Transnational Environmental Law (2026) **15**(**2**), 333–365
doi:10.1017/S2047102526100260

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ARTICLE

Network Interactions and Mutual Dependence in the Global Sustainability Governance System

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(First published online 11 June 2026)

Abstract
This article examines the hybrid network structure of the global sustainability governance system, focusing on the evolving relationships between private transnational regulators (PTRs) and intergovernmental organizations (IOs). We argue that a defining feature of this structure is the mutual dependence between PTRs and IOs: PTRs invoke public international law instruments (PILIs) – and, by extension, the authority of the IOs behind them – to bolster their own authority and to enhance the normative force of the standards they promulgate. IOs rely on PTRs to disseminate their norms within corporate settings, thereby strengthening their compliance capacities. This interdependence carries significant synergistic potential. We examine the grounding relationship between PTRs and PILIs/IOs through extensive network analysis based on a specially curated dataset comprising 55 PTRs, 393 private standards, 261 PILIs (including treaties, conventions, and declarations), and 41 IOs. Citation patterns within this network support our thesis. We also offer tentative evidence regarding the second prong of our model and outline directions for future research. Finally, we assess the vulnerabilities of this interdependent structure, highlighting the fragility of the global sustainability legal order in the face of rising nationalism and anti-multilateralist pressures.

Keywords: Private regulators; Hybrid governance; Network interactions; Emergence; Complexity; Synergy

1. Introduction

The climate summits under the United Nations Framework Convention on Climate Change (UNFCCC)[1] from Glasgow to Belém have highlighted the fragility of the global environmental governance system. While these Conferences of the Parties (COP) reaffirmed commitment to the 1.5 degrees Celsius (°C) warming threshold established in the Paris Agreement,[2] they made limited progress in implementing the actions necessary

[1] New York, NY (United States (US)), 9 May 1992, in force 21 Mar. 1994, available at: https://unfccc.int.
[2] Paris (France), 12 Dec. 2015, in force 4 Nov. 2016, available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

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https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

to achieve that goal. This shortcoming was highlighted in the United Nations Environment Programme (UNEP) Emissions Gap Report of 2023,[3] which noted:

> Due to the failure to stringently reduce emissions in high-income and high-emitting countries (which bear the greatest responsibility for past emissions) and to limit emissions growth in low- and middle-income countries (which account for the majority of current emissions), unprecedented action is now needed by all countries.[4]

Similar implementation gaps exist in other fields, including biodiversity, plastic pollution, and the oceans.[5]

As treaty-based governance regimes struggle to implement and enforce international commitments, private transnational regulators (PTRs) have assumed a growing role in global governance, contributing to the emergence of a hybrid regulatory system.[6] We use the term 'PTR' to refer to institutional entities that set and enforce standards, primarily targeting companies.[7] We distinguish between private transnational standards (PTS), developed by PTRs, and the rules promulgated through international treaties and their institutional bodies. We refer to these formal legal instruments as public international law instruments (PILIs). PTRs operate across diverse domains, including product standards, environmental protection, financial reporting, and human and labour rights.[8] Within this evolving hybrid governance system, private transnational initiatives work alongside and engage closely with intergovernmental organizations (IOs), including entities such as UNEP, the secretariat of the UNFCCC, and the secretariat of the Convention on Biological Diversity (CBD).[9]

The shift toward a hybridized and increasingly decentralized model of global governance introduces new theoretical and practical challenges.[10] Critics of private

[3] UNEP, *Emissions Gap Report 2023: Broken Record – Temperatures Hit New Highs, Yet World Fails to Cut Emissions (Again)* (UNEP, 2023).

[4] Ibid., p. xvi.

[5] A. Perino et al., 'Biodiversity Post-2020: Closing the Gap between Global Targets and National-Level Implementation' (2022) 15(2) *Conservation Letters*, article e12848; P. Stoett, 'Plastic Pollution: A Global Challenge in Need of Multi-Level Justice-Centered Solutions' (2022) 5(6) *One Earth*, pp. 593–6; G.T. Pecl et al., 'Future Seas 2030: Pathways to Sustainability for the UN Ocean Decade and Beyond' (2022) 32 *Reviews in Fish Biology and Fisheries*, pp. 1–7.

[6] B. Cashore et al., 'Private Authority and Public Policy Interactions in Global Context: Governance Spheres for Problem Solving' (2021) 15(4) *Regulation & Governance*, pp. 1166–82.

[7] In some cases, the standard-setting and compliance functions are provided by different bodies.

[8] Examples of standards include the Global Organic Textile Standard, Fairtrade International, Responsible Care and ISO 14001, and the International Financial Reporting Standards Foundation: Global Organic Textile Standard (GOTS), Düsseldorf (Germany), Aug. 2002, available at: https://global-standard.org; Fairtrade International, Bonn (Germany), 1997, available at: https://www.fairtrade.net/us-en.html; Responsible Care, Canada, today Brussels (Belgium), 1985, available at: https://cefic.org/guidance-and-management-frameworks/responsible-care; International Organization for Standardization (ISO) Standard 14001 – Environmental Management System, Geneva (Switzerland), 1 Sept. 1996, available at: https://www.iso.org/standard/60857.html; International Financial Reporting Standards Foundation (IFRS), Delaware (US), 8 Mar. 2001, available at: https://www.ifrs.org.

[9] Rio de Janeiro (Brazil), 5 June 1992, in force 29 Dec. 1993, available at: https://www.cbd.int/convention.

[10] J.P. Elsässer et al., 'Institutional Interplay in Global Environmental Governance: Lessons Learned and Future Research' (2022) 22 *International Environmental Agreements: Politics, Law and Economics*,

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

voluntary schemes question their capacity to serve as credible counterparts to state-backed regulation, particularly in the light of concerns about greenwashing.[11] While these concerns are valid, the prospects for revitalizing the public international legal system – especially in the aftermath of United States (US) President Trump's re-election in 2024 – remain limited. This suggests that a deeper understanding of the structure and dynamics of the global hybrid governance system will remain a crucial priority for the foreseeable future. Our analysis focuses on the coordination challenges arising from the decentralized and highly fragmented global governance system, contrasting two opposing dynamics: conflictive and synergistic hybridization. *Conflictive hybridization* highlights the risks posed by a fragmented regulatory structure. Overlapping mandates and inconsistent agendas can create tensions and obstruct collaborative solutions for global dilemmas.[12] It may also trigger a race to the bottom, allowing firms to exploit regulatory arbitrage by selecting the least stringent PTS. Furthermore, inadequate coordination can blur the distinction between high- and low-quality standards, exacerbating the risk of greenwashing.[13] By contrast, the idea of *synergistic hybridization* highlights how hybrid governance can promote innovation, experimentation, and mutual learning by harnessing specialization, division of labour, and complementary strengths, ultimately generating synergistic benefits.[14]

Significant progress has been made in the theoretical analysis of hybridization and fragmentation,[15] but there is a shortage of empirical work that can advance the understanding of these related concepts.[16] In this article, we seek to fill this gap by analyzing the interaction between IOs and PTRs in the global sustainability domain, using social network analysis (SNA). Our study complements existing research, which has tended to focus on interactions among IOs, and contributes to the emerging scholarship on public–private interactions in transnational regulatory governance.[17]

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pp. 373–91, at 379; A. Marx et al., 'Global Governance through Voluntary Sustainability Standards: Developments, Trends and Challenges' (2024) 15(4) *Global Policy*, pp. 708–28.

[11] See, e.g., I. Heras-Saizarbitoria, O. Boiral & A. Díaz de Junguitu, 'Environmental Management Certification and Environmental Performance: Greening or Greenwashing?' (2020) 29(6) *Business Strategy and the Environment*, pp. 2829–41.

[12] Elsässer et al., n. 10 above, p. 379; M. Bogers et al., 'The Impact of the Sustainable Development Goals on a Network of 276 International Organizations' (2022) 76 *Global Environmental Change*, article 102567; F. Biermann et al., 'The Fragmentation of Global Governance Architectures: A Framework for Analysis' (2009) 9(4) *Global Environmental Politics*, pp. 14–40.

[13] T. Pratt, 'Deference and Hierarchy in International Regime Complexes' (2018) 72(3) *International Organization*, pp. 561–90, at 564; K.W. Abbott & D. Snidal, 'International Regulation Without International Government: Improving IO Performance through Orchestration' (2010) 5(3) *The Review of International Organizations*, pp. 315–44, at 323–4.

[14] Pratt, ibid., p. 564; Biermann et al., n. 12 above.

[15] K.W. Abbott & B. Faude, 'Hybrid Institutional Complexes in Global Governance' (2022) 17(2) *The Review of International Organizations*, pp. 263–91; F. Biermann et al., 'The Fragmentation of Global Governance Architectures: A Framework for Analysis' (2009) 9(4) *Global Environmental Politics*, pp. 14–40.

[16] A. Orsini et al., 'Forum: Complex Systems and International Governance' (2020) 22(4) *International Studies Review*, pp. 1008–38; S. Burch et al., 'New Directions in Earth System Governance Research' (2019) 1 *Earth System Governance*, article 100006.

[17] See, e.g., R. Clark, 'Pool or Duel? Cooperation and Competition among International Organizations' (2021) 75(4) *International Organization*, pp. 1133–53; Y.Z. Haftel & T. Lenz, 'Measuring Institutional

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Our article advances both theoretical and empirical objectives. Theoretically, we contribute to the conceptualization of the hybrid governance paradigm and highlight the potential of SNA as a tool for analyzing how this hybridity manifests in practice. We argue that the mutual dependence between PTRs and IOs is a defining feature of the global governance system, representing an emergent response to coordination challenges that holds significant synergistic potential. These interdependencies take shape through a complex network of interactions spanning multiple social layers, including citation practices and organizational affiliations. In particular, PTRs invoke the formal texts of international sustainability law (PILIs) as grounds for strengthening both their own authority and the normative force of the standards they promulgate. Within this framework, grounding is understood as a constitutive relation of dependence, through which less fundamental entities obtain or derive their status by virtue of their connection with more fundamental entities.[18] PTRs thus face two fundamental challenges: the absence of a formal legal foundation and the democratic deficit that arises from their status as private actors. Both factors can weaken their ability to influence corporate behaviour through standard-setting and enforcement mechanisms.[19] At the same time, IOs rely on PTRs as decentralized mechanisms for disseminating and operationalizing international norms into corporate governance contexts, thus compensating for their limited enforcement capabilities.[20]

Empirically, our goal is more modest: we seek to demonstrate the plausibility of our theoretical framework by applying SNA to a novel dataset. Our analysis focuses on one aspect of the relations of mutual dependence between PTRs and IOs: how PTRs rely on global treaty documents as grounds. We leave the systematic study of the second prong of our framework – how IOs draw on PTRs to enhance compliance with treaty-based norms – to future research (by us or others). Here, we provide only tentative evidence of this dependency.[21]

SNA is based on the idea that the structure of social ties in which actors are embedded significantly shapes the dynamics of social systems.[22] It models these dynamics by representing the social system as an abstract network of nodes and edges, capturing different types of entity and the relations between them. This relational

Overlap in Global Governance' (2021) 17(1) *The Review of International Organizations*, pp. 323–47; P. Schleifer et al., 'Voluntary Standards and the SDGs: Mapping Public-Private Complementarities for Sustainable Development' (2022) 14 *Earth System Governance*, article 100153.

[18] B. Tripkovic & D. Patterson, 'The Promise and Limits of Grounding in Law' (2023) 29(3) *Legal Theory*, pp. 202–28, at 204; O. Perez, 'Transnational Networked Authority' (2022) 35(2) *Leiden Journal of International Law*, pp. 265–93, at 274–5.

[19] R. Barlow, 'Deliberation Without Democracy in Multi-Stakeholder Initiatives: A Pragmatic Way Forward' (2022) 181 *Journal of Business Ethics*, pp. 543–61; M. Isailovic & P. Pattberg, 'Private Governance', in C. Ansell & J. Torfing (eds), *Handbook on Theories of Governance* (Edward Elgar, 2016), pp. 510–8.

[20] For the idea that private sustainability standards enforce public international law see also A. Marx, 'The Public-Private Distinction in Global Governance: How Relevant Is It in the Case of Voluntary Sustainability Standards?' (2017) 3(1) *The Chinese Journal of Global Governance*, pp. 1–26, at 13.

[21] Elsässer et al., n. 10 above, p. 381; T. Hickmann, *Rethinking Authority in Global Climate Governance: How Transnational Climate Initiatives Relate to the International Climate Regime* (Routledge, 2016).

[22] L. Freeman, *The Development of Social Network Analysis: A Study in the Sociology of Science* (Empirical Press, 2004).

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perspective enables a systematic exploration of governance hybridity, uncovering the patterns of dependence and interconnection between PTRs and IOs.

In Section 2, we explain how our argument about the mutual dependence between PTRs and IOs fits within the literature on complexity theory and global governance. We then develop four propositions focusing on the PTR-IO grounding dependency. Next, we outline our methodology and present our findings, drawing on a comprehensive network analysis based on specially curated data, which includes 55 PTRs, 261 PILIs, and 41 IOs (Sections 3 and 4).[23] In the concluding section (5), we discuss how our analysis contributes to the debate on the nature and dynamics of hybrid global governance and we outline avenues for future research. We also examine vulnerabilities within this structure of mutual dependence, highlighting the growing fragility of the global sustainability legal system amid rising nationalist and anti-multilateralist trends.

2. Mutual Dependence Between PTRs and IOs: Leveraging Treaty Documents as Grounds

We base our argument about the synergistic relation between PTRs and IOs on the general framework of complexity theory.[24] The potential contribution of complexity science to the study of global governance has received considerable attention in the literature. Two distinct aspects of complexity are relevant in this context.[25] The first concerns the complexity of the global socio-ecological system.[26] The second, which is the focus of this article, concerns the complexity of the global governance system, which arises from the proliferation of norms, institutions, and communities operating in the field, and their multiple forms of interconnectedness.[27]

Complex systems are characterized by several key features: non-linearity, self-organization, emergence, and adaptation. *Non-linearity* reflects the sensitivity of complex systems to initial conditions, the existence of multiple evolutionary trajectories, and susceptibility to abrupt systemic changes through tipping points.[28] *Self-organization* refers to the spontaneous evolution of structured order in the

[23] Listed in the online Supplementary Materials, Appendices A, B and C.

[24] R. Conte et al., 'Sociology and Social Theory in Agent Based Social Simulation: A Symposium' (2001) 7 *Computational & Mathematical Organization Theory*, pp. 183–205.

[25] Orsini et al., n. 16 above.

[26] O.R. Young, *Governing Complex Systems: Social Capital for the Anthropocene* (The MIT Press, 2017), pp. 1–22; O.R. Young, 'Beyond Regulation: Innovative Strategies for Governing Large Complex Systems' (2017) 9(6) *Sustainability*, article 938.

[27] F. Biermann & R. Kim, 'Architectures of Earth System Governance: Setting the Stage', in F. Biermann & R.E. Kim (eds), *Architectures of Earth System Governance: Institutional Complexity and Structural Transformation* (Cambridge University Press, 2020), pp. 1–34; R. Kim, 'Is Global Governance Fragmented, Polycentric, or Complex? The State of the Art of the Network Approach' (2020) 22(4) *International Studies Review* pp. 903–31.

[28] S.A. Levin, 'Ecosystems and the Biosphere as Complex Adaptive Systems' (1998) 1(5) *Ecosystems*, pp. 431–6; Young, n. 26 above; T.M. Lenton et al., 'Tipping Elements in the Earth's Climate System' (2008) 105(6) *Proceedings of the National Academy of Sciences*, pp. 1786–93.

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absence of external control.[29] *Emergence* refers to the arising of novel structures and properties through the interactions of multiple distributed elements that cannot be deduced solely from the properties of the interacting elements.[30] A key feature of emergent phenomena is *synergy,* which refers to the 'combined, "cooperative" effects that arise from the relationships and interactions among various forces, particles, elements, parts, genomes or individuals in a given context—effects that are not otherwise attainable'.[31] The literature distinguishes between *synergies of scale,* which result from aggregation (for example, adding or multiplying similar elements)[32] and often exhibit threshold effects,[33] and *synergies of functional complementarity*, which emerge when entities with different properties interact in ways that generate novel beneficial effects.[34] *Adaptation* refers to the capacity of complex systems to learn from their environment and co-evolve without losing their autonomy.[35]

Building on the above framework, we argue that the network relations between IOs and PTRs constitute an emergent and adaptive response to the coordination and enforcement challenges of global governance. Specifically, PTRs invoke PILIs to bolster both their authority and the normative weight of their standards, while IOs turn to PTRs to operationalize and promote compliance with treaty-based norms. By leveraging the respective strengths of IOs and PTRs, this reciprocal dynamic creates a mutually reinforcing system that harnesses functional complementarities and generates significant synergies. As we elaborate below, references to PILIs represent one dimension of a broader architecture of normative grounding. A second mechanism operates through horizontal peer recognition, reflected in reciprocal citations among private standards. Together, these vertical and horizontal grounding linkages help to constitute PTRs as autonomous sources of normative authority.[36]

Our network model of the relationship between PTRs and IOs, and among PTRs themselves, challenges prevailing accounts of global governance by emphasizing that mutual dependence arises through decentralized and uncoordinated interactions rather than from hierarchically controlled processes. As an emergent network phenomenon, the interaction between PTRs and IOs in this model does not conform to

[29] H. Haken & J. Portugali, 'Information and Self-Organization' (2017) 19(1) *Entropy*, article 18; M. Prokopenko, 'Design Versus Self-Organization', in M. Prokopenko (ed.), *Advances in Applied Self-Organizing Systems* (Springer, 2013), pp. 3–21.

[30] U. Wilensky & W. Rand, *An Introduction to Agent-Based Modeling: Modeling Natural, Social, and Engineered Complex Systems with Netlogo* (The MIT Press, 2015), p. 6; P.A. Corning, 'The Re-Emergence of "Emergence": A Venerable Concept in Search of a Theory' (2002) 7(6) *Complexity*, pp. 18–30; J. Goldstein, 'Emergence as a Construct: History and Issues' (1999) 1(1) *Emergence*, pp. 49–72.

[31] P. Corning, 'Systems Theory and the Role of Synergy in the Evolution of Living Systems' (2014) 31(2) *Systems Research and Behavioral Science*, pp. 181–96, at 187.

[32] P. Corning, *Nature's Magic: Synergy in Evolution and the Fate of Humankind* (Cambridge University Press, 2003), p. 17.

[33] Ibid., p. 19.

[34] P. Corning, *Holistic Darwinism: Synergy, Cybernetics, and the Bioeconomics of Evolution* (University of Chicago Press, 2010), p. 64.

[35] Orsini et al., n. 16 above; J. Braithwaite et al., 'When Complexity Science Meets Implementation Science: A Theoretical and Empirical Analysis of Systems Change' (2018) 16 *BMC Medicine*, article 63.

[36] O. Perez & O. Stegmann, 'Transnational Networked Constitutionalism' (2018) 45(1) *Journal of Law and Society*, pp. 135–62.

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frameworks of delegation or deference. It is not delegation, as neither actor formally transfers authority to the other;[37] nor is it deference, as authority is not ceded from one to the other. Instead, both actors strategically engage with one another to reinforce and extend their own authority. Likewise, the self-referential dynamic of peer recognition among PTRs resists hierarchical conceptions of authority, operating instead through horizontal processes of mutual validation.

It is useful to distinguish our theoretical framework from related literature. Firstly, while our model shares some affinities with the orchestration framework proposed by Abbott and Snidal,[38] particularly in suggesting that IOs rely on PTRs as semi-compliance agents, it carves a distinct path. Abbott and Snidal describe orchestration as an active process, in which IOs deliberately enlist intermediaries by providing material and ideational support.[39] In contrast, we argue that the mutual dependence between PTRs and IOs emerges organically from uncoordinated interactions and cannot be fully captured by orchestration alone.

Secondly, our model also differs from the theoretical framework developed by Axel Marx in a recent article.[40] Marx examines the phenomenon of mutual dependence between what he terms 'voluntary sustainability standards' (VSS) and public law, arguing that the distinction between public and private governance blurs when the unit of analysis shifts from the legal status of the entity producing the standard to the function it serves. From this perspective, VSS and public law – including both international treaties and national laws – become components of an integrated system of public governance. While our analysis begins with a similar empirical observation, we emphasize the network structure of these interactions and their emergent qualities, which arise despite the system's lack of centralized coordination. Rather than a functionally integrated system, we highlight the decentralized and adaptive interdependencies between IOs and PTRs, shaped by self-organized interactions rather than deliberate policy design.

Our article addresses a significant gap in the literature by systematically analyzing the interrelations between private and public institutions in the global sustainability domain. A key limitation of existing research on global governance is its tendency to invoke complexity science in a largely metaphorical or abstract manner,[41] without

[37] C.A. Bradley & J.G. Kelley, 'The Concept of International Delegation' (2008) 71(1) *Law and Contemporary Problems*, pp. 1–36.

[38] Abbott & Snidal, n. 13 above.

[39] B. Eberlein, 'Who Fills the Global Governance Gap? Rethinking the Roles of Business and Government in Global Governance' (2019) 40(8) *Organization Studies*, pp. 1125–45.

[40] Marx, n. 20 above.

[41] A. Bousquet & S. Curtis, 'Beyond Models and Metaphors: Complexity Theory, Systems Thinking and International Relations' (2011) 24(1) *Cambridge Review of International Affairs*, pp. 43–62; S. Gunitsky, 'Complexity and Theories of Change in International Politics' (2013) 5(1) *International Theory*, pp. 35–63; E. Kavalski, 'The Complexity of Global Security Governance: An Analytical Overview' (2008) 22(4) *Global Society*, pp. 423–43; S. Oberthür & J. Pożarowska, 'Managing Institutional Complexity and Fragmentation: The Nagoya Protocol and the Global Governance of Genetic Resources' (2013) 13(3) *Global Environmental Politics*, pp. 100–18; J.N. Rosenau, 'Global Governance as Disaggregated Complexity', in A. Ba & M.J. Hoffmann (eds), *Contending Perspectives on Global Governance: Coherence and Contestation* (Routledge, 2005), pp. 131–53; J. Ruhl & D.M. Katz, 'Mapping Law's Complexity with "Legal Maps"', in J. Murray, T. Webb &

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applying computational methods to empirical analysis.[42] Studies that employ quantitative or network-based computational approaches remain rare.[43]

It is important to recognize that empirical research on global governance presents significant challenges, particularly in disentangling multi-causal complexities, addressing the scarcity of longitudinal data, and overcoming restricted access to proprietary information. These limitations make it nearly impossible to test all aspects of our model within a single study. Accordingly, our aim is not to provide a complete and definitive validation of our model but rather to assess its plausibility and identify promising directions for future research. Furthermore, we emphasize that uncovering new phenomena – such as the interaction patterns between PTRs and IOs explored below – is essential for advancing and refining theoretical thinking in this field of study.[44]

In the following section, we articulate several propositions that elaborate on the grounding relations between PTRs and IOs, and empirically evaluate them using a specially curated dataset of private transnational standards and PILIs (including treaties, declarations, and protocols). Our analysis focuses specifically on citation practices rather than other forms of interaction – such as personnel exchanges, institutional affiliations, or financial relationships – for two key reasons. Firstly, citations provide a visible and well-established mechanism for conferring authority, offering clear signals to firms seeking certification and to states considering the incorporation of PTR-based standards into their own legal systems. Secondly, citations constitute a relatively objective form of evidence, particularly when compared to data derived from interviews.

2.1. Citations as Grounding Mechanisms

We argue that the network architecture of global governance enables PTRs to establish themselves as valid sources of normative power. They do so both by linking themselves to more fundamental international entities, such as authoritative intergovernmental organizations and PILIs (the focus of this article), and by engaging in reciprocal patterns of endorsement with peer schemes. This model of network grounding challenges the traditional pyramidal conception of authority, which views formal authority as deriving solely from vertical delegation by hierarchically superior public law sources. Instead, the authority of PTRs is cyclically co-generated through a web of

S. Wheatley (eds), *Complexity Theory and Law: Mapping an Emergent Jurisprudence* (Routledge, 2019), pp. 23–44.

[42] Orsini et al., n. 16 above.

[43] R. Kim, 'The Emergent Network Structure of the Multilateral Environmental Agreement System' (2013) 23(5) *Global Environmental Change*, pp. 980–91. Within the context of private–public interactions, e.g., works such as Marx (n. 20 above) and S. Fernandez de Cordoba et al., *The Future of Sustainable Trade: Due Diligence Initiatives, Voluntary Sustainability Standards and Developing Countries* (United Nations Conference on Trade and Development (UNCTAD), 2024) do not undertake the kind of systematic computational analysis attempted here.

[44] M.I. Eronen & L.F. Bringmann, 'The Theory Crisis in Psychology: How to Move Forward' (2021) 16(4) *Perspectives on Psychological Science*, pp. 779–88.

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interrelations among PTRs, IOs/PILIs, and other PTRs. This dynamic, non-linear model conceptualizes authority and validity as products of an evolving web of constitutive dependence, in which authority is continuously constituted and reconstituted across interacting regimes. It thus contributes to a growing body of scholarship that emphasizes the relational foundations of authority in transnational regulatory regimes.[45]

Groundedness is also central to the legitimacy of normative authority. Meyer and Rowan refer to this as the question of an institution's 'legal mandate',[46] and Scott emphasizes this dimension in his often-quoted definition of legitimacy: 'Legitimacy is not a commodity to be possessed or exchanged but a condition reflecting cultural alignment, *normative support, or consonance with relevant rules or laws*'.[47] Although normative grounding is neither the only strategy that PTRs employ to establish legitimacy, nor always a sufficient one, it remains a core mechanism through which they seek to assert normative authority, particularly in the absence of formal legal mandates. Recognizing that PTRs also draw on other legitimation strategies – including stakeholder participation, appeals to moral authority, and reliance on expert knowledge – we focus on grounding as a key dimension of their authority-building practices.[48]

To examine this argument, we analyzed the citation network linking PTS and PILIs.[49] Although we do not investigate the underlying motivations driving PTR citation practices or how these references are received by external audiences – questions we leave for future research – we argue that evidence of a network-based architecture of normative grounding, if demonstrated, would support our claim that

[45] N. Roughan & A. Halpin, 'The Promises and Pursuits of Pluralist Jurisprudence', in N. Roughan & A. Halpin (eds), *In Pursuit of Pluralist Jurisprudence* (Cambridge University Press, 2017), pp. 326–66; C. Culver & M. Giudice, *Legality's Borders: An Essay in General Jurisprudence* (Oxford University Press, 2010), p. 124; S. Wood et al., 'The Interactive Dynamics of Transnational Business Governance: A Challenge for Transnational Legal Theory' (2015) 6(2) *Transnational Legal Theory*, pp. 333–69; E. Tsingou, 'Outsourcing Authority in Global Policy: Legitimating the Anti-Money Laundering Regime through Professionalization' (2024) 43(1) *Policy and Society*, pp. 70–82.

[46] J.W. Meyer & B. Rowan, 'Institutionalized Organizations: Formal Structure as Myth and Ceremony' (1977) 83(2) *American Journal of Sociology*, pp. 340–63, at 347.

[47] W.R. Scott, *Institutions and Organizations* (Sage, 1995), p. 45 (emphasis added).

[48] For further analyses of PTR legitimation strategies see B. Cashore, 'Legitimacy and the Privatization of Environmental Governance: How Non-State Market-Driven (NSMD) Governance Systems Gain Rule-Making Authority' in P.M. Haas (ed.), *International Environmental Governance* (Routledge, 2008), pp. 339–61; P. Schleifer, 'Varieties of Multi-Stakeholder Governance: Selecting Legitimation Strategies in Transnational Sustainability Politics' (2019) 16(1) *Globalizations*, pp. 50–66; O. Perez, 'The Hybrid Legal-Scientific Dynamic of Transnational Scientific Institutions' (2015) 26(2) *European Journal of International Law*, pp. 391–416.

[49] We focus on citations between legal documents, although transnational non-governmental organizations (NGOs) also use other forms of partnership with international organizations to legitimize their actions; see V. Collingwood, 'Non-Governmental Organisations, Power and Legitimacy in International Society' (2006) 32(3) *Review of International Studies*, pp. 439–54, at 448. For example, the Global Reporting Initiative (GRI) was founded in 1997 with the involvement of UNEP, although this involvement has later been discontinued; see GRI, 'Our Vision and Mission', available at: https://www.globalreporting.org/about-gri/mission-history.

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PTRs derive their authority from embeddedness in citation networks, rather than from formal delegation alone.[50]

The following examples demonstrate how citation functions as a grounding mechanism. Article 6.3.10.3 of the International Organization for Standardization (ISO) 26000 Guidance on Social Responsibility[51] supports its prohibition of child labour ('Organizations should not engage in or benefit from any use of child labour') by referencing the International Labour Organization (ILO) conventions that determine the minimum age for work.[52] Similarly, Article 6.5.2.1 of the ISO 26000 Guidance, which requires organizations to respect and promote a precautionary approach, cites the 1992 Rio Declaration on Environment and Development[53] and several conventions.[54] Finally, Principle 2 of the Aquaculture Stewardship Council (ASC) Freshwater Trout Standard,[55] which addresses the conservation of habitats and biodiversity, cites the CBD,[56] which was adopted at the 1992 Earth Summit.

We argue that cross-references between PTR standards and PILIs have a cumulative and synergistic effect on the authority and legitimacy of PTRs. Accordingly, our analysis focuses on the aggregate impact of referencing multiple PILIs, rather than the effect of any single citation on the legitimacy of a particular rule.

Proposition 1: The number of citations between PTS and PILIs is significant. We measure significance both by checking the relative portion of PTS that cite PILIs and by comparing the number of citations between PTS (internal citations) and between PTS and PILIs (external citations).

For clarity, we define *internal citations* as references from one PTS to another within the private regulatory sphere, while *external citations* involve a PTS citing a PILI, thereby invoking a public legal source. Although competition between PTRs may suppress internal citation practices, our data reveals notable instances of such peer

[50] C. Jäger, 'Epistemic Authority, Preemptive Reasons, and Understanding' (2016) 13(2) *Episteme*, pp. 167–85; O. Shulayeva, A. Siddharthan & A. Wyner, 'Recognizing Cited Facts and Principles in Legal Judgements' (2017) 25 *Artificial Intelligence and Law*, pp. 107–26.

[51] ISO Standard 26000 – Social Responsibility, Geneva (Switzerland), 1 Nov. 2010, available at: https://www.iso.org/iso-26000-social-responsibility.html.

[52] E.g., ILO Minimum Age Convention (No. 138), Geneva (Switzerland), 26 June 1973, in force 19 June 1976, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_ilo_code:C138, and ILO Worst Forms of Child Labour Convention (No. 182), Geneva (Switzerland), 17 June 1999, in force 19 Nov. 2000, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_ilo_code:C182.

[53] Rio Declaration on Environment and Development, Rio de Janeiro (Brazil), 14 June 1992, UN Doc. A/CONF.151/26/Rev.1 (Vol. I), Annex I, available at: https://www.un.org/esa/dsd/agenda21/Agenda%2021.pdf.

[54] E.g., Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Montreal (Canada), 16 May 2000, in force 11 Sept. 2003, available at: https://www.cbd.int/doc/legal/cartagena-protocol-en.pdf.

[55] ASC, 'ASC Freshwater Trout Standard', Feb. 2013, v. 1, p. 21, available at: https://www.asc-aqua.org/wp-content/uploads/2017/07/ASC-Freshwater-Trout-Standard_v1.0.pdf.

[56] N. 9 above.

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referencing.[57] These internal citations can serve as a form of self-referential grounding, through which PTRs reinforce each other's authority in the absence of hierarchical validation.[58] Comparing internal and external citations offers a valuable lens for understanding how PTRs draw on both private and public sources to construct normative authority within a hybrid governance system.

For PTRs to ground their authority through citations, they must explicitly invoke them, linking a specific rule in a PTS to a corresponding provision in a PILI. We distinguish between two types of grounding citation: (a) references to a specific PILI norm as part of the explication of a PTS rule, and (b) citations that treat the PILI as a dictionary: an interpretative source for a term or concept within the PTS. In both cases, the content of the private norm is grounded in the text of the public norm. We contrast these cases with normatively weaker citations, such as bibliographic references that provide general, non-specific support for the standard.

Proposition 2: Citations of PILIs by PTS are used mostly in a strong normative form to explicitly ground the content of the citing standard in an authoritative PILI.

2.2. Emergence of Hubs and Authorities in the Network of PTRs and IOs

The network of private standards and PILIs exhibits scale-free properties. In random networks, the distribution of edges follows a bell-shaped curve: most nodes have approximately the same number of links, and it is extremely rare to find nodes that have significantly more or fewer links than the average.[59] Random networks, therefore, tend to be non-hierarchical. Fragmentation can be understood as a claim that the network of PTRs and IOs consists of randomly distributed nodes. By contrast, scale-free networks contain hubs, which are nodes with a very high number of links. In such networks, the distribution of edges follows a power law: most nodes have only a few links and some

[57] E.g., we find in the data citations between PTRs that compete in the same sector; in the textile domain the Global Organic Textile Standard (GOTS) and the Textile Exchange (TE) had reciprocal citations: the TE cited OEKO-TEX (OEKO) and OEKO cited GOTS; in the seafood area, the Aquaculture Stewardship Council (ASC) and the Marine Stewardship Council (MSC) had reciprocal citations; in sustainable forest management, the Forest Stewardship Council (FSC) cited the Programme for the Endorsement of Forest Certification (PEFC); in the environmental reporting domain, the Greenhouse Gas Protocol (GGP) and the Global Reporting Initiative (GRI) cited the Carbon Disclosure Project (CDP). GOTS, n. 8 above; Textile Exchange (TE), Lamesa, TX (US), 2002, available at: https://textileexchange.org; OEKO-TEX, Bönnigheim (Germany) & Vienna (Austria), Mar. 1992, available at: https://www.oeko-tex.com/en; Aquaculture Stewardship Council (ASC), Utrecht (The Netherlands), Apr. 2010, available at: https://asc-aqua.org; Marine Stewardship Council (MSC), London (United Kingdom (UK)), 17 Feb. 1997, available at: https://www.msc.org; Forest Stewardship Council (FSC), Toronto (Canada), 7 Oct. 1993, available at: https://fsc.org/en; Programme for the Endorsement of Forest Certification (PEFC), Paris (France), 30 June 1999, available at: https://www.pefc.org; Greenhouse Gas Protocol (GGP), Washington, DC (US) & Geneva (Switzerland), 1998, available at: https://ghgprotocol.org; Global Reporting Initiative (GRI), Boston, MA (US), 1997, available at: https://www.globalreporting.org; Carbon Disclosure Project (CDP), London (UK), 4 Dec. 2000, available at: https://www.cdp.net/en.

[58] Perez & Stegmann, n. 36 above.

[59] The probability that a node is connected to k other nodes decreases exponentially for large k.

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

have a very large number of them. In a seminal article,[60] Albert-László Barabási and Reka Albert demonstrated that complex networks exhibit a propensity to conform to a power law distribution, irrespective of the nature of their constituent elements.[61]

Barabási has argued that the emergence of scale-free networks with large hubs can be explained by two mechanisms: growth and preferential attachment. As new nodes appear, they tend to connect to the more connected nodes, and these popular nodes acquire more links over time than less connected ones. The 'rich get richer' process tends to favour the early nodes, which are more likely to become hubs.[62]

We argue that the network of PTS and PILIs is characterized by a few highly connected nodes, but the mechanism that leads to the emergence of these nodes is different from the one described by Barabási and his co-authors. To understand the unique structure of the citation network, we use an algorithm developed by Jon Kleinberg.[63] Kleinberg's algorithm distinguishes between *authorities*, which are nodes cited by many other nodes, and *hubs*, which are nodes that cite a large number of other nodes. The algorithm works recursively: a node that is a *good hub* cites many *good authorities*, and a node that is a *good authority* is cited by many *good hubs*.[64] In our case, because citations go only from PTS to PILIs, only PILIs can serve as authorities and only PTS can serve as hubs.

We argue that the PTS-PILI network is more likely to exhibit a hub-authority structure than a random one. This claim rests on two arguments. Firstly, it builds on Barabási's general thesis on the power law structure of networks, which has been validated across numerous studies in different domains.[65] Secondly, the structure of global sustainability governance – made up of general PTS (such as the Global Reporting Initiative (GRI)[66] and ISO Standard 26000 – Social Responsibility (ISO 26000)[67]) alongside sectoral ones (such as Social Accountability 8000 (SA8000),[68] Equator Principles (EP),[69] and Forest Stewardship Council (FSC)[70]), as well as highly prominent PILIs such as the CBD[71] and the UNFCCC,[72] and ILO Conventions[73] – fosters the emergence of a hub-authority configuration. This hub-authority structure is driven primarily by the system's normative

[60] A.L. Barabási & R. Albert, 'Emergence of Scaling in Random Networks' (1999) 286(5439) *Science*, pp. 509–12.

[61] In such networks, probability $P(k)$ that a node links with k other nodes can be approximated by: $P(k) \sim k^{-\gamma}$; and the value of γ is typically in the range of $2<\gamma<3$.

[62] A.L. Barabási, 'Scale-Free Networks: A Decade and Beyond' (2009) 325(5939) *Science*, pp. 412–3; A.L. Barabási & E. Bonabeau, 'Scale-Free Networks' (2003) 288(58) *Scientific American*, pp. 60–9.

[63] J.M. Kleinberg, 'Authoritative Sources in a Hyperlinked Environment' (1999) 46(5) *Journal of the ACM*, pp. 604–32.

[64] J.H. Fowler & S. Jeon, 'The Authority of Supreme Court Precedent' (2008) 30(1) *Social Networks*, pp. 16–30.

[65] A.L. Barabási, *Network Science* (Cambridge University Press, 2016).

[66] N. 57 above.

[67] N. 51 above.

[68] New York, NY (US), 1997, available at: https://sa-intl.org/programs/sa8000.

[69] Washington, DC (US), 4 June 2003, available at: https://equator-principles.com.

[70] N. 57 above.

[71] N. 9 above.

[72] N. 1 above.

[73] N. 52 above.

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

architecture, which reflects differences in prominence and generality, and is further reinforced by Barabási's observed temporal effects.

Proposition 3: The network has a hub-authority structure, in which relatively few PTS operate as hubs, citing many PILIs, and relatively few PILIs operate as authorities, receiving citations from many PTS.

2.3. Role of IOs/PILIs in Facilitating Policy Coherence between PTRs

As noted above, a key challenge of regulatory hybridization is diminished regulatory cohesion resulting from the proliferation of public and private institutions with overlapping mandates and inconsistent agendas. This misalignment can impede collaborative solutions for global dilemmas and diminishes the overall effectiveness of governance frameworks.[74] To fulfil its purpose, the regulatory system requires mechanisms for coordination and integration. We argue that PILIs can play an important role in reducing fragmentation among PTRs and facilitating thematic coordination by indirectly linking PTRs through common citations to PILIs.

Proposition 4: PILIs contribute to the cohesiveness of the PTR system by linking distinct PTRs through common citations.

3. Methodology and Data

Our dataset included citations from 393 legal texts associated with 55 PTRs, 261 PILIs, and 41 IOs. The PTRs are related to multiple sectors – from textile and coffee to quarried substances and golf – and they provide guidance in a variety of regulatory domains, including the environment, labour, and human rights. Below, we explain how the dataset and the network were created.

3.1. Data Related to PTRs

To construct the PTR list, we followed the methodology used in our previous article on transnational networked constitutionalism.[75] Firstly, we created an initial list of candidate PTRs based on a review of the literature, and expanded the list through an internet search. For the 55 PTRs on the list,[76] we collected all associated PTS, concluding with a list of 393 documents (some PTRs have several standards associated with different products, certification types, or company types).[77] PTRs use various terms to refer to their PTS, including standards (Bonsucro),[78] principles (Women's Empowerment Principles (WEPs)),[79] criteria (Global Sustainable Tourism Council

[74] Elsässer et al., n. 10 above, p. 379.
[75] Perez & Stegmann, n. 36 above, pp. 151–2.
[76] The initials and full names of the PTRs are listed in the Supplementary Materials, Appendix A.
[77] The full PTS list appears in the Supplementary Materials, Appendix B.
[78] London (UK), 2008, available at: https://bonsucro.com.
[79] New York, NY (US), 8 Mar. 2010, available at: https://www.weps.org.

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

(GSTC)),[80] codes of practice (Responsible Jewellery Council (RJC)),[81] and position statements (International Council on Mining and Metals (ICMM)).[82] We also collected 'governance' standards that determine the decision-making structure of the organization and the procedures for rule-making.

We collected additional data about each PTR in the sample, including foundation year, sector, regulatory focus (labour, environment or other; multiple categories enabled), dominant governing stakeholder (industry, civil society or states; multiple categories enabled), and the stringency of the compliance regime (we distinguished between 'soft' schemes that rely on self-verification by member firms and 'strict' schemes in which verification is undertaken by the PTR or a third party).[83] While some PTRs in our sample feature hybrid governance involving both state and private actors (for example, Investors in People (IIP)[84] and the UNEP Principles for Sustainable Insurance (UNEP PSI)),[85] we included them because their governance remains largely independent from the formal frameworks of either state or treaty law. This approach ensures our analysis reflects the full spectrum of private regulatory forms.[86]

3.2. Data Related to PILIs

The second type of node included in the network consists of the PILIs that PTS cite. We first created a list of generic titles of international law instruments that could be cited by PTS, which included generic terms such as 'conventions', 'treaties', 'agreements', 'declarations', and 'protocols'. We then searched for these terms in all the PTS files, using a specially developed *Python* programme to identify all the citations to PILIs. The program exported a file with 'text windows' in which the designated term appeared (lower case or upper case, with or without spaces). For example, the search for 'convention' generated a spreadsheet with 1,845 rows. Each row contained the sentence that included the term 'convention' and some sentences before and after (text window) so that the general context of the citation could be analyzed. Twelve PILI files that were not machine-readable (for example, OEKO-TEX standards)[87] were searched manually.

In the third step, we manually read the citations (text windows) and labelled the PILIs that were mentioned. As part of this close reading, we also labelled additional types of PILI that were found in the text windows close to the original search term (for example, the International Union for the Conversation of Nature (IUCN) Red List of

[80] Barcelona (Spain), 2007, available at: https://www.gstc.org.
[81] London (UK), 11 May 2005, available at: https://www.responsiblejewellery.com.
[82] London (UK), 2001, available at: https://www.icmm.com.
[83] Descriptive statistics for the PTR sample are provided in the Supplementary Materials, Technical Supplement, Table 1.
[84] London (UK), Oct. 1991, available at: https://www.investorsinpeople.com.
[85] Rio de Janeiro (Brazil), 19 June 2012, available at: https://www.unepfi.org/insurance/insurance.
[86] Details of the distribution of the PTRs' governing stakeholders are provided in the Supplementary Materials, Technical Supplement, Table 1.
[87] N. 57 above.

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

Threatened Species[88] was found while searching for 'conventions').[89] In some cases, the automated search did not lead to a PILI (for example, the search for 'convention' led to the word 'conventional';[90] in other cases, the word was used generically, without referencing a particular PILI).[91] Finally, we merged titles that referred to the same object (PILIs), such as 'United Nations Framework Convention on Climate Change'[92] and 'International Climate Change Convention'.[93] Table 1 provides summary statistics for the different PILI categories.

3.3. Constructing the Edges

Our final sample included 261 PILIs.[94] We created a list of synonyms and common abbreviations for each PILI, based on typical citation formats in PTS texts and on the websites of the PILIs: for example, 'United Nations Framework Convention on Climate Change' and 'UNFCCC'. We then searched again the PTS dataset for each PILI abbreviation, shorthand, and the keywords of the full treaty title. For each result we checked that it reflects a citation of a PILI. If we found a valid citation of a PILI in a PTS, we coded the citation as an edge between the PTR associated with the PTS and the cited PILI. Thus, an edge between PTR-PILI indicates the existence of at least one citation between a PTR standard and a PILI. Using this method, we built the PTR-PILI network, which consisted of 914 edges.

We classified PILIs into three categories: environment, human rights, and economics, with multiple categories enabled. These primary categories were further divided into subtopics, as elaborated in Table 2.

3.4 Developing a Citation Taxonomy

To better understand how PTRs cite PILIs, we analyzed a sample of 100 citations to develop a taxonomy distinguishing five categories of references.

1. **Normatively substantive references**: The normative content of the PTS is based explicitly on the norms of a particular PILI in a detailed and concrete manner. Example from ASC standard: 'Rationale – Adherence to the child labor codes and definitions included in this section indicates compliance with what the ILO

[88] Gland (Switzerland), first published in 1964, available at: https://www.iucnredlist.org.

[89] Fairtrade International (FI), *Fairtrade Standard for Hired Labour* (2014, v. 1.3), pp. 51–2 ('In addition to local and regional information, your company may want to look at IUCN red list of threatened species at www.iucnredlist.org. For further information on alien invasive species see the Convention of Biological Diversity at www.cbd.int/invasive' [n 9 above].

[90] Alliance for Water Stewardship (AWS), *AWS International Water Stewardship Standard* (2014, v. 1), p. 30, available at: https://a4ws.org/wp-content/uploads/2017/04/AWS-Standard-Full-v-1.0-English.pdf.

[91] ProTerra Foundation (PT), *ProTerra Standard – Social Responsibility and Environmental Sustainability* (2014, v. 3.0), p. 36, available at: https://www.proterrafoundation.org/wp-content/uploads/2017/02/ProTerra_Standard_V3.0_EN.pdf.

[92] ISO Standard 26000 – Social Responsibility (ISO 26000), *International Standard – Guidance on Social Responsibility* (2010), p. 108, available at: https://www.iso.org/standard/42546.html.

[93] Greenhouse Gas Protocol (GGP), *Greenhouse Gas Protocol* (rev. edn), p. 98, available at: https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf.

[94] The initials and full names of PILIs are listed in Supplementary Materials, Appendix C.

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

Table 1. Summary Statistics for the Different PILI Categories

No.	Type	Raw Citations (before checking)	Distinct Valid PILIs	PILI Example
1	**Convention**	1,845	115	Convention on Biological Diversity[a]
2	**Agreement**	1,334	12	Paris Agreement[b]
3	**Treaty(ies)**	72	1	Treaty on European Union[c]
4	**Protocol**	1,333	15	Protocol concerning the Control of Emissions of Nitrogen Oxides[d]
5	**Declaration**	452	21	Universal Declaration of Human Rights[e]
6	**Covenant**	58	3	International Covenant on Civil and Political Rights[f]
7	**Code**	455	8	Food and Agriculture Organization of the United Nations (FAO) Code of Conduct for the Import and Release of Exotic Biological Control[g]
8	**Memorandum**	14	0	
9	**Guidelines**	1,177	35	The United Nations Guiding Principles on Business and Human Rights[h]
10	**Exchange of letters**	1	0	
11	**Exchange of notes**	1	0	
12	**Goals**	Indirect search	1	The Millennium Development Goals[i]
13	**Indicators**	Indirect search	1	UN World Tourism Organization (UNWTO) Indicators of Sustainable Development for Tourism Destinations[j]
14	**List**	Indirect search	1	IUCN Red List of Threated Species[k]
15	**Model**	Indirect search	1	FAO Model Code of Forest Harvesting Practice[l]
16	**Principles**	Indirect search	2	Children's Rights and Business Principles (United Nations Children's Fund (UNICEF))[m]
17	**Recommendation**	Mainly in ILO search	44	ILO Welfare Facilities Recommendation[n]
18	**Statements**	Indirect search	1	Hazard statements form part of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS)[o]
	Total PILIs		**261**	

Notes

[a] N. 9 above.

[b] N. 2 above.

[c] Treaty on European Union (TEU), Maastricht (Netherlands), 7 Feb. 1992, in force 1 Nov. 1993, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A11992M%2FTXT; last amended at Lisbon (Portugal), 13 Dec. 2007, in force 1 Dec. 2009, available at: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A12012M%2FTXT.

[d] Sofia (Bulgaria), 31 Oct. 1988, in force 14 Feb. 1991, available at: https://unece.org/environment-policy/air/protocol-concerning-control-emissions-nitrogen-oxides.

[e] Paris (France), 10 Dec. 1948, available at: https://www.un.org/en/about-us/universal-declaration-of-human-rights.

[f] New York, NY (US), 16 Dec. 1966, in force 23 Mar. 1976, available at: https://www.ohchr.org/en/instruments-mechanisms/instruments/international-covenant-civil-and-political-rights.

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[g] Rome (Italy), 31 Oct. 1995, available at: https://www.fao.org/4/x5585e/x5585e0i.htm.
[h] Geneva (Switzerland), 16 June 2011, available at: https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf.
[i] New York, NY (US), 8 Sept. 2000, available at: https://www.un.org/millenniumgoals/bkgd.shtml.
[j] Madrid (Spain), 1997, available at: https://tourismgreeneconomy.weebly.com/uploads/8/1/3/1/81312260/indicators_of_sustainable_development_for_tourism_destinations_unwto.pdf.
[k] N. 88 above
[l] Rome (Italy), 1995, available at: https://www.fao.org/sustainable-forest-management/toolbox/tools/tool-detail/zh/c/217923.
[m] London (UK), 12 Mar. 2012, available at: https://www.unicef.org/media/96136/file/Childrens-Rights-Business-Principles-2012.pdf.
[n] Geneva (Switzerland), 26 June 1956, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p = NORMLEXPUB:12100:0::NO:12100:P12100_INSTRUMENT_ID:312440:NO.
[o] Geneva (Switzerland), 25 July 2003, available at: https://unece.org/ghs-rev9-2021.

and related international conventions generally recognize as the key areas for the protection of children and young workers'.[95]

2. **Definitional reference:** The PTS uses the PILI as a 'dictionary' to define specific terms. Example from Ethical Tea Partnership (ETP) standard:[96] 'except for light work as provided for by ILO Convention 138, Article 7'.[97]
3. **Encyclopaedic reference:** The PTS cites the PILI in a general manner, which does not alter the normative content of the PTS. Example from ASC standard: 'WWF is one of four global non-governmental organizations (NGOs) that have been associated with the Ramsar Convention[[98]] since its inception as … an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands'.[99]
4. **Procedural reference:** The PTS cites the PILI to establish a time frame relevant to its application. Example from Marine Stewardship Council (MSC) and ASC joint standard: 'The timeframe adopted was originally set in the MSC program with reference to the date of adoption of the [CBD] requirements on alien species'.[100]
5. **Bibliographic reference:** The PTS lists the PILI as a source in its bibliography.[101]

Using the above framework, we analyzed our complete dataset of references to conventions (1,820 raw occurrences). Two research assistants (law students) read all the citations and classified them according to the above taxonomy, each working separately. The students also labelled citations that should be excluded from the sample, focusing on these paradigmatic examples:

[95] ASC, 'ASC Seriola and Cobia Standard', Oct. 2016, v. 1, p. 42.
[96] Ethical Tea Partnership, 'ETP Global Standard', 2016, p. 26.
[97] ILO Minimum Age Convention (No. 138); ILO Worst Forms of Child Labour Convention (No. 182), n. 52 above.
[98] Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, Ramsar (Iran), 2 Feb. 1971, in force 21 Dec. 1975, available at: https://www.ramsar.org/sites/default/files/documents/library/current_convention_text_e.pdf.
[99] ASC, 'ASC Tilapia Standard', Apr. 2017, v. 1.1, p. 19.
[100] ASC & MSC, 'ASC-MSC Seaweed (Algae) Standard', 30 Apr. 2018, v. 1.01, p. 58; CBD, n. 9 above.
[101] ASC, 'ASC Freshwater Trout Standard', Feb. 2013, v. 1, p. 55.

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Table 2. Classification of PILIs

Topic	Subtopic	PILIs	Example
Environment	Sustainable development (general)	6	Rio[a]
	Pollution	7	Basel[b]
	Ozone and greenhouse gas	7	UNFCCC[c]
	Nature conservation	8	Ramsar[d]
	Marine pollution	3	MARPOL[e]
	Chemical use	10	Rotterdam[f]
	Biodiversity conservation (genetics)	3	Nagoya[g]
	Biodiversity conservation	27	CITES[h]
	Environment subtotal	**71**	
Human rights	State operation	5	UNCAT[i]
	Racism and foreigners	5	ICERD[j]
	Organize crime	3	UNTIP[k]
	Medicine	2	Bioethics[l]
	Labour wage	15	ILO C173[m]
	Labour safety and health	24	ILO R192[n]
	Labour relationships	8	ILO C158[o]
	Labour groups	24	ILO C143[p]
	Labour general	20	ILO C177[q]
	Labour conditions	25	UN Slavery[r]
	Labour association	11	ILO C87[s]
	Human rights (general)	8	UDHR[t]
	Equality and vulnerable populations	8	CRPD[u]
	Culture and community	8	Cultural Heritage[v]
	Human rights subtotal	**166**	
Economics	Technical	2	WBank Operational[w]
	International trade	5	Cocoa[x]
	Corruption	7	UNCAC[y]
	Consumer and information protection	4	OECD Privacy[z]
	Regime creation	1	TEU[aa]
	Economics subtotal	**19**	
Environment and Human rights	Sustainable Development (General) and Human Rights General	3	MDGs[bb]
Environment and Economics	Biodiversity Conservation and Economics	1	UNCLOS[cc]
Environment and Human rights and Economics	Labour General and Human Rights General and Sustainable Development (General) and Economics General	1	OECD-ME[dd]
Total PILIs		**261**	

Notes

[a] N. 53 above.

[b] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Basel (Switzerland), 22 Mar. 1989, in force 5 May 1992, available at: https://www.basel.int.

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

[c] N. 1 above.
[d] N. 98 [above/below].
[e] International Convention for the Prevention of Pollution from Ships (MARPOL), London (UK), 2 Nov. 1973, in force 2 Oct. 1983, available at: https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx.
[f] Rotterdam Convention on Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, n. 140 below.
[g] Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity, Nagoya (Japan), 29 Oct. 2010, in force 12 Oct. 2014, available at: https://www.cbd.int/abs/text.
[h] Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington, DC (US), 3 Mar. 1973, in force 1 July 1975, available at: https://cites.org/eng/disc/text.php.
[i] Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment, New York, NY (US), 10 Dec. 1984, in force 26 June 1987, available at: https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-against-torture-and-other-cruel-inhuman-or-degrading.
[j] International Convention on the Elimination of All Forms of Racial Discrimination, New York, NY (US), 21 Dec. 1965, in force 4 Jan. 1969, available at: https://www.ohchr.org/en/instruments-mechanisms/instruments/international-convention-elimination-all-forms-racial.
[k] Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children, supplementing the United Nations Convention against Transnational Organized Crime (Palermo Protocol), Palermo (Italy), 12–15 Dec. 2000, in force 25 Dec. 2003, available at: https://www.ohchr.org/en/instruments-mechanisms/instruments/protocol-prevent-suppress-and-punish-trafficking-persons.
[l] UN Educational, Scientific and Cultural Organization (UNESCO) Universal Declaration on Bioethics and Human Rights, Paris (France), 19 Oct. 2005, available at: https://unesdoc.unesco.org/ark:/48223/pf0000146180.
[m] ILO Protection of Workers' Claims (Employer's Insolvency) Convention (No. 173), Geneva (Switzerland), 23 June 1992, in force 8 June 1995, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p = NORMLEXPUB:12100:0::NO:12100:P12100_INSTRUMENT_ID:312318:NO.
[n] ILO Safety and Health in Agriculture Recommendation (No. 192), Geneva (Switzerland), 21 June 2001, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p = NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312530.
[o] ILO Termination of Employment Convention (No. 158), Geneva (Switzerland), 22 June 1982, in force 23 Nov. 1985, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p = NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C158.
[p] ILO Migrant Workers (Supplementary Provisions) Convention (No. 143), Geneva (Switzerland), 24 June 1975, in force 9 Dec. 1978, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p = NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C143.
[q] ILO Home Work Convention (No. 177), Geneva (Switzerland), 20 June 1996, in force 22 Apr. 2000, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p = NORMLEXPUB:12100:0::NO:12100:P12100_INSTRUMENT_ID:312322:NO.
[r] UN Supplementary Convention on the Abolition of Slavery, the Slave Trade, and Institutions and Practices Similar to Slavery, Geneva (Switzerland), 7 Sept. 1956, in force 30 Apr. 1957, available at: https://www.ohchr.org/en/instruments-mechanisms/instruments/supplementary-convention-abolition-slavery-slave-trade-and.
[s] ILO Freedom of Association and Protection of the Right to Organise Convention (No. 87), San Francisco, CA (US), 9 July 1948, in force 4 July 1950, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p = NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312232.
[t] Universal Declaration of Human Rights (UDHR), Paris (France), 10 Dec. 1948, available at: https://www.un.org/en/about-us/universal-declaration-of-human-rights.
[u] UN Convention on the Rights of Persons with Disabilities, New York, NY (US), 13 Dec. 2006, in force 3 May 2008, available at: https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html.
[v] UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage, Paris (France), 17 Oct. 2003, in force 20 Apr. 2006, available at: https://ich.unesco.org/en/convention.
[w] World Bank Operational Guidelines, Washington, DC (US), 1964 (first official procurement guidelines), available at: https://policies.worldbank.org/en/policies/operational-manual.
[x] International Cocoa Agreement, Geneva (Switzerland), 25 June 2010, in force 1 Oct. 2012, available at: https://treaties.un.org/doc/source/signature/2010/english.pdf.
[y] United Nations Convention against Corruption, Mérida (Mexico), 9 Dec. 2003, in force 14 Dec. 2005, available at: https://www.unodc.org/unodc/en/corruption/uncac.html.
[z] Organisation for Economic Co-operation and Development (OECD) Guidelines on the Protection of Privacy and Transborder Flows of Personal Data, Paris (France), 23 Sept. 1980, available at: https://www.oecd.org/en/publications/oecd-guidelines-on-the-protection-of-privacy-and-transborder-flows-of-personal-data_9789264196391-en.html.
[aa] Treaty on European Union (TEU), Maastricht (Netherlands), 7 Feb. 1992, in force 1 Nov. 1993, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri = CELEX%3A11992M%2FTXT; last amended at Lisbon (Portugal), 13 Dec. 2007, in force 1 Dec. 2009, available at: https://eur-lex.europa.eu/legal-content/en/TXT/?uri = CELEX%3A12012M%2FTXT.
[bb] New York, NY (US), 8 Sept. 2000, available at: https://www.un.org/millenniumgoals/bkgd.shtml.
[cc] UN Convention on the Law of the Sea (UNCLOS), Montego Bay (Jamaica), 10 Dec. 1982, in force 16 Nov. 1994, available at: https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf.
[dd] OECD Guidelines for Multinational Enterprises on Responsible Business Conduct, Paris (France), 21 June 1976, available at: https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/06/oecd-guidelines-for-multinational-enterprises-on-responsible-business-conduct_a0b49990/81f92357-en.pdf.

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1. **Sentences that are not citations** – for example, 'the application of conventional pesticides'.[102]
2. **Non-specific references to a convention** – for example, 'or other sources of conventions and norms for allocating emissions'.[103]
3. **Redundant citations**: when the same convention is mentioned twice in the same sentence – for example, 'This definition is based on the International Labour Organization (ILO) Convention 154, Collective Bargaining Convention, 1981[104]'.[105]

We then compared the outputs of the two research assistants and, wherever they did not agree, the authors read the citation again and determined which classification suits the taxonomy. Finally, we verified a random sample of the classified citations to ensure that the classification was appropriate. The outcome of this process was a weighted edge table between PTRs (through their associated PTS) and conventions, which considered both the number of citations between PTS and conventions and the distribution of the citation types for each PTS-convention relation.

3.5 Data Related to IOs

We assembled the list of IOs by singling out those that have an institutional link with the PILIs on our list. We adopted a broad view of institutional linkage, not limited to the organ responsible for administering the convention. Based on this approach, we associated, for example, the UNFCCC with UNEP, the World Meteorological Organization (WMO) and the Intergovernmental Panel on Climate Change (IPCC). This analysis produced a list of 41 IOs.[106] In the case of umbrella organizations, such as the United Nations (UN), we refined the analysis to identify the most relevant sub-unit. For example, the UN International Convention for the Protection of All Persons from Enforced Disappearance[107] was associated with the UN Commission on Human Rights. Using this data, we expanded the PTR-PILI network by linking each PILI in the network to its associated IO.[108] We then created a dataset that included the three types of node and all the edges between them (PTRs-PILIs-IOs). We used *R* to analyze the network and *Gephi* to produce the network visualizations.

Figure 1 provides a snapshot of the relationships anticipated by our model. It includes firms certified by PTRs to illustrate the indirect channel through which

[102] Better Cotton Initiative (BCI), 'Better Cotton Production Principles and Criteria Explained', Oct. 2013, p. 6.
[103] Greenhouse Gas Protocol (GGP), 'Product Life Cycle Accounting Reporting Standard', 041613, p. 71.
[104] Geneva (Switzerland), 19 June 1981, in force 11 Aug. 1983, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C154.
[105] Global Reporting Initiative (GRI), 'GRI 102: General Disclosures', 2016, p. 30.
[106] The initials and full names of IOs are listed in Supplementary Materials, Appendix D.
[107] New York, NY (US), 20 Dec. 2006, in force 23 Dec. 2010, available at: https://www.ohchr.org/en/instruments-mechanisms/instruments/international-convention-protection-all-persons-enforced.
[108] For the IO-PILI edge table see 'Tri-Partite Network Edges.csv' or 'PILIs Attributes.csv' in O. Stegmann & O. Perez, 'Private-Public Networked Database' (2025) V1 *Harvard Dataverse*, available at: https://doi.org/10.7910/DVN/ATVNWV.

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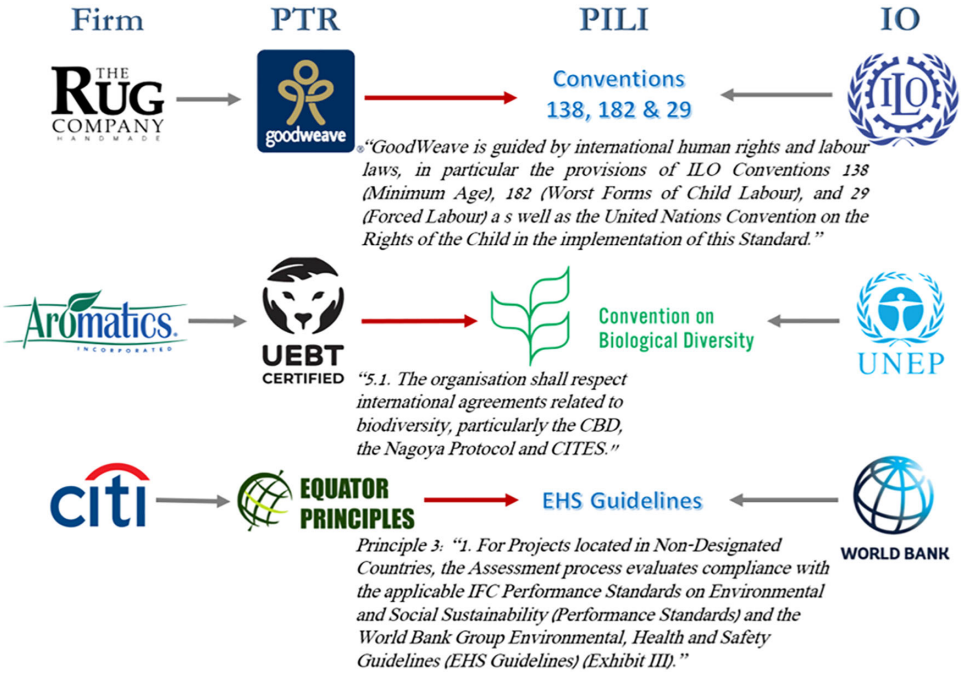


Figure 1. Snapshot of Network Connection: Subscribing Firm-PTR-PILI-IO

private–public influence is exercised. Through the reliance of PTRs on PILIs, private firms effectively adopt public norms and regulations shaped by IOs. In this way, the legitimacy-seeking behaviour of PTRs – reflected in their citations of PILIs – positions them as indirect regulatory agents of IOs. Figure 2 presents the full network linking PTRs, PILIs, and IOs.

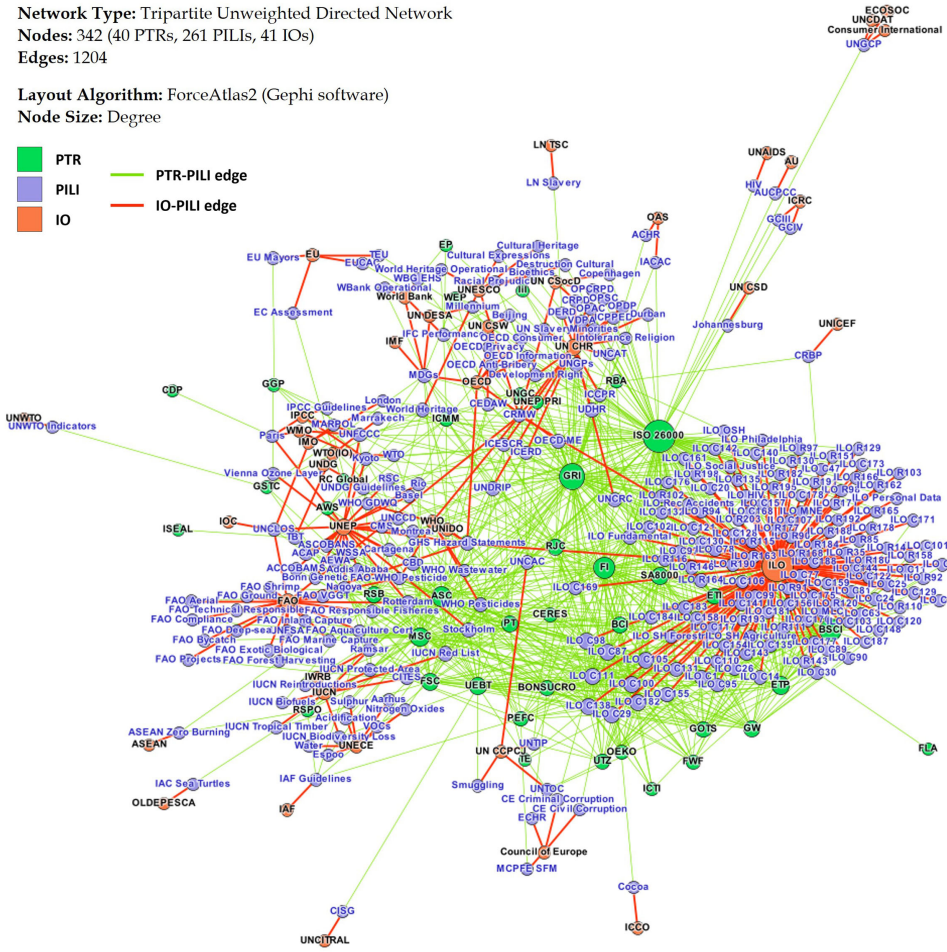
4. Findings: Analysis of the Complete Hybrid Network

4.1. Proposition 1

We hypothesized that the number of citations between PTRs and PILIs is substantial. To evaluate this, we (a) examined the proportion of PTRs that cite PILIs and (b) compared the number of distinct PILIs cited by a PTR with the number of distinct PTRs cited by a PTR, effectively comparing the average out-degree[109] in the respective networks. We found significant support for this proposition. Figure 3 presents the PTRs-PILIs

[109] 'Average degree' is the average of the degrees of all nodes in the network. 'Node's degree' is the number of edges connected to a node. If we select a random node in the network, its expected degree will be the average degree. In directed networks, like the citations network, we can separately count the edges that originate from a node (out-degree) and those that enter a node (in-degree). Therefore, the 'average out-degree' in the PTRs-PILIs network is the number of PILIs cited by an average PTR, and the average out-degree in the PTRs network is the number of PTRs cited by an average PTR.

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Network Type: Tripartite Unweighted Directed Network
Nodes: 342 (40 PTRs, 261 PILIs, 41 IOs)
Edges: 1204
Layout Algorithm: ForceAtlas2 (Gephi software)
Node Size: Degree
PTR
PILI
IO
PTR-PILI edge
IO-PILI edge
ISO 26000
GRI
FI
SA8000
ETI
BCI
IPT
CERES
FSC
UEBT
BONSUCRO
RJC
PEFC
GOTS
GW
ETP
FWF
ICTI
OEKO
UTZ
IE
UNDP
UNCAC
UNDRIP
UNCRC
UNGC
UNEP FI
UNHCR
UDHR
ICCPR
ICESCR
ICERD
CRMW
CEDAW
OECD ME
OECD
MDGs
UNGPs
UNCAT
UN CHR
UN CSW
UN CSocD
UN CSD
UNESCO
WHO
UNEP
UNIDO
UNCCD
UNFCCC
IMO
ILO
ILO Philadelphia
ILO OSH
ILO Social Justice
ILO Rec Accidents
ILO Personal Data
ILO HIV
ILO MNE
ILO C102
ILO C169
ILO C138
ILO C182
ILO C29
ILO C105
ILO C111
ILO C100
ILO C95
ILO C155
ILO C132
ILO C135
ILO C98
ILO C87
ILO C184
ILO C158
ILO C141
ILO C154
ILO C135
ILO C177
ILO C187
ILO C89
ILO C90
ILO C30
ILO C81
ILO C129
ILO C110
ILO C148
ILO C120
ILO C16
ILO C171
ILO C173
ILO C92
ILO C25
ILO C24
ILO C22
ILO C15
ILO C14
ILO C1
ILO R103
ILO R162
ILO R165
ILO R178
ILO R158
ILO R129
ILO R97
ILO R156
ILO R130
ILO R147
ILO R166
ILO R89
ILO R192
ILO R120
ILO R143
ILO R187
ILO R181
ILO R184
ILO R185
ILO R193
ILO R195
ILO R198
ILO R199
ILO R135
ILO R146
ILO R180
ILO R164
ILO R190
ILO R191
ILO R182
ILO R119
ILO R20
ILO R94
ILO R203
ILO R207
ILO R102
ILO R146
ILO R163
ILO R144
ILO R188
ILO R189
ILO R193
ILO R198
ILO R199
ILO C176
ILO C174
ILO C148
ILO C156
ILO C183
ILO C187
ILO C142
ILO C140
ILO C161
ILO C87
ILO C98
ILO C105
ILO C111
ILO C100
ILO C95
ILO C155
ILO C132
ILO C135
ILO C29
ILO C102
ILO C121
ILO C128
ILO C130
ILO C74
ILO C144
ILO C151
ILO C182
ILO C138
ILO C169
ILO C68
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ILO C94
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ILO C17
ILO C14
ILO C1
ILO C110
ILO C143

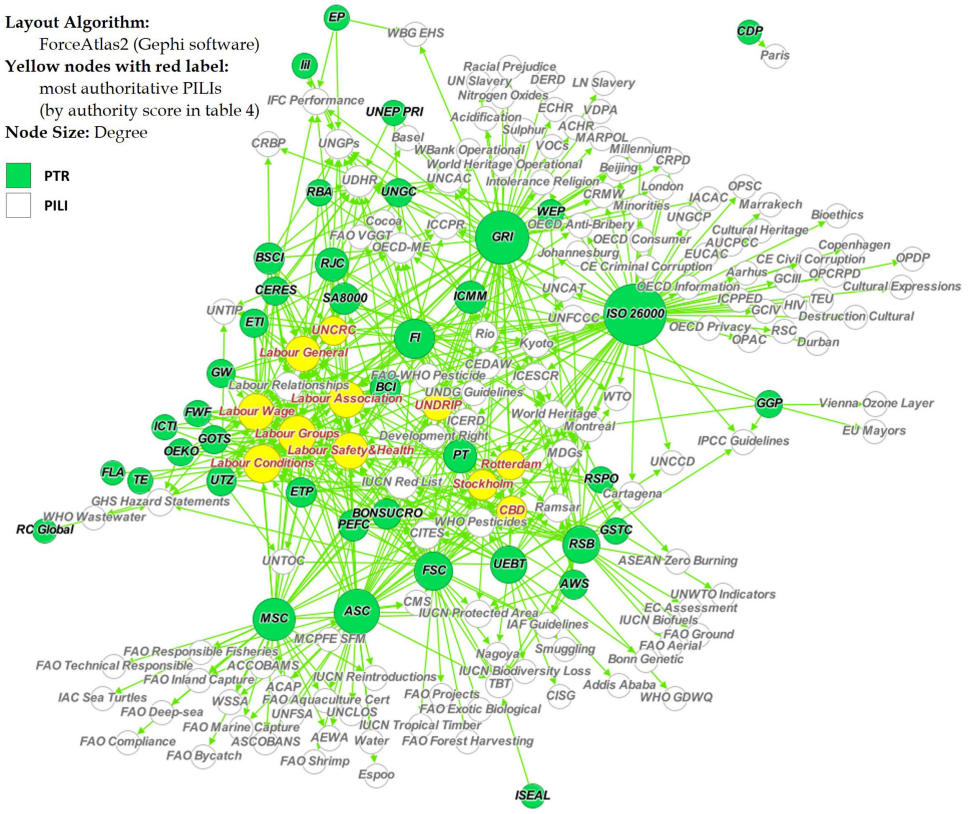


Figure 3. The PTRs-PILIs Network

Note: 'Node's degree' is the number of edges connected to a node, which is equivalent to the number of neighbours it has. In the PTRs-PILIs network, a PTR's degree represents the number of distinct PILIs it has cited. A 'bi-partite network' connects two distinct types of node, with edges permitted only between nodes of different types. In the PTR-PILI network, this means that edges may link PTRs to PILIs, but not PTRs to other PTRs or PILIs to other PILIs.

PTRs. Therefore, PTRs tend to rely more on treaty-based norms than on private norms produced by their peer organizations.

To further demonstrate the dependence between PTRs and PILIs, we created a projected PTRs-IOs network based on their common association with PILIs (Figure 4). A PTR is linked to an IO when it cites a PILI that is associated with this IO. PTRs and IOs that have more PILIs in common are depicted as being closer to each other by the Force Atlas layout algorithm. For example, the MSC is close to the Food and Agricultural Organization of the UN (FAO), the ILO, and UNEP because it cites them the most (17 PILIs associated with the ILO, 10 with the FAO, and 9 with UNEP). The graph shows that the network is highly connected. This graph may also have practical implications for IOs, as it can help in identifying closely aligned PTRs for active orchestration.[111]

[111] See additional details in the Supplementary Materials, Technical Supplement, Figure 1 and Table 2.

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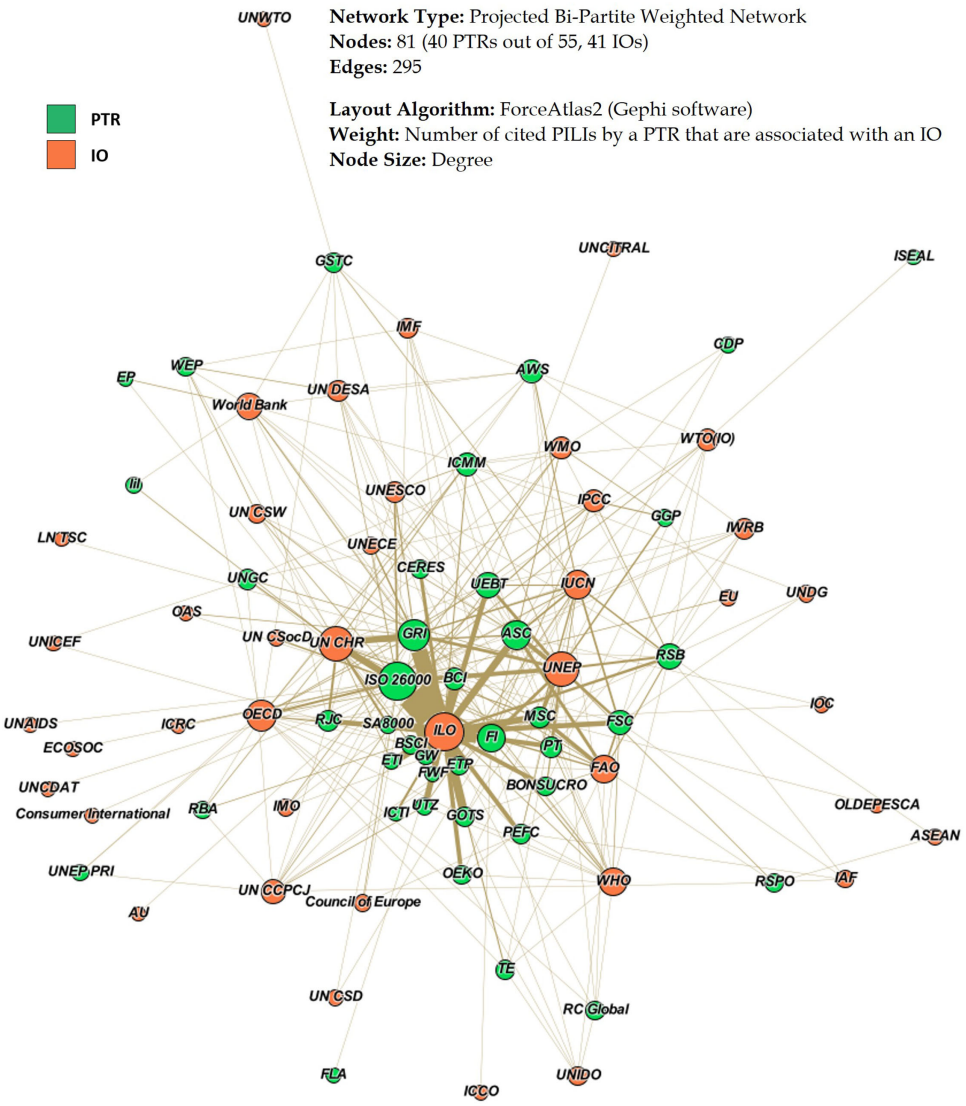


Figure 4. Projected PTRs-IOs Network

4.2. Proposition 2

Our second proposition posited that PTRs tend to cite PILIs as grounds for the content of the norms they produce. Based on the taxonomy we developed, this tendency should result in most citations being either normative-substantive or definitional. We found that on average 70.3% of the PTR citations were either normative-substantive (31.2%) or definitional (39.1%), 19% bibliographic, 7.4% encyclopaedic, and 3.4% procedural. When calculating the percentages across the

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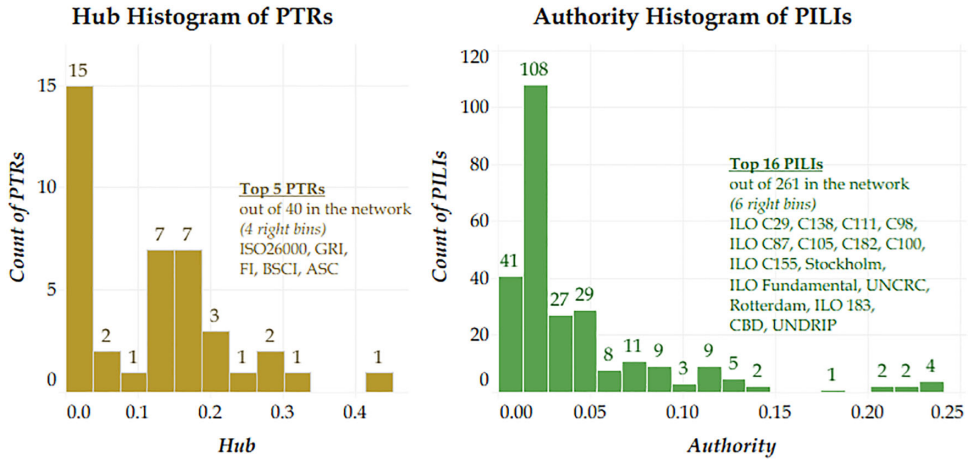


Figure 5. Distribution of Hub and Authority Scores
Note: The scatterplots and histogram were plotted using Tableau Software.

total number of citations, 66% were normatively substantive or definitional (952 out of 1,443).[112]

4.3. Proposition 3

Our third proposition stated that the network has a hub-authority structure. Our findings support this proposition. The distribution of citations to PILIs has a power-law pattern, in which few PTRs (hubs) cite many PILIs, and relatively few PILIs (authorities) receive citations from many PTRs. This pattern is captured in Figure 5, which illustrates the distribution of hub and authority scores across the PTRs-PILIs populations.[113]

Table 3 presents the top five hubs.[114]

Table 4 presents the most authoritative PILIs.

Interesting questions that lie beyond the scope of this article include which types of PTR are more likely to cite PILIs and why. In a subsequent study, we tested several hypotheses regarding patterns of PTR citation behaviour.[115] For example, we found that PTRs targeting firms in the plant, forest, and marine product sectors (primarily food-related) tend to cite more PILIs than PTRs operating in other sectors – including general-purpose PTRs designed to apply across industries.

[112] There was a large variance in the number of references between PTRs. We calculated the overall measure of normatively substantive references using simple summation across the entire PTR sample.

[113] In the Supplementary Materials Technical Supplement we show that the PTRs-PILIs network differs significantly from a random network.

[114] Hub and authority measures are imperfectly correlated with out-degree and in-degree measures; see the discussion in the Supplementary Materials, Technical Supplement.

[115] O. Stegmann & O. Perez, 'Network Interactions and Legitimacy Patterns in the Global Sustainability Governance System' (2025) V1 *Harvard Dataverse*, available at: https://doi.org/10.7910/DVN/8T10V3.

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Table 3. Top Hubs

No.	PTR	Initials	Hub	Citations (No. of PILIs)
1	ISO Standard 26000 Social Responsibility[a]	ISO 26000	0.442	131
2	Global Reporting Initiative[b]	GRI	0.332	87
3	Fairtrade International[c]	FI	0.29	58
4	Business Social Compliance Initiative[d]	BSCI	0.268	66
5	Aquaculture Stewardship Council[e]	ASC	0.255	50

Notes
[a] N. 51 above.
[b] N. 57 above.
[c] N. 8 above.
[d] Business Social Compliance Initiative (BSCI), Brussels (Belgium), Mar. 2003, available at: https://www.amfori.org/amfori-bsci.
[e] N. 57 above.

4.4. Proposition 4

Proposition 4 posited that PILIs function as cohesive bridges between distinct PTRs through shared citations, thereby facilitating greater thematic coordination among private schemes. To test this hypothesis, we created a *projected network* consisting exclusively of PTRs. In this network (Figure 6), a link exists between two PTRs if they cite a common PILI. The network is weighted: edges are assigned weights that reflect the number of common PILIs between every two nodes. For example, the edge between the Forest Stewardship Council (FSC)[116] and the Programme for the Endorsement of Forest Certification (PEFC),[117] which operate in the forestry sector, has a weight of 17, reflecting the number of their common citations.[118] Another example is the (cross-sectoral) link between the Global Organic Textile Standard (GOTS)[119] (textile) and Marine Stewardship Council (MSC)[120] (sustainable fishery), which is based on 13 common citations.[121] We used the Force Atlas algorithm,[122] which pulls together PTRs connected by highly weighted edges.

The *projected PTR network* includes 39 PTRs that have at least one commonly cited PILI, representing 70.9% of our PTR sample. The projected network is highly cohesive: it has a *density* of 0.655, which means that 65.5% of the potential connections between the nodes are realized (485 edges out of 741 potential edges between the 39 PTRs). The *average weight* is 7.89, which means that on average 2

[116] N. 57 above.
[117] Ibid.
[118] CBD | CITES | IAF Guidelines | ILO C100 | ILO C105 | ILO C111 | ILO C138 | ILO C169 | ILO C182 | ILO C29 | ILO C87 | ILO C98 | ILO Fundamental | ILO SH Forestry | Stockholm | UNDRIP | WHO Pesticides.
[119] N. 8 above.
[120] N. 57 above.
[121] ILO C1 | ILO C100 | ILO C105 | ILO C111 | ILO C131 | ILO C138 | ILO C155 | ILO C158 | ILO C182 | ILO C29 | ILO C87 | ILO C98 | IUCN Red List.
[122] M. Jacomy et al., 'ForceAtlas2, A Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software' (2014) 9(6) *PLoS ONE*, article e98679.

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Table 4. Most Authoritative PILIs

No.	PILI	Initials	Authority	Citations (No. of PTRs)
1	Forced Labour Convention[a]	ILO C29	0.236	25
2	Minimum Age Convention[b]	ILO C138	0.236	25
3	Discrimination (Employment and Occupation) Convention[c]	ILO C111	0.235	24
4	Right to Organise and Collective Bargaining Convention[d]	ILO C98	0.229	23
5	Freedom of Association and Protection of the Right to Organise Convention[e]	ILO C87	0.226	22
6	Abolition of Forced Labour Convention[f]	ILO C105	0.219	21
7	Worst Forms of Child Labour Convention[g]	ILO C182	0.213	21
8	Equal Remuneration Convention[h]	ILO C100	0.213	21
9	Occupational Safety and Health Convention[i]	ILO C155	0.177	16
10	Stockholm Convention on Persistent Organic Pollutants[j]	Stockholm	0.137	13
11	Declaration on Fundamental Principles and Rights at Work[k]	ILO Fundamental	0.135	13
12	United Nations Convention on the Rights of the Child[l]	UNCRC	0.13	10
13	Rotterdam Convention on Prior Informed Consent[m]	Rotterdam	0.129	12
14	Maternity Protection Convention[n]	ILO C183	0.129	10
15	Convention on Biological Diversity[o]	CBD	0.125	11
16	United Nations Declaration on the Rights of Indigenous Peoples[p]	UNDRIP	0.121	11

Notes

[a] Geneva (Switzerland), 28 June 1930, in force 1 May 1932, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312174.

[b] N. 52 above.

[c] Geneva (Switzerland), 25 June 1958, in force 15 June 1960, available at: https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312256.

[d] Geneva (Switzerland), 1 July 1949, in force 18 July 1951, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312243.

[e] ILO Freedom of Association and Protection of the Right to Organise Convention (No. 87), San Francisco, CA (US), 9 July 1948, in force 4 July 1950, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312232.

[f] Geneva (Switzerland), 25 June 1957, in force 17 Jan. 1959, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312250.

[g] N. 52 above.

[h] Geneva (Switzerland), 29 June 1951, in force 23 May 1953, available at: https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312245.

[i] Geneva (Switzerland), 22 June 1981, in force 11 Aug. 1983, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312300.

[j] N. 139 below.

[k] Geneva (Switzerland), 18 June 1998, available at: https://www.ilo.org/sites/default/files/2024-04/ILO_1998_Declaration_EN.pdf.

[l] New York, NY (US), 20 Nov. 1989, in force 2 Sept. 1990, available at: https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-child.

[m] N. 140 below.

[n] Geneva (Switzerland), 15 June 2000, in force 7 Feb. 2002, available at: https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:55:0:::55:P55_TYPE,P55_LANG,P55_DOCUMENT,P55_NODE:REV,en,C183,/Document.

[o] N. 9 above.

[p] New York, NY (US), 13 Sept. 2007, available at: https://www.un.org/development/desa/indigenouspeoples/declaration-on-the-rights-of-indigenous-peoples.html.

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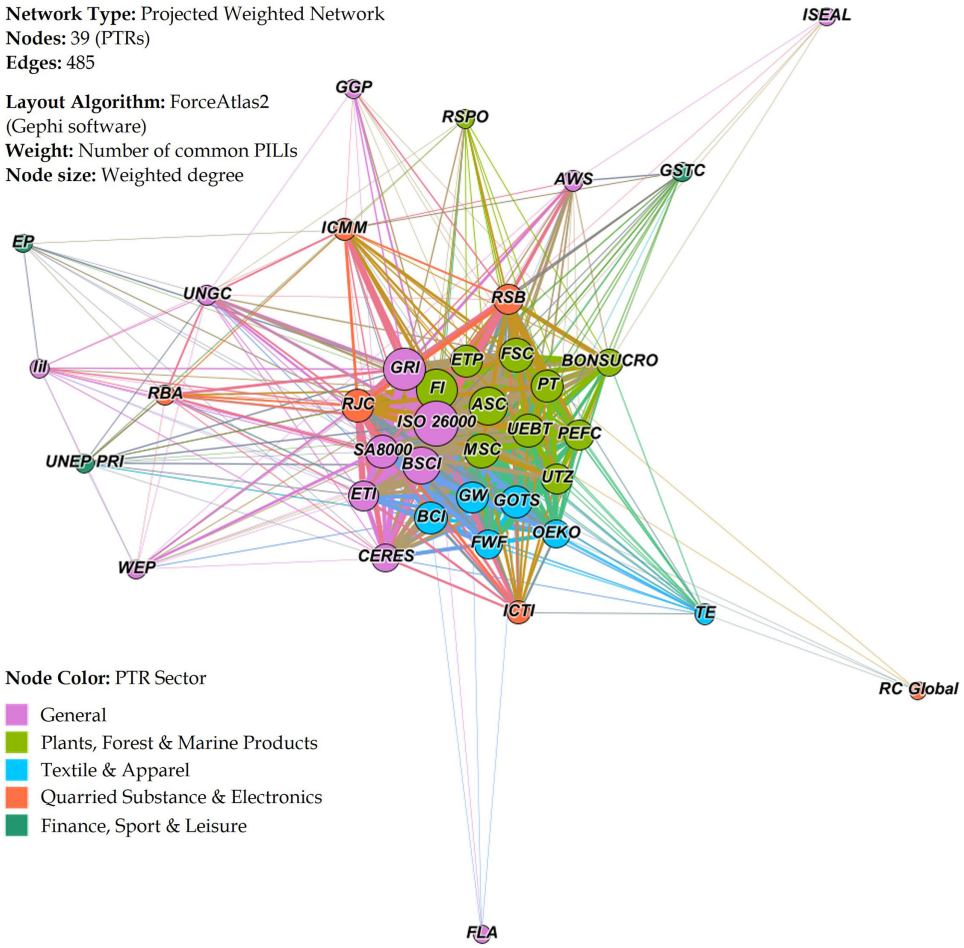


Figure 6. Projected PTR Network

random PTRs in the network cite between 7 to 8 common PILIs. A further indication of the network cohesiveness is the low *average path length*[123] (1.35).

To assess the extent to which the sector attribute influences the connectivity patterns within the network of PTRs, we employed the Louvain modularity clustering algorithm to partition the graph into five distinct clusters.[124] If the intrasector

[123] 'Average path length' is the average distance of all possible shortest paths between any two nodes in the network. Distance refers to the number of edges separating two nodes along the shortest path between them. A smaller average path length indicates more efficient information flow within the network. The minimum value is 1, when every node is connected to all the others. If we randomly select two nodes, the expected distance between them would be the average path length.

[124] V.D. Blondel et al., 'Fast Unfolding of Communities in Large Networks' (2008) 10 *Journal of Statistical Mechanics: Theory and Experiment*, article 10008; R. Lambiotte, J.C. Delvenne & M. Barahona, 'Laplacian Dynamics and Multiscale Modular Structure in Networks' (2008) *arXiv preprint arXiv*, article 0812.1770.

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

connections were substantially stronger than the intersector connections, we would expect the clusters to exhibit a high degree of homogeneity, in which each cluster would consist predominantly of PTRs from a single sector. For instance, all textile-related PTRs (and only those) would be grouped into one cluster. However, the resulting clusters revealed a heterogeneous composition, with a purity level of 56.4% (where a completely heterogeneous cluster is assigned with zero purity and a completely homogeneous one with a purity of 1).[125] For instance, one cluster encompassed 5 textile-related PTRs, 2 PTRs focused on plants, forestry, and marine products, 2 PTRs related to quarried substances or electronics, and 1 PTR with a general scope. This finding suggests that the network's construction transcends sectoral boundaries, with interconnections occurring across diverse sectors.

5. Discussion

Our article makes both theoretical and empirical contributions. Theoretically, we argue that a core aspect of the shift towards hybridity in global governance is the mutual dependence between PTRs and IOs. PTRs invoke formal treaty instruments to ground their authority and secure the normative force of the standards they promulgate, while IOs rely on PTRs as channels for norm diffusion into corporate governance settings. This interdependence emerges as a functional response to the coordination challenges inherent in a non-hierarchical global governance system. This mutual dependence, we argue, is not an isolated phenomenon but part of a broader structural shift in global governance – one that we have termed 'networked constitutionalism' in a related work.[126] Unlike traditional, state-based constitutionalism, which operates through hierarchical authority and centralized enforcement, network-based constitutionalism is horizontal and relies on mutual monitoring and peer accountability, rather than top-down control. We argue that this networked interdependence is an emergent property of the global governance system, reflecting its adaptive capacities.

Empirically, our analysis demonstrates how PTRs strategically leverage the authoritative status of IOs to anchor their rules and reinforce their authority through a dense network of citations.[127] Using network analysis, we captured an emergent feature of this complex regulatory system: a previously undocumented private–public network linking PTRs, PILIs, and IOs. This network appears to have self-organized, without centralized control, into a large connected component characterized by dominant hubs and authorities. Through their substantial and widespread reliance on PILIs, PTRs adapt to the public international legal environment while maintaining

[125] $\text{Purity}(\Omega, C) = \frac{1}{N}\sum_k \max_j |\omega_k \cap c_j|$ where Ω is the set of clusters $\{\omega_1, \omega_2, \ldots \omega_k\}$, $\mathbb{C}$ is the set of classes (sectors) $\{c_1, c_2, \ldots c_k\}$, and N is the number of nodes (PTRs) in the graph. See C.D. Manning, P. Raghavan & H. Schütze, *Introduction to Information Retrieval* (Cambridge University Press, 2008), pp. 356–7.

[126] Perez, n. 18 above; Perez & Stegmann, n. 36 above.

[127] We do not examine the motivations or effects of these citation practices – questions left for future research. Still, their frequency and context lend support to the view that PTRs use them to confer normative authority on their rules.

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institutional autonomy – a dynamic consistent with the notion of adaptation in complexity theory. One of the synergistic effects of this private–public network is enhanced thematic coordination among PTRs, including across sectors, facilitated by the citation of common PILIs. This coordination reduces fragmentation and decentralization within the PTR field, countering conventional assumptions about the disjointed nature of private transnational governance.

Although a comprehensive examination of the dependence of IOs on PTRs lies beyond the scope of this study, our preliminary analysis of three key IOs – the ILO, the UNFCCC, and the CBD – offers tentative support for our argument. Each has taken steps to engage more directly with private actors and appears to rely, to some extent, on private intermediaries to advance its regulatory agenda. A more systematic and in-depth analysis is needed to validate this claim and assess its broader implications. That said, even without further investigation into the deliberate strategies of IOs, our data already supports the view that IOs benefit from the incorporation of their rules into PTR texts, as such incorporation facilitates the diffusion of public norms into corporate practices – advancing IO objectives without direct regulatory control.

The ILO, in 2008, issued detailed guidelines on improving the impact of international labour standards through technical cooperation,[128] and has since expanded its collaboration with the private sector. In an overview of the ILO's public–private partnerships (PPPs), the ILO Director-General at the time, Guy Ryder, outlined the strategy, stating that it 'continues to promote the development of PPPs as an effective and collaborative way of leveraging its values, principles and standards in today's rapidly changing world of work'.[129]

The UNFCCC Secretariat established the Non-state Actor Zone for Climate Action platform (NAZCA), which aims to extend collaboration with the private sector. The platform now includes over 250 cooperative initiatives through which non-state and subnational actors, and in some cases national governments, collaborate across borders to advance climate goals.[130] The UNFCCC Secretariat has recently published a guiding framework on recognition and accountability for non-party stakeholder climate action, which sets the principles of engagement, governance, and data management to ensure greater accountability of voluntary initiatives that operate through NAZCA.[131] Finally, the CBD Secretariat has published a Best Policy Guidance for the integration of biodiversity and ecosystem

[128] ILO, *Improving the Impact of International Labour Standards through Technical Cooperation: A Practice Guide* (ILO, 2008), available at: https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@ed_norm/@normes/documents/publication/wcms_100381.pdf.

[129] ILO, *Public-Private Partnerships for Decent Work: An Alliance for the Future* (ILO, 2016), available at: https://www.ilo.org/pardev/public-private-partnerships/WCMS_239399/lang–en/index.htm.

[130] Global Climate Action NAZCA, 'Cooperative Climate Initiative Tracking', available at: https://climateaction.unfccc.int/Initiatives (as at 12 Jan. 2026).

[131] UNFCCC Secretariat, 'UNFCCC Secretariat Recognition and Accountability Framework for Non-party Stakeholder Climate Action', 4 June 2023, available at: https://unfccc.int/sites/default/files/resource/UNFCCC_Recognition_and_Accountability_Framework_v1_04062023.pdf.

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services in standards,[132] which aims to facilitate further improvements in standards systems with regard to biodiversity and ecosystem service safeguards.[133] In addition, the CBD has established a unique Business Engagement Programme, which seeks to facilitate and encourage private sector engagement with biodiversity issues.[134]

It is important to distinguish our model from the approaches advanced by Abbott and Snidal,[135] and by Marx.[136] Whereas Abbot and Snidal conceptualize orchestration as a deliberate strategy pursued by IOs to steer intermediaries, we argue that the mutual dependence we identify arises organically from uncoordinated interactions between PTRs and IOs. As such, it cannot be fully captured by the orchestration framework. Similarly, whereas Marx contends that VSS and public law evolve into an integrated system of public governance, our analysis emphasizes the networked structure and emergent character of these interactions – features that persist in the absence of centralized coordination or formal institutional integration. This distinction is reinforced by our hub-authority analysis, which reveals a dual coordination structure within the PTR-IO system: a small number of PTRs function as hubs, citing multiple PILIs (such as ISO 26000, GRI, Fairtrade International[137]), while a smaller subset of PILIs act as authoritative nodes, receiving citations from a broad array of PTRs (such as the ILO,[138] Stockholm,[139] and Rotterdam[140] Conventions). This structure suggests a self-organizing dynamic, where key actors from both the PTR and IO domains shape governance interactions without a centralized coordinating authority. Finally, our model conceptualizes citation not as a zero-sum transfer of authority, but rather as a mutualistic relationship, in which both the citing and cited entities benefit from the exchange.

While we have emphasized the positive synergies generated by the mutual dependence between PTRs and IOs, it is equally important to recognize the vulnerabilities inherent in this networked structure. If the treaty framework

[132] CBD Secretariat, 'Best Policy Guidance for the Integration of Biodiversity and Ecosystem Services in Standards', CBD Technical Series No. 73, Oct. 2012, available at: https://www.cbd.int/doc/publications/cbd-ts-73-en.pdf.

[133] Ibid.

[134] CBD, 'Business Collaboration in Achieving the Goals of the Convention of Biological Diversity', available at: https://www.cbd.int/business, and 'Decision VIII/17 Adopted by the Conference of the Parties to the Convention on Biological Diversity at its 8th Meeting', in Curitiba (Brazil), 20–31 Mar. 2006, UN Doc. UNEP/CBD/COP/DEC/VIII/17, 15 June 2006, available at: https://www.cbd.int/doc/decisions/cop-08/cop-08-dec-17-en.pdf.

[135] Abbott & Snidal, n. 13 above.

[136] Marx, n. 20 above.

[137] N. 8 above.

[138] Sources listed at notes (a)–(k) and (n) to Table 4.

[139] Stockholm Convention on Persistent Organic Pollutants, Stockholm (Sweden), 22 May 2001, in force 17 May 2004, available at: https://www.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx.

[140] Rotterdam Convention on Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Rotterdam (The Netherlands), 10 Sept. 1998, in force 24 Feb. 2004, available at: https://www.pic.int/default.aspx.

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

anchoring PTRs continues to erode, as evidenced by actions like the US withdrawal from the Paris Agreement[141] and the World Health Organization, both the perceived authority of PTRs and the compliance pressure exerted by IOs may be significantly weakened, ultimately reducing their regulatory effectiveness. This erosion is already evident in the climate governance arena, where major corporations and financial institutions are increasingly scaling back their commitments. This trend suggests that, in the absence of robust institutional anchors, the PTR-IO dependency may generate a negative feedback loop, further undermining the resilience of the global governance system.[142]

At the same time, the ongoing retreat from treaty-based governance may generate structural shifts in the global regulatory landscape that partially mitigate the decline in intergovernmental capacity. Firstly, the subset of PTRs that succeed in maintaining credibility and market relevance may gain increased influence in addressing complex transnational challenges, such as climate change. As IOs lose institutional power, they may increasingly engage with these resilient PTRs to pursue their mandates – potentially resulting in closer formal collaboration. In this evolving landscape, our projected IO–PTR network could provide a useful tool for identifying 'like-minded' PTRs for strategic partnerships. Secondly, PTRs may increasingly rely on peer recognition and cross-referencing within private networks as a means of normative grounding, rather than on linkages to public international legal instruments – a reversal of the pattern observed in this study. While such a shift could enhance the autonomy and adaptability of private schemes, it also raises concerns about accountability, transparency, and normative compatibility. Thirdly, states themselves may increasingly rely on private regulatory schemes to fill governance gaps, especially in areas where multilateral efforts stall. Jointly, these trends risk further entrenching private regulatory power in ways that may weaken democratic oversight. As such, they call for closer scrutiny – not only of their functional implications, but also of their broader normative and democratic repercussions.

To conclude, we would like to highlight several avenues for further research. Firstly, while we argued that IOs rely on PTRs to extend the reach of their norms, more research is needed to uncover the mechanisms through which IOs leverage the compliance capabilities of PTRs and assess the extent of this phenomenon. This includes examining how IOs select the PTRs with which to engage and how they monitor and evaluate enforcement efforts. Secondly, our study focused on one dimension of the multilayered relationship between PTRs and IOs: the citation network between private standards and public legal instruments. A deeper understanding of these interactions requires exploring additional layers, such as

[141] N. 2 above.

[142] S. Barnes, 'Does ESG Stand a Chance in the Trump 2.0 Era?', *International Banker*, 23 Jan. 2025, available at: https://internationalbanker.com/finance/does-esg-stand-a-chance-in-the-trump-2-0-era; M. Goldberg & D. McGlinchey, 'Five Things to Know About the U.S. Withdrawal from the Paris Agreement: What President Trump's Executive Order Does—And Does Not—Mean for Federal and International Climate Action', Woodwell Climate Research Center, 30 Jan. 2025, available at: https://www.woodwellclimate.org/us-withdrawal-paris-agreement.

https://doi.org/10.1017/S2047102526100260 Published online by Cambridge University Press

organizational ties, financial relationships, and personnel exchanges between PTRs and IOs. Thirdly, a crucial question is why certain PTRs and PILIs emerge as dominant hubs and authorities. Investigating the institutional, political or network attributes that shape these patterns would provide valuable insights into the structural forces driving global governance. Lastly, the evolution of PTR-IO interactions over time remains an open question. Longitudinal studies tracking citation patterns, partnerships, and policy alignments could provide valuable insights into how these relationships develop, stabilize or shift, and thereby shed light on the broader dynamics of the global governance system.

Supplementary material: To view supplementary material for this article, please visit https://doi.org/10.1017/S2047102526100260.

Acknowledgements: Author contribution – OP: Conceptualization, formal analysis, methodology, supervision, writing (original and review); OS: Conceptualization, formal analysis, methodology, data curation, software, visualization, writing (original and review).

Funding statement: Not applicable.

Competing interests: The authors declare none.

Cite this article: O. Perez & O. Stegmann, 'Network Interactions and Mutual Dependence in the Global Sustainability Governance System' (2026) 15(2) *Transnational Environmental Law*, pp. 333–365. https://doi.org/10.1017/S2047102526100260

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