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RESEARCH ARTICLE

A combinatorial theory of institutional invention

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Abstract
From climate change to disruptive technologies, policymakers constantly face new problems calling for unprecedented institutional solutions. Yet, we still poorly understand the inventive process leading to the emergence of new institutional forms. Existing theories argue that exogenous changes provide incentives and opportunities for institutional invention. However, they fail to explain how the inventive process endogenously structures their emergence. Drawing from complexity theory and Brian Arthur's work on technological inventions, we develop a structural theory recasting the process of inventing new institutions as the combination of pre-existing institutions. Building on three assumptions related to this combinatorial process, we argue that the distance between institutions shapes the emergence of new institutional forms and their regime's trajectory. Following the initial take-off in the number of institutional inventions at the creation of a regime, we expect the rate of institutional inventions over replications will slow down as nearby institutions are combined and accelerate as distant ones are combined. We illustrate these expectations by looking at three regimes: data privacy, climate governance, and investment protection. Together, they showcase how our combinatorial theory can help make sense of the emergence of unprecedented institutions and, more generally, the pace of unfolding complexity in various international regimes.

Keywords: Combinatorial theory; complexity; institutional change; invention

Introduction

Unprecedented institutions continuously emerge in global governance. In addition to replicating existing institutions, policymakers frequently design novel institutional designs. Consider norms banning the use of specific weapons on the battlefield. While now widely adopted, these norms were once unthinkable. For some, imposing limits on the battlefield still runs against the very logic of war. At The Hague conferences of 1899 and 1907, state delegates yet broke new ground by

inventing a norm prohibiting poisoned weapons.[1] Since then, we have seen the invention of norms forbidding landmines, cluster munitions, and many other weapons.[2] While not always followed, they all contribute to today's global security regime.

This paper is interested in how such institutional inventions emerge. We here understand an institution as a collection of rules and procedures that govern behaviors of specific actors in specific circumstances.[3] Institutions can take various forms, including regulations, norms, and organizations. They are usually part of a 'regime', that is, a set of institutions that jointly govern a given issue-area.[4] In this context, we define an institutional invention as the creation of an institution qualitatively different from existing ones in a given regime. It is a broad definition: institutional inventions can be formal or informal, procedural or substantive, and minor or major. Institutional inventions must merely be unprecedented relative to other institutions of the same regime. For example, the North American Free Trade Agreement was an institutional invention since no other trade agreement was like it in 1992. However, the 2004 free trade agreement between the USA and Morocco was not, since it mainly replicated provisions from other agreements.

Following Schumpeter[5] and other scholars working on the emergence of technologies,[6] we distinguish inventions from innovations. The definitions of these two terms vary significantly across disciplines. Here, we understand an invention as the first occurrence of a novelty and an innovation as the successful application of a novelty. In other words, an invention 'is the bringing of something new into being [and] an innovation the bringing of something new into use'.[7] Although an invention occurs at a specific time and place, innovation is a process that can be more diffused. This paper looks at the question of institutional invention and leaves aside the related question of institutional innovation.

It is important to better understand how inventions emerge even if they are not always widely adopted, do not always provide a public good, and do not always have a transformative effect. The diversity of institutions is itself a public good.[8] As boundedly rational actors operating in a complex and uncertain world, institutional designers can hardly design an optimal institution to address a given problem on their first attempt. This creates a 'problem of fit' between institutions and what they seek to govern.[9] However, some institutional inventions that failed to reach their original objective may end up offering solutions to unanticipated problems.[10] In this context, a diverse portfolio of institutions increases a regime's capacity for adaptation and resilience.[11] Like genetic variation, which contributes to biological

[1]Price 1995.
[2]Carpenter 2011.
[3]March and Olsen 1998, 948.
[4]Krasner 1982.
[5]Schumpeter 1911.
[6]Rogers 2010.
[7]Black *et al.* 2006, 7.
[8]Ostrom 2005; Duit *et al.* 2010.
[9]Young 2017.
[10]Crouch and Farrell 2003.
[11]Sabel and Zeitlin 2008; Boulton *et al.* 2015.

diversity, each new institutional invention makes a regime more diverse. The results are hard to predict at the level of a specific institution, but a regime that cultivates inventions is more diverse and, therefore, more likely to adapt to new circumstances. In other words, although an individual invention does not necessarily constitute an improvement, improvements at the system level necessarily arise from individual inventions.

So far, the emergence of institutional inventions has received scarce attention. Rational theories typically assume that actors create new institutions to respond to new problems without engaging with the question of what constrains their supply. They pay little attention to the inventive process itself and to the structural conditions influencing the emergence of inventions. Yet, institutional inventions appear in a particular sequence and temporality. It is unlikely that the international ban on landmines would have been invented in the 1990s if earlier international institutions had not paved the way by banning other weapons. Meanwhile, historical institutionalism pays greater attention to the supply of new ideas, contextual factors, and endogenous processes. It is particularly suited to explain incremental and self-reinforcing patterns. However, historical institutionalism tends to resort to exogenous factors to explain the emergence of unprecedented institutions, leaving aside again the question of how their endogenous supply shapes their emergence.

In this paper, we offer a structural theory of institutional inventions drawing on Brian Arthur's pioneer work on the evolution of technology. We argue that boundedly rational institutional designers try to solve specific policy problems by combining pre-existing institutional elements to create unprecedented institutions. Once invented, unprecedented institutions become design elements that can potentially be combined to create additional institutional inventions. Combining nearby institutional elements is less demanding for institutional designers than combining distant ones, but it reduces the potential for future inventions over the long run as it restricts the diversity within the pool of institutional elements. One important implication is that the distance between existing institutions affects the fluctuating pace of a regime's expanding institutional complexity: the combination of nearby institutions leads to 'refinement inventions' and is associated with periods of slower increase in the number of institutional inventions created, while 'bridge inventions' combining distant elements are associated with periods of growing institutional complexity. This original combinatorial theory of institutional inventions complements existing theories on institutional change by detailing the endogenous process behind the emergence of institutional inventions and explaining the varying pace of unfolding complexity in international regimes.

In the next section, we review various theories related to institutional change. We discuss the current literature's focus on innovation and reliance on exogenous variables to the extent that they look at inventions. The following section presents our combinatorial theory of the inventive process. Building on three core assumptions, it details how the distance between existing institutions shapes the emergence of new ones. The third section outlines three observable expectations inferred from our theory and related to the growth in complexity of regimes. The fourth illustrates our expectations by looking at three different regimes: data protection at the domestic level, urban climate governance at the transnational level, and investment protection at the inter-state level.

Institutional change: A review of the literature

There are well-established "bodies of literature looking at institutional innovation" institutional innovation, including on 'policy innovation'[12] and 'organizational innovation'.[13] "Each of these studies" how certain institutions are successfully used and replicated across time and space. Early sociological institutionalists, for example, have highlighted patterns of 'isomorphic institutional change' through which new institutions mimic pre-existing ones.[14] Likewise, studies on policy diffusion,[15] institutional learning,[16] experimentalist governance,[17] policy transfer,[18] and organizational ecology[19] emphasize how certain institutions are selected and replicated. These various streams of literature explain why certain institutional features are broadly adopted while others remain singular. However, they do not offer insights into the emergence of the very first instance of unprecedented institutions in a regime.

The invention of an institution is analytically distinct from its subsequent replication.[20] Designing institutions different from all others in a regime is a form of exploration of the unknown. In contrast, replicating existing institutions is a form of exploitation of what we already know.[21] The processes of invention (exploration) and replication (exploitation) are even competing forces. Although the former implies more divergence and heterogeneity, the latter leads to greater convergence and homogeneity. A system characterized by intense exploration but deprived of selection and replication would be chaotic.[22] Conversely, a system based solely on exploitation but completely deprived of novelty would lead to systemic stasis and inertia. Fueled by this tension, the twin processes of invention and replication operate together and create dynamics that propel a regime's trajectory.[23]

Most institutional theories turn to exogenous factors to account for the introduction of unprecedented institutions. These exogenous factors vary greatly across different theoretical schools. For some analysts, institutional inventions arise out of the creative genius of key individual founders.[24] John Maynard Keynes, Maurice Strong, Robert Schuman, and Cordell Hull, for example, are thought to have left their imprint on the international institutions they helped design. This narrative mirrors the popular image of lone technological inventors having eureka moments in their laboratory. It fails to conceptualize invention as a social process and misses important systemic factors that enable or disable potential inventors.

[12]Gray 1973; Berry 1994.
[13]Damanpour 1991; Wolfe 1994.
[14]DiMaggio and Powell 1983.
[15]Dobbin *et al.* 2007.
[16]Poulsen and Aisbett 2013.
[17]Sabel and Zeitlin 2008.
[18]Dolowitz and Marsh 1996.
[19]Abbott *et al.* 2016.
[20]Jordan and Huitema 2014.
[21]Duit and Galaz 2008; March 1991.
[22]*Ibid.*
[23]Waldrop 1993.
[24]Lewis and Steinmo 2012.

Another frequently mentioned exogenous explanation for institutional invention is environmental change. The literature on the rational design of international institutions conceives negotiators as rational actors and institutions as equilibrium outcomes.[25] Under this perspective, the design of unprecedented institutions results from a novel problem structure that calls for change. When institutions change abruptly, it is most likely because actors face new conditions and constraints.[26] This could be a scientific discovery or a reconfiguration of global power structures. This new problem structure modifies preferences and creates new opportunities, which constitute conditions favorable for institutional inventions.

Perhaps the exogenous source of institutional inventions most thoroughly studied is the pressure coming from political actors. These actors can be epistemic communities,[27] norm entrepreneurs,[28] orchestrators,[29] reformist principals,[30] or autonomous intergovernmental organizations.[31] There is strong evidence that these actors can, in some circumstances, use their skills, resources, and connections to influence others and change international institutions. However, these explanations usually do not elucidate how these actors develop original ideas leading to institutional inventions.

Explaining institutional inventions based on exogenous factors emphasizes the *demand* for institutional inventions. These explanations are reminiscent of classical Newtonian thinking: institutions remain inert until an exogenous force exercises pressure on or attraction to them.[32] This mechanical and linear thinking is also prevalent in discussions on technological inventions. Economic incentives, such as subsidies and the prospect of future profits, are often assumed to be sufficient to generate new technologies. However, this linear model focuses on just one side of the invention equation. It does not explain the endogenous *supply* of invention and what constrains the form new institutions can take remains undetermined.[33]

Some scholars pay close attention to the endogenous source of institutional changes. Historical institutionalists chiefly point to path dependency as a source of endogenous change where positive feedback and increasing returns strengthen the foundations of existing institutions.[34] Their focus on self-reinforcing patterns yet does not fully explain the emergence of institutional inventions. In their seminal contribution, Mahoney and Thelen associate the introduction of new rules with two types of institutional change: displacement and layering.[35] Layering assumes that new rules will be introduced 'on top of or alongside' existing ones, and displacement that new rules will replace previous ones. The origins of new rules, or as

[25]Shepsle 1986.
[26]Colgan *et al.* 2012; Manulak 2020.
[27]Haas 1992.
[28]Finnemore and Sikkink 1998.
[29]Abbott and Snidal 2010.
[30]Hawkins *et al.* 2006.
[31]Finnemore 1993; Johnson 2014.
[32]Bernstein *et al.* 2000; Ma 2007; Kavalski 2012.
[33]Aggarwal 1998; Jupille *et al.* 2013.
[34]Thelen 1999; Pierson 2004; Fioretos 2017.
[35]Mahoney and Thelen 2009, 16.

we define them, institutional inventions, yet fall outside their analytical framework. Meanwhile, Greif and Laitin combine historical institutionalism with game theory insights to show how repeated interactions can change quasi-parameters and, in the long run, affect the stability of existing institutions.[36] While helpful to understand when self-undermining patterns may emerge and force institutional arrangements to change, they do not explain the emergence of *sui generis* institutions. In effect, most scholars from the historical institutionalist tradition turn to exogenous forces to explain nonlinear changes at critical junctures.[37]

A related theoretical tradition taking endogenous changes seriously is complex systems analysis.[38] Complex systems are systems 'in which large networks of components with no central control and simple rules of operation give rise to complex collective behavior'.[39] Common examples of complex systems include the stock market, an ant colony, a brain, and a jazz band. For all these systems, the whole is not reducible to the sum of its constitutive elements. The complex interconnections among the various elements give rise to system-level properties, such as a capacity for self-organization and adaptation. In turn, these changes at the system level can lead to changes at the element level. Therefore, the multiscale lens of complex systems analysis is particularly well suited to explain nonlinear and endogenous changes.

Some recent studies have applied the insights of complex systems analysis to understand the evolution of international institutions, such as investment treaties,[40] environmental agreements,[41] and trade agreements.[42] However, complex systems analysis has not yet been used to explain the more specific question of institutional invention. Farrell and Shalizi use complex systems thinking to study the dynamics of institutional change, but they rely on the idea of random 'deviations' to explain institutional invention.[43] They argue that 'the "deviation rate", is analogous to the "mutation rate" in evolutionary biology'.[44] However, in biology just like for international institutions, deviation from established standards seldom occurs randomly. In the next section, we build on the idea of complex systems to develop an original combinatorial theory of institutional inventions.

A combinatorial theory of institutional inventions: three assumptions

Institutional inventions are rarely random. They are not equally likely to occur at any point in space and time. While sometimes unexpected, the environment in which they emerge determines where and when they can appear. The combinations of rules and procedures that make up institutions such as the Security Council, the International Criminal Court, and the G7 were unthinkable to 19th-century

[36]Greif and Laitin 2004.
[37]Capoccia 2016; Gerschewski 2021.
[38]Gunitsky 2013. Orsini *et al.* 2020.
[39]Mitchell 2009, 13.
[40]Beaumier 2016; Pauwelyn 2014; Roberts and St John 2022.
[41]Kim 2013.
[42]Morin *et al.* 2017.
[43]Farrell and Shalizi 2012.
[44]*Ibid.*, 12.

international institutional designers. We hereafter develop a combinatorial theory drawing on complexity scholarship and, more specifically, Brian Arthur's work on technological invention, to explain the endogenous emergence of institutional inventions.[45]

One of Arthur's key insights is that new technologies are invented by combining existing technologies. For example, the computer was invented by combining a mainboard, a hard drive, a visual graphics card, and a processor. Each of these components is a technology made of a distinct set of components (or technologies) that can be each decomposed into *n* 'smaller' components. A processor is composed of electronic circuits printed on a silicon wafer. Meanwhile, an electronic circuit combines resistors, transistors, diodes, and other electronic components. Since technological inventions are created by combining existing technologies, the stock of existing technologies enables (and constraints) the inventive process.[46] Inventors can see further not by standing on the shoulders of one giant but by standing on a pile of inventions made by their predecessors.

Although Arthur's combinatorial theory was developed with physical technologies in mind, we contend that it can be extended to institutions as a form of 'social technology'.[47] Hereafter, we argue that institutions have properties similar to technologies and that institutional designers face constraints similar to technological inventors.[48] More specifically, our combinatorial theory of institutional innovation rests on three main assumptions: (1) institutional designers are boundedly rational problem-solvers, (2) institutions are modular and autopoietic, and (3) and the invention process is constrained by the distance among components.

First, we assume that institutional designers, that is, individuals or organizations creating new institutions, are boundedly rational problem-solvers. An invention's starting point is a problem that a given actor attempts to solve and for which no institution, to their knowledge, can directly address in its current form.[49] That problem may result from exogenous events. Even if an institution adequately addresses a given problem at one point in time, it might become maladapted and call for adjustment. In other cases, problems emerge endogenously out of the system of human-made institutions. Once a novel institution is introduced into a regime, it can have unintended consequences and create new problems calling for further institutional inventions.

When faced with a specific problem, institutional designers think inductively and look for satisfying rather than maximizing solutions.[50] Most of the rich literature on the rational design of institutions assumes that states follow a deductive and maximization logic.[51] However, full rationality is unlikely to reflect the actual decision-making process of most institutional designers because of the exponential

[45]Arthur 2007, 2009.

[46]Arthur 2009, 36.

[47]Beinhocker 2006, 261.

[48]We do not argue that institutions and technologies are identical artifacts, only that they emerge following similar constraints based on our three assumptions.

[49]This is strikingly different to the Darwinian paradigm of evolution according to which variation occurs randomly before any entity interacts with its environment (Gilady and Hoffmann 2013, 311).

[50]Arthur 1994.

[51]Koremenos *et al.* 2001.

costs of processing information, incomplete information, and uncertainty.[52] In this context, most actors only look to invent a new institution when dissatisfied with an existing one and alternative models.[53] Being boundedly rational, they invent by engaging in a 'local search for additional extant options available for selection'.[54] They learn from past experiences and use the information at their disposal to make satisfying decisions.[55]

Our second assumption is that institutions are autopoietic.[56] Autopoiesis refers to a system that produces its own elements through the interaction of its elements. It implies that institutions can be broken down into smaller components that can be combined in different ways. Jupille and Caporaso recently reviewed nearly 80 different definitions of 'institutions' and found that most of them use concepts like 'set', 'collection', 'system', 'array', 'congregation', 'web', 'mosaic', 'structure', 'arrangement', or other terms that denote a combination of smaller units.[57] For example, several treaties share a similar set of components, including the creation of a joint body, an amendment procedure, a dispute settlement mechanism, provisions on the entry into force, and an official depositary. Although not all treaties include all these components, which exist in various forms, and different configurations produce different treaty designs, all treaties can be decomposed into smaller components.

Autopoiesis is possible because institutions are structurally recursive. Recursivity means that the modular structure of institutions repeats in a tree-like fashion. Each institution may become the elemental component of a broader institution. For example, the prohibition of slavery is an institution that is part of several international declarations and treaties on human rights, which are themselves institutions. Together, the set of all international institutions on human rights forms an institution called the 'global human rights regime'. An array of regimes, such as the human rights, migration, and conflict resolution regimes, forms an institutional configuration called a 'regime complex',[58] and a set of regime complexes forms a constellation recently named 'governance super-cluster'.[59] This recursive nature of institutions implies that even a seemingly modest invention at a micro-level may eventually lead to deep macro-level changes.[60]

Another factor allowing institutions to be autopoietic is the non-rivalrous property of institutional components.[61] New institutions can be developed using the design of previous institutions. New trade agreements, for one, generally share the same basic structure as previous ones. They include a similar set of chapters, which all comprise similar principles and rules. This duplication is an increasingly institutionalized practice, with many states developing model trade agreements that

[52]Simon 1972.
[53]Jupille *et al.* 2013.
[54]Jupille and Caporaso 2022, 25.
[55]Bruneau 2022.
[56]Teubner 1993; Luhmann 2004; Johnson 2014.
[57]Jupille and Caporaso 2022.
[58]Raustiala and Victor 2004.
[59]Kim and Morin 2021.
[60]It is noteworthy that the relationship between parts and wholes remain a topic of debate in the philosophy of science.
[61]Romer 1990.

they use as a starting point for negotiation.[62] Moreover, a state can technically copy an institutional design first developed by another state. For example, since the USA adopted labor and environmental side agreements in the North American Free Trade Agreement, other countries have followed suit, including similar chapters in their trade agreements.[63] Some institutions remain unique but others, like the national treatment principle, are replicated hundreds if not thousands of times. This non-rivalry means that there is, in principle, no limit to the constant proliferation of international institutions. The need for only a few random interactions to create 'small-world' effects and make institutions widely accessible supports the spread of certain institutional designs.[64]

In this context, new institutions do not emerge 'from nowhere'.[65] There is no 'virgin' institutional birth. All institutional inventions are made of previous institutions and have institutional ancestry. The first design components introduced in a regime combine existing institutions from other regimes. Later, institutional inventions can combine institutions from inside and outside the regime. What distinguishes a design component from an institutional invention is its location on the arrow of time: institutional inventions created today will be design components for future institutional inventions. Not all institutions will give rise to an institutional invention. Although all inventions have ancestry, not all have offspring.

Third, we assume that inventing is a combinatorial process. Existing rules and procedures can be combined to design unprecedented institutions. Combining design components to create a new arrangement is the essence of the inventive process. It contrasts with the process of replication that applies an existing institution in a new context without bringing changes to it. Seeing the process of inventing as one of the combining existing components implies that it is contingent. It depends on the stock of components available in a specific space and time.[66] What can be created today differs from what could be in the past or the future. As inventions are introduced, new combinations become possible, giving rise to previously unthinkable ones. The sequence in which these appear is irreversible. The iPhone could not have been invented before the first mobile phone, the GPS, the Internet, and the touchscreen. Likewise, the European Union in its current form could not have been created at the time of the 1957 Treaty of Rome. Now that it exists, it may serve as a source of inspiration for other regional integrations. In other words, time has directionality.

Following these three assumptions, we argue that the topography of existing institutions constrains the inventive process. Not all institutions are equally accessible to institutional designers to invent new ones. The more readily accessible components include institutions from the same regime or closely related regimes. These can be institutions created long ago. Distance crucially relates to the number of connections separating institutions rather than their time of creation. Distance should also be understood in relative terms and will vary across regimes depending on the

[62]Peacock *et al.* 2019; Allee and Elsig 2019.
[63]Morin *et al.* 2017.
[64]Watts and Strogatz 1998.
[65]Arthur 2009, 2.
[66]Bruneau 2022.

level of connectedness among institutions or, in network terminology, their density. In that regard, social network analysis offers useful tools to operationalize the concept of distance.

As boundedly rational actors, institutional designers first engage in inventing by exploring the most accessible components. They only explore more distant alternatives when proximate components are unsatisfactory. For example, when exploring options for an enforcement mechanism, the negotiators of a new treaty on marine biodiversity are more likely to look for inspiration in existing treaties governing land biodiversity or fisheries than to consider the enforcement mechanisms used in treaties related to denuclearization or human rights.

We associate the distance between components with two types of invention: refinement and bridge. The combination of proximate components leads to *refinement inventions*.[67] Refinement inventions specify, deepen, or extend existing institutions. The invention of rules banning various types of weapons after the original prohibition of poisoned weapons is an example of refinement. In contrast, we call *bridge inventions* combinations including at least one distant component linking different clusters of institutions. One example would be the combination of weapon bans with climate change institutions to create a fossil fuel non-proliferation treaty.[68] Since bridge inventions require more exploratory efforts on the part of boundedly rational institutional designers, they are much less frequent than refinement inventions.

Figure 1 presents this combinatorial process. It shows how early inventions set hard-to-reverse path dependency patterns as the following inventions emerge from their combinations. Solid lines and dashed lines respectively surround refinement and bridge inventions. The latter are relatively rare and come from a combination of more distant institutions (i.e. older institutions like in invention 11 or institutions from another regime like in invention 12). At the origin of a regime, institutional inventions represent bridges of institutional components from other regimes. Institutional designers creating a new regime, in effect, do not operate on a blank slate. They work from the institutional landscape in which they previously operated.

Our combinatorial theory contrasts with rational design arguments positing that institutional designers develop optimal solutions to answer specific problems.[69] Echoing ideas from historical institutionalism, it emphasizes that the design of institutions is a function of the existing landscape and their position on the arrow of time. These similarities are not accidental. Brian Arthur's work was also a key source of inspiration for historical institutionalism.[70] The concept of path dependence is partly based on his work on 'increasing returns'.[71] What historical

[67]We conceptualize refinements and bridge invention as two types of invention. We associate both with the process of exploration, and we associate replication of existing institutions with the process of exploitation. This view contrasts with some authors that associate refinement with exploitation (see Duit and Galaz 2008; March 1991). Their typology attaches greater importance on the expected impact of inventions, while this paper is more centered on the origin of invention.

[68]Mitchell and Carpenter 2019.

[69]Koremenos *et al.* 2001.

[70]Crouch and Farrell 2003; Pierson 2004; Ma 2007.

[71]Arthur 1994.

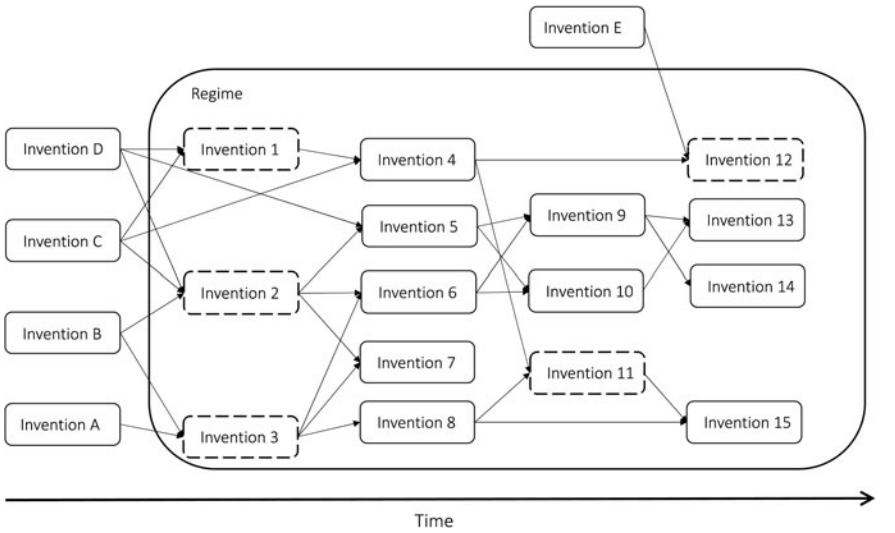

Figure 1. Combinatorial invention process.

institutionalism lacks is again an explanation for how institutional inventions emerge. For example, Crouch and Farrell's work emphasizes the potential of 'dormant institutions' to break from path dependencies.[72] While making an important contribution by pointing out that abandoned institutions could provide a source of endogenous adaptation, they offer no insight into how unprecedented institutions come to be in the first place. Like most other historical institutionalist scholars, they consider the pool of institutions as fixed. By seeing institutions as combinations of existing institutional elements, we offer a new way to understand how an institutional landscape may endogenously grow in diversity over time.

In that regard, our combinatorial theory is parallel to the concept of bricolage recently introduced in international relations.[73] Like our combinatorial view, it argues that it is the act of piecing together existing elements that creates change. At each step, bricoleurs enrich the repertoire of solutions available for future uses and thereby plant the seeds for future ones to emerge. Our combinatorial theory differs in that it focuses on the broader institutional structure rather than on individual entrepreneurs. It highlights how distance across institutions in a regime shapes its evolution. As such, it also goes further than previous bounded rationality theories by emphasizing the variation in the costs associated with creating different types of invention.[74]

As a structural theory, our combinatorial theory cannot provide a general explanation for specific inventions.[75] Nor can it predict who will invent, what

[72]Crouch and Farrell 2003.

[73]Carstensen 2011; Kalyanpur and Newman 2017.

[74]Jupille *et al.* 2013. The latter place the creation of new institutions on a continuum of options along which actors will move depending on the costs and benefits.

[75]Waltz 1979.

will be the impact of an invention, and how many inventions a particular regime will generate. As a complex system, the stock of institutions does not follow a linear pattern where one invention straightforwardly leads to another. Instead, the invention process is highly context-dependent, and inventions themselves contribute to constantly changing the context. Change and continuity are thus two sides of the same coin: an invention generates change, but that change builds on past inventions. Because our combinatorial theory takes the arrow of time seriously, the next section introduces three time-related expectations on institutional change.

Three expectations on the endogenous growth in complexity of regimes

Our combinatorial theory aims to understand how unprecedented institutions endogenously emerge in a regime. Institutional designers pursue institutional change when faced with a problem that current institutions cannot solve. Over time, each invention contributes to making regimes more diverse and complex.[76] Building on the assumptions presented above, this section introduces three expectations on the growth in complexity of regimes.[77] Each refers to a different phase in the development of a regime: its takeoff, slowdown, and acceleration. We expect each phase to have a different ratio of institutional inventions over replications of existing institutions.

Research in biology, psychology, and business studies has found that actors with long time horizons tend to favor exploration (search for new solutions) over exploitation (use of existing solutions).[78] A prime example of this is people's tendency to explore with multiple and diverse social partners early on in their life. As time goes on, this relation is reversed. People tend to rely on a smaller group of close and familiar partners.[79] This example reflects that inventions often generate gains in the long run. While time horizons for people and regimes differ, we expect the value institutional designers assign to inventing institutions (exploration) over the replication of existing institutions (exploitation) to follow a similar trajectory.

The value of inventing should be higher when much remains to be invented in a regime and the pool of existing institutions is limited. In the early days of an international regime, boundedly rational institutional designers have little information on the effects of existing institutional designs, and they have no reason to focus on specific elements.[80] In these circumstances, they are more likely to explore new combinations, following a trial-and-error logic, than to replicate institutions from other regimes. Each new combination in turn becomes a component in another and allows the regime to grow in an autopoietic fashion. Therefore, we expect the ratio of inventions over replications to takeoff quickly once a new regime emerges:

E1: The ratio of institutional inventions over replications rises quickly in the early days of a regime.

[76]Weitzman 1996.
[77]Other empirical expectations can be derived from our combinatorial theory.
[78]Carstensen *et al.* 1999.
[79]*Ibid.*
[80]Mitchell 2009, 196.

A regime grows in complexity as its inventions accumulate. Yet, as boundedly rational actors, institutional designers have limited capacity to process new information. They tend to follow an 'availability heuristic' and select the most accessible components when they need to invent a new institutional form.[81] They start by combining close institutional components from the same cluster. As a result, their inventions progressively take the form of refinements according to our third assumption. Over time, this selection process leads to a tight and increasingly standardized regime. While institutional inventions increase diversity, the reliance on a small subset of design components reduces the potential for new combinations. Institutional designers become trapped in local solutions. Stuart Kauffman refers to this as the 'complexity catastrophe'.[82] As the selection process leads toward more tightly coupled systems, the latter tend to become more ordered and less prone to autopoiesis. New institutional inventions tend to have close kinship with existing institutions and contribute to the growing consanguinity within the regime. The restricted pool of institutional elements makes the invention process less rewarding. Investing in inventions often becomes relatively less attractive than replicating existing institutions that had time to prove themselves. We thus expect the ratio of inventions to slow down after takeoff:

E2: The combination of close design components will progressively lead to a decrease in the ratio of inventions over replications.

As institutional designers progressively exhaust all potential combinations in their proximate environment, they will start exploring combinations of more distant elements following their bounded rationality priors. It may mean looking at the design of institutions with which they had no prior interactions in their regime or others. In doing so, they bridge different clusters of institutions. These bridge inventions bring fresh air to a regime. They reduce the distance between previously distant components and facilitate the autopoietic emergence of other unprecedented institutions. This idea relates to the network theory finding that 'weak ties' connecting two clusters may have powerful system effects.[83] One direct implication is that the growth rate of institutional inventions should increase following the combination of distant elements. New combinations will become salient to boundedly rational institutional designers and disrupt the status quo. This results in our third expectation:

E3: The combination of distant design components will lead to periods with higher ratios of inventions over replications.

Together, our three expectations should lead us to observe a succession of periods with high and low ratios of inventions over replications, as illustrated in Figure 2. The slope and length of each curve may vary. Some periods marked by high political saliency might, for example, lead to shorter periods of high ratios of

[81]Poulsen and Aisbett 2013, 278.
[82]Kauffman 1993.
[83]Granovetter 1973.

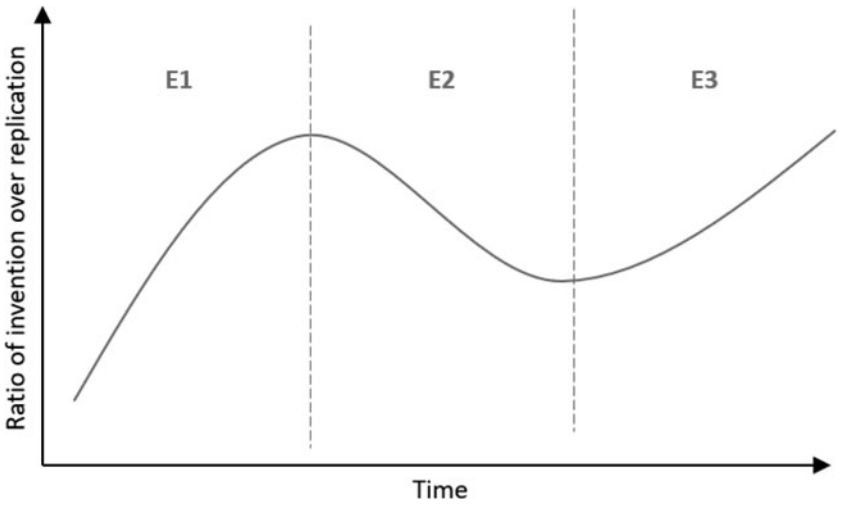

Figure 2. Evolution of the ratio of inventions over replications.

inventions over replications. Some regimes may also tend to be more institutionalized than others. Our combinatorial theory does not seek to explain why some regimes generate more inventions than others. Rather, it emphasizes the role of structural dynamics to explain when institutional inventions are more likely to emerge. In that regard, the overall trend should be similar across various regimes.

Institutional designers in a new regime start by inventing many new institutional designs (E1). Over time, new inventions take the form of refinements and lead to the creation of increasingly similar institutions. As a result, the gains from inventing diminish and replication becomes the dominant process (E2). The combination of distant components finally creates bridges among different clusters of institutions and may spur a new wave of institutional inventions (E3). While possibly recurring, it is not a deterministic process. The trajectory is non-linear, the destination remains indeterminate and the move from one period to another depends on actors looking to solve new problems. Institutional designers can potentially fail to combine distant elements, leading a regime to become increasingly stagnant, or fail to replicate known institutions, leading a regime to become increasingly chaotic. But overall, we expect a regime to grow in complexity by oscillating between periods of intense invention and replication. The following section illustrates these expectations looking at three regimes.

Three illustrations: data privacy, climate governance, and investment

We illustrate our expectations with examples from three regimes: data protection, urban climate governance, and investment privacy. Each illustration acts as a plausibility probe for our theoretical argument and showcases how the temporal distribution of inventions follows the same trend of moving through slowdown and acceleration phases after the initial take-off. They also show how different regimes move at a varying pace between each phase and may not go

through a new acceleration. It depends on the combinations bridging distant institutions.

Data privacy

As a regime, data privacy emerged in the 1970s through the combination of property rights and freedom of information rights. At the time, the growing collection of personal information challenged the pre-existing vision of privacy as a right to limit intrusion in one's private property and supported a new vision of it as a form of control over information.[84] As this new regime took off, it provided the basis for the invention of multiple data privacy rules, in line with E1.

In 1973, the US Department of Health, Education, & Welfare (HEW) first published a report maintaining that any 'record containing information about an individual in identifiable form must […] be governed by procedures that afford the individual *right to participate* in deciding what the content of the record will be and what disclosure and use will be made of [it]' (emphasis added).[85] It went on to invent five fair information practices, which all combined existing rules on freedom of information and the concept of individual participation. As the HEW report highlights, freedom of information regulations already regulated data collection and dissemination but did not give any real weight to individual interests.[86] The five principles of fair information practices created a bridge between the two and focused on providing more individual control over the collection and use of personal information. As such, their creation marks a watershed moment in the regulation of data privacy.

By the end of the 1970s, new laws replicated more than they invented new data privacy rules, pursuant to E2. The Organisation for Economic Co-operation and Development (OECD) *Guidelines on the Protection of Privacy and Transborder Flows of Personal Data* of 1980 and the Council of Europe *Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data* of 1985 codified many of the early fair information practices and encouraged their replication globally.[87] The invention of data privacy rules, moreover, took the form of small refinements combining the same rules. German privacy laws notably required obtaining the consent of individuals for other protected phases of the information process, such as the collection, storing, and transfer of personal information.[88]

An acceleration in the invention of data protection rules came from combinations bridging distant institutional components in the mid-1990s and early 2000s, as emphasized by E3. The development of new data practices by private companies created a new impetus for regulation and connected different regulatory

[84]Westin 1967, 383.

[85]U.S. Department of Health Education and Welfare 1973, 41. The Younger report adopted a year before in the UK came to similar conclusions without expressing the same paradigm shift toward privacy as a form of control over oneself information model. Meanwhile, the first data protection law adopted by the German state of Hesse in 1970 still mainly relied on administrative rather than individual control.

[86]*Ibid*., 37.

[87]Newman 2008, 25–26.

[88]Mayer-Schonberger 1997, 231.

ideas for the first time. The collection of personal data on children, for example, progressively led to the development of private codes for that specific type of data in the USA.[89] Combining rules for advertising to children with principles of fair information practices, the Children's Advertising Review Unit of the Better Business Bureau first set out a set of rules specifically for children. The latter included obligations like requiring parental consent before collecting children's data and maintaining a specifically tailored notice for children. Moreover, repeated failures to report data losses to affected individuals led regulators in California to create the first-ever data security breach requirement. The latter bridged two previously distant sets of rules requiring private companies to keep personal data secure and inform individuals when their information is shared.[90] Since then, new data breach rules have required private companies to inform individuals of potential security risks in their services, disclose to data protection authorities when they suffer a security breach, and maintain a specific policy to respond to potential security breaches. These new rules nowadays further limit what companies can do with personal data they collect online.

Meanwhile, the development of the European project brought together different privacy models in Europe under one legal agreement for the first time in 1995.[91] More than simply replicating the rules found in each jurisdiction, it created a bridge between different regulatory models. Competing interests in promoting the free flow of information and maintaining a high level of data protection led to several new rules. For example, instead of banning the collection and use of sensitive data, such as ethnic origin or political opinion, as some countries were previously doing, the Data Directive invented a whole new set of rules for that category of personal data combining existing rules.[92] It notably required the explicit consent of individuals and the establishment of special security measures for sensitive data. These new rules contributed to a transatlantic rift that continues today as the USA still does not have a federal privacy law, and data flows between both jurisdictions are regularly at risk of being curtailed.

Nevertheless, many observers have been keen on emphasizing that data privacy regulations went through a significant process of convergence.[93] In a process consistent with E2, there was a second decrease in the ratio of inventions over replication. Many countries adopted privacy laws replicating the European Directive.[94] They include the same fair information practices' guarantees designed in the 1970s and more recent rules bridging previously distant institutional designs. The Canadian privacy law, for example, included rules for sensitive data upon its adoption in 2000. Its 2015 revision then replicated data breach rules. Even the new General Data Protection Regulation (GDPR) replicates more than it invents new rules. While the switch from a Directive to a Regulation is significant, most of its substantial standards are, in fact, in the European Directive of 1995 and other regulations adopted

[89]Lascoutx 2002.
[90]Preston and Turner 2004.
[91]Simitis 1995, 449–50.
[92]*Ibid*., 460–61.
[93]Schwartz 2019.
[94]Bach and Newman 2007, 833.

since then. It notably includes rules on the collection and use of children's data and data breach notification replicating those originally present in American laws.

At most, few inventions refine existing requirements, such as the right to be forgotten. The latter builds on the existing right of individuals to request the deletion of their data when found to be erroneous. It mostly adds that individuals can also request the erasure of their data when it is no longer necessary for the purposes for which it was collected. As the European Court of Justice made clear in a 2014 decision involving Google, this new right comes from the combination of the requirement that companies keep accurate personal data and the right of individuals to request the deletion of erroneous data found in the 1995 European Directive. It represents a refinement of the existing rule allowing individuals to request the deletion of personal information by adding a new valid ground for it.

Urban climate governance

Urban climate governance entered the global political agenda at the end of the 1980s. While states have predominantly been seen as the primary actors of climate governance, cities voluntarily seeking to curb their emissions and adapt to irreversible changes generated the field of transnational urban climate governance. Transnational city networks rose as organizations dedicated to coordinating and enhancing cities' efforts toward climate policy from a transnational perspective. For instance, ICLEI, an inclusive network with a large membership of local governments worldwide, emerged in 1990 through the International Union of Local Authorities and the United Nations Environment Programme.[95] As the first transnational city network focusing on sustainability, it is a bridge invention from two other regimes, transnational urban governance and intergovernmental environmental governance. Networks such as ICLEI have sought to offer an original answer to the assumption that cities lack information and skills to deal with climate issues.[96] They have sought to answer what they perceived to be a problem of international climate governance rather than purposefully try to foster institutional diversity. The voluntary character of cities' participation in urban climate governance is entrenched in the functioning of these older networks, to the point that some describe early urban climate governance as a period of municipal voluntarism.[97]

As part of their strategy to enhance urban climate policies, transnational city networks have created instruments to orient the behavior of their member cities.[98] We see both networks and governance instruments as potential institutional inventions. Our understanding of governance instruments is broad. Examples include political declarations setting new norms for urban climate mitigation, events disseminating good practices on urban climate adaptation, reports on new green technologies, or capacity-building workshops on natural disasters. Networks and their instruments are inventions when they represent unprecedented combinations of governance parameters (e.g. rule-setting, norm-setting, information sharing,

[95]Betsill and Bulkeley 2004.
[96]Bulkeley *et al.* 2003.
[97]Bulkeley 2013.
[98]Papin 2020.

voluntary or compulsory tools), understood as different design components of urban climate governance.

In line with E1, when municipal voluntarism emerged, the number of inventions took off and quickly grew compared with replications. ICLEI was the most inventive. In 1990, it coordinated its first World Congress inviting all its founding members to share information and set norms about the types of actions cities should undertake to become more sustainable. In 1991, it launched the Urban CO_2 Reduction Project, the first voluntary program to help cities reduce their greenhouse gas emissions. This was an unprecedented initiative to promote the sharing of information for emission reduction among cities and create a commitment that made it hard for them to leave the nonetheless voluntary program. Following up on the project's success, ICLEI invented the Cities for Climate Protection (CCP) campaign in 1993, which had a significant capacity-building component and was directed at both member and non-member municipalities. Cities that did not pay ICLEI's membership fee could still participate in the campaign. Institutional designers also replicated some institutions. Some networks' rules copied the model first set by Metropolis, an older and more general transnational city network. Yet, overall, in this first phase of urban climate governance, the number of inventions over replications accelerated rapidly.

A few years after the emergence of urban climate governance, the ratio of inventions over replications progressively slowed down, in keeping with E2. Most tools relied on combinations of close design components, often including norm-setting and information sharing in voluntary settings. For instance, ICLEI's 1994 Local Agenda 21 Model Communities Program mostly replicated the Urban CO_2 Reduction Project's design components, except that it was open to non-members, making it a refinement invention. Looking at what was available in the regime, networks often replicated or sometimes refined pre-existing instruments. In 1995, UBC launched its Municipal environmental audit program, which replicated ICLEI's CCP governance parameters. Likewise, ICLEI's World Congress model, a combination of norm-setting and information sharing in a voluntary setting for members only, was replicated under different forms and names by networks, including Climate Alliance in 1998, UBC in 1999, Eurocities in 2000, or Metropolis in 2002. The governance parameters city networks almost all relied on were in line with a soft or managerial mode of governance, seeking to induce actors to adopt a certain behavior rather than coerce them.

With the long and complex intergovernmental Kyoto negotiations and the rise of global climate awareness, a growing dissatisfaction emerged with climate governance's slow progress. Around the mid-2000s, networks started to bridge instruments from other regimes to evolve their own governance practices. As per E3, the number of inventions over replications increased again. In a second wave described as 'strategic urbanism',[99] new transnational city networks, working with more and more non-city actors, started to promote unprecedented governance instruments. Institutional designers used components from other fields, including venture capitalism and intergovernmental climate governance's climate clubs.[100]

[99]Bulkeley 2013.
[100]Falkner 2016.

For example, following the practices of climate clubs, the C40, a network of megacities seeking to lead urban climate action, decided on new way to select its members based on an invitation from members. This bridge invention contrasted with earlier networks' selection methods, which generally welcomed all cities agreeing to pay a membership fee. The influence of venture capitalists acting as network funders also led C40 to develop compliance mechanisms to ensure member cities follow its mission and reach their ambitions. Members' attendance at the C40 summit, in contrast with ICLEI's World Congress, is compulsory. Cities must also participate in one or more subnetworks, another C40 invention, through which they share information and set norms on specific climate-related issues. These bridge inventions have made it easier for other networks to generate more inventions, including refinements. For instance, the 100 Resilient Cities (100RC) network, created in 2013 by the Rockefeller Foundation, designed a challenge to allow cities to become members, thus becoming selective and exclusive, in a way of a club.

These bridge inventions borrowing components from other regimes have allowed transnational city networks to resort to governance parameters scarcely used before, including rule-setting and obligation. More recent networks such as C40 and 100RC have sought to compel their members to adopt a behavior they considered best to lead to effective climate policies. In so doing, they have redefined their voluntary nature. Cities still decide whether to become network members. Yet, once they are members, the costs of staying in or leaving the network are higher than in older networks. Member cities failing to comply might even be excluded.[101] This approach to governance starkly contrasts with the managerial one presented above. It is more in line with a command-and-control approach common to other regimes, such as intergovernmental climate governance.[102] The import of practices from other fields in the phase of strategic urbanism has brought fresh air to transnational urban climate governance, leading to an acceleration in the number of inventions compared to the replication of pre-existing institutions. These inventions have likely benefitted more some cities than others. Large and global cities, which can afford to be part of both older and new generation (costly) networks, have gained visibility and centrality at the expense of the numerous small cities that participate in urban climate governance. This might help them select and impose the instruments, and more generally the norms that cities should generally follow to mitigate and adapt to climate change.

Investment protection

The regime of foreign investment comprises more than 3200 international investment agreements (IIAs). They include bilateral investment treaties, trade agreements with investment chapters, and a few regional and multilateral agreements. In each case, treaty designers try to balance guarantees provided to foreign investors with the need to protect their state's regulatory sovereignty. The first modern IIA concluded between the Federal Republic of Germany and Pakistan in 1959 was a short and focused agreement (14 articles in 6 pages). Recent IIAs are more

[101]Nielsen and Papin 2021.
[102]Hickmann 2016.

sophisticated and often include more than 35 detailed articles. Three periods in which the ratio of inventions over replication accelerated and slowed down succeeded each other and marked the growth in complexity of this regime.[103]

Foreign investment first emerged as a 'hybrid' regime combining elements of private contract law with international public law.[104] The IIA between Germany and Pakistan notably included the first-ever 'umbrella clause' whereby each state commits by treaty to comply with its contractual obligations with investors from the other. Starting with the 1969 IIA between Italy and Chad, an increasing number of IIAs provided that foreign investors could use international arbitration mechanisms to settle disputes with their host states. These arbitration mechanisms were modeled on private commercial law, with ad hoc arbitrators, confidential proceedings, relatively short delays, and final decisions without the possibility of appeal. These bridge inventions were introduced in the regime when it was still limited in terms of its number of agreements and their degree of sophistication, making the ratio of inventions over replications particularly high as expected by E1.

A slowdown in the ratio of inventions came in the following decade with the 'modelization' trend as per E2.[105] The *Draft Convention on the Protection of Foreign Property* adopted by the OECD in 1967 and arbitration clauses adopted by the International Center International Centre for Settlement of Investment Disputes in 1969 both contributed to setting a model of IIA that was widely replicated throughout the 1970s.

In line with E3, an acceleration in the number of institutional inventions came in the 1980s when the USA started to conclude an increasing number of IIAs. One of the inventions introduced by the US government was to make the investor–state dispute settlement mechanism available not only for a breach of a contract, but also for a breach of any other obligation in the IIA itself. This sealed the bridge first created in European IIAs between international public law and private contract law. The USA also invented many new IIA provisions by taking inspiration from its past program of bilateral Friendship, Commerce, and Navigation agreements.[106] In particular, it introduced in its IIAs provisions on the acquisition and establishment of foreign investments, making IIAs not only about investment *protection* but also about investment *liberalization*.[107] This led to the creation of multiple new provisions, including on the repatriation of profits, non-conformity measures, and personal investor protection.[108] As Alschner notes 'rather than blindly copying from

[103]Alschner (2017, 19) identifies four periods in the evolution of investment governance. We, however, consider the third period in his account to reflect a period of relative slowdown. While the number of inventions created in that period was significant in absolute numbers, it was also the period where the number of replications exploded.

[104]Douglas 2003; Pauwelyn 2014.

[105]Newcombe 2013, 19.

[106]*Friendship, Commerce and Navigation* agreements can arguably be considered as IIAs. However, as noted by Schill, 'their primary purpose was to establish closer commercial and political relations between the contracting parties' (2009, 29). This is why we consider the 1959 Germany and Pakistan agreement as the symbolic birth date of this regime.

[107]Alschner 2013, 469.

[108]*Ibid.*

European-style treaties, US drafters strove to *combine* the best of both worlds' (emphasis added).[109]

The number of IIAs exploded in the 1990s, with the conclusion of more than 100 IIAs per year between 1992 and 2005, with a peak of 228 IIAs for the single year of 1996. Most of these new IIAs replicated provisions from existing IIAs, reflecting a second period of slow-down in the inventive ratio (E2).[110] It is a period marked by the adoption of model agreements by high-income countries, such as the UK in 1991 and the USA in 1994. By using template agreements and duplicating standardized provisions, negotiators reduced transaction and management costs arising from the negotiation and supervision of dozens of agreements. Most inventions introduced at that time were refinements. Instead of replicating an entire IIA, some negotiators selectively mix and match provisions from existing IIAs to create original combinations. Alschner and Skougarevskiy give the example of the Iran–Slovakia agreement, which they describe as a 'mosaic of clauses', borrowing elements from American, Canadian, European, and Australian IIAs.[111] A few IIAs introduced novelties from other regimes, but these bridge inventions were relatively rare compared to the widespread replication going on.[112] Several analysts note that the practice of replicating existing IIAs was so entrenched that it created 'excess inertia'[113] and negotiators replicated suboptimal provisions that 'd[id] not suit their interests'.[114]

A third increase in the ratio of invention occurred in recent years following the introduction of several bridge inventions combining elements from investment and trade governance in line with E3. This latest source of inspiration relates to the fact that, since the late 1990s, an increasing share of trade agreements includes an investment chapter, and some investment negotiators have a background in trade negotiations.[115] At least three categories of bridge inventions were introduced from trade governance. First, some recent IIAs include provisions inspired by the General Agreement on Trade in Services. They include the notion of 'substantive business operations' to identify the nationality of a foreign investor and a list of commitments on pre-establishment market access in certain specific sectors.[116] Second, recent IIAs include increasing detailed exceptions to protect the capacity of states to adopt regulations related to health, safety, environment, and other legitimate public policy objectives. Some of these exceptions were inspired by similar provisions in agreements on the World Trade Organization.[117] Third, recent IIAs borrow procedures for investor–state dispute settlement from trade governance. After a series of controversial investment disputes, the legitimacy of procedures

[109] *Ibid.*, 468.

[110] Alschner and Skougarevkiy 2016.

[111] *Ibid.*, 175.

[112] One source of inspiration for institutional inventions is domestic law. For example, some US IIAs borrow their definition of indirect expropriation from a supreme court case (Gagné and Morin 2006, 371), and some French IIA include a definition of corporations inspired by French civil law (Douglas 2003, 172).

[113] Pauwelyn 2014, 414.

[114] Poulsen 2014, 6.

[115] Beaumier and Ouellet 2018; Chaisse *et al.* 2022.

[116] Shan and Zhang 2014.

[117] Alschner 2013, 481.

inspired by private contractual law to adjudicate the compliance of public regulatory measures with treaty obligations was increasingly challenged. The hybridization of contract law with international public law, at the origin of the regime, had endogenously created legitimacy problems that called for a greater alignment with international public law. Therefore, recent IIAs provide that the main documents of the proceedings should be released, that hearings should be open to the public, and that non-disputant parties may present *amici curiae* submissions.[118] Some IIAs even anticipate the creation of a multilateral appellate body on investment modeled after the mechanism of the World Trade Organization.[119] These recent bridge inventions were introduced in the regime, as the growth rate of IIAs declined and negotiators became more careful before reproducing the clauses of existing IIAs. The ratio of inventions over replications might currently be at another peak before it declines again.

Conclusion

Unprecedented institutions continuously reshape global governance. The invention of new data privacy rules, instruments for urban climate governance, and investment protection norms have redefined expectations and practices in their respective regime. These three cases illustrate our three expectations related to periods of slowdown and acceleration in invention rate. Following an early take-off in each case, new inventions slightly refined previous institutions and progressively led to periods of higher replication. The increasing modeling of data privacy rules, transnational city networks, and investment agreements exemplify this trend. Over time, inventions bridging distant institutional components, such as children and data privacy rights, compulsory instruments in municipal governance, or investment and trade provisions spurred highly inventive periods and supported each regime's growth in complexity. These were followed by other periods of greater replication. In the case of investment protection, the combination of distant institutions led to at least two more periods with a high rate of inventions.

In all three cases, not all institutional inventions were transformative. Many refinements never became widely adopted. Meanwhile, other inventions have been hotly debated since their adoption. The extension of investor–state dispute settlement to any investment treaty violations is increasingly criticized for giving more rights to foreign investors and limiting states' capacity to pursue legitimate regulatory objectives. Yet, institutional inventions contributed to making these three regimes more diverse and shaping what can emerge in the future. The same dispute settlement mechanism currently criticized for giving too much power to foreign investors could provide a basis to giving more rights to other categories of actors, such as workers, in the future.

Our combinatorial theory helps make sense of the growing diversity of institutions and explains the fluctuating pace of global governance's expanding institutional complexity. Most theories adopt an actor-centric perspective assuming actors invent in response to specific exogenous shocks. Even historical institutionalism, which emphasizes the role of existing institutional landscapes, often ends up

[118]Tams 2014.
[119]Steger 2013.

pointing to the role of individual actors or exogenous shocks when explaining the emergence of institutional inventions. Existing theories do not sufficiently consider how the existing institutional structure shapes the content and the tempo of institutional inventions.

Our theoretical framework is structural, although it is not incompatible with agent-centric explanations. It emphasizes that regimes expand in an autopoietic fashion as actors combine institutional components. When faced with a problem, actors use what exists in their environment to invent new institutions. The distance among existing institutional components, in turn, shapes which combinations are more likely to form. We argue that, over time, the combination of closer components should lead to periods of smaller ratios of inventions over replications, and the combination of distant components to periods of higher ratios of inventions over replications. Our three illustrations suggest that this pattern may be at play at different levels of governance and in different institutional settings. Future work can build on this theoretical contribution by more systematically testing how the distance among institutions influence the emergence of unprecedented institutions.

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