the objectives of states that design such institution. However, we can ask how changes in standing rules affect the enforcement of international law. Figure 2 illustrates a set of broad implications of my formal model⁹:

Implication 1. *Holding constant the diffuseness of the enforcement benefit, the institutional design that is likely to yield the most enforcement is: transnational enforcement*

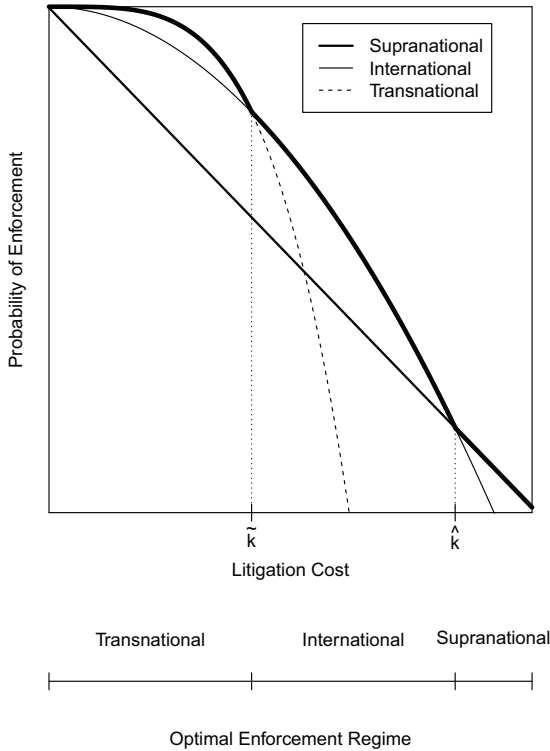


Figure 2. Maximizing enforcement.

Note: this figure was created in R from simulations of equilibrium behavior.

when the litigation cost is small; international enforcement when the litigation cost is moderate; and supranational enforcement when the litigation cost is high.

My formal model also has implications for diffuseness. Consider Figure 3. The lowest line graph (labelled as ‘low’ diffuseness) shows the optimal institutional design for the scenario that generates Figure 2. Enforcement benefits four firms that are equally divided between two states. Now suppose that we increase diffuseness so that the possible violation affects nine firms that are equally divided among three states. The institutional design that maximizes enforcement for this scenario is shown in the middle line graph (labelled as ‘medium’ diffuseness). As before, transnational enforcement is best for low costs, international enforcement is best for moderate costs, and supranational enforcement is best for high costs. However, the cutpoints in this line graph have shifted to the left: transnational enforcement is optimal for a smaller range of litigation costs, and supranational enforcement is optimal for a larger range of litigation costs than when there is low diffuseness. This reflects the logic of Proposition 4: greater diffuseness exacerbates the free rider problem, which changes the optimal institutional design. Finally, we can increase

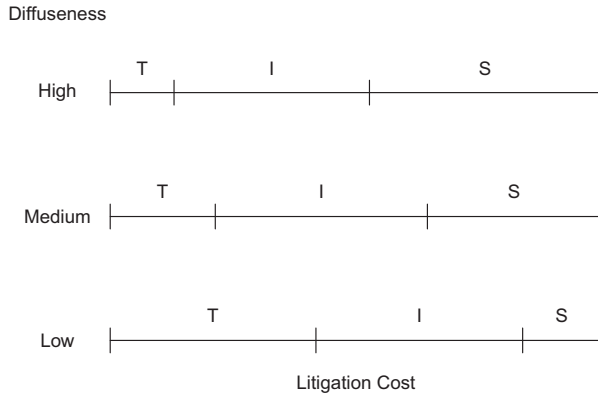


Figure 3. Impact of diffuseness on institutional design.

Note: this figure was created in R from simulations of equilibrium behavior.

diffuseness even more by assuming that enforcement benefits 16 firms that are equally divided between four states. The same pattern emerges, as shown by the top line graph in Figure 3 (labelled as ‘high’ diffuseness). Transnational enforcement continues to maximize enforcement for low litigation costs, but only for a very small range of litigation costs; and transnational enforcement is optimal for a much larger range of high litigation costs. Figure 3 graphically illustrates the second set of broad implications of my formal model:

Implication 2. *When the diffuseness of enforcement benefits increases, transnational enforcement is less likely to yield the most enforcement, and supranational enforcement is more likely to yield the most enforcement.*

Finally, my formal model has implications for hybrid regimes, which allow multiple forms of enforcement. For example, each of the nine major UN multilateral human rights treaties has an administrative body with formal procedures for challenging possible treaty violations. These bodies all use transnational enforcement by allowing individuals to file complaints, and most allow for international enforcement as well. Yet, six of these nine UN bodies also allow supranational enforcement, in which the treaty-based body can make its own complaints against member-states.¹⁰ Similarly, the EU has multiple pathways by which private actors, member-states, and EU bodies can challenge possible legal violations at the European Court of Justice. My formal model suggests:

Implication 3. *A cooperative regime is most likely to use hybrid enforcement when the regime:*

- *contains members that vary in their ability to pay litigation costs; or*
- *regulates issue areas that vary in benefit diffuseness or litigation costs.*

The major UN human rights treaties are all large multilateral treaties that aspire to universal membership. In some treaty members, like highly developed democracies, private actors can bear the cost of challenging possible violations relatively easily. These individuals do not fear retribution from their government, government policies are relatively transparent, evidence is relatively easy to collect, and civil society groups can function relatively freely to assist individuals with the complaint process. However, in other treaty members, like less-developed autocracies, private actors cannot bear the relative cost of challenging a government. Fear of retribution, lack of transparency, weak domestic institutions, and limits on civil society all hinder the enforcement of human rights law. This diversity in membership suggests that a hybrid regime is necessary for successful enforcement. In contrast, EU members are relatively homogenous—EU membership is conditional on having democratic institutions, economic stability, and commitment to fundamental EU values. However, the EU oversees a host of issue areas that vary greatly in their diffuseness. While private actors have incentive to uphold some EU rules, like intellectual property rules, they have less incentive to uphold others, like environmental regulations.

My formal model suggests that we should observe certain patterns of behavior in hybrid regimes that successfully enforce international rules. All bureaucracies face constraints on their time and resources. Even when an IO has the authority to challenge possible legal violations, it cannot challenge every possible legal violation. IOs may face political pressure from their members that shape enforcement decisions. Regardless, limited resources are likely to cause an IO will be likely to target its resources on those possible violations that others will not. This suggests the following:

Implication 4. *In hybrid regimes:*

- *Private actors should be most likely to litigate when they can more easily pay the litigation cost, and when enforcement provides relatively concentrated benefits.*
- *An IO should be most likely to litigate when other actors can less easily pay the litigation cost, and when enforcement provides relatively diffuse benefits.*

For example, the European Commission is one of the largest and most powerful international bureaucracies, yet it regularly faces constraints in terms of the number of cases that it can pursue. Accordingly, it must choose its battles wisely. When faced with multiple possible cases, it must consider: who else would be willing to enforce EU law? For example, the Commission has little incentive to get involved in trademarks disputes, which provide firm-specific benefits—it would be wasting its resources if it were to help those private actors that can help themselves. Instead, the Commission's resources are better spent on possible violations that are unlikely to be challenged by others. For example, private actors rarely dedicate their effort to upholding the EU's environmental rules. In his cross-national study of environmental regulation, Kelemen's explanation for the EU's relative lack of transnational and international enforcement on this specific issue echoes my broader argument: 'most environmental regulation concern matters of diffuse public interest

... private parties often lack the individual incentive to commence legal action to secure enforcement' (Kelemen, 2004: 49). In contrast, the EU Commission appears to target its limited resources on enforcing laws that generate diffuse benefits.

Qualitative evidence suggests that the Commission's heavy involvement in environmental litigation is not merely an anomaly. In his study of EU adjudication, Kelemen (2011) argues that the EU's growing emphasis on private actors is driven by the EU's limited resources for supranational enforcement. He writes: 'the EU is encouraging the spread of ... adversarial legalism as a mode of governance that can harness private litigants and national courts for the decentralized enforcement of European law' (Kelemen, 2011: 8). Encouraging litigation by private actors is meant to supplement international and supranational enforcement. By encouraging private actors to bring lawsuits that generate concentrated benefits, the EU Commission has more resources to devote to enforcement that generates diffuse, EU-wide effects.

5. Conclusion

My primary objective in constructing a theoretical account of legal standing is to understand the general mechanisms that drive international cooperation. I do not claim that states will always seek to design institutions to maximize enforcement: concerns about efficiency, sovereignty costs, and the long-term stability of institutions can all make imperfect enforcement a desirable outcome (Downs and Rocke, 1995; Johns, 2015; Rosendorff, 2005). Nevertheless, we cannot fully understand institutions as they are unless we also consider institutions as they could be. Game-theoretic analysis is inherently suited to such theorizing.

My formal model shows that when the benefit of enforcement is highly concentrated, an actor can fully internalize both the cost and benefit of enforcement. However, when the benefit of enforcement is diffuse, each potential litigant must pay a private cost to provide benefits to others. Diffuseness, therefore, has two competing effects: it increases the number of potential litigants, while also creating incentives for individuals to free ride on the effort of others. When litigation is relatively cheap, the positive effect of having more potential litigants outweighs the negative effect of free riding, ensuring that diffuseness increases the likelihood of enforcement. But when litigation is costly, the negative effect of free riding outweighs the positive effect of more potential litigants, meaning that diffuseness decreases the likelihood of enforcement.

In their study of public goods provision, Bliss and Nalebuff (1984) compare delays in the private provision of public goods to brinksmanship. They note that

[t]here are more gracious ways to find a volunteer than relying on brinksmanship. Binding agreements combined with side payments can always provide a superior outcome. But the world does not always provide an authority that can enforce the agreements to make them binding. (p. 10)

This paper suggests an alternative solution to free rider problems at the international level. Rather than creating binding contracts, states can reallocate legal standing to best reflect the strategic environment. When the cost of enforcement is relatively small, legal standing can be given to individuals, such as firms and people. When the cost of enforcement is moderate, legal standing can be given to states, which aggregate the welfare of their nationals. And when the cost of enforcement is high, legal standing can be given to international institutions, which reflect the collective interests of the international community. My formal model, therefore, provides a normative account of how institutions should be designed if states wish to maximize enforcement. Of course, states do not always have this objective—sometimes, states purposely design institutions with weak enforcement in order achieve competing objectives, like institutional stability (Downs and Rocke, 1995; Johns, 2015; Rosendorff, 2005). Nonetheless, the design of actual IOs suggests that my theory also has positive value: it helps us to understand the reasons why IOs look the way that they do.


Transnational standing is standard in the realm of international investment law, where powerful multinational firms can sue their host-governments to provide firm-specific compensation for mistreatment. Transnational standing has also been successful in promoting human rights within relatively democratic and developed regions, like Europe and Latin America. In contrast, supranational standing has become the standard model for prosecuting human rights violations and war crimes in societies that lack democratic institutions and economic development. The ICC, and other ad hoc international and hybrid criminal tribunals, seek to enforce international rules when victims cannot enforce on their own behalf. In between these two extremes lie institutions like the WTO's dispute-settlement procedures. WTO litigation is sufficiently costly that individual firms and industries are unlikely to fully bear the costs of enforcement, but states have sufficient resources to do so. Additionally, the benefits of enforcing international trade law are sufficiently diffuse that states are willing to espouse the claims of their own firms, but still sufficiently concentrated that the effort of enforcing international trade law is worthwhile. My formal model also suggests that hybrid regimes, which allow multiple types of standing, are best suited to IOs that either contain members that vary in their ability to pay litigation costs, or regulate issue areas that vary in benefit diffuseness or litigation costs. We should expect to see hybrid standing in IOs that aspire to universal membership, but contain members that are not wholly committed to the regime's goals, such as the UN's human rights bodies. We should also expect to see hybrid standing in IOs that oversee diverse issues, such as regional integration bodies.

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Supplementary material

Supplemental material for this article is available online.

Notes

1. These perspectives are best embodied in the 2000 and 2001 special issues of *International Organization* devoted to the rational design of international institutions (Koremenos et al., 2001) and legalization (Goldstein et al., 2000).
2. Three recent exceptions are: Abbott et al. (2016), Johns (2015), and Koremenos (2016).
3. For example: on trade agreements, see Baccini et al. (2015), Johns (2014), and Johns and Peritz (2015); on the WTO, see Johns and Pelc (2018); on investment arbitration, see Johns et al. (2019); on human rights, see Hafner-Burton (2013); on humanitarian law, see Morrow (2014); on state responsibility, see Johns and Parente (2019).
4. *Loewen Group, Inc. and Raymond L. Loewen v. United States of America*, ICSID Case No. ARB(AF)/98/3. See Weiler (2003) for an overview of the case.
5. See ‘New UN team to collect evidence for Syria war crime prosecutions’, *The Guardian (UK)*, 16 February 2017. Available at: <https://www.theguardian.com/world/2017/feb/16/syria-un-sets-up-unit-to-aid-prosecutionsof-war-crimes>; and ‘UN human rights panel concludes ISIL is committing genocide against Yazidis’, UN Press Release, 16 June 2016. Available at: <https://news.un.org/en/story/2016/06/532312-un-human-rights-panel-concludes-isilcommitting-genocide-against-yazidis>
6. This solution concept requires that strategies are sequentially rational and beliefs are consistent with Bayes’ Rule where possible.
7. The replication code for the simulation used to generate this figure is available in the online supplementary material.
8. I thank Lisa Martin for this suggestion.
9. The replication code for the simulation used to generate this figure is available in the online supplementary material. All assumptions about the model structure, strategies, and equilibrium behavior continue to hold for these implications. As detailed in the replication code, the implications follow from comparisons of equilibrium behavior under the different legal-standing scenarios.
10. See: International Covenant on Economic, Social and Cultural Rights (ICESCR), Optional Protocol Art. 11; Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), Optional Protocol Art. 8; Convention Against Torture (CAT), Art. 20; Convention on the Rights of the Child (CRC), Optional Protocol on Communication Procedures Art. 13(1); Convention on the Rights of Persons with Disabilities (CRPD), Optional Protocol Art. 6; and CED, Art. 33.

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Appendix I

Let $\delta \in (0, 1)$ represent the common discount factor, and ρ_{-i} denote i 's belief about the probability that no other country will file. Let V_i denote i 's continuation value. Then, conditional on reaching t , the expected utility functions for player i are:

$$EU_{it}(\text{file}|\alpha_{it}, \tau_i) = \frac{\delta}{1-\delta}(r+b)\tau_i - k$$

$$EU_{it}(\text{don't file}|\alpha_{it}, \tau_i) = -\alpha_{it}\tau_i + (1-\rho_{-i})\frac{\delta}{1-\delta}r\tau_i + \rho_{-i}\delta V_i$$

Proof of Proposition 1. Player i has incentive to file if:

$$\begin{aligned} \frac{\delta}{1-\delta}(r+b)\tau_i - k &\geq -\alpha_{it}\tau_i + (1-\rho_{-i})\frac{\delta}{1-\delta}r\tau_i + \rho_{-i}\delta V_i \\ \Leftrightarrow \alpha_{it} &\geq \frac{k}{\tau_i} - \frac{\delta}{1-\delta}b - \rho_{-i}\frac{\delta}{1-\delta}r + \frac{\delta\rho_{-i}}{\tau_i}V_i \equiv \bar{\alpha}_i \end{aligned} \quad (1)$$

Equilibrium behavior is, therefore, monotonic and player i 's best response function is characterized by the value of $\bar{\alpha}_i$ implicitly defined in equation (1). This ensures that:

$$\begin{aligned} \rho_i &= \Pr(\alpha_{it} < \bar{\alpha}_i) = F(\bar{\alpha}_i) \quad \text{and} \quad \rho = \prod_k \rho_k = \prod_k F(\bar{\alpha}_k) \\ \text{and} \quad \rho_{-i} &= \prod_{j \neq i} \rho_j = \frac{\prod_k F(\bar{\alpha}_k)}{F(\bar{\alpha}_i)} \end{aligned}$$

In an interior equilibrium—an equilibrium in which $\bar{\alpha}_i \in (0, A)$ for all i —player i 's continuation value is:

$$\begin{aligned} V_i &= \int_0^{\bar{\alpha}_i} \left[-\alpha\tau_i + (1-\rho_{-i})\frac{\delta}{1-\delta}r\tau_i + \rho_{-i}\delta V_i \right] f(\alpha) d\alpha + \int_{\bar{\alpha}_i}^A \left[\frac{\delta}{1-\delta}(r+b)\tau_i - k \right] f(\alpha) d\alpha \\ &= \rho_i \left[(1-\rho_{-i})\frac{\delta}{1-\delta}r\tau_i + \rho_{-i}\delta V_i \right] + (1-\rho_i) \left[\frac{\delta}{1-\delta}(r+b)\tau_i - k \right] - \tau_i \int_0^{\bar{\alpha}_i} \alpha f(\alpha) d\alpha \end{aligned} \quad (2)$$

Manipulating equation (2) to isolate V_i yields:

$$V_i = \frac{1}{1-\delta\rho} \left[(1-\rho)\frac{\delta}{1-\delta}r\tau_i - (1-\rho_i) \left(k - \frac{\delta}{1-\delta}b\tau_i \right) - \tau_i \int_{\alpha_L}^{\bar{\alpha}_i} \alpha f(\alpha) d\alpha \right] \quad (3)$$

Substituting equation (3) into equation (1) yields:

$$\begin{aligned} \bar{\alpha}_i &= \frac{k}{\tau_i} - \frac{\delta}{1-\delta}b - \rho_{-i} \frac{\delta}{1-\delta}r \\ &+ \frac{\delta\rho_{-i}}{\tau_i(1-\delta\rho)} \left[(1-\rho) \frac{\delta}{1-\delta}r\tau_i - (1-\rho_i) \left(k - \frac{\delta}{1-\delta}b\tau_i \right) - \tau_i \int_{\alpha_L}^{\bar{\alpha}_i} \alpha f(\alpha) d\alpha \right] \end{aligned} \tag{4}$$

If we manipulate equation (4), we can see that cutpoint $\bar{\alpha}_i$ is implicitly defined by:

$$\Psi^i \equiv \bar{\alpha}_i(1-\delta\rho) - (1-\delta\rho_{-i}) \left(\frac{k}{\tau_i} - \frac{\delta}{1-\delta}b \right) + \delta\rho_{-i}r + \delta\rho_{-i} \int_0^{\bar{\alpha}_i} \alpha f(\alpha) d\alpha = 0$$

Recall that cutpoint $\bar{\alpha}_i$ is a best response to the strategies of other players, represented by ρ_{-i} . To see that this best response function generates an interior cutpoint, we hold ρ_{-i} constant and take the derivative of Ψ^i with respect to $\bar{\alpha}_i$:

$$\Psi'_{\bar{\alpha}_i} = \bar{\alpha}_i[-\delta\rho_{-i}f(\bar{\alpha}_i)] + (1-\delta\rho) + \delta\rho_{-i}\bar{\alpha}_i f(\bar{\alpha}_i) = 1-\delta\rho > 0$$

Because Ψ^i is monotonically increasing in $\bar{\alpha}_i$, if there exists a value $\bar{\alpha}_i$ that satisfies $\Psi^i(\bar{\alpha}_i) = 0$, this value is unique. Also,

$$\lim_{\delta \rightarrow 0} \Psi^i = \bar{\alpha}_i - \frac{k}{\tau_i} = 0 \quad \Leftrightarrow \quad \lim_{\delta \rightarrow 0} \bar{\alpha}_i = \frac{k}{\tau_i}$$

Recall that by assumption, $\frac{k}{\tau_i} \in (0, A)$ and α has full support over $[0, A]$. So player i has a unique interior cutpoint, $\bar{\alpha}_i \in (0, A)$, for small $\delta > 0$. Since this argument holds for an arbitrary player i , there exists a Bayesian Nash equilibrium for small $\delta > 0$ in which equilibrium strategies are implicitly defined by the system of n equations with n endogenous variables $\bar{\alpha} = (\bar{\alpha}_1, \bar{\alpha}_2, \dots, \bar{\alpha}_n)$:

$$\begin{aligned} \Psi^1(\bar{\alpha}) &= 0 \\ \Psi^2(\bar{\alpha}) &= 0 \\ &\dots\dots\dots \\ \Psi^n(\bar{\alpha}) &= 0 \end{aligned}$$

If we assume that each player's trade stake is identical (namely, that $\tau_i = \frac{I}{n}$ for every i), then there exists a symmetric Bayesian Nash equilibrium for an n -player game for small $\delta > 0$ in which every player's cutpoint, $\bar{\alpha}_n$, is implicitly defined by one equation with one endogenous variable:

$$\Psi^n(\bar{\alpha}_n) = \bar{\alpha}_n[1 - \delta F(\bar{\alpha}_n)^n] - \frac{kn}{T} + \frac{\delta}{1-\delta}b + \delta F(\bar{\alpha}_n)^{n-1}$$

$$\left(\frac{kn}{T} - \frac{\delta}{1-\delta}b + r + \int_0^{\bar{\alpha}_i} \alpha f(\alpha) d\alpha \right) = 0$$

Proof of Proposition 2. By the proof of Proposition 1, the unique cutpoint for the n -player game is defined by $\Psi^n(\bar{\alpha}_n) = 0$ and:

$$\lim_{\delta \rightarrow 0} \Psi^n = \bar{\alpha}_n - \frac{kn}{T} = 0 \quad \Leftrightarrow \quad \lim_{\delta \rightarrow 0} \bar{\alpha}_n = \frac{kn}{T}$$

Since this holds for any n :

$$\lim_{\delta \rightarrow 0} \Psi^{n+1} = \bar{\alpha}_{n+1} - \frac{k(n+1)}{T} = 0 \quad \Leftrightarrow \quad \lim_{\delta \rightarrow 0} \bar{\alpha}_{n+1} = \frac{k(n+1)}{T}$$

So, $\lim_{\delta \rightarrow 0} \bar{\alpha}_n < \lim_{\delta \rightarrow 0} \bar{\alpha}_{n+1}$, which means that each player is less likely to file when the number of players increases and δ is small.

Proof of Proposition 3. Let ϕ_n denote the ex-ante probability that no player files in period t (conditional on reaching period t):

$$\phi_n \equiv \prod_{i=1}^n F(\bar{\alpha}_i) = F(\bar{\alpha}_n)^n$$

For an interior equilibrium, define difference function:

$$\Gamma_n(k) \equiv (1 - \phi_{n+1}) - (1 - \phi_n) = \phi_n - \phi_{n+1}$$

$$\text{So, } \lim_{\delta \rightarrow 0} \Gamma_n(k) = F\left(\frac{kn}{T}\right)^n - F\left(\frac{k(n+1)}{T}\right)^{n+1} = \left(\frac{kn}{AT}\right)^n - \left(\frac{k(n+1)}{AT}\right)^{n+1}$$

Note that $\Gamma_n(k=0) = 0$. And for $k \neq 0$:

$$\Gamma_n(k) = 0 \quad \Leftrightarrow \quad \left(\frac{kn}{AT}\right)^n = \left(\frac{k(n+1)}{AT}\right)^{n+1} \quad \Leftrightarrow \quad k = \frac{ATn^n}{(n+1)^{n+1}} \equiv \kappa_n$$

Recall that we have an interior solution if $\frac{kn}{T} < A \Leftrightarrow k < \frac{AT}{n}$ for all values of n . So, $k < \frac{AT}{n+1}$. Note that $0 < \kappa_n$ and:

$$\kappa_n = \frac{ATn^n}{(n+1)^{n+1}} < \frac{AT}{n+1} \quad \Leftrightarrow \quad n^n < (n+1)^n$$

So, κ_n is an interior value for our parameter-space. Now note that:

$$\begin{aligned}
 \frac{\partial \Gamma_n}{\partial k} &= n \left(\frac{n}{AT} \right)^n k^{n-1} - (n+1) \left(\frac{(n+1)}{AT} \right)^{n+1} k^n \\
 &= \left(\frac{n^{n+1}}{A^n T^n} \right) k^{n-1} - \left(\frac{(n+1)^{n+2}}{A^{n+1} T^{n+1}} \right) k^n \\
 \Rightarrow \frac{\partial \Gamma_n}{\partial k} \geq 0 &\Leftrightarrow \left(\frac{(n+1)^{n+2}}{A^{n+1} T^{n+1}} \right) k^n \leq \left(\frac{n^{n+1}}{A^n T^n} \right) k^{n-1} \\
 \Leftrightarrow k &\leq \frac{n^{n+1} AT}{(n+1)^{n+2}} \equiv \gamma_n
 \end{aligned}$$

where $0 < \gamma_n$ and:

$$\begin{aligned}
 \gamma_n < \kappa_n &\Leftrightarrow \frac{n^{n+1} AT}{(n+1)^{n+2}} < \frac{ATn^n}{(n+1)^{n+1}} \\
 &\Leftrightarrow n < n+1
 \end{aligned}$$

So, $\Gamma_n(k)$ is non-monotonic: it is strictly increasing for $k \in (0, \gamma_n)$, and strictly decreasing for all $k > \gamma_n$. When combined with the fact that $\Gamma_n(k=0) = \Gamma_n(\kappa_n) = 0$, this implies that $\Gamma_n > 0$ for $k < \kappa_n$ and $\Gamma_n < 0$ for $k > \kappa_n$. So, increasing the number of players (i) increases the likelihood of enforcement when $k < \kappa_n$, and (ii) decreases the likelihood of enforcement when $k > \kappa_n$.

Proof of Proposition 4. How does the likelihood of free riding change as a function of n ? Recall that free riding occurs when $k > \kappa_n = \frac{ATn^n}{(n+1)^{n+1}} > 0$. Define the following functions over the domain \mathbb{R}_{++} , $y(x) \equiv x^x$ and $z(x) \equiv (x+1)^{x+1}$. We can use the properties of the natural log function and implicit differentiation to determine the derivatives of $y(x)$ and $z(x)$:

$$\ln[y(x)] = x \ln(x) \Rightarrow y'(x) = y(x)[\ln(x) + 1] = x^x[\ln(x) + 1]$$

$$\ln[z(x)] = (x+1) \ln(x+1) \Rightarrow z'(x) = z(x)[\ln(x+1) + 1] = (x+1)^{x+1}[\ln(x+1) + 1]$$

Now define $f(x) \equiv \frac{y(x)}{z(x)}$ over the domain \mathbb{R}_{++} . Note that:

$$f'(x) = \frac{y(x)z(x)[\ln(x) - \ln(x+1)]}{[z(x)]^2} < 0 \Leftrightarrow \ln(x) < \ln(x+1)$$

This holds for all $x > 0$. Now note that $\kappa_n = ATf(n)$. So, $ATf(n) > ATf(n+1)$ for all $n \in \mathbb{N}$, which implies that $\kappa_n > \kappa_{n+1}$ for all $n \in \mathbb{N}$. So, cutpoint κ_n is decreasing in n , meaning that as the benefit of enforcement grows more diffuse, the free rider problem becomes more severe.