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Sequencing binding and non-binding agreements: the case of outer space governance

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Abstract
Two states can have several bilateral agreements between them, some of which are legally binding and others are not. Is there a discernible pattern to how states structure the chronological sequence of binding and non-binding agreements governing a specific issue area? For example, do states prioritise a framework treaty to establish the foundation of their cooperation and let bureaucrats iron out details in non-binding instruments? Or do they first experiment with low-commitment agreements before eventually settling on a more permanent treaty? This paper explores these questions using the example of space governance, which is characterised by a high number of bilateral agreements. Examining space agreements between 287 state dyads, it argues that a combination of power asymmetry and trust levels influences the likelihood of certain types of sequences of binding and non-binding agreements. These findings are particularly relevant to the literature on informal governance, regime complexes, and space politics.

Keywords: non-binding agreements; outer space governance; regime complex; informal institutions; bilateralism; treaties; international institutions; institutional interactions; space politics

Introduction

Bilateralism is on the rise globally. In fact, several bilateral agreements can unite the same pair of states over the same issue area. For example, the European Union and Vietnam have concluded three agreements on foreign investment since 1995.[1] India and Bhutan have at least five bilateral trade agreements.[2] The United Kingdom and Switzerland have at least seven agreements in force on taxation.[3] Canada and the United States are linked by more than 47 bilateral environmental agreements.[4]

[1]UNCTAD 2024.
[2]Dür, Baccini, and Elsig 2014.
[3]UK Government 2025.
[4]Mitchell et al. 2020.

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Bilateral agreements vary in form, and not all of them are legally binding. This paper examines the sequencing of legally binding and non-binding bilateral agreements. For example, do dyads of states tend to sign a binding framework agreement first and then address the gaps with a series of non-binding bilateral agreements? Or do they first experiment with non-binding agreements before settling on a more permanent bilateral treaty? Exploring these questions reveals the crucial aspect of the temporal dimension in the study of institutional interactions.

In the last two decades, scholars of international institutions have broadened their analytical scope to study institutional complexes made up of multiple, diverse, and interacting institutions.[5] The set of bilateral agreements that unite two states over a given issue area constitutes a form of institutional complex.[6] Negotiators of bilateral agreements can be conceptualised as 'complex designers,'[7] who consider agreements concluded in the past and prepare the ground for those that might be concluded in the future within the same bilateral relationship.[8] Even for talented negotiators, it is nearly impossible to achieve a complete, stable, and optimal bilateral agreement from the very beginning of a cooperative relationship. From the perspective of institutional complex formation, a better understanding of the conditions under which the adoption of one type of agreement (binding or non-binding) can subsequently favour the adoption of an agreement from another type has important implications.

This paper contributes to the literature in three ways. First, it highlights the significance of non-binding intergovernmental agreements (N-BIAs), which have long been neglected by political scientists. Second, it proposes an original typology of four different sequences of binding and non-binding agreements. Third, by examining the case of space governance, it provides evidence that power asymmetry and trust influence the likelihood of certain sequencing types.

Non-binding intergovernmental agreements

Over the past two decades, research has explored the diversity of institutional forms within global governance, moving beyond traditional treaties and intergovernmental organisations. This exploration has uncovered a variety of 'informal institutions'[9] and 'low-cost institutions,'[10] including unwritten norms, public-private partnerships, transnational organisations, and informal organisations. Another form of informal institutions is *N-BIAs*. To date, political scientists have not focused as much on N-BIAs as on other informal institutions.[11] In contrast, legal scholars have thoroughly recognised and documented the growing significance of N-BIAs.[12]

[5]Raustiala and Victor 2004.

[6]It is a unique form of institutional complex due to stable and complete membership overlap. This stability facilitates our analytic focus on the temporal sequences of institutions. That said, a set of bilateral agreements can feature various horizontal (across related issues) as well as vertical linkages (involving different hierarchical levels within state apparatuses). Institutions in a bilateral context can be embedded, nested, overlapping, or clustered, just like in a regional or multilateral context. Young 1996.

[7]Roberts and St John 2022.

[8]Meunier and Morin 2017.

[9]Roger, Snidal, and Vabulas 2023.

[10]Abbott and Faude 2021.

[11]Andonova and Elsig 2012.

[12]Aust 1986; Boyle 1999; Bradley, Goldsmith, and Hathaway 2023; Pauwelyn, Wessel, and Wouters 2012; Pollack and Shaffer 2012; Raustiala 2002; Slaughter 2005.

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We define N-BIAs as cross-border arrangements concluded between public authorities, but that are not components of international public law. As Bradley et al.[13] highlight, 'the difference between a binding and a non-binding agreement is easy to articulate in theory, but distinguishing between the two in practice can be challenging.'[14] A complicating factor in identifying N-BIAs is the variability in their official titles, ranging from 'joint statements' and 'administrative agreements' to 'communications,' 'declarations,' 'regulatory agreements,' 'resolutions,' and 'memorandums of understanding.' In some cases, arrangements that have a denomination that sounds non-binding, such as 'resolutions,' can be binding under international law. This is the case of resolutions of the United Nations Security Council and several resolutions on quotas adopted by regional fisheries management organisations. Some arrangements, like the Paris Agreement on climate change, can be considered as executive agreements by some domestic jurisdictions while still being binding treaties under international law. There are also instances of arrangements for which the concluding parties disagree on their binding status, such as the 2015 Iran nuclear deal.

N-BIAs differ significantly from other forms of informal international institutions. For example, one of the most widely studied informal international institutions is the unwritten norms emerging from intersubjective or power structures.[15] Unlike these norms, N-BIAs are intentionally negotiated and approved by specific parties, and they are typically outlined in a written document. For example, American negotiators meticulously crafted the 1994 memorandum of understanding on nuclear issues with North Korea and the 2014 joint announcement on climate change with China, two N-BIAs of major diplomatic importance.

Moreover, N-BIAs differ from transnational institutions involving private actors, such as public-private partnerships and transnational regulatory organisations.[16] N-BIAs are strictly intergovernmental: they are negotiated and concluded by public authorities. These public authorities include not only government chief executives but also various regulatory or operational agencies that interact directly with their foreign counterparts.[17] Domestic agencies responsible for aviation, for example, frequently sign N-BIAs with their foreign counterparts.

N-BIAs are also distinct from informal organisations. Recent scholarship in global governance has analysed informal intergovernmental organisations like the G7 and the Alliance of Small Island States.[18] In contrast, most N-BIAs are bilateral and do not form collective entities. While the G-7 frequently calls for specific intergovernmental organisations to address particular problems, N-BIAs have limited scope beyond the bilateral relationship of the two states involved.

Furthermore, N-BIAs should not be confused with the broader category of soft law agreements. While agreements are either legally binding or not, they vary in their degree of softness along a continuum. Abbott et al.[19] describe soft law institutions as those scoring relatively low in precision, obligation, or delegation. All N-BIAs are at

[13]Bradley, Goldsmith, and Hathaway 2023, 1291.

[14]Bradley, Goldsmith, and Hathaway 2023 point to the parties' intent and the agreement's objective as a useful indicator of bindingness.

[15]Finnemore and Sikkink 1998.

[16]Abbott, Green, and Keohane 2016; Andonova 2017; Reinsberg and Westerwinter 2021.

[17]Lipson 1991.

[18]Roger and Rowan 2021; Vabulas and Snidal 2013.

[19]Abbott et al. 2000.

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least somewhat soft, due to their limited obligation under international law. Yet, N-BIAs can include detailed commitments and establish enforcement mechanisms.[20] Under this perspective, some N-BIAs can be considered 'harder' than vaguely worded binding treaties, governed by the principle of *pacta sunt servanda.* In short, N-BIAs vary in their degree of 'softness' and not all soft law instruments are N-BIAs.

Like other informal international institutions, N-BIAs are proliferating in global governance. While lacking the prominence of formal treaties, they are more numerous and continue to mushroom.[21] They form 'transgovernmental networks' facilitating cooperation in various areas of global governance.[22] Though not legally binding, N-BIAs shape expectations, influence domestic policy decisions, and guide behaviours.[23] Incentives such as avoiding reputational costs, fear of retaliation, and the benefits of cooperation motivate public actors to comply with N-BIAs.[24] Studies in diverse issue areas, from migration to climate change, have found that states often change their behaviour to comply with N-BIAs.[25]

Three main reasons explain why public authorities often prefer N-BIAs to binding treaties.[26] First, N-BIAs offer efficiency advantages relative to treaties.[27] They are simpler, cheaper, and faster to negotiate due to fewer formalities. They are also easier to revise and withdraw from, providing parties with greater flexibility. This makes N-BIAs particularly attractive when the problem at hand is urgent, uncertain, or unstable.

Second, there are circumstances where enforceability under international law is not desirable.[28] In classic coordination games, when there is no risk of defection, the inherent benefits of cooperation suffice to ensure compliance, and N-BIAs can provide a sufficient institutional framework. Conversely, when the probabilities of unilateral defections are high and parties themselves expect that they will not comply with their commitments, opting for N-BIAs rather than treaties can preserve some legitimacy. This makes N-BIAS an option of choice when compliance is either highly likely or highly unlikely.

Third, domestic political constraints can make N-BIAs more attractive than treaties for public authorities.[29] In particular, N-BIAs enable the circumvention of ratification procedures, preventing technical issues from becoming overly politicised. For this reason, N-BIAs are appealing when treaty ratification requires a parliamentary supermajority, when debates are highly polarised, or when parliamentarians are concerned about sovereignty costs. N-BIAs limit the involvement of veto players and give technical experts more control over the approval process.

Once the specific nature and advantages of an institutional form are identified, it becomes pertinent to explore how it interacts with more traditional international institutions. For example, Stone[30] investigated how written and unwritten rules

[20]Bradley, Goldsmith, and Hathaway 2023.
[21]Ibid.; Raustiala 2005.
[22]Slaughter 2002.
[23]Bach and Newman 2010; Shelton 2008.
[24]Pauwelyn 2014.
[25]Höflinger 2020; Jacquet and Jamieson 2016; Tepper 2024.
[26]Bradley, Goldsmith, and Hathaway 2023; Westerwinter, Abbott, and Biersteker 2021.
[27]Abbott and Faude 2021; Abbott and Snidal 2000; Lipson 1991.
[28]Keohane 1982; Stein 1982.
[29]Roger 2020; 2024.
[30]Stone 2011.

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Table 1. Typology of N-BIAs-treaty sequencing

		Following arrangement	
		Treaties	N-BIAs
Prior arrangement	Treaties	1. Legalising	2. Gap-filling
	N-BIAs	3. Experimenting	4. Breakout layering

operate within intergovernmental organisations, Abbott et al.[31] examined how intergovernmental and transnational organisations affect each other's growth rates, and Roger[32] analysed how formal organisations facilitate the creation of informal organisations. However, these insights have limited applicability for N-BIAs. As predominantly bilateral, intergovernmental, and written agreements, N-BIAs differ significantly from organisations, social norms, or transnational initiatives. The next section theorises on N-BIAs' interactions with binding treaties.

How binding and non-binding agreements succeed one another

How do N-BIAs interact with binding treaties? This question requires clarification, as it can be interpreted in various ways. In the context of this paper, we are not exploring how the introduction of an institution impacts pre-existing institutions. While treaties and N-BIAs may influence each other's interpretation, prominence, and performance, analysing the substantive changes occurring within each institution is beyond the scope of this paper. Instead, we ask whether the adoption of an institution of a given form increases the likelihood of adopting institutions of the same or a different form.

Various configurations are possible. This paper introduces an original typology of four sequences (Table 1). First, treaties can create conditions conducive to the adoption of additional treaties (Box 1 of Table 1). Multiple examples of this can be found in the trade regime. By institutionalising cooperation in one issue area, such as tariff reduction, treaties generate demand for further cooperation in related areas, such as non-tariff barriers to trade, services, and subsidies. Multiple regional trade agreements have generated such a spillover effect.[33] Treaties also facilitate the negotiation of subsequent treaties by lowering transaction costs and providing insights into the preferences and reliability of other countries.[34] Domestically, interest groups that benefit from cooperation grow stronger and become more influential in advocating for additional treaties. Such dynamics promote a trend towards increasing legalisation.[35] The development of the European Union since the Treaty of Rome in 1957 serves as a quintessential example of this progressive accumulation of treaties.[36]

Second, treaties can facilitate the proliferation of N-BIAs (Box 2 of Table 1). Certain binding treaties provide the institutional foundation for the development of

[31]Abbott, Green, and Keohane 2016.
[32]Roger 2022.
[33]Haas 1964.
[34]Keohane 1982.
[35]Abbott et al. 2000.
[36]Stone Sweet, Sandholtz, and Fligstein 2001.

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more specialised N-BIAs.[37] They establish general principles, define key rules, and create a broad institutional framework, but leave the specifics to be ironed out by technical experts in subordinate N-BIAs. Sometimes, treaty negotiators fail to resolve crucial issues, leading to N-BIAs filling these gaps.[38] Following a World Trade Organization (WTO) dispute over U.S. trade policies regarding the imports of shrimps – regarded as a protectionist barrier disguised as an environmental measure to protect sea turtles – the United States negotiated a detailed N-BIA with 35 countries on the protection of marine turtles as a way to soften trade tensions.[39] In other cases, the rigidity of treaties renders them incapable of adapting to evolving geopolitical contexts or new technologies.[40] In such scenarios, when treaties are at risk of becoming 'zombie institutions,'[41] more adaptable and agile N-BIAs can orient cooperation in new directions. An example of this is the surge in N-BIAs governing global value chains, as the WTO and its formal treaties increasingly appear outdated and disconnected from the current political landscape.[42]

Third, N-BIAs can pave the way for the adoption of binding treaties (Box 3 of Table 1). They can serve as institutional laboratories, allowing for the experimentation of new commitments at low risk.[43] This is particularly likely in emerging issue areas when there is no template treaty available and when the appropriate direction remains unclear. N-BIAs can foster consensus or build trust, which, if successful, could lead to formalisation into a treaty. This pattern is often observed in environmental diplomacy, where the process typically begins with the adoption of a declaration outlining general principles and objectives, eventually leading to a convention in subsequent years.[44] Another example is the conclusion of a memorandum of understanding between the United States and the Soviet Union to exchange data on the number of weapons on both sides, which pave the way for the negotiations of a treaty on the limitation of strategic offensive arms in 1979.

The fourth and last scenario posits that N-BIAs lead to the creation of more N-BIAs (Box 4 of Table 1). Hofmann and Yeo[45] argue that low-cost institutions 'enable a rapid process of 'breakout layering,' resulting in a high density of mostly informal institutions.' A high density of N-BIAs allows public authorities to attain a level of institutional sophistication, mobilisation, and cohesion comparable to that of a treaty, but with reduced risks and less opposition. This is analogous to a rope composed of several intertwined thin strings being stronger and more resilient than a single metallic tube. This is particularly attractive when governing new technologies or facing political resistance. Under this BREAKOUT LAYERING logic, state cooperation is characterised by multiple N-BIAs and few treaties, as the Asian security complex exemplifies.[46]

[37]Bradley, Goldsmith, and Hathaway 2023; Roger 2022; Tieku 2019.
[38]Pollack and Shaffer 2012.
[39]Shaffer 2004.
[40]Hageman, Huddleston, and Thierer 2018; Patrick 2015.
[41]Gray 2018.
[42]Pauwelyn 2014.
[43]Bradley, Goldsmith, and Hathaway 2023; Raustiala 2002; Shelton 2008; Tieku 2019.
[44]Gehring 2008.
[45]Hofmann and Yeo 2024.
[46] Ibid.

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Explaining sequencing types

What conditions favour the occurrence of each of these four sequencing types? The previous section has pointed to certain problem structures – such as institutions generating externalities or issue areas marked by intense polarisation – that may predispose towards a particular sequence of N-BIAs and binding treaties. In this paper, we instead investigate how the types of dyadic relationships shape the likelihood of certain sequences.

More specifically, we argue that power asymmetry and trust among partners play a crucial role in explaining the sequencing of treaties and N-BIAs. We expect that more powerful states prefer to formalise their agreements as binding treaties rather than N-BIAs when dealing with less powerful states. Whether a treaty or an N-BIA, negotiated agreements tend to reflect the preferences of the most powerful state.[47] A treaty offers to the most powerful state the extra benefit of increased likelihood that the less powerful state will comply with its preferences.

Other scholars have argued that in the context of international organisations, powerful states benefit from informal governance, while weaker states prefer formal rules.[48] However, this perspective is generally limited to multilateral frameworks where weaker states can form coalitions to extract concessions from powerful states. Moreover, the creation of a collective decision-making body or the delegation of governance functions to a secretariat might cause powerful states to fear losing control over cooperation outcomes.[49] In contrast, within bilateral settings, power asymmetry clearly favours the most powerful player and joint institutions rarely reduce the control exerted by the most powerful state once an agreement is concluded.

We expect trust to be another dyadic variable impacting the sequences of N-BIAs and treaties. For example, one would not expect the European Union to institutionalise its cooperation with Russia as it would with Canada, even though the two countries have similar GDP levels.[50] We anticipate that parties with mutual trust are more inclined than distrustful partners to formalise their agreement in treaties. Given their binding nature, treaties are a rigid form of cooperation and may lead to unexpected consequences over time. Parties that trust one another can be confident in their ability to address future challenges based on their past interactions and the horizon of their future relationship. Conversely, distrustful parties may fear potential exploitation by the other side under the terms of the treaty.

Combining power asymmetry and trust leads to four types of dyadic relations, and we expect that each makes a particular sequencing more likely (see Table 2). First, we hypothesise that a relationship characterised by high-power asymmetry and high trust facilitates legalisation through a succession of treaties. This is the type of relationship that characterises dyads such as France-Belgium, Russia-Serbia, and the United States-Canada. High-power asymmetry makes the more powerful party more inclined to propose a treaty as the initial form of cooperation, while high trust makes the less powerful party more likely to accept this proposal. This high degree of institutional cooperation is likely to generate spillover effects and increase the

[47]Drezner 2009.
[48]Eilstrup-Sangiovanni 2016; Stone 2011; Vabulas and Snidal 2013.
[49]Morin, Tremblay-Auger, and Peacock 2022.
[50]Kydd 2007.

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Table 2. Hypothesis linking the type of partnership to the types of N-BIAs-treaty sequencing

		Power asymmetry	
		High	Low
Trust	High	1. LEGALISING	2. GAP-FILLING
	Low	3. EXPERIMENTING	4. BREAKOUT LAYERING

demand for more treaties. An example of this pattern is the cooperation between the United States and Canada over water. Despite the United States being a party to relatively few multilateral environmental agreements, it signed with Canada (represented by the United Kingdom) one of the early treaties on shared water in 1909 and has since concluded multiple treaties with Canada related to water quality and management, all connected to the original 1909 treaty.

We hypothesise that a condition of high trust combined with low asymmetry favours the sequence of treaties and N-BIAs that we call 'GAP FILLING.' A high degree of trust enables governments to intentionally leave technical issues to be resolved by bureaucrats from both sides, without excessive concerns that one party will exercise overly influence of the outcome. For example, since New Zealand and Singapore concluded their trade treaty in 2001, the two countries have signed multiple related N-BIAs, covering areas such as business development, food safety, cybersecurity, border procedures, scientific cooperation, and work permits.

We hypothesise that conditions of low trust but high asymmetry favour the 'EXPERIMENTING' sequence type. Initially, it might be challenging for parties that distrust each other to conclude a comprehensive treaty. Instead, N-BIAs can serve to gradually build trust and create the conditions for a successful treaty. Power asymmetry increases the probability that the most powerful party will eventually insist on concluding a treaty that reflects its preferences. The relationship between the People's Republic of China and the Republic of Korea over trade provides a good example. The two governments only established diplomatic relations in 1992, as the former previously recognised only North Korea, while the latter recognised only Taiwan. In the following decades, the two governments signed multiple N-BIAs, strengthening their ties from a 'friendly cooperative relation' in 1992, to a 'collaborative partnership' in 1998, a 'comprehensive cooperative partnership' in 2003, a 'strategic cooperation partnership' in 2008, and an 'enriched strategic operative partnership' in 2014, culminating with a bilateral free trade treaty in 2015.

We hypothesise that low trust and low asymmetry favour the accumulation of N-BIAs (BREAKOUT LAYERING). When rival states not only distrust each other but are also of roughly the same power level, no amount of cooperation with N-BIAs may overcome their distrust, and neither party wants to concede to the preferences of the other. An example might be the Conference on Security and Cooperation in Europe (CSCE), which managed the relationships between the U.S.-led NATO and the Soviet-led Warsaw Pact through a series of N-BIAs. These N-BIAs include the 1975 Helsinki Final Act, the 1978 Belgrade Declaration, the 1980 Madrid Declaration, the 1989 Vienna Declaration, and the 1990 Charter of Paris for a New Europe. Non-legally binding initiatives conducted under the CSCE, including its Council of Ministers and Committee of Senior Officials, addressed a wide range of issues, from scientific cooperation to human rights, migrant workers, environmental protection,

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cultural exchange, and freedom of the press. Despite certain successes, none of these initiatives turned into a legally binding treaty.

Of course, each of these four dyadic types is likely to include elements from the four sequencing types. It is also possible that one particular sequencing type predominates across all dyadic types. Our argument is that some sequencing types are more likely under certain dyadic conditions than under other dyadic conditions.

In practice, identifying specific sequencing types can be challenging, as numerous pairs of states have accumulated a long series of interrelated treaties and N-BIAs. To address this problem, the remainder of this paper focuses on space governance. Focusing on one issue area allows us to eliminate some issue-specific explanations, such as the degree of scientific uncertainty or public polarisation. Additionally, since space activities are not one of the main sources of power resources or a conventional means of building interstate trust, it reduces the risk of endogeneity. The following section presents our dataset on space treaties and N-BIAs.

Space treaties and NBIAs

The bedrock of global space governance consists of multilateral instruments, including legally binding treaties and N-BIAs. A pioneering multilateral N-BIA was the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, adopted by the United Nations General Assembly in December 1963. This declaration established nine principles that laid the normative foundation for four pivotal multilateral space treaties: the 1967 Outer Space Treaty, the 1968 Agreement on the Rescue of Astronauts, the 1972 Convention on International Liability for Damage Caused by Space Objects, and the 1975 Convention on the Registration of Objects Launched into Outer Space.[51] This process may represent one of the earliest occurrences of an 'experimentation' sequence between a foundational N-BIA and a series of treaties within the field of space governance.

Over the last 50 years, reaching a multilateral consensus on space issues has become increasingly difficult. The 1979 Moon Agreement has attracted only 17 parties, primarily developing countries with limited space capabilities. Since then, proposals for new multilateral space treaties, such as China's suggestion for a space arms control treaty, have failed to gain sufficient support to initiate negotiations. Instead, the last 50 years of multilateral space diplomacy have been focused on a few N-BIAs, such as the 1986 Principles on Remote Sensing, the 2005 Resolution on the Application of the Concept of the Launching State, and the 2007 Space Debris Mitigation Guidelines.[52] These N-BIAs are examples of the GAP-FILLING sequence, as they clarified important aspects left ambiguous in multilateral treaties adopted in the 1960s and 1970s. While not legally binding, they have been implemented in multiple domestic space laws and influence states' behaviours.[53] However, even reaching new N-BIAs at the multilateral level is becoming increasingly challenging due to intensifying geopolitical rivalry among spacefaring nations.[54] This adverse context leaves several crucial issues, such as the use of space resources, space debris

[51]Tronchetti 2011.
[52]Martinez 2019; Tepper 2024.
[53]Tronchetti 2011.
[54]Tepper 2024.

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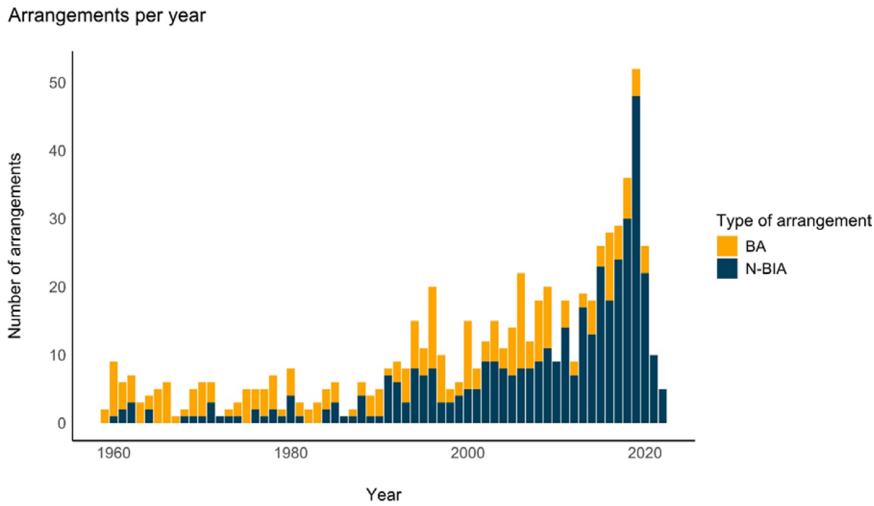


Figure 1. Arrangements per year.

removal, and the ban on anti-satellite missiles, inadequately regulated at the multilateral level, whether by treaties or N-BIAs.

As multilateral agreements become elusive, states have been increasingly pivoting towards bilateral initiatives. The most notable among these is the Artemis Accords, a series of bilateral N-BIAs concluded by the United States with 37 partners.[55] The Artemis Accords have garnered significant attention due to the ambitious goals of NASA's Artemis Program and controversial provisions regarding the use of space natural resources and the involvement of private actors. However, they represent just a tree – admittedly an important one – that conceals a forest of bilateral treaties and N-BIAs.

As Figure 1 illustrates, bilateral arrangements governing space activities have proliferated rapidly since the 1990s. This figure is based on the catalogue of space arrangements introduced by Morin and Tepper.[56] We excluded contracts involving private companies and guidelines followed by unidentified actors to focus exclusively on bilateral intergovernmental space arrangements, including both treaties and N-BIAs. These arrangements address a broad spectrum of issues, from facilitating intern mobility to establishing comprehensive frameworks for the launch of spacecraft. In total, we identified 564 bilateral space arrangements, involving 90 countries in 252 dyads. Most of these arrangements have been concluded in recent years, lending support to Tepper's claim that global space governance is undergoing a 'big bang' of arrangements, expanding beyond traditional multilateral space forums.[57]

Figure 1 also reveals that an increasing share of bilateral arrangements are N-BIAs instead of binding treaties.[58] While the number of new bilateral treaties has remained

[55]Byers and Boley 2023.

[56]Morin and Tepper 2023. See also Morin and Couette 2025. The dataset is available at www.institutions.space.

[57]Tepper 2022.

[58]The distinction between binding and non-binding arrangements is not universally agreed upon. For analytical purposes, we used three main criteria as suggested by Raustiala 2005: legality, substance, and structure. We examined whether there was an intent to create an obligation in the form, vocabulary, and

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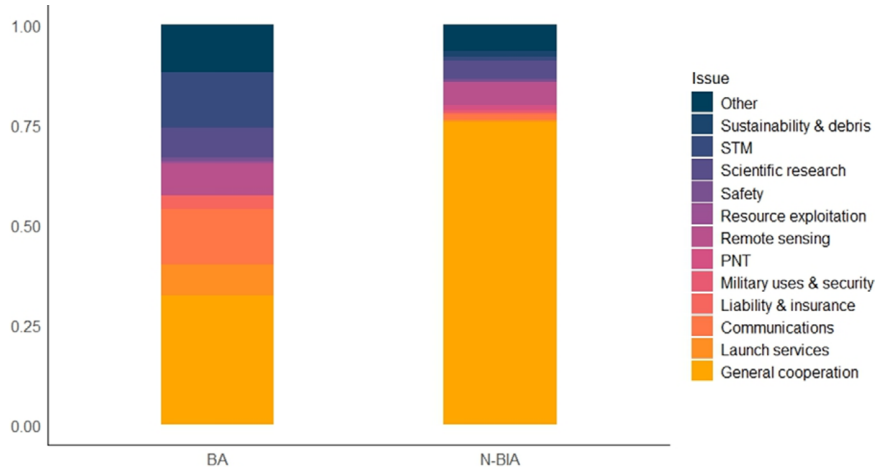


Figure 2. Issue per type of arrangement, in percentage.

roughly stable over time, bilateral N-BIAs first increased in the 1990s and then exploded in the 2010s, reaching a peak of 48 new N-BIAs concluded in 2019 alone. N-BIAs clearly appear as the preferred mode of formalising bilateral cooperation.[59]

Figure 2 shows that treaties and N-BIAs also differ in the distribution of issues they cover. The vast majority of N-BIAs establish a general cooperation between two states or two governmental agencies. In contrast, most treaties focus on specific issues, such as traffic management, scientific research, safety issues, positioning, navigation and timing systems, liability, or launch services. Only a few specific issues, including the management of space debris and the military use of outer space, are more represented in percentage points in the distribution of N-BIAs than in treaties.

Many dyads employ a combination of treaties and N-BIAs to formalise their cooperation, often in alternating sequences. This is notably the case of dyads involving the most active spacefaring states, which also tend to conclude more arrangements than others. The next section explores whether particular patterns of treaties and N-BIAs succession are related to the level of power asymmetry and trust between the involved parties.

Power asymmetry, trust, and agreement sequences

We argue that power asymmetry and trust between two states contribute to explaining the sequencing of their treaties and N-BIAs. The processes of LEGALISING, GAP-FILLING, EXPERIMENTING, and BREAKOUT LAYERING do not necessarily occur between two arrangements that immediately succeed each other. Therefore, to categorise the processes that likely led to a new arrangement within a dyadic relationship, we consider any prior arrangement concluded by the same two states.

formal registration process of the instrument (legality). We assessed the depth of the arrangement, focusing on the extent to which states commit to the project (substance). Additionally, we analysed the rules and procedures for monitoring parties' performances and the mechanisms for enforcing them (structure).

[59]Soucek 2018; Tronchetti 2011.

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For example, a dyad with three arrangements would yield three sequences: between agreements #1 and #2, between #2 and #3, and between #1 and #3. Dyads with only one arrangement were omitted from our analysis.[60] From an initial dataset comprising 564 bilateral arrangements across 252 dyads, we retained 402 arrangements that are part of a sequence of at least two arrangements, involving 90 dyads. This resulted in a total of 728 sequences of arrangements concluded by the same parties.

To measure power asymmetry between each dyad, we look at their GDP levels. Despite their limitations, GDP-based measures are widely used proxies for various dimensions of power.[61] We opt for total GDP over GDP per capita because, as Dinar et al. point out, 'the ratio of total GDP (GDP ratio) reflects overall power asymmetry, or economic power, whereas the ratio of GDP per capita (GDP per capita ratio) indicates wealth asymmetry or welfare power.'[62] Given that economic power is more relevant than welfare power in explaining the outcome of international negotiations, we concentrate on the former metric. We sourced GDP data (in constant 2015 USD) from the World Bank, spanning from 1957 to 2022 – a timeframe that encompasses the conclusion of all arrangements in our dataset.[63] To quantify asymmetry within a dyad, we divide the average GDP of the most powerful state by that of the least powerful state over the given time period.

Among all the 90 dyads analysed, the average asymmetry ratio is 8.04. The dyad with the highest level of asymmetry is the United States and Senegal, with a GDP ratio of 436.99. In contrast, the dyad with the least asymmetric relationship is Brazil and Russia, with a ratio of 1.12. In general, dyads with high levels of asymmetry tend to engage in fewer arrangements than their more symmetric counterparts. Moreover, in line with our expectations, highly asymmetric dyads conclude a greater proportion of their arrangements as treaties relative to N-BIAs. Up to 37.4% of the arrangements concluded in the quartile with the highest degree of asymmetry are treaties, as opposed to only 30.9% in the quartile with the lowest level of asymmetry.

We used the formal alliance dataset version 4.1 from the Correlates of War (CoW) database to measure trust.[64] Specifically, we used the defence pact category (Type I) of the database, which includes states that 'commit to intervene militarily on the side of any treaty partner that is attacked.'[65] This category represents the highest level of commitment, indicating significant trust and shared values. Additionally, this indicator remains relatively stable over time and is valid outside the space realm.

Trust was assessed at the date of the arrangement's conclusion, using yearly dyadic data provided by the CoW database. Since version 4.1 stops at 2012, we used the latest available data for arrangements made after that year. We identified 22 dyads as high-trust partnerships, characterised by one or more active defence pacts. In contrast, 68 dyads lacked a defence pact, indicating a low or moderate level of trust between them.

[60]A total of 160 arrangements are not part of a sequence. Among those, a large majority (56.1%) were concluded by a dyad displaying low-trust, high-asymmetry characteristics.

[61]Beckley 2018.

[62]Dinar et al. 2015, 61.

[63]When GDP data were not available for a given year, we calculated the mean GDP on the basis of available data.

[64]Gibler 2009.

[65]Ibid., lvii.

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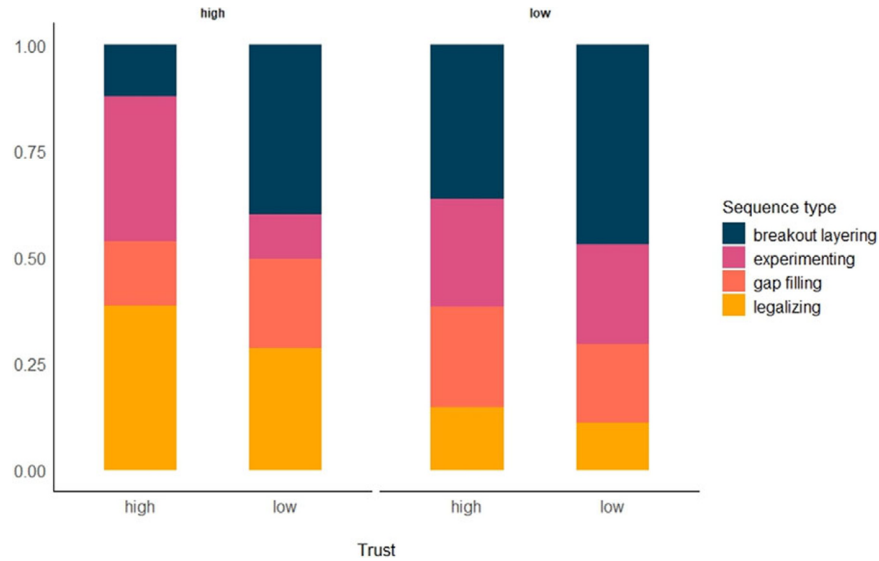


Figure 3. Type of sequence per power asymmetry and trust level.

Figure 3 categorises dyads into four groups based on power asymmetry and trust. Dyads with asymmetry levels below the median are classified as having low asymmetry, while those above the median are classified as high asymmetry. Our analysis reveals that most dyads from each of the four categories participate in all four types of sequences. However, their participation varies according to the nature of the dyadic relationship. This variance in distribution lends support to several hypotheses outlined in Table 2. We added in the Appendix the results of a multinomial logistic regression performed to test the validity of the results displayed below.

We performed a similar analysis for sequences where arrangements explicitly quote a previous one within a dyad. Without surprises in that case, we have a much lower number of sequences (317) and dyads (43). The results are presented in Figure 4. Under these conditions, we can also observe significant variability according to the nature of the dyadic relationship, lending further support to our hypotheses displayed in Table 2.[66]

A dyad with a high level of asymmetry and a high level of trust is more likely to engage in a LEGALISING sequence than any other type of dyad. In this type of dyad, LEGALISING sequences represent 38.6% of the total number of sequences, which is significantly more than other types of sequences. Moreover, most occurrences (52.12%) of LEGALISING sequences are found under conditions of high trust and high

[66]To further consolidate our results, we also performed a chi-square test that suggested a highly significant association between consecutive agreement types ($\chi^2 = 44.423$, df = 1, $p < 0.001$), indicating strong sequential dependencies in negotiation patterns. The standardised residuals show pronounced persistence effects: BAs are followed by another BA 63.2% of the time, while NBIAs are followed by other NBIAs 64.9% of the time. Both transition patterns exhibit strong positive residuals (+6.75), while cross-type transitions (BA → NBIA and NBIA → BA) show equally strong negative residuals (−6.75), occurring only about 35%–37% of the time. The observed distribution then differs significantly from what would be expected under independence, thus giving weight to our theoretical argument.

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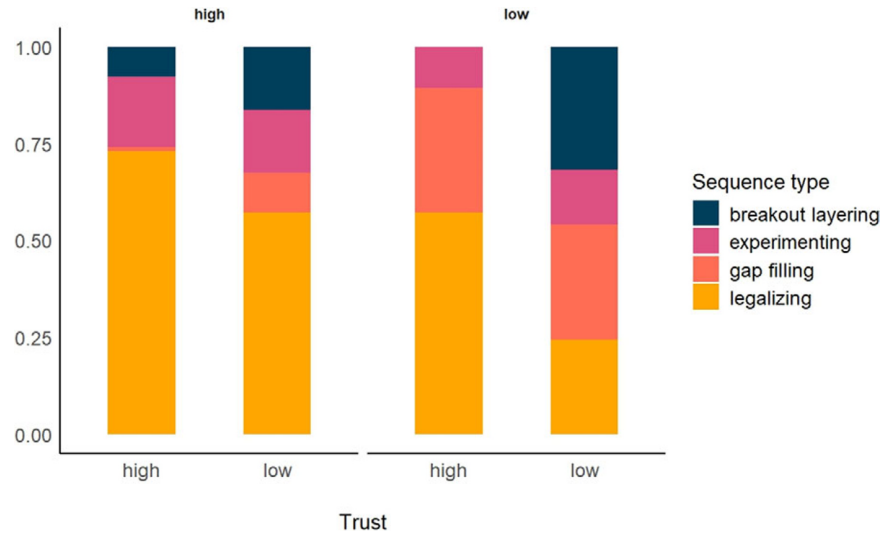


Figure 4. Type of sequence with citation per power asymmetry and trust level.

asymmetry relative to other types of dyads. In this context, binding agreements often build on one another. Looking at Figure 4, we can see that LEGALISATION clearly dominates when the dyad displays high trust and high asymmetry, representing 73% of the sequences in that configuration. This is in line with our hypothesis: when partners trust each other, they are more likely to build a relationship based on a succession of treaties. This also informs us further on the dynamics of the legalising sequence, suggesting that binding agreements tend to pave the way for more binding agreements when partners are highly asymmetrical but highly trust each other, more than in any other type of configuration.

An interesting example can be found in arrangements concluded between Mexico and the United States in the 1960s. Both parties signed a first agreement in 1960 to establish a space vehicle tracking facility as part of the Project Mercury. Five years later, a new agreement was reached, recognising the success of this initial cooperation and proposing to expand it, in three new specific scientific programs, focusing on meteorological soundings by scientific rockets, the establishment and operation of a station in Mexico to receive automatic transmission from meteorological satellites and participation by Mexican scientists in a Remote Sensing Project developed by NASA, respectively.

In other cases, LEGALISING sequences display arrangements that are independent from each other, each focusing on a specific project or area of cooperation. For instance, Argentina and the United States engaged in a LEGALISING sequence from 1962 to 2011, with three binding arrangements dedicated to distinct projects concerning detection and transmission stations. This sequence culminated in 2011 with the signing of a framework agreement. The preamble of the said agreement acknowledges both the long and fruitful cooperation resulting from previous arrangements and the desirability of enhanced cooperation between the two governments. Following this framework agreement, the sequence transitions towards a BREAKOUT LAYERING one, and no new binding agreements were signed between Argentina

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and the United States. In both the Mexican and the Argentinean cases, cooperation started as part of a U.S.-led project, where power asymmetry and trust relationship benefited primarily the United States, and the success of these initial projects created favourable conditions for further cooperation in the form of binding agreements.

The distribution of the GAP-FILLING sequences shows a less distinct pattern. It is most frequently seen in dyads with low asymmetry, whether states are part of the same alliance (25.7% of sequences) or not (33% of sequences). Looking at sequences where arrangements quote a previous one, we can see that, as hypothesised, GAP-FILLING tends to dominate when asymmetry is low between partners (89%). When asymmetry is low and trust is high, GAP-FILLING sequences represent 32% of the total, which is more than in any other type of configuration. It is notable that this type of sequence is almost absent when asymmetry is high, and suggests a contrasting dynamic compared to LEGALISING: in low asymmetry settings, an initial treaty tends rather to pave the way for a succession of N-BIAs.

An illustrative example of this pattern is observed in the succession of agreements between France and the United States. In 2007, these two NATO powers signed a framework agreement, followed by two specific N-BIAs in 2008 and 2015. These N-BIAs, between the National Oceanic and Atmospheric Administration and the *Centre National d'Études Spatiales*, pertain to satellite-based environmental data and proved to be a flexible and expeditious form of cooperation. Notably, the 2015 N-BIA highlights an 'urgent need' for collaboration on this matter, to ensure continuity of service of the COSPAS-SARSAT system of which both France and the United States are founding members. This example shows that dyads with a high level of trust can engage in swift coordination and utilise existing cooperative relations through flexible instruments.

A similar example can be found by looking at the relationship of cooperation between Brazil and China. Both parties have established a strong partnership in the space sector, signing 14 arrangements between 1988 and 2015. This series of agreements includes several GAP-FILLING sequences. It begins with a protocol for joint research and production of a Sino-Brazilian satellite. A few months later, an N-BIA specifies the modalities of cooperation between the two countries and their respective space agencies. In 1996, another N-BIA further details the goals of cooperation on this joint satellite. In both the U.S.-France and the China-Brazil cases, GAP-FILLING sequences occur in the context of well-established cooperative relationships that go well beyond the space realm. The combination of high trust and low asymmetry seems to favour these flexible instruments, allowing these space-faring nations to address issues requiring rapid cooperation and coordinate activities towards a shared goal.

BREAKOUT LAYERING is an interesting type of sequence. It is significantly more frequent when trust is low than when it is high (21.8% compared to 11.2% of sequences). Asymmetry seems to play less of a role, as shown in Figure 3. Yet, most occurrences of the BREAKOUT LAYERING sequence (48.3%) are found in dyads characterised by low trust and low asymmetry levels relative to the three other dyad types.

Since a growing share of space arrangements are N-BIAs, it is not surprising that BREAKOUT LAYERING jumps from 25.3% of sequences pre-2010 to 47.2% of sequences post-2010. However, most dyads continue to use a combination of sequences, even in recent years. Prior to 2010, BREAKOUT LAYERING sequences represented 50.4% of the sequences under low trust and low asymmetry, compared to 10% of the sequences in

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contexts of high trust and high asymmetry. Post-2010, the gap remains wide as BREAKOUT LAYERING sequences represent 46.2% of sequences for dyads characterised by low trust and low asymmetry, compared to 12.6% of the sequences for dyads characterised by high trust and high asymmetry. States with little trust for each other conclude fewer arrangements between them than states united by a security pact, and they are particularly less likely to include a binding treaty in their mix of bilateral arrangements.

Looking at sequences with citations, BREAKOUT LAYERING is more frequent (31.9%) when dyads display low trust and low asymmetry compared to 7.7% in a high-trust high-asymmetry configuration. This is in line with the logic of the sequence, where no amount of cooperation through N-BIAs can overcome the distrust between partners. In that case, if cooperation is needed, the preferred form seems to be through N-BIAs.

An example of BREAKOUT LAYERING is the space cooperation between Russia and the United States in the aftermath of the Cold War. In 1992, the two superpowers signed an N-BIA referencing the Outer Space Treaty and expressing satisfaction with this existing cooperation. This agreement remains quite general, outlining the fundamental terms of their partnership. Subsequently, in 1993, they issued a joint statement specifically addressing cooperation in space research, thus broadening the scope of their collaboration. The statement highlighted both countries' recognition of the value of occasional joint activities and their commitment to expanding scientific cooperation. During this period, both the United States and Russia were actively involved in space activities and acknowledged the necessity of coordination in this domain. Their bilateral relationship was marked by a series of N-BIAs to build trust and acknowledge the necessity of cooperation in space. We see here how N-BIAs can be used as building blocks to establish a functional relationship of cooperation without having to make legally binding commitments.

Another BREAKOUT LAYERING sequence is observed between China and India, with three N-BIAs signed between 1991 and 2014. The first agreement, signed between governments, outlines conditions for cooperation. Two subsequent agreements, concluded between the countries' respective space agencies, expand and specify the terms of cooperation in 2002 and 2014. The first one identifies general areas for potential cooperation, while the 2014 one defines specific areas such as research and development of satellites, or launch, tracking, and control services. It also further clarifies the methods of cooperation, for example, about the exchange of personnel and data. This N-BIA explicitly states in its preamble that it builds on the successful cooperation established since 1991. This accumulation of N-BIAs serves as another example of the dynamics of a BREAKOUT LAYERING sequence, where partners benefit from cooperation and gradually expand and specify their collaboration while avoiding firm commitments.

EXPERIMENTING also represents an interesting dynamic. Contrary to our expectations, it is not particularly frequent in situations of high asymmetry and low trust. When it comes to sequences with citations, EXPERIMENTING does not seem to display a distinct pattern based on the types of dyads. There are, nevertheless, a few empirical cases that align with our theoretical expectations. Cooperation between Argentina and Ukraine provides an interesting example. In 1995, both countries signed a declaration of interest in space cooperation, simply stating that cooperation would benefit both parties. In 2006, the signing of a framework agreement marked the conclusion of the negotiations that began following the initial N-BIA. The treaty formalises ideas contained in the declaration of intent, for the benefit of both parties.

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In some cases, an initial EXPERIMENTATION phase paved the way for a LEGALISING sequence. An example emerges from the agreements between Brazil and the United States. Initially, a memorandum of understanding (MoU) was signed between the two countries in 1965. This was followed by a binding agreement in 1979 predicated on the 'close cooperation that has been established in this area.'[67] The treaty served to formalise the provisions of the initial MoU, indicating that the cooperation was considered sufficiently effective to warrant a formal treaty. A comprehensive framework agreement signed in 2011 further strengthened the relationship. The sequence of arrangements between Australia and the United States also demonstrates this complementarity between EXPERIMENTING and LEGALISING sequences. The two states signed 27 arrangements between 1960 and 2019, with sequences mainly alternating between EXPERIMENTING and LEGALISING. In this case, N-BIAs typically focus on new areas of cooperation and binding agreements subsequently formalise successful areas of cooperation.

Conclusion

This paper draws attention to the role of bilateral agreements, and particularly N-BIAs, in global governance. N-BIAs are one of the most frequent – if not the most frequent – forms of international institutions. Yet, they have been largely overlooked by political scientists. Most of the literature on informal institutions focuses on multilateral institutions. Investigating the specific role of N-BIAs is important as state interactions differ substantially in bilateral settings. In particular, there are good reasons to believe that powerful states prefer legally binding agreements when negotiating bilaterally with weaker players, even when they favour informal mechanisms at the multilateral level. This implies that arguments developed from the study of multilateral institutions are unlikely to directly apply to the study of bilateral ones.

A central argument of this paper is that N-BIAs do not exist in isolation. They are almost always part of sequences of bilateral agreements, which include other N-BIAs and binding agreements. More specifically, this paper argues that power asymmetry and trust interact to explain the sequence of legally binding and non-legally binding agreements in a dyadic setting. Our research suggests that dyads characterised by high-power asymmetry and high trust are more likely to initiate a LEGALISING sequence and accumulate treaties compared to other types of dyads. Settings characterised by low asymmetry are conducive to GAP-FILLING sequences, in which a treaty is followed by N-BIAs. Conversely, BREAKOUT LAYERING, or the accumulation of N-BIAs without a preceding treaty, is frequently observed under conditions of low trust. EXPERIMENTING with N-BIAs is a strategy often employed in contexts of low trust. However, our findings indicate that the interaction of power asymmetry and trust does not significantly explain why dyads opt for this sequence.

These findings have implications beyond the realm of space politics. Multiple areas of global governance, including trade, security, investment, the environment,

[67]Exchange of notes constituting an agreement concerning sounding rockets and balloons for space research (with memorandum of understanding). Brasilia, 14 November 1978 and 24 January 1979, United Nations, New York (UN Treaty Series Vol. 1871, 520–8).

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and taxation, are primarily governed by bilateral agreements. Moreover, an increasing number of these agreements are N-BIAs. However, scholars of global governance have largely overlooked bilateralism in favour of multilateralism. Theories that exclusively focus on multilateral organisations are insufficient for explaining the dynamic evolution of governance systems. States exhibit different preferences and behaviours in bilateral contexts, including in relation to the institutional form of cooperation. A deeper understanding of these nuances is critical, as institutional complexity largely emerges from bilateral agreements.

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Appendix

We performed a multinomial logistic regression to verify that trust and power asymmetry were significant variables. We used the nnet package version 7.3-19,[68] in R version 4.3.3.

In the formula used, we specified that the type of sequence was our dependent variable and tested the effect of power asymmetry, shared membership in a military alliance (trust), the involvement of the United States in the bilateral arrangement, and the decade on the type of sequence. A reference variable was arbitrarily assigned to the EXPERIMENTING sequence.

To test the overall effect of variables in our model, we used a likelihood ratio test, and the results are displayed below:

- *LR Chisq*: Likelihood Ratio Chi-Square. Measures the goodness of fit of the model by comparing a reduced model (without certain explanatory variables) with the full model (with all the explanatory variables).
- *Df*: Degree of Freedom. Number of values free to vary.
- *Pr(>Chisq)*: *p*-value associated with the chi-square statistic.

The multinomial logistic regression analysis (Table A1) reveals that power asymmetry is a significant determinant of the sequencing strategy adopted by dyads ($p < 0.001$), indicating a clear divergence in state behaviour based on power relations. In dyads characterised by low asymmetry, states are significantly more likely to pursue breakout layering strategies compared with experimenting approaches (Odds Ratio = 1.80), while high-asymmetry dyads show a strong preference for legalising strategies (OR = 0.41 for low asymmetry in legalising, indicating that high asymmetry increases legalising odds).

Trust levels also influence the sequencing strategy, although in a lesser manner ($p = 0.024$). Interestingly, despite showing notable coefficients in the initial model output, the involvement of the United States in a dyad appears not to have statistical significance in the likelihood ratio tests ($p = 0.282$), suggesting that the involvement of the United States in a dyad does not reliably predict treaty sequencing choices once other variables are controlled for.

These findings show that power asymmetry and level of trust are significant drivers of how states approach the sequencing of non-binding agreements and formal treaties.

Table A1. Analysis of deviance table

	LR Chisq	Df	Pr(>Chisq)
Asymmetry	37.657	3	**3.341e–08*****
Trust	9.475	3	**0.0236***
US involved	3.817	3	0.2820
Decade	91.574	21	**7.536e–12*****

**p*<0.05, ***p*<0.01, ****p*<0.001. Bold entries are the ones with a significant value, where p-value < 0.05

[68]Venables and Ripley 2003.

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