

The Evolution of Global Fisheries Governance 1960–2010



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From and for my most important relationships.

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Abstract

Fisheries straddling or migrating between international maritime boundaries represent a typical case of the tragedy of the commons. Over two dozen Regional Fisheries Management Organisations (RFMOs) have been created to manage these fisheries, which means it also represents a typical case of 'regime complexity' or 'governance architecture'. These literatures recognise that such institutions do not operate independently and therefore institutional functions such as attracting participants, practising their regulatory role, and performing their mandate should be understood as interdependent.

This thesis proposes that we study such institutions together with actors and architectures of relations between and among them, which together I term 'governance complexes', by means of a relational approach. This relational approach combines relational theory, which posits the operation of endogenous relational mechanisms alongside exogenous explanations such as institutional design, with network methods that enable structural insights and robust inference that takes into account these interdependencies.

The dissertation comprises two main parts that describe and explain the global fisheries governance complex, respectively. The first describes how the governance complex's three main components, states, RFMOs, and states participation in these RFMOs, have evolved. A topological typology utilising key network concepts is proposed and employed to show that the global fisheries governance complex is not fragmenting but becoming more overlapped and nested.

The second part explains how this governance complex has evolved in terms of (1) participation, (2) practice, and (3) performance. First, it finds that while states find institutional design features such as an RFMO's internal organisation attractive, relational mechanisms such as popularity and closure also provide important heuristics for participatory decisions in complex settings. Second, it finds that high levels of organisation also enables higher regulatory activity, but so do relational mechanisms such as coercion or imitation. Third, it proposes the concept of net effectiveness to gauge an institution's "take-home" performance once its position in the broader governance complex has been taken into account. The result is not only an explanation of the evolution of global fisheries governance but also a developmental step towards an institutional relationalist theory of governance complexes.

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List of Acronyms

CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCBSP	Convention for the Conservation and Management of Pollock Resources in the Central Bering Sea
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CFP	EU Common Fisheries Policy
DWFN	Distant Water Fishing Nation
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization
FOC	Flags of Convenience
FONC	Flags of Non-Compliance
GFCM	General Fisheries Commission for the Mediterranean
GFG	Global Fisheries Governance
IATTC	Inter-American Tropical Tuna Commission
IBSFC	International Baltic Sea Fishery Commission
ICCAT	International Commission for the Conservation of Atlantic Tuna
ICNAF	International Convention for the Northwest Atlantic Fisheries
IGO	Intergovernmental Organisation
IOTC	Indian Ocean Tuna Commission
IR	International Relations
IUU	Illegal, Unreported, and Unregulated

NAFO	North Atlantic Fisheries Organization
NASCO	North Atlantic Salmon Conservation Organization
NEAFC	North East Atlantic Fisheries Commission
NPAFC	North Pacific Anadromous Fish Commission
QAP	Quadratic Assignment Procedure
REIO	Regional Economic Integration Organisation
RFA	Regional Fisheries Arrangement
RFB	Regional Fisheries Body
RFMO	Regional Fisheries Management Organisation
RECOFI	Regional Commission for Fisheries
SAOM	Stochastic Actor-Oriented Model
SEAFO	South East Atlantic Fisheries Organization
SIOFA	South Indian Ocean Fisheries Agreement
SOFIA	State of the World Fisheries and Aquaculture
UNCLOS	United Nations Convention on the Law of the Sea
UNFSA	Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
WCPFC	Western and Central Pacific Fisheries Commission

Glossary

design Institutional features such as scope, organisation, control, and flexibility that are decided upon by negotiating parties when the institution is created and are rarely changed thereafter.

participation A formal relationship between actors and institutions which can include observing (not treated here), cooperating, and full membership.

practice What actors and institutions do as opposed to how they are designed, in particular as it relates to their legislative or regulatory role.

performance An institution's effectiveness in changing the behaviour of its members.

architecture A set of ties between and among actors and/or institutions and their structure.

governance complex A system of actors and institutions that govern an issue area, and relations between and among them.

network A way of representing the world as (sets of) units or 'nodes' and a rule defining whether, how, and to what extent any two nodes are related or tied to each other.

unipartite network A network consisting of a single set of nodes and ties among them.

bipartite network A network consisting of two distinct sets of nodes and where ties are only defined between these two node sets.

network theory Theory that includes relational and endogenous mechanisms, such as popularity, closure, and homophily that can be represented as network effects.

network analysis Tools for describing and measuring network structures.

network modelling Tools for explaining macro network structures as the product of micro relational mechanisms.

gross effectiveness The direct effect of an institution on its members behaviour in its mandate.

net effectiveness The effect of an institution on its members behaviour once the overlapping membership and mandates of other institutions are taken into account.

Part I
Introduction

“association in the sense of connection and combination is a ‘law’ of everything known to exist. [...] Nothing has been discovered which acts in entire isolation”

John Dewey, *The Public and Its Problems*, 1988, p. 250

1

Dire Straits

1.1 Taking Fish For Example

THERE IS CONSIDERABLE UNCERTAINTY about how many fish are in the oceans, how many are caught each year, how many could be safely caught without jeopardising future catches or, assuming we know all of the above, how to ensure that fishing actors do not overfish.¹ Nonetheless, there is a growing consensus that we have been collectively “failing the high seas”,² that a comprehensive failure would have significant negative sociopolitical effects, and therefore action needs to be taken.

The common analysis of this problem is that fish stocks represent a typical case of a classic collective action problem called the ‘tragedy of the commons’. Garrett Hardin, who popularised the term,³ highlighted the ultimately deleterious effects of actors rationally seeking to maximise their own utility from a common, finite resource where excluding over-extractors or free-riders is difficult. Since each actor cannot guarantee that other resource users will behave in a way consistent with the collective good when their individual incentives are to over-extract, they are driven to fulfil this role themselves to obtain at least some utility from the resource before it is depleted. The “remorseless working” of these globally counter-productive individual incentives prompted Hardin to frame the problem as a “tragedy”.⁴ This logic of overexploitation only worsens as more actors gain access to the commons and the resource approaches depletion, and remains unmitigated by the resource

¹See DeSombre 2014, p. 468.

²Cullis-Suzuki and Pauly 2010; Beddington et al. 2007; Hilborn 2007.

³Hardin 1968; see also Ostrom 1990; Diez et al. 2002.

⁴Hardin 1968, p. 1244.

being renewable—as fish are—so long as each fish caught leaves one fewer for others using the resource, one fewer to repopulate the stock, and one closer to stock depletion. Indeed, fisheries are considered such a typical case of the tragedy, it is sometimes called the ‘tragedy of the fishers’.⁵

Numerous careers have been made on investigating the analytic and empirical conditions where this tragedy is particularly pernicious or fails to hold.⁶ Still, the most common solution for avoiding such tragedies is “enclosure” of these commons through multilateral institutions or, as Hardin put it, “mutual coercion, mutually agreed upon by the majority of the people affected”.⁷ It is easy to see why this is such a popular solution: because fish stocks renew naturally given a sufficient adult population, to be determined by scientific investigation, science-based institutions promise to maintain predictable catches of a given stock indefinitely by restricting resource exploitation to an appropriate level.⁸

To see the commonality of such an institutional solution,⁹ we need look no further than Global Fisheries Governance (GFG): the governance of fish stocks that straddle, migrate between or, less often, reside solely beyond international maritime borders. Global fisheries is not governed by any single institution, but one to two dozen (depending on how one counts) so-called Regional Fisheries Management Organisations (RFMOs). These international organisations have a rather robust management mandate (by global public policy standards) to regulate the activity of those states that submit to their authority within a particular region and often with respect to particular fish stocks. Collectively, RFMOs now manage most oceanic areas and industrially viable fish stocks.

However, “RFMO performance has not lived up to expectation”.¹⁰ Despite their strong management mandate and high regulatory activity, the RFMO system is considered generally ineffective. The evidence appears damning. The biennial reports of the Food and Agriculture Organization (FAO) on the State of the World Fisheries and Aquaculture (SOFIA) report have reported decreasing catches since the 1990s, resulting in nearly 30% of Earth’s fish stocks classified as overexploited or

⁵Bowles 2003, pp. 27-29.

⁶Most notably Ostrom 1990.

⁷Hardin 1968, p. 1247.

⁸DeSombre 2014, p. 468.

⁹Distinctions between international institutions, regimes, and organisations are not imposed heavily here, but see: Keohane 1989, p. 3; Levy et al. 1995; Young 1986, p. 110; all are products of actors’ attempts to coordinate themselves – whether they subsequently accrete some agency is a matter of empirical investigation. See also: Stokke and Oberthür 2011, p. 3.

¹⁰Lodge et al. 2007, p. vi.

collapsed.¹¹ Another 57% are already at their limit, meaning nearly 90% of global fish stocks are fully- or over-exploited. The proportion of stocks overfished is even greater among those straddling or migrating across national maritime borders or into the international waters of the high seas, suggesting that the extra governance challenges there from common, 'global' access and the difficulties in excluding overfishers or free-riders translate into even poorer performance.¹²

Nonetheless, RFMOs remain the main institutional response. The proliferation of these RFMOs is driven in part by a significant correlation between governance and less Illegal, Unreported, and Unregulated (IUU) fishing,¹³ and an expert consensus that RFMOs or something like them provide one of the best means of addressing these problems.¹⁴ This is because "in an open environment like the sea, international co-operation is vital",¹⁵ and a primary purpose of institutions is to coordinate cooperation among multiple actors. Therefore, despite heavy criticism, institutions remain a vital site for political governance.¹⁶

So why is the GFG system of RFMOs failing and what can we do about it?

1.1.1 Design and Architecture

There are two main institutional ideas diagnosing this failure and, implicitly or explicitly, providing policy direction.¹⁷ First, it is observed that despite failing collectively, some RFMOs do better than others, and it is to the sources of this variation that we should look for insight into action. This variation can be due to both internal and external attributes, called in the literature their *design* features and problem structure or setting, respectively.¹⁸ The hope is that, after controlling for differences in institutions' individual problem setting, which are typically rather intractable, some design features, which are thought to be more manipulable, can be identified that improve institutional efficacy under certain conditions so that new institutions can be designed more robustly and existing institutions can, where necessary, undergo promising reform.

¹¹In the face of uncertainty about the current and historical condition of stocks, fisheries scientists operationalise overfishing through catch rates. When catch rates fall to 10% of their historical 'high', the stock is considered depleted or collapsed. See FAO Fisheries and Aquaculture Department 2012.

¹²Mora et al. 2009.

¹³Agnew et al. 2009.

¹⁴Balton 2004.

¹⁵Beslier 2004.

¹⁶Vogler 2003.

¹⁷There are other, non-institutional ideas about how one might 'save the fish', but these are not the topic of the current study.

¹⁸Koremenos et al. 2001.

This approach is popular among policy circles. The most prominent example within global fisheries governance are the “best practices” reports financed by the fisheries-related departments of the Australian, British, Canadian, and New Zealand governments, along with the World Wildlife Fund, published by Chatham House, and prepared by an international panel of experts.¹⁹ The aim of these reports were to “develop a ‘model RFMO’ based on a comprehensive assessment of best practices worldwide”.²⁰ In other words, what constitutes a model RFMO is largely a question of design.

It is also popular within the academy. Most scientific research on RFMOs tends to either study RFMOs comparatively,²¹ as the expert panel did, or focus on individual RFMOs as case-studies of particularly good or bad practice in especially favourable or challenging circumstances.²² This comparative institutional focus is representative of a more general approach, and indeed the study of international institutions in this way has a long, strong heritage within International Relations (IR) and political science more broadly.²³

Second, some policy-makers and commenters have located the problem not so much in poor institutional design, but in actors’ lax participation in those institutions. The argument here is that, because the voluntary framework of international law requires states to submit to the kinds of collective authority offered by institutions such as RFMOs,²⁴ improving RFMO design is irrelevant if the actors most required by the institution to be effective are not members.

This idea has been articulated many times in policy rhetoric. President of the United States Bill Clinton recognised the importance of participation when he stated that it was “problems of ‘non-member’ fishing that have undermined the effectiveness of regional fishery organizations”.²⁵ Later, the Introduction to the

¹⁹Lodge et al. 2007; Mooney-Seus and Rosenberg 2007; Owen 2007; Bjørndal and Martin 2007.

²⁰Lodge et al. 2007, p. 9.

²¹For example Webster 2013.

²²For example Webster 2011.

²³Hasenclever et al argue that this may be driven in part by the empirical proliferation of institutions (Hasenclever et al. 1997). While IR is notorious for attending to current proliferations, perhaps a more compelling reason for the persistent attention attracted by institutions is their implicit or explicit promise to enable actors to govern collective problems. Unsurprisingly then, one of the main debates in the institutional literature to date has concerned how effective international institutions are in general or specifically. Sceptical questions originally posed by realists about whether international institutions are effective at all or mere epiphenomena have proven hard to shake (e.g. Mearsheimer 1995), but a range of responses from neoliberal and constructivist corners have proven resilient (for an overview see Stokke 2012, pp. 11-16).

²⁴Reus-Smit 1997.

²⁵Balton 1996, p. 61.

International Plan of Action on IUU Fishing considered the ineffectiveness of global fisheries governance as being “due to a lack of political will, priority, capacity and resources to ratify or accede to and implement them”;²⁶ in other words, actors’ participation in institutions, rather than any particular features of the institutions themselves, are the basis for effectiveness and ineffectiveness.

This idea has been somewhat less developed in academic circles than the design approach.²⁷ Most research on the topic of RFMO (non-)participation has involved diagnostics on the piratical subject of IUU fishing.²⁸ Much of the literature on IUU fishing concerns how international legal rules of consent to be bound and flag state jurisdiction play out in the context of global fisheries governance. On an actor level, IUU fishing can break down into two categories. First, fishing vessels may ‘flag’ (register) with Flags of Convenience (FOC), which are states that are not members of relevant RFMOs and thus fishing vessels registered to them may legally fish as much as they like in line with the letter of the law.²⁹ Second, fishing vessels may flag with Flags of Non-Compliance (FONC) where, although the registering state is a member of the relevant RFMO, they can expect that the state will not exercise flag state jurisdiction for profit or due to poverty and thus they can fish with relative impunity.³⁰ Such IUU behaviour not only impacts global fisheries governance by contributing to overfishing, but the associated under- or unreporting also increases the uncertainty surrounding scientific advice on appropriate catch levels. This uncertainty exposes the regulatory decision-making process to more political considerations, which are typically weighted towards short term than long term values. Moreover, the illegality or unregulatedness of IUU fishing highlights the free-rider problem to actors and undermines collective trust in the institution’s efficacy.³¹ The failures of global fisheries governance then, many lament, is not due to a lack of or better designed RFMOs, but appropriate participation.³²

²⁶FAO 2001.

²⁷Perhaps this is due to concepts like “political will” being difficult to define, let alone conceptualise and measure.

²⁸For an excellent example, see DeSombre 2005.

²⁹The compliance of such activity with the letter of the law is debatable in the context of Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), but the practice continues nonetheless.

³⁰Again, there have been inroads into the impunity or efficacy of this behaviour, but this is not the topic of the current study.

³¹Ostrom 1990.

³²Benn 2011.

1.1.2 The Argument

In thinking about how global fisheries governance has evolved, this thesis does not consider these two ideas of institutional design and participation as competing but rather as complementary. If institutions can only be effective if they have the right participants, then institutional design might represent one way of attracting members. One does not want to design institutions only to attract participants at the risk of compromising their ability to practice their regulatory role though. And then there is the question of whether these aspects even add up to more effective institutions. I thus consider them offering complementary narratives across what I assert are three central purposes for any collective sociopolitical institution: attracting and maintaining the right members (**‘participation’**), fulfilling its primary regulatory role adequately (**‘practice’**), and ultimately impacting the behaviour of institutional participants positively (**‘performance’**). In such ways, then, institutional **design** and participatory **architecture**—attribute and structure—co-evolve.

While the thesis is synthetic in perspective, its contribution lies more on the side of the participation narrative. This part of the narrative is important because, while institutions’ design rarely changes, their membership is much more fluid, especially as the composition of the interstate system changes and new states gain sovereignty, develop, and engage with the existing framework of international institutions. Moreover, while institutional (non-)participation has been problematised and design-related routes to attracting participation have been explored, little attention has been paid to the endogeneity of institutional participation and how patterns of participation may attract or dissuade further institutional participation, affect how an institution regulates, or how effective an institution is on the behaviour of members and non-members.

My main argument in this thesis is that **the architecture of relations between actors and institutions influences all three central institutional functions—participation, practice, and performance—and thus how global fisheries governance has evolved.**

This dissertation makes this argument by way of a relational approach. I call it an ‘approach’ to capture how it couples relational or network theory and method, and to distinguish it as more productive than ‘just an ontological perspective’ and more principled than ‘just tools for presenting data’. In demonstrating this approach, this thesis makes theoretical, methodological and substantive contributions. Before

outlining these contributions, the following section presents some of the key analytic moves made in this argument and, with respect to the existing literature, presents the theory in broad strokes.

1.2 Literature

The primary contribution of this thesis is the early development of a relational theory, which I will call ‘institutional relationalism’, for the study of what I call **governance complexes**: the actors and institutions involved in the governance of particular issue areas, and various relations between and among them. Before outlining some of this theory, though, I will review two sets of literatures from which this theory and indeed approach gains inspiration.

1.2.1 Relational Institutionalism

The philosophical position of relationalism, upon which relational institutionalism is premised, can be seen as the other side of the coin from substantialism. Indeed, they are often considered contrasting.³³ Whereas substantialism emphasises entities as the building blocks of social analysis, relationalism accentuates relations between and among them. However, both are, of course, implicated in our accounts of reality—just as light can be analysed as both a particle and a wave, depending on one’s purpose³⁴—and there are few (if any) scholars who wholly represent one side or the other. Still, I shall argue here that a relationalist perspective holds particular promise here for the analysis of large-scale phenomena such as governance complexity.

For relationalists, the “stuff of social reality—of action no less than structure, and their intersection in history—lies in relations”.³⁵ Indeed, the stuff is not just material. Nothing has meaning except through relations: “if structures exist it is because they are continually being created and recreated, and if the world has meaning, it is because actors are constructing and reconstructing intentions and accounts, and thereby, their own and others’ identities”.³⁶ A relational

³³For more on the distinction between substantialism and relationalism see Tilly 2008.

³⁴Jackson and Nexon 1999, p. 292.

³⁵Bourdieu and Wacquant 1992, p. 15; relational sociology has a long heritage in the mould of Marx, Simmel, Durkheim, Weber, Douglas and Bourdieu, and has more recently been championed at and around Columbia University: Emirbayer and Goodwin 1994; Emirbayer 1997; Emirbayer and Johnson 2008, This dissertation will not and does not need to go as far as Bourdieu and Emirbayer, but many of their insights are useful here.

³⁶Scott 2004, p. 13; see also White 2008.

approach thus recognises that the preferences, positions and properties of actors and institutions are only meaningful relative to one another.

The ‘relational turn’ implementing this position into social scientific research has been embraced by a growing number of scholars, especially within sociology.³⁷ It has also become more popular in IR, largely through the work of Patrick Thaddeus Jackson and Dan Nexon.³⁸ However, despite the growing popularity of such approaches, the only other work within IR that I am aware of attempting to develop what he calls a ‘relational institutionalism’ is Nexon’s book, *The Struggle for Power in Early Modern Europe*.

Nexon’s book and the current work share many features, such as a macro-historical perspective and an interest in explaining “transformations in [...] structure”.³⁹ Yet, despite calling his theory ‘relational institutionalism’, the framework Nexon develops does not explicitly include institutions. Instead, his framework consists of relations between actors, and these relations are equated to institutions.⁴⁰ For Nexon, this is unproblematic. His relational institutionalism is the product of joining relationalism with historical institutionalism, and it is from the latter tradition that he gains his conception of institutions as “ligatures fastening social sites, relationships, and large-scale processes to each other to produce historically variable outcomes”.⁴¹

But while I would accept that this treatment of relationships as institutions and institutions as relationships is a legitimate analytic move in the context of bilateral relationships, such as those prevalent in early modern Europe, modern global governance is replete with multilateral institutions. Indeed, systems such as global fisheries governance can hardly be described without explicit reference to formal, multilateral institutions such as RFMOs. Therefore, an *institutional* relationalism must accommodate the explicit inclusion of institutions. As we shall see in the following subsection though, too much of a focus on institutions and the relationships between them without explicitly including and endogeneising actors is also unsatisfactory.

³⁷Emirbayer 1997; Mische 2011.

³⁸Jackson and Nexon 1999; see also for example Cederman and Daase 2003; Montgomery 2005.

³⁹Nexon 2009, p. 22.

⁴⁰See for example Nexon 2009, p. 17.

⁴¹Katznelson 1997, p. 103 cited in Nexon 2009, p. 32.

1.2.2 Institutional Complexity

As stated above, IR has long studied international institutions and how they vary in their purpose, design, and effectiveness. Until recently, these literatures have primarily focused on explaining institutional effectiveness from institutional design, or institutional design from the problem structure it engages, but typically treated each institution and its trajectory as largely independent. Treating institutions as decomposable on analytic grounds facilitated the comparative institutional approach, but scholars increasingly recognise that institutional causes and effects are also interdependent. This recognition has in part been motivated by observations of institutional proliferation and increasing “regime density”,⁴² but scholars have had differing reactions to this observation.

On the one hand, Kal Raustiala and David Victor’s seminal 2004 article in *International Organization* has led to substantial interest in what they call ‘regime complexes’.⁴³ They define regime complexes as “array[s] of partially overlapping and non-hierarchical institutions” or “elemental regimes” governing a particular issue-area.⁴⁴ Elemental regimes have four main features: (1) they are “distinct fora with participation of different sets of actors”; (2) they “overlap in scope, subject, and time; events in one affect those in others”; (3) importantly though often not emphasised in this literature, they have “divergent rules and norms”; and (4) while rules can overlap, there is no overall hierarchy structuring the whole set.⁴⁵ Note that the picture presented here is a methodologically individualist one, made up of “arrays” of largely independent, “distinct” things that sometimes “overlap” or interact substantively once instituted. This atomisation may be due to a more direct inheritance from the regime literature than the governance architecture literature below.

In collaboration with Robert Keohane, Victor has since produced a more normative piece presenting the advantages of regime complexes over integrated regimes.⁴⁶ In it they argue that the polycentricity of regime complexes has the twin advantages of “flexibility and adaptability”; leaving room for innovation, redundancy, and choice. While they avoid proclaiming regime complexes superior in all circumstances, a clear normative preference is displayed, one that is consistent

⁴²Young 1996, p. 1; see also Zürn et al. 2007; Stokke and Oberthür 2011, p. 5.

⁴³Raustiala and Victor 2004, pp. 278-279, 299, 305.

⁴⁴Incidentally, calling something elementary seems to attract decomposition, at least in the natural sciences: Simon 1962, p. 468.

⁴⁵See also Keohane and Victor 2011, p. 8; Alter and Meunier 2009, p. 13.

⁴⁶Keohane and Victor 2011, pp. 16-19.

with the atomisation of methodological individualism and identifies productive consequences to pluralism.

On the other hand, Frank Biermann and his associates at the Global Governance Project approach similar phenomena from a more holistic angle.⁴⁷ They define “the overarching system of public and private institutions - that is, organisations, regimes and other forms of principles, norms, regulations and decision-making procedures - that are valid or active in a given issue area of world politics” as a global governance architecture.⁴⁸ They see governance architectures as the “meta-level of governance”, consisting of “patchwork[s] of international institutions that are different in their character (organisations, regimes and implicit norms), their constituencies (public and private), spatial scopes (from bilateral to global) and subject matter (from specific policy fields to universal concerns)”.⁴⁹⁵⁰ The governance architecture literature captures considerably broader phenomena than that of the regime complexity literature, including both public and private institutions, with its more holistic “overarching”, “meta-level” and systemic analytic perspective. Note however that the whole still consists of distinct things, institutions arrayed in a “patchwork”.

Normatively, Biermann and collaborators are wary of polycentrism for the rule conflicts expected to abound without integration or centralisation.⁵¹ This perspective can be found in the primacy of principle over practice in their research. The deontological nature of rules demands hierarchy to avoid conflict, rather than the pragmatism of practice. They thus see institutional complexity as many international lawyers do: a perturbingly fragmented departure from an (equally legalese) integrative utopia.⁵² Unsurprisingly then, these scholars are also those often advocating centralising the global environmental governance system with a UN or World Environmental Organisation.⁵³ Their commitment to methodological holism brings with it a normative tendency towards the whole, even if they do not make this a prescriptive element in their programme.

⁴⁷Biermann et al. 2009b; Biermann et al. 2009a.

⁴⁸Biermann et al. 2010, p. 16; this renders architecture “broader than the concept of international regimes”, yet “narrower than the notion of order”: Biermann et al. 2009b, pp. 15-16.

⁴⁹Biermann et al. 2010, p. 16.

⁵⁰Arguably the nesting of multiple, potentially overlapping governance architectures within what they contend is a broader (and more vague) notion of ‘order’ suggests the governance level is rather a penultimate one.

⁵¹For a recent expression see Biermann et al. 2010.

⁵²Koskenniemi and Leino 2002; see also Benvenisti and Downs 2007.

⁵³Biermann and Bauer 2005; such an entity is supposed to act as a gravitational centre for the myriad of multilateral environmental agreements: Meyer et al. 1997.

While these literatures do start from quite different assumptions, they also share some important features. First, they both identify institutional interlinkages as relevant for many global risks which we strive to govern.⁵⁴ Second, they recognise that these interlinkages result in complex interdependencies between these institutions and that the whole is thus not necessarily the sum of its parts.⁵⁵ Third, they understand that these insights have methodological implications, for if individual regimes are non-decomposable from others they cannot be isolated for study let alone experimentation.⁵⁶ Institutions are neither formed nor maintained on a “clean slate”, a fact well known by international negotiators and occasionally recognised by but rarely of methodological import to researchers.⁵⁷ Because of this shared attentiveness to the complexity inherent in issue areas governed by multiple, interdependent institutions, these literatures are sometimes referred to together as institutional complexity.⁵⁸

However, while the current literature is admirably cognisant of complex interaction, institutional complexity has an emphasis on institutions that leaves actors an exogenous or supporting role at most. Of course, both literatures do reference actors, particularly states and especially when explaining institutional creation. In an excellent example of this, Stokke and Oberthür champion an approach marrying institutional interaction with (institutional) interplay management that is explicitly actor-oriented.⁵⁹ Their contribution highlights actors’ strategies of dealing with complex institutional interaction in a way that is theoretically parsimonious but powerful.⁶⁰

Yet, actors are not just the creators or consumers of institutional complexity, but their choices are indeed shaped by the institutional structure in which they are embedded. Alter and Meunier recognise such a blindspot in the literature and suggest it is due to its institutional emphasis.⁶¹ If we are to understand the evolution of the politics of institutional complexity, they argue, then this gap must be filled. Alter and Meunier also comment that such a research focus on how actors perceive institutional complexity cannot be satisfactorily explained by rational choice for,

⁵⁴Raustiala and Victor 2004, p. 278.

⁵⁵Alter and Meunier 2009, p. 15; here institutional complexity interfaces with the trans-disciplinary complexity science literature: Urry 2005; Castellani and Hafferty 2009.

⁵⁶Raustiala and Victor 2004, pp. 277-278; the implications for ‘best practice’ studies such as Lodge 2007, are damning.

⁵⁷Raustiala and Victor 2004, p. 296.

⁵⁸Oberthür and Stokke 2011.

⁵⁹Stokke and Oberthür 2011, p. 6.

⁶⁰See Stokke and Oberthür 2011, pp. 9-10.

⁶¹Which may be inherited from its progenitor, regime studies.

while institutional complexity does offer a wealth of choice, the overwhelming amount of information can also frustrate the strategic, rational exercise of choice and lead to selective information processing and a reliance on heuristics.⁶² Indeed, as a next step for the literature, Alter and Meunier suggest that:⁶³

We need to better understand heuristics - informal methods, ideologies, ideas, and rules of thumb. How are heuristics generated and changed? When and how do heuristics shape decision-making? How do heuristics vary across states, cultures and time? Once we know more about the heuristics states use, the formal approaches of complexity studies can help us think about how heuristics play out over time, and about how changing heuristics and assumptions may alter outcomes.

Therefore, whereas I have argued the relational institutionalist literature requires an explicit incorporation of formal institutions, a next step for the literature on institutional complexity is a more explicit incorporation and indeed endogeneisation of actors so as to understand how their heuristics form and are formed by the structure of what I call the governance complex around them. The next section sets out what I mean by a governance complex and offers a brief vignette of the relational theory developed in this thesis for studying such governance complexes.

1.3 Toward an Institutional Relationalism

1.3.1 Governance Complexity

This thesis thus seeks to build theoretically upon and contribute to two sets of IR literatures: work in IR taking the relational turn, and especially Nexon's relational institutionalism, and the institutional complexity literatures. Put simply, it does so by explicitly including and endogeneising multilateral institutions into a relational institutionalist framework and by explicitly including and endogeneising heuristic-using actors into a institutional complexity framework.

To recap, the main argument of this thesis is that the architecture of relations between and among actors and institutions influence three central institutional functions: participation (such as cooperation or membership), practice (such as legislative or regulatory behaviour), and performance (i.e. effectiveness). This

⁶²Alter and Meunier 2009, p. 17; see also Wilson 2002, p. 335.

⁶³Alter and Meunier 2009, p. 18.

main argument can now be informed by the discussion of the past section. Like the institutional complexity literatures, I consider RFMOs' fulfilment of these functions interdependent in complex ways. Each RFMO is part of the larger global fisheries governance complex. However, as many relational sociologists would, I consider this interdependency to be driven by states' overlapping and interlocking participation in those RFMOs.

The theory thus takes as its principal empirical components the primary actors and institutions populating a given issue-area, as well as various relations between and among them. As a label for the combination of these empirical components—actors, institutions, and relations between and among them—I use the term 'governance complexity', a blend of the labels for the two institutional complexity literatures, 'governance architectures' and 'regime complexity'. This thesis therefore studies the "global fisheries governance complex".

Relations can have different content.⁶⁴ They may be state-based, such as friendship or membership, flow-based, such as the movement or exchange of material or ideas, or event-based, such as the transmission of an email or a meeting of two bodies at a particular point in time.⁶⁵ The phenomena of governance complexes encompasses all these types of relationships. This multiplexity is inescapable and of theoretical and empirical interest as relationships are often "thick" with multiple dimensions of understanding and influence. Moreover, the embedding of actors and institutions in multiple networks of different content points to their frequent maintenance of multiple roles and identities simultaneously.⁶⁶

The relational approach I propose here gives analytic prominence to the state-based, associational, *architectural* relationships between and among actors and institutions such as countries' cooperative or membership affiliation in RFMOs described and explained in chapters 2 and 3.⁶⁷ While some relationalists disparage such architectural relations for not "adequately captur[ing] the dynamic interplay of 'negotiation and creativity' often at stake in specific processes of transformative and reproductive collective action",⁶⁸ this represents a misunderstanding of the nature of architectural relations between actors and institutions. While social architectures

⁶⁴See Simmel 1955.

⁶⁵Knoke and Yang 2008; Stadtfeld 2012; Mellon and Hollway 2013.

⁶⁶Uzzi 1996; Uzzi and Lancaster 2003; Ingram et al. 2005, p. 829; White 2008.

⁶⁷Borgatti and Foster 2003; Borgatti and Lopez-Kidwell 2011.

⁶⁸Nexon 2009, p. 27.

between only actors may be seen as the “congealed residues of history”,⁶⁹ the act of actors affiliation to institutions does still *mean* something aside from the frequency or intensity of practice between actors and institutions alongside (or instead of) it.

Indeed, architectural mappings are more appropriate for the kind of questions asked here.⁷⁰ While flow- or event-based studies might be more appropriate for investigating how, say, nodes pick up traits (a homogeneity model) or capital (a contagion model) through the flow of material or ideational resources, neither are the chief concern here.⁷¹ This study is concerned instead with the coordinative facilities and structural power afforded by social capital residing in architectural positions as represented analytically by an architectural network.⁷²

Therefore, where I use architecture in this study I mean it as a networked structure of affiliational or associational ties between or among actors and institutions. This has the benefit of moving beyond nebulous metaphor and introducing some conceptual precision to the literature. One important implication of this move for the literature is to cleave architecture from institution, which are often conflated. If, as I argue here should be the case, we consider architectures to be the overall structures of associational ties between actors and institutions, then institutions become mere (albeit important) nodes within the architecture and the architecture itself becomes abstracted away from actors’ decisions to affiliate with particular institutions.⁷³ This renders architectures emergent and “spontaneous” and not intentional or negotiated;⁷⁴ if architectures were negotiated, I suggest, they would be institutions. Architectures are therefore both the product and the context of actors’ decisions.

1.3.2 Relational Theory

How does this all translate into an institutional relationalist *theory* of governance complexity? I state the theory here explicitly in terms of three assumptions:

⁶⁹Padgett and Powell 2012, p. 3.

⁷⁰Emirbayer and Goldberg 2005, p. 508.

⁷¹Borgatti and Foster 2003; Borgatti and Lopez-Kidwell 2011; for a recent attempt studying the exploitation of marine fisheries using network economic flow models see Mullon 2013.

⁷²An advantage is that, as architectural ties tend to be binary (unweighted), they are more amenable computationally to structural analysis and modelling.

⁷³This is in line with the empirics. So far institutional complexes “have not arisen from collective bargaining or institutionalized decision making at the aggregate level but rather have gradually evolved from, and are continuously shaped and reshaped by, the numerous decentralized decisions made within individual institutions and the interaction effects thereby arising”. See Oberthür and Gehring 2011, p. 47.

⁷⁴See Oran Young’s discussion of Hayek’s term of “spontaneous order” in Young 1982, p. 282.

1. Actors (including collective actors) are influenced by other actors' actions . . .
2. Particularly those to which they are already tied . . .
3. And especially under conditions of uncertainty and complexity.

From almost all theoretical perspectives, the first item will appear rather banal. Rationalists and constructivists agree, for example, that actors care about what other actors are doing and may be influenced by their behaviour (though perhaps on different grounds).

The theoretical work is done in the second item of the statement. Institutional relationalism rests upon the notion of a reference group, operationalised as co-members or partners in an institution. When actors join an institution, they not only tie themselves to the institution, but also to all other members of that institution. I argue that, in diverse ways, these institutional partners then serve as a reference group for action, whether it be further relational action (such as joining new institutions) or behavioural action (such as how much to legislate or how much of a resource to extract). Not all institutional partners will be influential, and not all influential institutional partners will be influential all the time. Moreover, one or more actors may choose to differentiate themselves from their reference group, perhaps for competitive reasons. Often though, the actions of an actor's reference group will have isomorphic influence. I argue that this influence occurs through several relational mechanisms by which we might expect patterns of participation to influence institutional functions, such as how an RFMO might appear more attractive to a state if its partners in another RFMO have already joined or if the RFMO's current members are similar to the state in some way. Such *relational mechanisms* are elaborated later in the main content of this thesis with respect to particular institutional functions.

Lastly, I propose that there are two conditions under which we would expect the reference groups actors gain by joining multilateral institutions to play a stronger role: uncertainty and complexity. The first covers situations in which actors are uncertain about the effects of their actions, for example whether an RFMO a state is considering joining will be effective or not. I argue that actors seek to mitigate such uncertainty by taking cues about the efficacy of their actions by observing the actions of their reference group. The second condition is broader. As a governance complex grows, with more actors, more institutions, and more relations between and among them, it usually becomes more complex, frustrating even resourceful

actors' cognitive ability to keep track of all activity and reintroducing uncertainty. But complexity does not simply reduce to uncertainty. Complex interdependencies also introduce occasionally quite powerful externalities into actors' decision-making processes.⁷⁵ For example, a state may join an RFMO to mitigate the structural advantage other states may gain through collective action. While uncertainty and complexity overlap, they are nonetheless analytically distinct and together provide important conditions for when we might expect the theoretical statement above to hold most strongly.

Later, I articulate and demonstrate the mechanisms of this theory, such as popularity, homophily, and closure. But these three assumptions are the main tenets of the theory. Next I outline how I will develop this theory in this thesis and demonstrate that patterns of participation influence three central institutional functions: participation, practice, and performance.

1.4 Setting Course

Having presented this thesis' argument, it is the purpose of this section to outline how this dissertation's seven chapters aggregate to make this argument and to discuss the status of its findings.

1.4.1 Bearing

The argument of this thesis is that relational mechanisms, expressed as patterns of participation, influence all three central institutional functions—participation, practice, and performance—and thus how the global fisheries governance complex has evolved. These relational mechanisms combine with institutional design, problem setting, and other explanations to provide an explanation of how the global fisheries governance complex has evolved.

Armed with such an explanation, I argue that we can better understand how states' choices about how to design or re-design RFMOs will interact with the existing participatory architecture and the impact they will have on attracting further participants, performing their central regulatory role, and ultimately how they will affect behaviour.

In demonstrating this argument, this thesis also demonstrates how the theory and method developed here combine to provide a viable relational approach for

⁷⁵On the distinction between information and externality arguments see Kinne 2013.

studying other governance complexes beyond the exemplar case of the global fisheries governance complex.

Since the institutional complexity and relational institutionalist literatures are rather embryonic,⁷⁶ this study adopts an abductive approach that seeks to combine analytically distinct mechanisms to provide an account of the evolution of the global fisheries governance complex, rather than to test existing theory. But while this does result in a case-specific narrative in which the empirical insights are limited to the GFG complex, the approach taken here and the mechanisms uncovered are analytically generalisable.⁷⁷

Explanatory power in relational sociology rests not in causal regularities as it does in variable, interactional work, but in the hunt for causal processes, powers, or mechanisms. Scientific reductionism then is not from structure to things, but to relations and the mechanisms that work upon those relations. Relational sociologists try to identify recurrent mechanisms that affect relations in different contexts, while recognising that any particular outcome is due to a unique interplay of these mechanisms and thus ultimately idiographic.⁷⁸ All humans are unique, for example, but we can and do still say something about how the interacting processes at different levels, for example the cellular level, giving rise to a unique human can be generalised.⁷⁹ This project thus contributes to the hunt for processes and mechanisms, not looking for regularity-based laws of governance complexity. The resulting insights into mechanisms of complexity can then be used to tease at other questions of international cooperation, common-pool resource governance, socio-ecological complex systems, and resilience.

1.4.2 Waypoints

While this thesis has an overarching argument, it can nonetheless be seen as making this argument over two parts.

The first part, consisting of the following two chapters, concentrates on describing the global fisheries governance complex. Accurate description is, I argue, under-appreciated in contemporary social scientific scholarship, but remains

⁷⁶See Stokke and Oberthür 2011, p. 14; Nexon 2009, p. 22.

⁷⁷Nexon 2009, p. 27.

⁷⁸This is a realist reading of relationalism: Tilly 2008; relationalism does also have space for a more analytic reading though: Jackson and Nexon 1999; Jackson 2011.

⁷⁹Whether this is an empirical or analytic generalisation of processes, powers or mechanisms depends on the type of relationalism practiced.

a crucial research step. It is even more crucial in the case of governance complexity studies.

The first of these two descriptive chapters introduces the three core elements of a 'language' of governance complexity: actors, institutions, and the relations between and among them. I justify why this thesis focuses on states as the actors, RFMOs as the institutions, and two core participatory architectures of states cooperative and membership affiliations in these RFMOs as the main architectural relations of interest.

The second of these two descriptive chapters turns the attention to measurement. Description is at its most analytic when it facilitates comparison and categorisation. I first argue that these three components can be fruitfully represented as networks, and conclude the chapter with some graphs of how networks of these three components have evolved through time. I then consider one of the primary concepts by which institutional complexity describes and compares institutional complexes: fragmentation. I find that the concept does not offer us so much analytic traction here, and instead propose a two-dimensional way of characterising architectures based on two key network concepts: centralisation and clustering. The chapter then turns its attention to three additional concepts prevalent in the institutional complexity literatures—fit, linkages, and nesting or overlap—and provides relational reconceptualisations of them that facilitate measurement. I conclude this section by arguing that the two-dimensional way of characterising architectures provides us with dimensions by which we might evaluate the sufficiency of a model explaining the evolution of a governance complex, and that the relational reconceptualisations of fit, linkages, and nesting point to ways in which we might problematise or theorise institutions' architectural interdependency.

The second part consists of three chapters that explain by way of statistical network models how RFMOs' three central institutional functions have evolved in the context of larger architectures and especially as influenced by several relational mechanisms.

The first of these three explanatory chapters considers how RFMOs might address the problem of non- or under-participation. It justifies why one should model this using statistical network models. It then elaborates several relational mechanisms—popularity, homophily, context, and closure—that combine with institutional design, problem setting and other explanations to provide a model that

explains how the core participatory architectures of cooperation and membership have evolved.

The second of these three explanatory chapters considers how RFMOs potentially face a trade-off between performing their regulatory role or ensuring that all relevant actors are members. It justifies why one should model these together as a coevolution of actors selecting institutions and institutions (as sites of collective action) choosing a level of regulatory behaviour. It also adds to the mix states legislative activity in the area of fisheries governance. It then elaborates several endogenous mechanisms inspired by the policy diffusion literature—emulation, learning, adaptation, coercion, harmonisation, and imitation—that combine with institutional design, problem setting and other explanations to provide a model that explains how the membership architecture, RFMOs’ regulatory behaviour, and states’ legislative behaviour all evolve.

The third of these three explanatory chapters considers how RFMOs’ effectiveness in changing actors’ fishing behaviour is interdependent. It first assesses the degree to which a “balloon” account of RFMOs collective failure is fitting, before adapting the analogy to study inter-institutional externalities that complicate the evaluation of RFMOs’ effectiveness. It proposes a notion of relational or ‘net effectiveness’ that is premised on the contribution of institutions and their features on the behavioural relationships states have with the resources RFMOs govern.

These two parts of the dissertation combine to provide a description and explanation of how RFMOs’ three central functions have evolved within the context of a greater GFG complex and, in particular, through relational mechanisms that operate along core participatory architectures. A relational approach supplements a design perspective on institutional evolution and provides a richer narrative about how institutions coevolve. The conclusion reviews this primary argument of the thesis, reviews the myriad ancillary contributions it makes, and considers ways in which it might be extended to new cases and by developing further theory and method.

Part II

Describing Governance Complexity

“Philosophy is written in that great book which ever lies before our eyes – I mean the universe – but we cannot understand it if we do not first learn the language and grasp the symbols, in which it is written.”

Galileo Galilei, *The Assayer* (1623),
as translated by Thomas Salusbury (1661), p. 178

2

Uncharted Waters

2.1 The Global Fisheries Governance Complex

GALILEO ONCE ARGUED THAT EXPLAINING the velocity of falling objects first requires an accurate description of their velocity.¹ While often maligned and rarely published, accurate, analytic description of historical process is and must be a central part of any work in International Relations. This is thus the purpose of the current and following chapters: to provide an analytic description of the evolution of the global fisheries governance complex, before transforming this description into an explanatory account in the next part of the dissertation.

Indeed, an accurate, analytic description of the global fisheries governance complex is sorely required because, while there is plenty of literature on fisheries governance, global fisheries, and global governance, the particular combination ‘global fisheries governance’ remains understudied. I briefly review the strengths and weaknesses of these literatures here.

First, there is a wealth of economic and environmental literature on *fisheries governance* and management, but this tends to deal with the global level only tangentially if at all. Few mention RFMOs,² the primary international institutions of the global fisheries governance complex, and those that do tend to be case-based regional studies lacking a more comprehensive global perspective. Several areas have received strong focus, including the North Sea,³ the Arctic,⁴ the Antarctic,⁵

¹See Russett 1985, p. 213.

²A Thomson Reuters Web of Science search returns only 21 (accessed November 2013).

³Skjærseth 2006.

⁴Stokke 2007; Stokke 2011.

⁵Stokke and Vidas 1996.

and the eastern Pacific,⁶⁷ but others are less popular. In part this may be due to the attraction of relatively well- or poorly-functioning regimes as exemplars of strong or weak regime designs or other aspects—which, considered as a literature, would be an extreme case selection strategy—but this case-based regional focus means few have engaged with the global level of abstraction required to encompass the interdependencies highlighted by the balloon problem.⁸ Some work studies the vertical nesting of RFMOs within major legal documents, especially United Nations Convention on the Law of the Sea (UNCLOS) and UNFSA.⁹ However, UNCLOS and UNFSA are only two institutions in a complex governance system and are more constitutive instruments than the cooperative, coordinative, or managerial RFMO institutions studied here. To be sure, these legal documents have changed RFMOs' legal setting profoundly, but they are not this study's central focus.

Second, what *global fisheries* literature there is rarely deals with governance. The majority of work on global fisheries is not political scientific but marine ecological, legal, or economic.¹⁰ These are broad, long-running literatures and, in discussing (over)fishing from their disciplinary perspective, they inevitably touch upon political issues. However, with a few exceptions,¹¹ these approaches typically elide issues of political power and participation in fisheries cooperation and coordination and do not give them the attention they deserve. An example of where the study of politics can contribute conceptually is from the study of global governance. Used analytically,¹² global governance captures certain recent phenomena or processes in world politics, such as the recognition of a host of non-traditional actors and institutions involved in governing, that are otherwise not well captured within the traditional notions of IRs.¹³ Indeed, the idea that world politics consists only of nation-states is a contemporary and historical fiction.¹⁴ While there has been some recent work on transnational certification schemes like the Marine

⁶Walsh 2004.

⁷In this view, even the burgeoning academic and policy literatures on the supranational European Common Fisheries Policy is insufficiently global, and consequently insufficiently attentive to important externalities.

⁸Barkin and DeSombre 2013, see chapter 6.

⁹On UNCLOS see Vidas 2000; on UNFSA or both see Boyle 1999; Stokke 2000; Stokke 2001.

¹⁰Sydnés 2002; Munro 2006; Finus et al. 2011; Grafton et al. 2006; Tarasofsky 2007.

¹¹For a particularly good example see Österblom and Bodin 2012.

¹²To be clear, taking a global fisheries governance perspective analytically does not necessarily wed research to government ideals such as a global fisheries or world environment organisation; these are separate, normative questions. See Dingwerth and Pattberg 2006, p. 189.

¹³Senghaas 1993; Finkelstein 1995; Keohane 2001; Paterson et al. 2003.

¹⁴Sørensen 2004; Hurrelmann et al. 2007.

Stewardship Council and other GFG actors,¹⁵ this has barely touched the surface of an issue area awash with transnational actors at all levels. Still, the impact of these new entrants on the rather conservative international system can be easily overstated. More research is needed that looks not only at either 'old' or 'new' actors and institutions, but how these sets interact. In sum, it is important that the social scientific and especially political study of global fisheries catch up to the ecological and economic literatures so that the gap between technical solutions and the political realities of different values and perspectives might be breached.

Third, the *global governance* literature rarely deals with fisheries. This was not always the case. In the 1970s and 1980s, IR scholars were fascinated by international fisheries,¹⁶ perhaps because the prolonged, historic politics of the innovative Third Conference on the Law of the Sea (UNCLOS III) overlapped with the contemporary theoretical interest in institutional formation. However, the interests of the discipline then moved on to institutional effectiveness and legitimacy at a time when UNCLOS appeared stalled and indeed IR distanced itself from international law more generally.¹⁷ As such, international fisheries fell out of general disciplinary interest and became the remit of specialists who have since largely focused on specific regimes. Even now, while the emerging institutional complexity literatures appreciate that issue area-related institutions are interdependent, they choose to demonstrate this with more publicly visible issue areas such as climate change.¹⁸ This is unfortunate, for global fisheries governance is a fractal within which one can find many classic problems of global environmental governance, such as the tragedy of the commons and institutional complexity identified in the last chapter, as well as plenty of interesting variation in how these challenges are addressed empirically. The study of global environmental governance would benefit from renewed attention to global fisheries governance.

¹⁵The Marine Stewardship Council or MSC was established as a sort of joint venture between the International Non-Governmental Organisation, the World Wildlife Fund, and a corporation, Unilever, as inspired by the success of the Forest Stewardship Council certification scheme. The MSC represents one of several attempts to employ transnational certification schemes, and there are now around a dozen consumer codes or advisory lists in circulation. For more see Gulbrandsen 2005; Auld and Gulbrandsen 2010; Gale and Haward 2011.

¹⁶Buzan 1981, E.g. Sebenius 1984.

¹⁷Slaughter 1993; Slaughter et al. 1998.

¹⁸Indeed, I coin the term global fisheries governance to introduce some parity for fisheries with the currently more popular topic in global environmental governance: global climate governance. See Biermann et al. 2009b, p. 17; see though Stokke 2000; Young 2006; Alcock 2011; Oberthür and Gehring 2011, pp. 26-31.

The last three paragraphs have shown that there are lacunae in multiple literatures for an analytic description of the overall structure of the global fisheries governance complex. Since global fish stocks are in such dire straits (see chapter 1), there are also compelling practical reasons to fill this gap. Moreover, if we want to know why the system evolved the way that it did, we must first describe how it evolved, as intimated in the reference to Galileo in the first sentence of this chapter, and this motivates this part of the dissertation.

However, it is not the first sentence but the epigraph that informs the purpose of this chapter: to learn the language or grasp the symbols in which a relational universe is written. As I established in chapter 1, I conceive of the *empirical* substance with which this thesis is concerned as a “global fisheries governance complex”. A governance complex consists of actors, institutions, and relations between and among them. The next three sections takes each of these elements in turn, defines and discusses them. Together, these are the main characters in the narrative to follow and so some time is spent introducing them. Finally, as I will for each chapter in this dissertation, I will summarise the findings of the chapter in a section entitled “Catch of the Day” and connect it to the following chapter.

2.2 Actors

The concept of the ‘governance complex’ used here has been defined intentionally broadly. In principle this enables it to encompass a broad set of actors, including but certainly not limited to nation-states, leaving plenty of room to extend upon this dissertation and leverage the flexibility of the framework proposed here to incorporate so-called ‘new’ actors and institutions that are increasingly playing particular roles in global fisheries governance.¹⁹ However, to begin with, this thesis restricts itself to the main, core actors and institutions of the global fisheries governance complex. The main actors are states.

2.2.1 Why States?

There are three reasons for concentrating on states here: power, accountability, and legitimacy. First, although a state-only narrative would clearly be inadequate for telling the whole story about global order,²⁰ a state-based narrative is often the first cut into a particular political historical narrative, and for good reason: states

¹⁹See Green 2013.

²⁰Hurrell 2007, p. 6.

are the most powerful actors in world politics. While the nature of the state has changed,²¹ state-like polities have been the dominant and indeed constitutive actors of international politics for some time. This is slowly changing, but the state and its relevance to world politics are unlikely to disappear any time soon.

Second, whether this power translates into efficacy or not, states are thought to be accountable for managing public or collective goods such as fisheries and other environmental resources. Despite the “very prevalent suspicion of the state on the part of many ecologists”,²² a historically contingent globalisation has left communities with the impression that the state is ascribed agentic powers and responsibilities to govern collective resources, and the expectation that they will do so in concert if necessary to govern global or regional resources.²³ This accountability is particularly important here because, while it is not states that fish but fishing companies and vessels registered in states, states serve as the accountable unit.

Lastly, since they are considered to be powerful and accountable actors, states have also long been considered the appropriate unit of statistical aggregation. While research making use of national data then contributes to the further naturalisation of this actor, this is largely unavoidable. The FAO, for example, still chiefly collates fishing information from its member *states*, and therefore the data unit is, most often, at the state level. This is beginning to change; IR-relevant data is increasingly being aggregated at (and produced for) non-state levels. But since the questions asked in this dissertation require considerable amounts of quality, historical data, this dissertation is tied to what is currently feasible.

Taking states as the actors of the global fisheries governance complex is thus a reasonable simplification of the system. This in no way precludes future work from elaborating and extending upon the framework developed here to a broader range of actors.

2.2.2 Which States?

This study concerns 198 ‘states’, including all sovereign states of the interstate system. Of course, not all states fish the high seas. Nearly a quarter (49) of these

²¹See the literature on the transformation of the state: Hurrelmann et al. 2007.

²²Hurrell 2006, p. 166.

²³Lipschutz and Conca 1993, p. 19; instead, the state continues to be more interested in economic than environmental matters, perhaps explained by its peculiar evolution: Dyer 2014, p. 85; see also Tilly 1985.

states do not report any high seas fishing. In 90% of these cases it is because they are landlocked.²⁴ So why include all states?

First, according to international law, all states have the sovereign right to access and fish the high seas.²⁵ This also means that states have the right to ‘flag’ or register fishing vessels despite not having an oceanic coastline. While this rarely happens in practice, this allowance does change the structural context many of these institutions operate in. Moreover, while not studied here, there are fisheries institutions governing international but landlocked bodies of water.

Second, some landlocked states were not always landlocked and/or would like to be coastal: Ethiopia lost its coastline when Eritrea became independent; Serbia similarly to Montenegro; and Bolivia to Chile in the War of the Pacific. Consequently, for complex historical and aspirational reasons, both Serbia and Bolivia are involved in global fisheries governance despite no oceanic fishing. Rather than arbitrarily decide on which states to include, I include all states and instead control for the lower probability of landlocked states showing interest in global fisheries governance where necessary.

Next, there are some non-sovereign territories that are nonetheless both enjoying a degree of autonomy and relevance to global fisheries derived from Exclusive Economic Zones (EEZs) covering productive fishing grounds, such as the Faroe Islands or Greenland.²⁶ For this study, I have chosen to subsume their participation under the state currently assuming sovereignty on their behalf. The main reason for doing so is the difficulty in parsing out independent agency otherwise. Informational limits are another reason. Only in some cases does some data exist for these levels, and never do we have complete information. Moreover, the former colonial states encompassing these far-flung territories – the United Kingdom, the Kingdom of Denmark, the French Republic – may be taking on extra-European Union (EU) participation on behalf of several territories simultaneously.²⁷ In any case, the role of these territories in global fisheries

²⁴For Bosnia-Herzegovina, Haiti, Myanmar, Somalia, Yemen People’s Republic, it is rather that we do not have any record of their fishing.

²⁵Articles 124 and 125 of UNCLOS.

²⁶Others, such as American Samoa, Commonwealth of the Northern Mariana Islands, French Polynesia, Guam, New Caledonia, Tokelau, Wallis and Futuna, have even weaker standing under international law. Nonetheless, these territories may participate in the work of the Western and Central Pacific Fisheries Commission (WCPFC) under the terms of article 43 and a separate rules of procedure. This is a distinctive level of participation though, and can be investigated in future work following the general framework provided here.

²⁷For example, while Greenland is not in the same legal situation as the Faroe Islands, in various cases their wishes are expressed jointly by Denmark, a member of the EU, or by the Faroe Islands on

governance is ambiguous, because it is unclear how other states treat these delegations. Assigning this participation to the sovereign state retains consistency in the meaning of ties/relations.

This does make things complicated within the EU though because the EU began assuming responsibility for the international fisheries policy of its members since the advent of the EU Common Fisheries Policy (CFP) in 1984. For many EU member states this tension could be resolved relatively unproblematically. When a state becomes an EU member, it ceases to be relevant for the global fisheries governance complex and so is effectively removed from the system; instead the EU, treated as an actor, takes full responsibility for these members' relations. However, the peculiar situation of the United Kingdom, Denmark, and France in particular highlights how an inflexible application of this rule would mean omitting their (parallel) membership on behalf of overseas territories not included in the EU and thus potentially a misrepresentation of the number of parties around the table and the power dynamics of interest in bargaining, for example. Ignoring the EU, on the other hand, would result in EU members appearing as non-participants of global fisheries governance artificially. Moreover, while the EU typically assumes responsibility for its members' participation in global fisheries governance upon their joining the EU or the start of the CFP (whichever the later), there are cases where other (than the UK, France, or Denmark) states retain membership in international fisheries institutions where membership precedes this date.²⁸ The notion of actorhood expressed here does encounter some difficult cases, but cases that are typical of the exceptionalism of the world political system.²⁹

Lastly, some ambiguity remains around fishing entities such as Chinese Taipei.³⁰ While not universally accepted as a sovereign state, compromises have been made that accept a truncated form of actorhood for Chinese Taipei in global fisheries governance owing to its high fishing activity.³¹ I therefore follow this decision and include Chinese Taipei here. For similar reasons, the Cook Islands is included here; it is also treated as a relevant actor in the global fisheries governance complex.

behalf of them both.

²⁸For example, Germany retains parallel membership in Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), and all EU member states that adjoin the Mediterranean retain membership in General Fisheries Commission for the Mediterranean (GFCM).

²⁹The notion of actorhood used here is broader or narrower than it may be in other issue areas, such as security.

³⁰Wang 2006.

³¹Note that Chinese Taipei is a member of the Inter-American Tropical Tuna Commission (IATTC) under the name 'Chinese Taipei', but participates as a fishing entity in the Extended Commission of the CCSBT under the name 'Taiwan'.

The change in composition of the actors in this complex is expressed in fig. 2.1. Start and end dates for the sovereignty (or sovereign-like status within this issue-area) of these states were taken from the Correlates of War project.³² As we can see in fig. 2.1, the result of these decisions is a system in which the number of actors at the end of the study period (198 at 2010-01-01) is more than twice the number of actors at the start of the study period (93 at 1960-01-01). Indeed, we see a general trend of actor growth, along with several periods of high actor growth through decolonisation or the fragmentation of existing states in Asia, Africa, Oceania, and Europe. Two states drop out of the system within the study period: East Germany through reunification with West Germany to form present-day Germany, and Yemen People’s Republic through reunification with Yemen Arab Republic to form present-day Yemen.

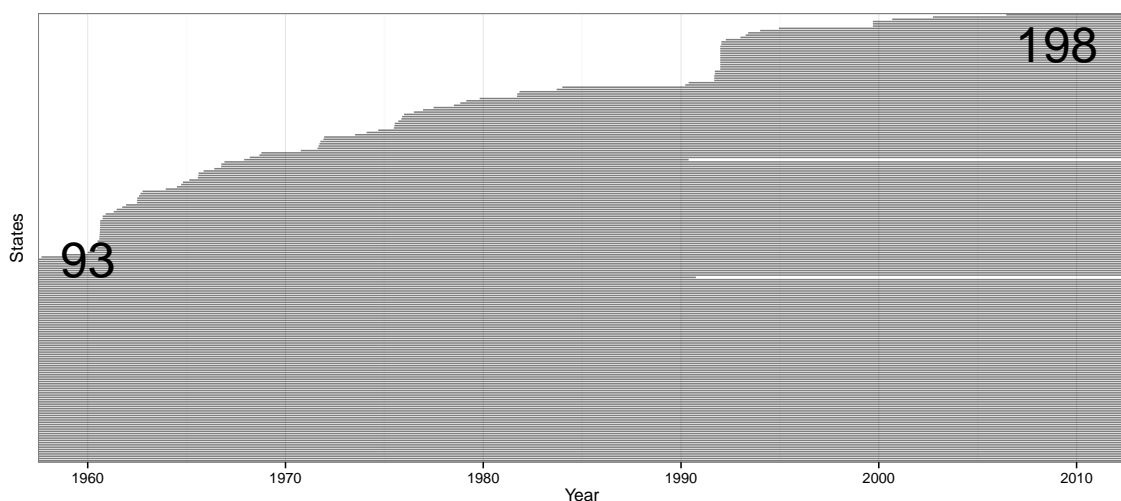


Figure 2.1: State System Growth: Each line represents a state’s existence through time.

The entrance of these 105 new state actors into the interstate system is significant for the structure of the global fisheries governance complex and its evolution. Since a governance complex explicitly includes actors as well as institutions, growth in the actor nodeset means growth in the governance complex. Moreover, institutions need to contend with and manage a plethora of new actors potentially relevant to the resources they govern, with sometimes differing interests and expectations to each other and to those that expected when the institution was first established. For example, states that have entered the system since 1960 due

³²Correlates of War Project 2008.

to decolonisation tend to be more interested in development opportunities than older, more developed states. It also means that there is more information in the system: other actors provide examples of consequential or appropriate behaviour, which help actors' efficacy in complex systems.³³

The next section turns to the institutions that states have established to govern this complexity.

2.3 Institutions

2.3.1 Why RFMOs?

Without any overarching authority, formal international cooperation on issues such as straddling or migratory fish stocks is usually managed by treaty. Articles 63, 64, and 118 of UNCLOS exhort all states to agree on regional institutions to coordinate the conservation and development of straddling, highly migratory, and discrete High Seas fish stocks. Today, states have used multilateral fisheries treaties to establish over 50 Regional Fisheries Arrangements (RFAs) to coordinate scientific advice and national policies regarding one or more stocks of a particular area.³⁴

This thesis does not study all multilateral fisheries agreements, or even all Regional Fisheries Bodies (RFBs). Instead it concentrates on RFMOs; those RFAs with the most powerful management mandate. A subset of RFAs called RFMOs are additionally endowed with a management mandate to specify annual quotas and produce “timely and effective” policy for fishing in those areas based on precautionary, ecosystem- and science-based management principles.³⁵ Though RFMOs lack independent enforcement power, they appear to enjoy considerably more autonomy and agenda-setting power than other international environmental organisations due to the non-sovereign status of their management areas and their epistemic prestige, and their management mandate is quite progressive by global public policy standards.³⁶

While each RFMO is different, there are some general similarities. Most RFMOs have at least two organs: a scientific council (for reaching consensus on information about stock) and a political commission (where regulatory decisions are made). Founding documents establish what kind of rules and regulations each RFMO may

³³This last point is particularly important for this thesis because it speaks to heuristics as relational mechanisms, as introduced in the previous chapter.

³⁴FAO 2012; Hollway and Koskinen 2015a; Hollway and Koskinen 2015b.

³⁵Stokke 2000; Meltzer 2005.

³⁶Walsh 2004; on global public policy see Reinicke 1997; Reinicke 1998.

make, but they usually involve catch limits, opened or closed areas or seasons for fishing, size limitations on the fish caught, gear restrictions, and (less frequently) bycatch limits. Commissions usually meet at least annually, though in some cases every two or three years, and it is at these sessions that they make regulations. The process for deciding on regulation differs, but it is usually one member–one vote. Many RFMOs are open in membership,³⁷ and entertain cooperating non-contracting parties too.

2.3.2 Which RFMOs?

There are or have been anywhere between one and two dozen RFMOs, depending on how one counts. For this study, I define the boundaries of the core of the global fisheries governance complex as oceanic, multilateral Regional Fisheries Management Organisations existing within the study period.

Since there are not so many RFMOs in any case, let me be explicit about which institutions this excludes. First, since we are interested here in *fisheries* the International Whaling Commission is excluded as a *sui generis* case for its cetacean subjects, normatively charged near-universal membership, particularly contentious politics, and official moratorium.³⁸

Second, we are only interested in oceanic RFMOs. This excludes RFMOs that govern inland bodies of water, such as the Lake Victoria Fisheries Organisation (LVFO) or the Central Asian and Caucasus Regional Fisheries and Aquaculture Commission (CACFish). The main reason for doing so is that these are effectively closed systems, making them an ill fit for a thesis on *global* fisheries governance and making the link between what goes on there and in the rest of the GFG complex more tenuous.

Third, I exclude bilateral RFMOs such as the International Pacific Halibut Commission (IPHC) and the Pacific Salmon Commission (PSC), for they are also rather closed systems. Both of these RFMOs govern stocks straddling US-Canada maritime borders, have only two members, and concern allocation more than conservation.³⁹ Because of these features, state membership in these bilateral RFMOs *means* something different than membership in a multilateral RFMO.⁴⁰

³⁷See DeSombre 2014, p. 471.

³⁸For more on this see Gillespie 2002; Epstein 2008a; DeSombre 2014.

³⁹For an account that explores both bilateral and multilateral fisheries treaties as a multilevel network structure see Hollway and Koskinen 2015a; Hollway and Koskinen 2015b.

⁴⁰Hollway and Koskinen 2015a; Hollway and Koskinen 2015b.

Lastly, I limit the study period to the half-century between the 1st of January 1960 and the 1st of January 2010. This means that a single major RFMO currently in existence, the South Pacific RFMO (SPRFMO), narrowly misses out on this window.⁴¹ This is lamentable, but a study period had to be drawn that maximised the data available. Further research may return to intervening developments when more data becomes available.

Following these boundary specifications leaves 17 RFMOs. These RFMOs are listed on the *y* axis in fig. 2.2, ordered by the date their founding documents were concluded. Similar to fig. 2.1, each line represents the existence of an RFMO through time. The dotted lines show the period of time after an RFMO’s establishing treaty was concluded, where it was open for signature and ratification, but had not yet entered into force.

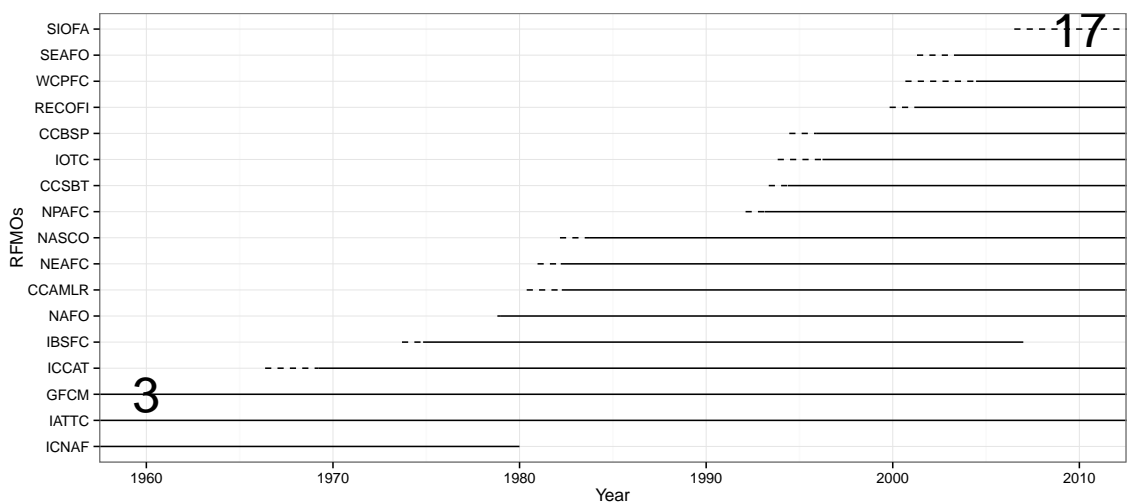


Figure 2.2: RFMO System Growth: Each line represents an RFMO’s existence. Dotted lines show RFMO-establishing treaties negotiated but not yet in force.

Several noteworthy developments are depicted in fig. 2.2. While the International Convention for the Northwest Atlantic Fisheries (ICNAF) was among the first RFMOs established and was “considered to have played a leading role in the assessment and management of fish stocks outside of national jurisdictions”,⁴² it was replaced at the end of the 1970s by the North Atlantic Fisheries Organization

⁴¹While the final draft of this treaty was signed in November 2009, the first nine states only signed the document in 2010. There is thus no architectural information related to this RFMO and this would frustrate both analysis and inference. For more see <http://www.southpacificrfmo.org/status-of-the-convention/>.

⁴²<http://www.nafo.int/icnaf/frames/icnaf.html>

(NAFO).⁴³ There were several reasons for this institutional substitution. By the end of the 1970s, unilateral declarations of extended EEZ had become more common, and the two primary coastal states of ICNAF's area, USA and Canada, had both extended their maritime claims considerably, leaving only a “nose” and a “tail” of the Grand Banks to be regulated. Moreover, the USA and Canada had both threatened to leave ICNAF in the late 1970s. In the end, only USA followed through. Lastly, by this time, the European Economic Community was emerging as an actor in international fisheries, and so ICNAF needed to be updated in any event to allow Regional Economic Integration Organisations (REIOs) to be institutional participants. Faced with the prospect of such a large overhaul, the parties chose to replace rather than amend the original RFMO with an institutions of new scope and design.

ICNAF was not the only RFMO to disband during this period. Following more than thirty years in operation, spanning tumultuous times for the Baltic and an ever-changing composition of coastal states, the 2004 “big bang” enlargement of the European Union left the International Baltic Sea Fishery Commission (IBSFC) with only two effective members—the EU and the Russian Federation. After some consideration, the two parties agreed to disband IBSFC in favour of bilateral arrangements. While each of these two cases of institutional dissolution, ICNAF and IBSFC, have special circumstances, the mechanisms behind them are nonetheless of interest for this study.

Other RFMOs never even came into force (within the study period). The last RFMO to be negotiated within the study period, South Indian Ocean Fisheries Agreement (SIOFA), underwent an extended period of political limbo before it finally gained the necessary ratifications to come into force in 2012. Nonetheless, I include SIOFA here as an example of when states' good intentions, as witnessed by signature of the negotiated text, fails to be converted into committal (i.e. ratification) by issues of political will. In the next section, I explore the main relations between the actors and institutions of the global fisheries governance complex, including signature and ratification, and explain how they sum to architectures.

⁴³Note that there was a year-long transition period and that, in contrast to RFMOs created in previously unregulated areas, NAFO came into force almost immediately.

2.4 Architectures

The final component of a governance complex are the relationships between and among its actors and institutions. This thesis makes use of several such relationships in its analysis and modelling. Here, however, I concentrate on two major sets of relationships, each with two main types, that are central to the narrative of the thesis. The first set of relations introduced is that of states' fishing from oceanic areas as aggregated by the FAO and as delineated by RFMO scope. The second set of relations is that of states' participation in those RFMOs, which can take on one of two values: cooperative association and full membership affiliation.

2.4.1 Actor-Resource

The first set of relationships represent how states relate to the fishery resources being governed. These relationships can be expressed in binary terms – whether a state fishes a particular stock, for example – or weighted by, say, the number or tonnes of fish fished.

One problem here though is that there are many (kinds of) fish in the sea. To facilitate analysis and modelling, I aggregate fish stocks by species and area. First, oceanic fish can be seen as belonging to one of two types, depending on where in the water column they reside when in the sea. Demersal fish stocks such as cod, haddock, flounder, and halibut reside on or close to the bottom of the sea floor. Such fisheries tend to straddle maritime boundaries because fish stocks are both more common and more exploitable closer to the coast. Pelagic fish stocks reside in the water column, neither close to the bottom nor the shore, and may be migratory, such as tuna, marlin, and salmon, or straddling, such as herring or sardines. An alternative, tripartite classification distinguishes between anadromous, straddling, and highly migratory or oceanic fish stocks.⁴⁴ However, the distinction between demersal and pelagic fishes is favoured here because it is chiefly the area of the water column in which they reside that dictates the gear fishers use to fish for these stocks. Similar gear can be used to fish similar types of stock, and often it is the gear used for fishing that RFMOs seek to regulate. Moreover, it is the classification favoured by the FAO, so data is already coded for this classification.

Not all states fish the oceans wide, and those that do have not always done so. Moreover, RFMOs are primarily *regional* institutions. Therefore, I also disaggregate

⁴⁴Webster 2013.

states' fishing activity by oceanic area in which they fish for demersal or pelagic fish stocks. The most straightforward disaggregation is the FAO's division of the oceans into statistical areas. The FAO numbers these areas, but for comprehensibility I replace these numbers with brief codes (Med for the Mediterranean, Atl for the Atlantic, Pac for the Pacific, and Ind for the Indian Ocean), appending the compass point of areas within each ocean governed (e.g. SW for south-west, NE for north-east, and WC for west-central).

Figure 2.3 shows how, in 2010, some areas are more heavily fished than others, and some species are more popular than others in those areas. In particular, AtIEC and IndWC seem to be popular fishing areas. This is in part because of the high number of coastal states in these regions. Others, such as PacNW and PacNE are less popular fishing areas due to the lower number of coastal states and the relative remoteness of these fishing areas.

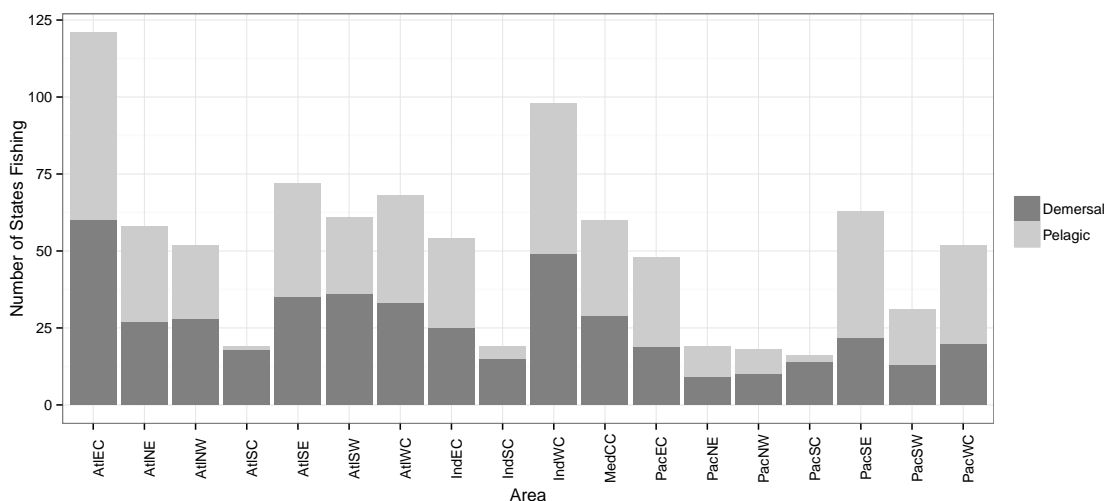


Figure 2.3: States by Area and Species Type

I explore this set of relationships further in the following chapter, where I refer to the network composed of these relations as the AREAFISHING architecture. However, to fulfill the current descriptive purposes, fig. 2.4 on the next page shows how mean fishing activity and its range has changed over time over four graphs. The top left plot shows that, while the catch of the largest fishing nations have fluctuated over time, the average annual catch by state has grown somewhat more steadily. A closer look at the distribution shows that it is a handful of countries—Japan, the EU, Russia, Korea, and so on—that are responsible for most of the fishing.

The bottom left plot tells a similar story, but this time from the perspective of each fishing stock (as defined here). Clearer here, however, is the growth trend for

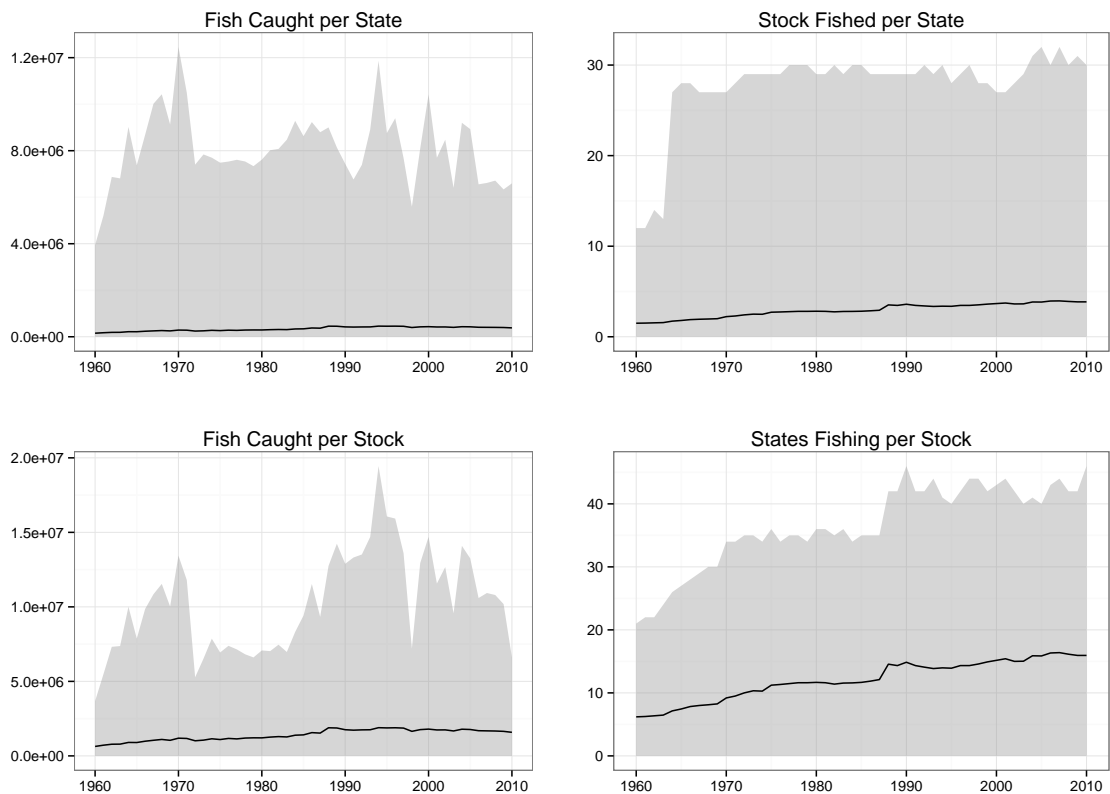


Figure 2.4: States by Stock Over Time: Thicker line shows the average value; shaded areas show the range.

the average catch per stock, as is how catch levels have largely plateaued since the late 1980s, or even decreased.

The plots on the right do not show quantitative catches, but binary activity. The top right plot shows how many stocks (areas times species types) states fish on average and the range of this distribution. We see that from the mid-1970s onwards, the most active states, which are called Distant Water Fishing Nation (DWFN), fish almost everywhere around the world. These are for the most part the same states that fish the most in the top left plot. What is more interesting is that the trend line steadily rises throughout the study period. This means that not only do the most active states fish more widely, but increasingly more states are fishing more and more widely.

Lastly, the bottom right plot shows how many states actively fish for each stock. Here the story is even more telling. Both the range and the trend line rise steadily, particularly through the 1970s and late 1980s before plateauing somewhat. This means that, on average, each stock is being fished by fishers flagged to more and

more states, greatly complicating matters of governance.

RFMOs' mandates regularly cover multiple FAO areas and species, however, and indeed overlap, as will be explored in the following chapter. This involves a different and sometimes cross-cutting aggregation to the AREAFISHING network introduced above, as can be seen in table 2.1 on the following page, which details the mandated scope of each of the 17 RFMOs. This overlapping of mandates is explored in more detail in the following chapter, where I call the architecture constructed by these relations the RFMOFISHING architecture, but despite this cross-coding, the trend of growth, especially in the 1970s and late 1980s, plateauing over the last couple of decades, and fluctuation in the activity of the most active fishing nations remains.

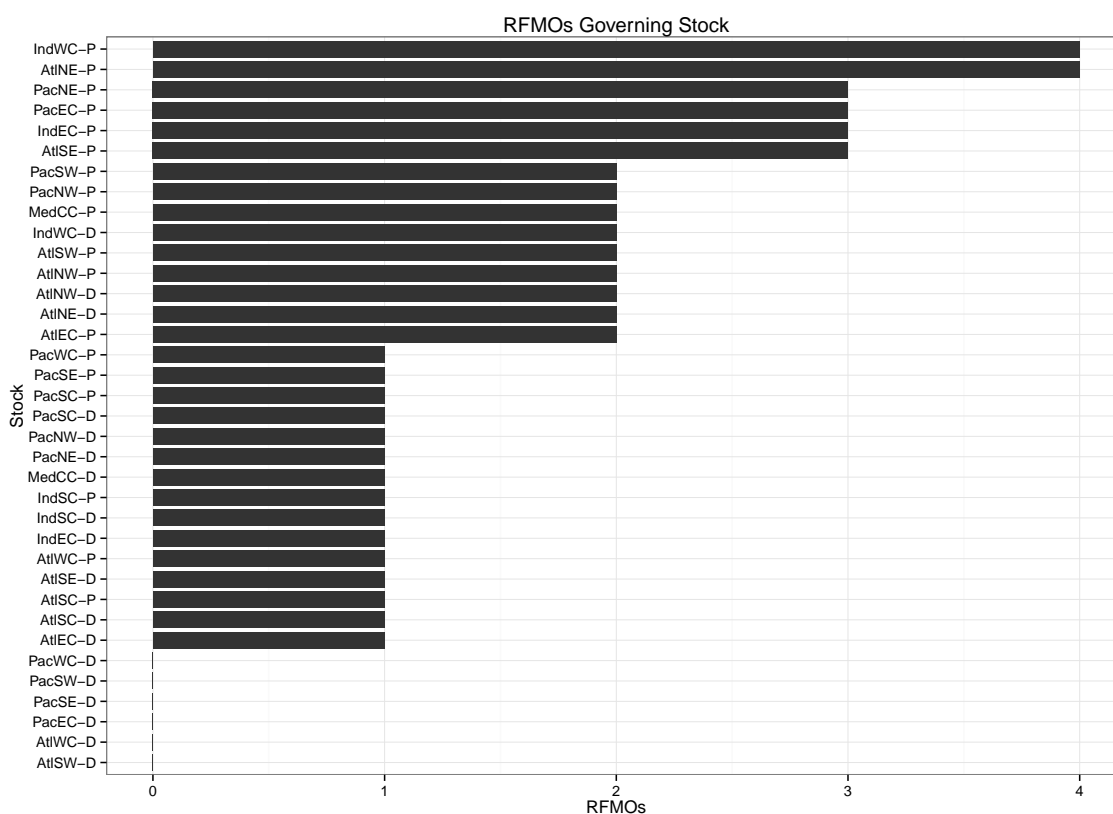


Figure 2.5: Areas by RFMOs

2.4.2 Actor-Institution

How states relate to the fish stocks they govern are RFMOs' main concern. This is a specific case of a more general purpose of institutions as viewed relationally: to affect the way actors relate to resources (in an environmental context) or to

Abbrev	Full Name	Species Type	FAO Areas
ICNAF	International Convention for the Northwest Atlantic Fisheries	Demersal	AtlNW
IATTC	Inter-American Tropical Tuna Commission	Pelagic	PacNE, PacEC, PacSE
GFCM	General Fisheries Commission for the Mediterranean	Both	MedCC
ICCAT	International Commission for the Conservation of Atlantic Tunas	Pelagic	MedCC, AtlNW, AtlNE, AtlWC, AtlIEC, AtlSW, AtlSE
IBSFC	International Baltic Sea Fishery Commission	Both	AtlNE
NAFO	North Atlantic Fisheries Organization	Demersal	AtlNW
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources	Both	AtlSC, IndSC, PacSC
NEAFC	North East Atlantic Fisheries Commission	Both	AtlNE
NASCO	North Atlantic Salmon Conservation Organization	Pelagic	AtlNW, AtlNE
NPAFC	North Pacific Anadromous Fish Commission	Pelagic	PacNW, PacNE, PacEC
CCSBT	Commission for the Conservation of Southern Bluefin Tuna	Pelagic	AtlSW, AtlSE, IndWC, IndEC, PacSW
IOTC	Indian Ocean Tuna Commission	Pelagic	IndWC, IndEC
CCBSP	Convention for the Conservation and Management of Pollock Resources in the Central Bering Sea	Demersal	PacNW, PacNE
RECOFI	Regional Commission for Fisheries	Both	IndWC
WCPPFC	Western and Central Pacific Fisheries Commission	Pelagic	PacWC, PacNW, PacEC, PacSW, PacNE
SEAFO	South East Atlantic Fisheries Organization	Both	AtlEC, AtlSE
SIOFA	Southern Indian Ocean Fisheries Agreement	Both	IndWC, IndEC

Table 2.1: RFMO Scopes

each other (in, say, a security context). Institutions' ability to influence actors' behaviour is, however, much greater in the case of their members, which have voluntarily committed to observing the institution's rules. As presented in the introduction, these institutional participatory relationships are also key components of a governance complex.

Institutional participation can take many forms and some constitute "stronger" ties than others. Some forms of participation are only open to some types of actors, and indeed struggles concerning the limits and forms of participation are central to political life. Here I focus on two core types of institutional participation between states and RFMOs which I call cooperative and membership affiliations. In sum, each set of relations constitutes an architecture.

The first is that of countries' full membership in RFMOs (hereafter MEMB), which entails the political right to participate in the institution's decision-making as well as a binding obligation to meet obligations set out by the institution's establishing treaty as modified or specified by commission regulations.⁴⁵

Institutional membership, though not a sufficient condition for the kind of engagement global fisheries governance requires, is nonetheless a necessary one. The contractual nature of the international system of sovereign states means that, apart from a few exceptions, states must first accede to multilateral institutions if they are to be bound by them.⁴⁶ States sharing membership of an institution are presumed to be minimally aware of each other, communicate more frequently, more likely to coordinate, and possibly share certain norms.⁴⁷ Institutionalised relationships can build trust, empathy and sympathy that improve coordination or cooperative behaviour within the group and accentuate differences to those outside the group.⁴⁸ Both institutional complexity literatures acknowledge state membership is an important component of institutional complexity, but tend to focus research on norms and institutions rather than this important element.⁴⁹

The ties were assembled in a new dataset merging FAO, ECOLEX, and IEA data to ensure comprehensivity and reliability,⁵⁰ and followed up where necessary

⁴⁵Hofmann defines membership as "all formal members of international organizations". See Hofmann 2011, p. 103.

⁴⁶Reus-Smit 1997.

⁴⁷Knight 1995.

⁴⁸Granovetter 1985.

⁴⁹Indeed, Biermann et al's primary criterion for the Convention on the Rights of the Child being the least fragmented regime was precisely its near universal membership. See Biermann et al. 2009b, p. 17.

⁵⁰ECOLEX 2011; Mitchell 2013; Hollway and Koskinen 2015a; Hollway and Koskinen 2015b.

through correspondence with staff at the respective RFMOs. Ties are thus binary (unweighted) and undirected (or unidirectional, from countries to RFMOs) and, for longitudinal modelling purposes, registered upon a country's ratification, accession, or approval of or in the establishing treaty of a particular RFMO until withdrawal or the end of the study period. The data was truncated to the period 1960 to 2010 to avoid a period of post-war architectural initialisation and for which there is greater information for modelling.

Membership is not the only relevant relationship between countries and RFMOs though. A number of states maintain the status of 'cooperating non-contracting parties' with some RFMOs pending their fulfilment of certain terms established by those RFMOs' commissions and, usually, with the intention of eventually becoming a full member. For the cooperating country, this typically involves expectations that they will not undermine the RFMO's regulations and comes with observer status to attend commission meetings, but no vote in the commission as a member would and either reduced or no quota of the fish governed for the time that they are only a cooperating party. As the high seas become saturated with RFMOs, this pre-membership status is becoming increasingly important and used more often by RFMOs to construct a hierarchy of membership. Therefore, another architecture, COOP, was included.

For recent years, these ties were operationalised in terms of official status as a cooperating party decided usually annually by RFMO commissions and dated by examining annual commission reports. Before this status became widespread and for RFMOs that have not yet entered into force, dates were set as a country's date of signature to an RFMO's establishing treaty, meaning that much of this analysis can largely double for a signature/ratification study.

As we see in fig. 2.6 on the next page, both cooperating and membership ties have increased over the study period. At first, they appear basically equivalent. In the last half of the 1960s though, they begin to diverge and, by virtue of the definition of membership ties implicating at least cooperation, there are thereafter always more cooperating ties. From about 2000 onwards though, this gap begins to grow due to the increasing use of cooperating status as a filter or hierarchy to full membership.

We thus know that the overall amount of fishing and governance participation has grown over the study period. What this review does not tell us, is about the distribution of these ties, such as whether some RFMOs are more popular than others or whether some states are more active than others. It also does not tell us

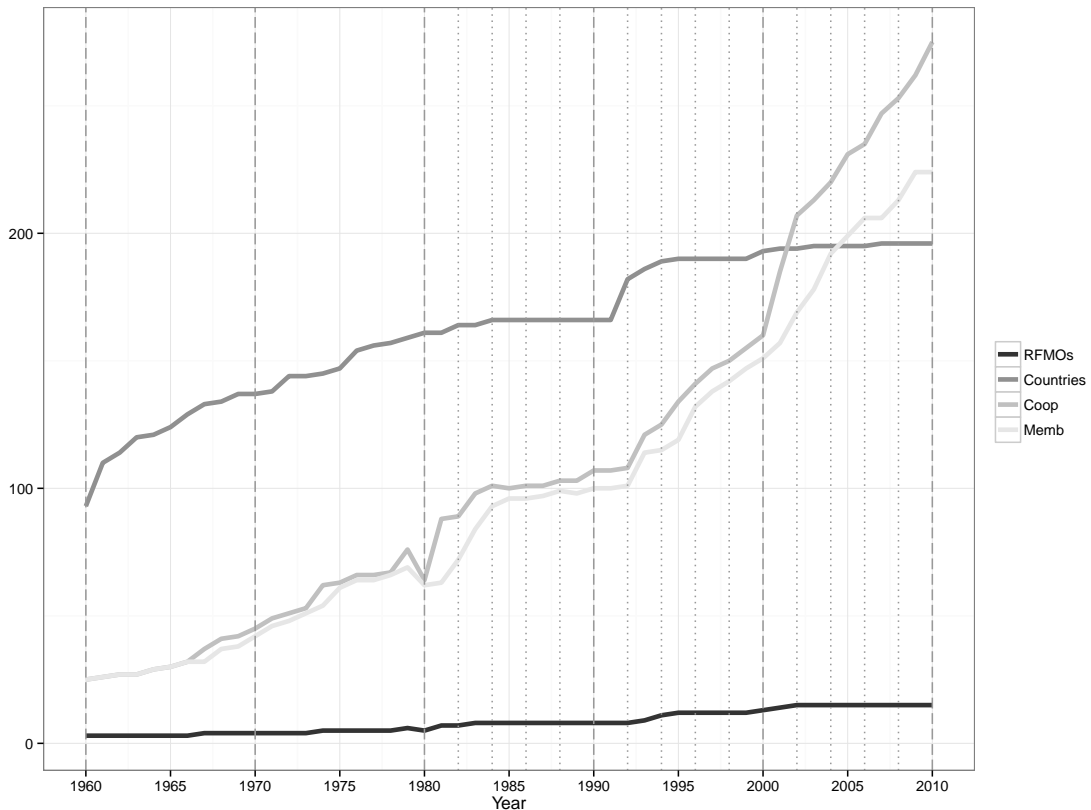


Figure 2.6: Node and Edge Growth: Dashed vertical lines represent the waves in chapter 4; dotted vertical lines represent the waves in chapter 5.

anything about the global structure of these architectures or the local patterns of participation each state is embedded in and can draw upon in heuristics that make use of these patterns. This is addressed in the following chapters.

2.5 Catch of the Day

This chapter began by arguing that global fisheries governance constitutes a lacunae for three literatures—those on global fisheries, fisheries governance, and global governance—and that therefore, given the dire straits that global fisheries governance is in, accurate description of the global fisheries governance complex, constituted by the actors and institutions of global fisheries governance and the architectural relations between and among them, is sorely needed.

The remainder of the chapter introduced, defined, and described these three components of the global fisheries governance complex. First, I argued that states were the main actors of global fisheries governance and defined the boundary of

the set of states included in this thesis quite broadly to include REIOs and fishing entities. Second, I argued that RFMOs were the main institutions of global fisheries governance and defined the boundary of the set of RFMOs more strictly, excluding institutions for conserving marine mammals such as the IWC, bilateral institutions such as IPHC and PSC, and landlocked institutions such as CACFish and LVFO. This meant an inclusive set of “actors” making choices but a restricted set of institutional choices to ensure that those choices left were as comparable as possible while remaining generalisable.

This descriptive review of the components of the global fisheries governance complex reveals two major themes: growth and variation. First, there has been considerable change in the composition of both the set of actors and the set of institutions in the global fisheries governance complex. Indeed, this change has been overwhelmingly in the direction of growth. This feature, which is likely to be common amongst global governance complexes, has direct implications for how one might analyse and model these phenomena as we shall see.

Second, we also see strong growth in the number of ties in the participatory networks reviewed here. Such growth does not appear uniformly distributed, however, which means that there is variability here too. Some states are more active than others, and some RFMOs are more popular than others. However, to analyse this structure requires appropriate methods. It is to method that I turn to in the next chapter.

*“Measure what can be measured,
and make measurable what is not so.”*

Galileo Galilei, as quoted in
Building Fluency Through Practice and Performance (2008)
by Timothy Rasinski and Lorraine Griffith, p. 64

3

Taking Stock

3.1 Measuring Architecture with Networks

The last chapter introduced the three main elements of the global fisheries governance complex: the state actors, RFMO institutions, and participatory architectures of the global fisheries governance complex. This chapter moves from the data description developed there to more methodological questions and, in particular, questions of measurement. This is an important task because, while conceptual creation in the study of institutional complexity proceeds apace, there is much work to be done in the quantification or ‘commensuration’ of these concepts; that is, in transforming “different qualities into a common metric”.¹ For this reason, much of this chapter is concerned with translating concepts developed in the literature on institutional complexity into precise architectural measures.

Networks offer a particularly useful tool for this purpose. The term ‘network’ is omnipresent in contemporary life. However, the increasing popularity of the term, both in lay parlance as well as across different academic disciplines has caused confusion as to what a network approach is and what it offers. It is therefore the purpose of this section to clarify what is meant by a ‘network’ and a ‘network approach’ in this thesis and, along with the rest of the chapter, introduce some of the key terms and contributions a network approach can offer to the study of governance complexes.

The remainder of this section has three parts. The first defines what a network is and introduces some of the central categories a network approach uses. The second counters some common arguments against using networks as being mostly

¹Espeland and Stevens 1998, p. 314; see also Carruthers and Espeland 1991; Espeland and Stevens 2008.

based around misunderstanding. The third provides arguments for networks over alternatives.

3.1.1 Definitions

A **network** is a way of representing the world as (sets of) units or ‘nodes’ and a rule defining whether, how, and to what extent any two nodes are related or tied to each other.² Nodes can be nearly anything, but social networks usually include either individual or collective agents.³

Networks can take many forms that are usually distinguished by the implications they have on how they are analysed. For example, networks may consist of ties between a single type or set of nodes, such as friendship between adolescents, or of ties that only occur between different ‘nodesets’, such as states joining institutions. The first type of network is called a one-mode or **unipartite network**. The second type of network is called a two-mode or **bipartite network**.⁴ Empirical networks are most commonly studied as unipartite networks, for it is for unipartite networks that most network descriptives and models have been developed. Indeed, all network work in IR that I am aware of utilises unipartite network methods, even if the underlying data has two modes.⁵ This is lamentable, as I will demonstrate in this dissertation, for bipartite networks may contain more structural information.⁶ The heavy use of bipartite networks here thus represents a significant contribution for the use of networks in IR.

Other distinctions rest not on the nodes, but on the ties: ties may be events (existing only at a certain time point, like an email) or states (which, once created, exist until they dissolve, like a partnership); ties may be binary (present or absent, like an agreement) or weighted (taking a particular value, like money exchanged, percentage of a firm owned, or fish landed); ties may be directed (from one node

²Wasserman and Faust 1994, p. 20; Maoz 2010, pp. 7-13.

³Note that while network analysis holds many distinctions, there are also many synonyms or near-synonyms that one might be aware of: nodes can also be termed vertices; ties, edges, links, and relations are synonymous (though arcs and affiliations have specific meanings), and whether one calls the sum of nodes and ties networks or graphs is more a matter of disciplinary background than anything.

⁴I use the terms bipartite and two-mode interchangeably here, but strictly speaking bipartite refers to a graph that is separable, which may or may not imply two different nodesets.

⁵Even networks that perhaps ought to, for example Ward 2006; Maoz 2010; Orsini et al. 2013; Kim 2013.

⁶For an argument that bilateral and multilateral treaty activity should be analytically separated but modelled jointly see Hollway and Koskinen 2015a; for a complementary argument that clustering may be mis-represented *unless* bilateral and multilateral treaties are modelled separately but jointly see Hollway and Koskinen 2015b.

to another) or undirected (between two nodes). Each of these distinctions can also be important for how one analyses a network.

3.1.2 Clarifications

Social networks have a long history in sociology and organisational studies,⁷ and are becoming increasingly popular in political science,⁸ IR,⁹ and resource management.¹⁰ Social networks are rarely used within the institutional complexity literatures though. Several common misunderstandings may contribute to this. One is that network methods are only appropriate for networks-as-actors, such as can be found in Keck and Sikkink's work on transnational advocacy networks.¹¹ Instead, network analysis is a general method for parsing and analysing networks-as-structures, a far more general notion.¹²

Another common misunderstanding is to consider networks as a mode of governance distinct from markets and hierarchies.¹³ Here the term 'network' is often used metaphorically to describe some diffuse scheme of governance.¹⁴ However, as can also be seen in the notion of networks-as-structures,¹⁵ networks can offer something far more useful than an abstract metaphor: a way of precisely measuring structure so as to identify whether a system is structured like a market, a hierarchy, or something more dense or diffuse.

Next, social networks are sometimes thought of as "merely description" without its own theoretical or inferential tools,¹⁶ and thus lacking utility for the explanatory aspirations of institutional complexity theorists. This perspective may stem from

⁷Galaskiewicz 2007, p. 1.

⁸Lubell et al. 2012; Robins et al. 2012.

⁹Ingram et al. 2005; Hafner-Burton et al. 2009; Volgy et al. 2009; Maoz 2010.

¹⁰Bodin et al. 2006; Bodin and Crona 2009; Bodin and Prell 2011; Bodin and Tengö 2012; Interestingly, one of the earliest qualitative studies in social network analysis concerned Norwegian fishing crews and in fact coined the term 'social network': Barnes 1954; oddly, the late Elinor Ostrom largely overlooked network analysis as a tool for natural resource management studies, preferring actor-based models: Poteete et al. 2010; her collaborator, Marco Janssen is, however, evidently a fan: Janssen et al. 2006.

¹¹Keck and Sikkink 1998.

¹²For more on the distinction between networks-as-actors and networks-as-structures see Kahler 2009.

¹³Powell 1990; Powell did not hold this position for long though. See Powell et al. 2005; Padgett and Powell 2012.

¹⁴E.g. Jogarajan 2011.

¹⁵Kahler 2009; See also Ward 2006; Ward 2009; Torfason and Ingram 2010; Maoz 2012.

¹⁶Some are skeptical that a network theory (of organisational or inter-organisational behaviour) can exist: Gould 2003, p. 256; Galaskiewicz 2007, p. 11; Alter and Meunier 2009, p. 15; see also Knoke 2001, p. 63.

the limited experience IR has with the formal study of networks, and results in a restricted view of what those studying networks (can) do. A couple of analytic distinctions drawn from scholarly specialisations may help here.

First, network scholars can be increasingly seen emphasising *network theory* in distinction to network methods. By defining their work in this way, scholars highlight that there are network theories too. While network theory itself is broad and eclectic,¹⁷ generally network theorists concern themselves with developing and elaborating theories that explain when or under what conditions relational mechanisms such as reciprocity, homophily, and transitivity might pertain or be particularly consequential. It is thus clear from this burgeoning literature that networks can be “much more than a methodology”.¹⁸ To be sure, these advances in network theory often go hand-in-hand with methodological advances, but this is not a unidirectional dependency, and advances in network methods are as much driven by the demands of more sophisticated theory as network theorists seek to drape theory across insights from more inductive investigations. In any event, this is a good state for the literature to be in, as it ensures that theory is wed to that which is demonstrable empirically and methods are developed purposively. This dissertation is an example of this.

Second, network methodologists can also be said to be falling into two complementary but distinct camps. Some network methodologists develop a broad range of equations for measuring concepts on the node, tie, or whole network level.¹⁹ Included within this would be role/positional measures and community detection algorithms. I will call this work *network analysis*. Other network methodologists seek to go beyond “mere description” and develop *network modelling* techniques and statistical packages that control for or indeed focus on dependencies between observations. They argue that not only are these methods appropriate for explanatory inference, but they are more appropriate for explanatory inference in the social sciences, where such interdependencies are commonplace, than most traditional statistics.²⁰ The difference between network analysis and modelling is akin to that of traditional descriptive and inferential statistics, where descriptive statistics can include producing tables, graphs, and plots to show patterns or distributions in the data, whereas inferential statistics is

¹⁷See for example Kadushin 2012; for an attempt within IR see Maoz 2010.

¹⁸Maoz 2010, p. 6.

¹⁹E.g. Borgatti and Everett 1997.

²⁰E.g. Snijders 2001; Duijn and Huisman 2011.

more about saying: yes, we see X, but it could be that X is just produced by chance, or factor Y, and/or factor P, and so on. I will call this work network *modelling*.

This thesis employs network theory, analysis, and modelling. Network theory and modelling are relied upon more in following chapters, where explanation is the goal; the remainder of this chapter utilises tools of network analysis for describing and measuring the global fisheries governance complex. Note that I refer to network theory as *relational theory* here, and network mechanisms as *relational mechanisms*. I use this naming convention to distinguish theory based on a relational ontology from a network operationalisation and technique for studying that ontology. Neither relational theory nor relational data necessitate the use of network methods. However, I argue in the following subsection that the combination of relational theory and empirics, and network analysis and modelling are a powerful combination.

3.1.3 Justifications

Network methods offer a systematic, formal and rigorous, transparent and replicable methods that are both comprehensible and useful for academics and practitioners alike.²¹

They meet these criteria in part by rendering (social) structure observable and measurable.²² Network methods ultimately inherit their rigour from mathematical graph theory, but these roots have been complemented and extended from within the social sciences (especially sociology) and statistics to produce a robust conceptual, analytical, and methodological toolkit for studying social phenomena.²³ Combined with more recent developments in software and theoretic tools, network methods now offer considerable leverage to be brought on questions such as those studied here. Nonetheless, it remains ambiguous toward the purported quantitative/qualitative divide in social scientific scholarship; excellent work has been done in interpretivist and critical veins as well as more computational and statistical studies.²⁴

²¹As an aside, visualising data as a network has the virtue of allowing ‘experts’ to audit data more easily than if large attributional datasets were used. Moreover, social network analysis has the added benefit in this context of resonating with marine biologists who use similar methodological tools to understand marine food webs, and visuals have the most impact on practitioners.

²²Knoke and Yang 2008, pp. 4-5.

²³Hafner-Burton et al. 2009; Prell 2012, p. 19.

²⁴For examples of the former see Hollstein 2011; Bellotti 2014; for examples of the latter see Pattison 2011; Duijn and Huisman 2011.

Network methods provide clear advantages for relational work over both qualitative and quantitative work. Its primary advantage over case study and ethnographic work is that it can take a larger context into account and still parse it meaningfully.²⁵ In understanding governance complexity, it is crucial to both encompass the full system and yet not get lost. Indeed, Alter and Meunier call for quantitative researchers to control for overlapping or parallel domains;²⁶ a task this chapter contends is better suited to network analysis. Network graphs allow considerable analytic leverage to be brought to bear in identifying both the most powerful and marginalised actors from large datasets.

Its primary advantage over traditional statistical approaches is that enables *dependencies* not only to be taken into account but become variables of interest.²⁷ This is crucial. When a state ratifies an international fisheries treaty it does so with considerable knowledge about which other states have ratified and which have not. That the UK ratifies a treaty only if the USA does is relevant to how the overall architecture is generated and thus how the global fisheries governance complex evolves. It thus allows dependent configurational analyses (for example, do states sharing one treaty share further treaties) in addition to traditional attributional analyses (is a state with a strong democracy more likely to ratify a treaty),²⁸ and does not necessarily anonymise or mask particular nodes so that identity can become a relevant factor without the cumbersome workaround of categorical identity controls.

There are some challenges to network analysis, however. First, network studies can be empirically demanding. Dyadic (i.e. relational) data is often more difficult to collect than monadic (i.e. attributional) data because it requires having information not only on ‘whether’ or ‘how much’ (as general observational questions), but also ‘in relation to which other’. Where network dynamics are the research interest, as in this thesis, the data requirements can be more demanding still, because time windows or, ideally, timestamps are required. Fortunately, such relational data is becoming more and more common, particularly in IR and especially in international

²⁵Compare, for example, the network graphs produced throughout this dissertation to the schematic for the Inter-American Development Bank’s ‘spaghetti bowl’ of trade agreements cited by Alter and Meunier (Alter and Meunier 2009, p. 13).

²⁶Alter and Meunier 2009, p. 21.

²⁷It thereby relaxes the assumption of independency of observations typical in studies that employ traditional statistical models such as Mansfield and Pevehouse 2008.

²⁸Emirbayer 1997, pp. 308-310; Knoke and Yang 2008, pp. 4-5; Robins et al. 2007a; Robins et al. 2007b; Pattison 2011.

environmental politics, where relations and behaviours are often more public or reported than in more private or security spheres.²⁹

Second, network studies have been slow to integrate culture or norms, with the majority of network studies being overwhelmingly structural.³⁰ However, this is not a necessary condition;³¹ there are ways that these topics can be explored fruitfully with a network approach.³² To reiterate, a network is way of representing relational structures or architectures, and is ambivalent and thus flexible to the content of the nodes and relations. They are as able to be turned fruitfully to issues of culture and norms as they are to materiality.

Ultimately though, proof of the utility of network analysis and modelling for studying governance complexity is in the pudding. The next three chapters aim to make a meal of this pudding, especially with respect to network modelling. The next three sections of this chapter provide the groundwork for this by using network analysis to illustrate the evolution of the global fisheries governance complex, analyse how its topology has changed over this period, and commensurate several major themes in institutional complexity into precise network measures of governance complexity.

3.2 Visualisation

One of the chief attractions of networks is that they provide ways of visualising structure that are (when done well) comprehensible and often revealing. Indeed, this is the purpose for which network analysis has been used most often in International Relations. This section provides a brief, qualitative overview of how the structure of the membership architecture global fisheries governance complex has evolved through visualising this as a network ahead of the more quantitative analysis to come in subsequent sections.

The next six figures present plots each of the membership architecture at decadal intervals over the study period from 1960 to 2010.³³ This visualisation reveals the

²⁹Yet these data requirements do still put restrictions on what can be investigated. Relational data on fish traded between each pair of states each year is too unreliable to be used here, for example.

³⁰Emirbayer and Goodwin 1994; Emirbayer and Johnson 2008, p. 34; Jackson 2008.

³¹Though Emirbayer and Johnson are skeptical, they acknowledge that it can be done Emirbayer and Johnson 2008, p. 10.

³²See for example the work of John Mohr: Mohr 1998; Mohr 2000; Mohr and White 2008; for a different kind of approach within IR which looks at communication events such as diplomatic cables as largely “inheriting” conversational norms see Hollway and Mellon 2014.

³³The COOP architecture is not presented here in the interests of saving space and is for the most part very similar.

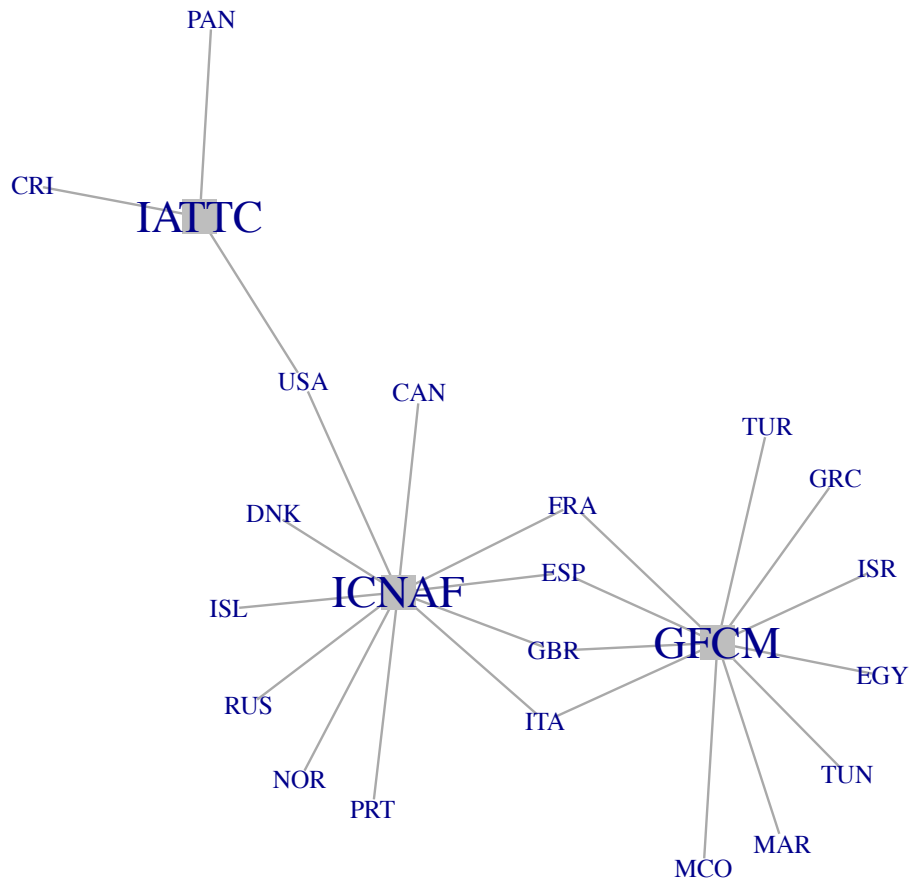
overall structure of the architecture. The layout is determined by a common force-directed algorithm called Fruchterman-Reingold that places nodes that are tied to one another closer together than the average spacing.³⁴ In each plot the layout is updated, so no strict interpretation on position is really possible between plots, only within plots.

This visualisation focuses only on the connected components of the networks, discarding the isolates to save space and make the node labels included here more comprehensible. The number of ties each node has is called its “degree”. Since tie creation largely results from the agency of states, we can conceptualise these ties as directed from states to RFMOs, which means we can speak of states “outdegree” and RFMOs’ “indegree”. This visualisation is thus useful for showing which nodes are the most active or popular in terms of ties for bipartite networks. A welcome side-effect of this is that it approximates several types of “centrality”, a concept that I shall return to below.

In 1960 already, we can see in fig. 3.1 on the following page that there is a single, main component made up of three RFMOs: IATTC, ICNAF and GFCM. This single component appears to have a daisy-chain-like structure, with IATTC sharing one member (USA) with ICNAF and ICNAF sharing four members (Italy, Spain, France and the UK) with GFCM. There are no shared members between IATTC and GFCM. This chain like structure largely recreates the geography of these institutions, with the Eastern Pacific IATTC and Western Atlantic ICNAF sharing the North American USA and the Western Atlantic ICNAF and Mediterranean GFCM sharing four European states with interests in both areas. ICNAF and GFCM are similarly popular in the network at this time, with indegrees of 12 and 11 respectively; IATTC is barely multilateral with just 3 members. States activity is less skewed, with most states having an outdegree of 1, except for those states that are members of two RFMOs as listed above. No state has an outdegree higher than 2.

By 1970, we begin to see more cross-cutting ties between the RFMOs in fig. 3.2 on page 52. On the left we see that the structure of the main component resembles a four-leaf clover. Each pair of RFMOs shares at least one member except for IATTC and GFCM. GFCM is now the most popular RFMO with an indegree of 15, with ICNAF narrowly following with 13. International Commission for the Conservation of Atlantic Tuna (ICCAT), which shares members with all other RFMOs, has an indegree of 10, and IATTC has now attracted a couple of extra members. Some states are now beginning to amass more than two RFMO memberships by now with

³⁴Fruchterman and Reingold 1991.



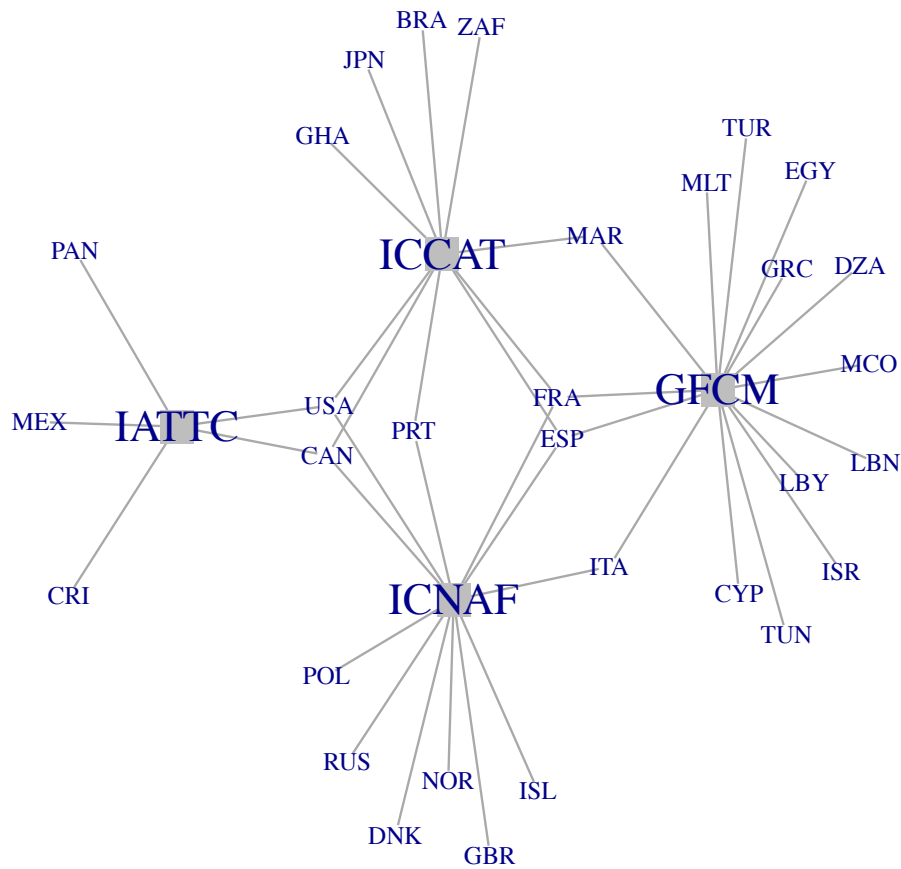
Plus 73 isolates

Figure 3.1: Memb Network 1960

an outdegree of three: France and Spain, USA and Canada. In a component of four institutions, this means that they are beginning to take a more active role in global fisheries governance than other states. Note that while IATTC and GFCM do not share any members, as in 1960, they are now indirectly connected through shared members with two other institutions. Note also that there are many more isolates in the system now than in 1960 due to the heavy decolonisation through this period.

In 1980, we can see from fig. 3.3 on page 53 that the clover structure more or less persists, but there is now a fifth RFMO, IBSFC, that is attached to the rest of the component more or less only through shared members with the other new entrant NAFO.³⁵ As explained in the previous chapter, NAFO was established as a replacement for ICNAF, and so largely takes ICNAF's place in the clover structure of the architecture at this time. Note however that the USA and Canada have reverted

³⁵One member of these two RFMOs, the Soviet Union, is also a member of ICCAT.

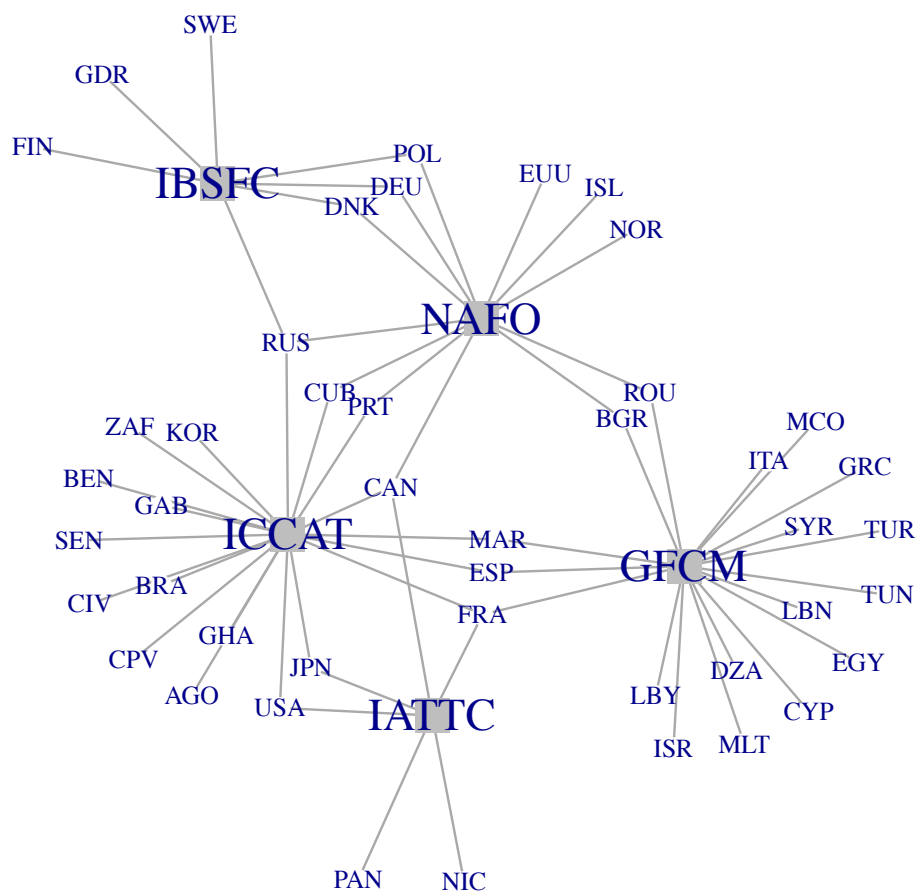


Plus 106 isolates

Figure 3.2: Memb Network 1970

to outdegrees of two following their departure/the disestablishment of ICNAF and their not having yet joined NAFO. By now ICCAT has become marginally dominant within the architecture, with an indegree of 19 over GFCM's 18, but also because it plays a more central role by sharing members with all other RFMOs. Russia, Canada and France are now the most dominant states in this system with outdegrees of three. The isolate crescent has become somewhat more dense.

From 1990 onwards, the architecture begins to become a lot more complex, as can be seen in fig. 3.4 on page 54. There are more states and more RFMOs in the governance complex, but there are also more overlapping ties and a more varied degree distribution for both nodesets. New RFMOs such as North East Atlantic Fisheries Commission (NEAFC), North Atlantic Salmon Conservation Organization (NASCO), and CCAMLR have attracted members quickly, and CCAMLR's quick rise in prominence (indegree of 20) can also be seen by its centrality in this graph. Note

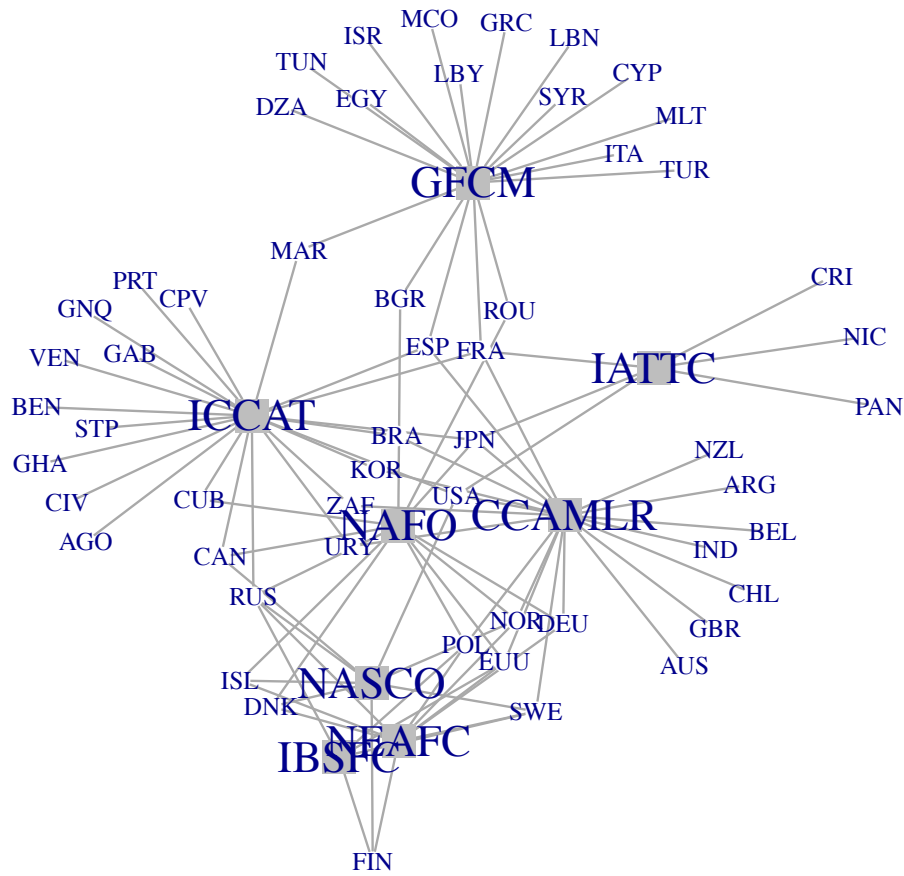


Plus 116 isolates

Figure 3.3: Memb Network 1980

also how the degree distribution on the state side means that some RFMOs (IBSFC, NEAFC, NASCO, NAFO) do not have any members that are not members of at least one other RFMO, whereas others (CCAMLR, ICCAT, and especially GFCM) still have substantial numbers of members that are not otherwise active in the system. While the number of states in the governance complex has grown from 1980 to 1990, the number of isolates remains similar to in 1980, which suggests that as many states have been joining RFMOs as have been joining the interstate system.

From fig. 3.5 on page 55 we can see that past decade has seen the indegree distribution for RFMOs become more skewed, as some RFMOs (CCAMLR, NAFO, ICCAT, GFCM, and a new RFMO Indian Ocean Tuna Commission (IOTC)) become more popular while other RFMOs (such as the new RFMOs Commission for the Conservation of Southern Bluefin Tuna (CCSBT), Convention for the Conservation and Management of Pollock Resources in the Central Bering Sea (CCBSP), and

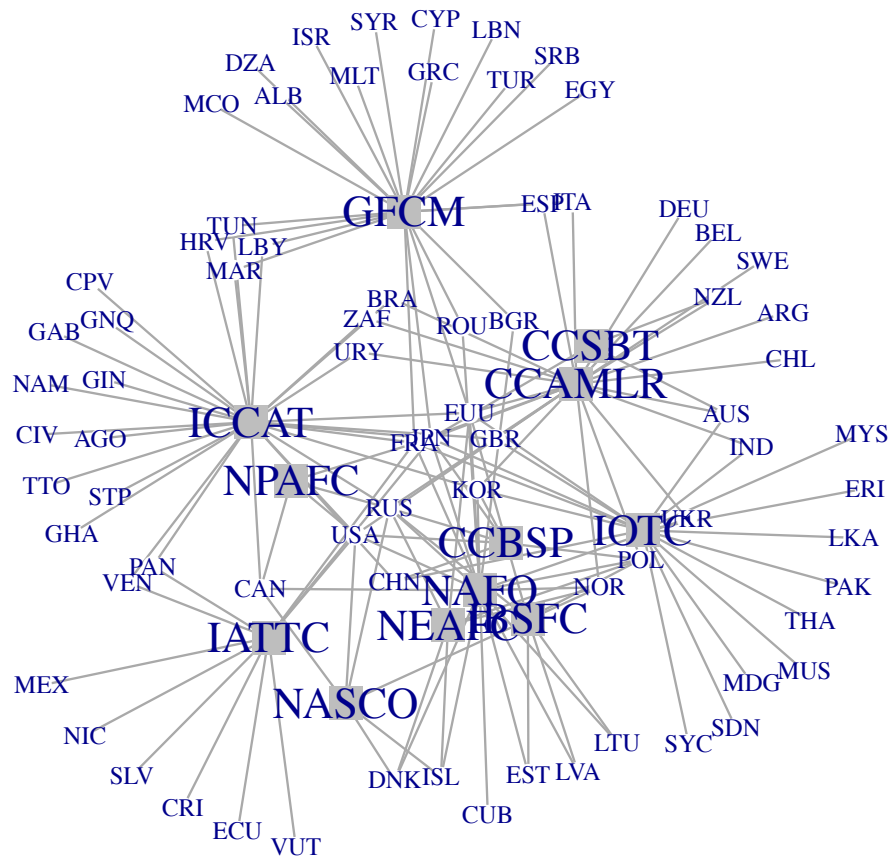


Plus 111 isolates

Figure 3.4: Memb Network 1990

North Pacific Anadromous Fish Commission (NPAFC)) remain smaller institutions in terms of membership size. Each of the major (mostly tuna) RFMOs for each ocean or sea—GFCM for the Mediterranean, ICCAT for the Atlantic, IATTC for the Pacific, and IOTC for the Indian Ocean—tend to have the highest number of unique members. Many other RFMOs only have members that are also members of other RFMOs. By now, the EU, USA, Russia, and Japan dominate the state side of this architecture, with outdegrees of 7, 7, 8, and 9 respectively.

Lastly, by the end of our study period, the membership architecture has become quite complex, with many cross-cutting ties and variation in both indegree and outdegree in fig. 3.6 on page 56. By 2010, ICCAT dominates the RFMOs in terms of membership size with an indegree of 48; nearly twice the size of the next largest RFMO, IOTC, with an indegree of 28. GFCM, CCAMLR and the new RFMO WCPFC follow with indegrees of 24, 25, and 26 respectively. There are a large number



Plus 118 isolates

Figure 3.5: Memb Network 2000

of states (63) that are only involved in a single RFMO and nearly half that again (30) that are involved in only two RFMOs. Beyond that there is more variation though: the EU and Japan, two big fish-consuming markets, are each members of 10 RFMOs; South Korea has the next highest number of memberships at 9; USA is now a member of 8 RFMOs and Russia now has the same number of memberships as France at 7. While the number of isolates is beginning to thin, there are still 84 isolates.

As we have seen in this section, such graphs provide easy ways to relate to and build a narrative off of complex structures that goes beyond what was possible simply from the descriptives provided in the last chapter on each component of the governance complex independently. But such visualisation exercises, though important for exploratory purposes, does not give us the precision we require for taking stock of the global fisheries governance complex. For this purpose we require

popular concepts for describing whole systems in IR.³⁷ Indeed, it has been claimed that fragmentation is a universal property of governance architectures,³⁸ especially in global environmental governance,³⁹ and has been used several times with respect to international fisheries law specifically.⁴⁰

However, despite the heritage and popularity of the concept, or perhaps because of it, there is little consensus as to its meaning. Most of this debate has revolved around the implications of fragmentation. On the one hand, fragmentation finds a natural home within the governance architecture literature,⁴¹ where the allusion to entropy fits well with their systemic ontology.⁴² On the other hand, fragmentation is sometimes used as an analytic foil by those who emphasise the learning opportunities and redundancy-related resiliency afforded by systems of multiple institutions. Such scholars have sought to reframe such systems as “polycentric”,⁴³ or consisting of “non-hierarchical orchestration”.⁴⁴ While this debate does highlight the increasing interest in topological description, it has also caused the concept to become essentially contested, despite the best intentions of those who employ it.⁴⁵ Unfortunately, this contestation undermines its utility for the topological analysis of institutional and governance complexes, since its usage is so normatively loaded.

I propose here a significant reworking of the fragmentation–integration typology using network analytic concepts to re-parse what I claim are two underlying dimensions: centralisation and clustering. The next subsection introduces the two dimensions underlying fragmentation—centralisation and clustering—and reviews several candidate measures in network analysis for expressing them. Using measures associated with these network analytic concepts, I argue, markedly increases the rigor and utility of topological description. The following subsection shows how these two dimensions can be fruitfully intersected to provide both a two-by-two analytic typology and, by considering the dimensions continuous, a

³⁷By way of international law and sociology. See Dupuy 1999; Koskenniemi and Leino 2002; Koskenniemi 2006; Fischer-Lescano and Teubner 2004; Pauwelyn 2004; McLachlan 2005; Leathley 2007.

³⁸A “frequent characteristic”, differing only in degree across time, space, and issue areas. See Biermann et al. 2009b, p. 16; Zelli and Asselt 2013.

³⁹Beisheim et al. 1999.

⁴⁰Boyle 1997; Young 2009.

⁴¹Zelli and Asselt 2013.

⁴²Zürn and Faude 2013; but see also Hollway 2011.

⁴³Ostrom 2010a; Ostrom 2010b.

⁴⁴Abbott and Snidal 2010.

⁴⁵Zelli and Asselt 2013.

two-by-two state space. This typology is thus not only precise but also flexible, and to conclude the section I discuss two potential uses for this “topological typology”.

3.3.1 Dimensions

The current formulation of fragmentation rests on a single spectrum ranging from fragmentation to integration. Biermann and colleagues conceptualise fragmentation as a three-type spectrum ranging from *synergy*, characterized by a dominant core institution, set of norms and actor group, through *cooperative*, which represents a more loosely networked set of institutions and actors that nonetheless maintain cooperative stances, to *conflictive*, where there is a broader plurality of potentially conflicting institutions, actor sets and norms.⁴⁶ Similarly, the regime complexity literature considers regime complexes to be a form of regime system lying in the middle of a spectrum between centrally coordinated regimes and parallel but unrelated regimes.⁴⁷

I argue here that such single spectrum typologies should be updated with a two-by-two ‘topological typology’ constructed by the intersection of two dimensions which network analysis may help us measure: centralisation and clustering. I submit that the topological typology ought to be preferred for two reasons. First, as I will explain below, the typologies above actually conflate two related but analytically distinct dimensions. Separating them and parsing them out independently will facilitate the next generation of topological analysis. Second, these typologies are quite imprecise, with the identification of systems of multiple institutions as one type over the other generally proceeding by analogy. We can introduce some precision here by constructing the typology around mathematically specific network measures, such as those reviewed below. Some flexibility ought to be retained though so that the generality and utility of the typology may be maximised. I suggest that, to be most useful, these measures considered ought to be able to be used for both bipartite network representations of governance complexes as well as unipartite networks. I also suggest that they be able to be expressed as a single point statistic for summaries and comparisons, as well as a distribution for examining the architectural network in more detail.

⁴⁶Biermann et al. 2009b, p. 19.

⁴⁷Keohane and Victor 2011; Morin and Orsini 2014.

Clustering

The first of these dimensions can be most straightforwardly described as cohesion or clustering, and is closest to the axis that van Asselt and Zelli describe as fragmentation.⁴⁸ While the integrated counterfactual of much of the fragmentation literature may appear utopian or naïve,⁴⁹ it still captures a notion of partitioning or dividedness as an antithesis to cohesion that is especially useful for the study of governance complexes, which are defined by, among other things, institutional multiplicity. To retain and clarify this notion then, I review four network concepts: density, modularity, fragmentation, and clustering.

The first network concept reviewed is density. Density is one of the most elementary network statistics and captures the ‘activity’ in or ‘connectivity’ of the overall network.⁵⁰ Density is a global measure for both unipartite and bipartite networks. In the unipartite case, it is simply the number of ties divided by the number of possible ties. For the bipartite case, it is similar, and is formally defined as:

$$Density = \frac{e}{A \times I} \quad (3.1)$$

where e is the number of edges or ties, A is the number of actors and I is the number of institutions. In other words, density is defined as the number of ties divided by the maximum number of ties possible, given that it is a bipartite network.

However, while this measure expresses global network activity or connectivity, it is not satisfactory for a topological measure in this case. The first reason is that adopting this measure may introduce confusion to a literature that often talks of “regime density” when discussing the growth in the sheer number of institutions.⁵¹ On its own, this reason could be circumvented though.

The second reason is more serious, however: the measure expressed above can be very sensitive to nodeset size. This is especially the case for social networks, where cognitive or other resource limitations mean that we do not expect social networks of 1000 nodes to be as dense as those of 10 nodes, and particularly the case for bipartite networks, in which asymmetries in nodeset size can result in the density being especially sensitive to the growth of one nodeset. For a network of 50 actors but only 3 institutions, for example, the establishment of a fourth institution represents the addition of another third possible ties. Since nodeset asymmetries

⁴⁸See Zelli and Asselt 2013.

⁴⁹Even in the exemplar case of (international) law. See Ramanujan 2009.

⁵⁰Borgatti and Everett 1997; Everett and Borgatti 2013; Prell 2012.

⁵¹Young 1996, p. 1.

are quite common with governance complexes, and nodeset growth is a regular feature, the use of density as a measure for cohesion could result only in a measure of changes in the composition of one or both nodesets (such as those we see in fig. 3.7), rather than offering us any analytic purchase on the structure of relations between them.

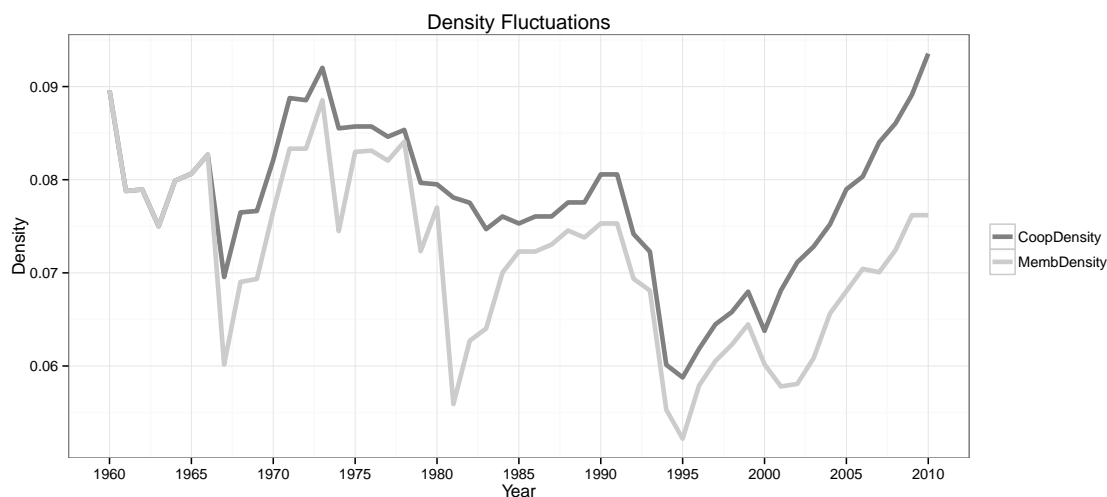


Figure 3.7: Density Fluctuations for Coop and Memb Networks

Another candidate is modularity. Modularity is a popular technique for detecting community structure in graphs and can return a summary statistic of the degree to which graphs can be separated into coherent communities.⁵² Modularity algorithms optimise the division of a network into subgraphs and nodes’ attributions to those subgraphs to maximise tie density within those subgraphs.⁵³ Modularity scores then quantify the deviation of these internal tie densities from the density one finds within the same groups of nodes in random graphs with the same degree distribution. The idea is that nodes linked at random will represent key density and degree features of the network (see above and below), but have no discernible community structure. High values of modularity thus suggest that the groups can be deemed “true communities”.⁵⁴

However, several recent works have cast some doubt on the reliability of most modularity algorithms to find the “right” decomposition of the network into groups. In particular, it has been shown that most common modularity algorithms are subject to resolution limits by which they fail to identify even unambiguous modules

⁵²See Girvan and Newman 2002.

⁵³Lancichinetti and Fortunato 2009.

⁵⁴Lancichinetti and Fortunato 2011.

(i.e. groups) depending on the size and density of the network.⁵⁵ This means that under imperfect conditions modularity and the modules or groups that modularity algorithms identify may not be a reliable basis for a measure. While this does not rule out the value of community detection solutions for exploratory work, it does suggest its unsuitability as a measure for clustering here.

Next is a network measure called fragmentation that is based around components instead of modules. From its name, it promises to be perfectly appropriate. However, its most common implementation as a network measure is less useful for our purposes than it would appear. This implementation measures fragmentation as the proportion of the nodes in the network that are not connected to the largest component. At first blush, this might appear a reasonable measure for our purposes, and indeed it is for some other questions. This measure gives a clear sense of the proportion of core and periphery, for example.

But there are two problems here. The first is inherent in the measure. While the measure can be useful for gauging the proportion of nodes in the core and periphery, and thus the division of the network, it gives no sense as to further subdivisions. It is typically silent as to whether there are multiple components. Alternative measures that simply count the number of disconnected components are unfortunately not of much help here either. One issue is the reverse of that of fragmentation: while component counts enumerate the disconnected subgraphs, they do not usually discriminate between components of different sizes. Moreover, accounting for component size is difficult, for each isolated node (a node without ties) is formally defined as a component. Since governance complexes typically have many disconnected actors, this would skew such a measure considerably. The second issue is related to this. Since governance complexes will share various common historical processes such as decolonisation, they will likely have uninformatively similar fragmentation scores. As such, the utility of such a score to describe the overall topology is limited.

The final candidate considered here is clustering.⁵⁶ Clustering has long been a subject of attention in both theoretical and empirical network research. Evidence suggests that in most real-world networks, and especially in social networks, nodes

⁵⁵For more on this, see Fortunato and Barthélemy 2007; Good et al. 2010; Lancichinetti and Fortunato 2011.

⁵⁶For more advanced analysis, such as identifying ensembles or sets of “key players” that could jointly fragment the network see Borgatti 2006; or “critical connectors” that bridge otherwise uncohesive networks see Valente and Fujimoto 2010.

cluster through relations into densely connected groups.⁵⁷

Such clustering can occur in unipartite and bipartite networks, and for both types of networks there are both count (summary statistic) and distributive measures available. For unipartite networks, which are perhaps the most straight forward to understand, clustering is usually measured as a count of transitive or closed triads;⁵⁸ triads of three nodes that are all connected, forming a “cluster”. Counting the preponderance of such “closed” structures gives a general sense of the overall cohesiveness of the network. The measure is sensitive to separated components, in that disconnected components provide many unclosed triads, but also captures the degree of intra-component or -module density.

Since this thesis concerns bipartite networks, triadic clustering is of little use.⁵⁹ An analogous measure for bipartite networks is the four-cycle.⁶⁰ This operates in a similar fashion to the unipartite case; instead of the number of three-cycles (fully connected triads) closing two-paths, the bipartite case looks at the number of four-cycles (fully connected sets of two nodes from one nodeset and two from the other) closing three-paths.

This CLUSTERING score serves well as a summary statistic for a network. Figure 3.8 on the next page shows how this statistic has varied across the study period. The first decade or so saw almost no clustering. The second decade saw more clustering, but it was not until the 1980s that the system became much more cohesive. After that, clustering dropped slightly in the 1990s before recovering in the 2000s.

There are three potential explanations for this marked shift in clustering from the 1970s to the 1980s. First, it may be that this simply represents the globalisation of the fisheries industry that took place in the 1980s. With states’ fishing industries fishing further from their coast and in foreign waters, there are more opportunities and sometimes incentives to join more RFMOs. Second, it may be that UNCLOS and later legal developments had the effect of encouraging states to participate in multiple RFMOs, generating clustering. UNFSA in particular promoted states’ participation in as many regional arrangements as appropriate. Third, it may be that this clustering is borne not by external mechanisms, but by endogenous sociorelational mechanisms. I will return to this in the next chapter, but this may take the form of peer referral for example, where states learn of the value gained

⁵⁷Holland and Leinhardt 1970; Opsahl and Panzarasa 2009; Opsahl 2011.

⁵⁸Holland and Leinhardt 1970.

⁵⁹Since ties can only exist between the two nodesets by definition, no triad can close.

⁶⁰Instead of the unipartite three-cycles closing two-paths. See Robins and Alexander 2004.

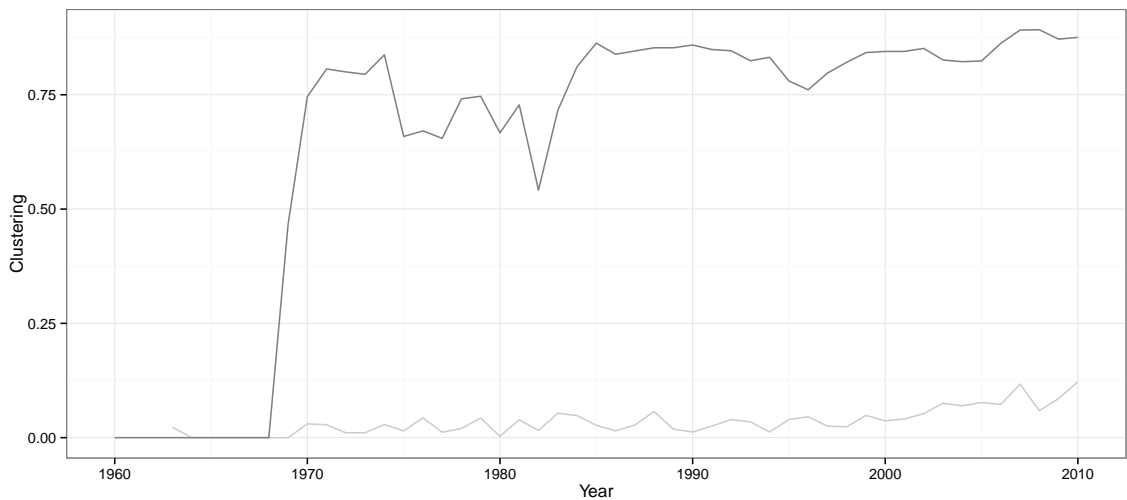


Figure 3.8: Clustering: The lower line provides the clustering of a graph of the same size and density in which ties are distributed at random.

from or the appropriateness of participation in a second RFMO from partners in a first RFMO.

These different explanations will be evaluated in the following chapter(s) using network models. Within these models, such a global clustering coefficient can operate as a useful target statistic for estimating coefficients. But a target statistic should not be used for evaluating the fit of such a model because it is directly modelled. In the unipartite case, triadic closure has a distributional form, consisting of a “triad census” of different structural motifs three nodes can take.⁶¹ Triad censuses are useful for capturing nuances about unipartite clustering, such as the amount of social constraint or influence to which nodes are subjected.⁶² However, there is little point in defining an internal distributional form for an auxiliary statistic, for almost all of the possible structural motifs can be targeted. Instead, I propose using an external form that looks at the distribution of the number of shared partners each node has with others of the same nodeset. This gets at the same notion of constraint expressed in the unipartite conception of clustering. I use this to evaluate the fit of the network dynamic part of these models in terms of the clustering dimension.

⁶¹See Holland and Leinhardt 1981, p. 43.

⁶²Burt 1992a.

Centralisation

Clustering represents the architectural cohesiveness dimension underlying fragmentation well. But the concept of fragmentation, at least as used by the governance architecture literature, conceals a second underlying dimension. Zürn and Faude recognise this second dimension when commenting that it is:⁶³

not fragmentation per se, but rather the *coordination* (or lack of it) of fragmented or differentiated institutions that becomes the most important issue. Only the absence of coordination may lead to additional undesirable outcomes such as exclusion or forum shopping, not the mere existence of institutional fragmentation.

In other words, there is another dimension to discussions surrounding fragmentation that rest upon the ability of the network to coordinate despite a lack of cohesion through a dominant institution. Since the focus of this chapter is on structural features, this dominance or coordinative potential is translated in structural terms as the centralisation of the architecture around a single institution.⁶⁴ A dominant, near-universal institution, nevertheless coexisting with other institutions in a given issue area, is an obvious counterpoint to the notion of fragmentation.⁶⁵

Network analysis is crowded with centrality measures that each express a different type of centrality or importance, and are thus useful in different contexts. An incomplete list includes degree, closeness, betweenness, eigenvector, Katz, and alpha centrality. They are too numerous to review here, and so I choose to simply accelerate to the core concept: degree centrality. Since the start of network theory, variation in degree centrality has been observed.⁶⁶ Research has found that most actors have only very few ties whereas some have many.⁶⁷ Degree centrality is also conceptually the simplest, and is defined as the number of ties each node has: a node with four ties has a degree of 4, and a node with no ties has a degree of 0. We can also speak of average degree, which will be greater than 0 for a social network, because the social networks we study usually include at least one tie.

⁶³Zürn and Faude 2013, 120, emphasis in original.

⁶⁴Note that the definition used here of centralisation is a network term that is structural or architectural. It differs from definitions of centralisation that are common in the rational design literature, for example.

⁶⁵On generality and universality see Koskenniemi 2006, p. 10.

⁶⁶Freeman 1979; Marsden 2002; Rivera et al. 2010, p. 103.

⁶⁷Borgatti and Everett 1999.

However, while average degree can be a useful baseline target statistic, it is not a terribly useful summary statistic, for it does not give any sense as to the distribution of degrees across the nodes of a network. For this we need to convert the distribution of degrees—which provides a perfectly capable auxiliary statistic but resists summary—into a degree centralisation measure.⁶⁸

Calculating centralisation for a unipartite network is relatively straightforward.⁶⁹ There centralisation is defined as the sum of differences in degree between the most central node and all other nodes, normalised by the maximum possible difference (i.e. a star graph, which is maximally centralised). For a unipartite network, the formula is:

$$Cent_{Unipartite}^{Degree} = \frac{\sum(D(A^*) - D(A_a))}{max \sum(D(A^*) - D(A_a))} \quad (3.2)$$

where $Cent$ is the centralisation of a unipartite graph, D is the degree centrality of a node, and the maximum is taken over all possible graphs of the same size.

While this general principle can be extended to the bipartite case, the two distinct nodesets there complicate matters, since degrees may be compared across the whole network or only within nodesets. When analysing governance complexes, which are typically characterised by asymmetric nodesets and institutions having higher degrees than actors, the latter comparison is more important. Fortunately, Borgatti proposed formulae for normalising “single mode centralizations” for bipartite graphs, requiring only the specification of which nodeset is most relevant.⁷⁰ For current purposes, we are most interested in institutional degree centralisation and so the following formula is for expressing the unnormalised centralisation of the network with respect to the institutional nodeset, I :⁷¹

$$Cent_{Bipartite}^{Degree} = \frac{\sum(D(I^*) - D(I_i))}{(\sum(A) - 1) \times (\sum(I) - 1)} \quad (3.3)$$

where A is the number of actors, I is the number of institutions, and D is the degree score of the maximum degree institution (*) and each other institution in the network (i).

Figure 3.9 on the following page shows how the global fisheries governance complex has developed over the study period according to this definition of

⁶⁸An alternative to measuring centralisation is to describe the overall degree distribution as an exponential, power law, or truncated power law function. See Clauset et al. 2009.

⁶⁹See Freeman 1979.

⁷⁰Borgatti and Everett 1997, pp. 259-263.

⁷¹An updated and more useful version of the formula can be found in Chapter 4 of Carrington et al. 2005, pp. 63-68.

CENTRALISATION. Centralisation begins with some fluctuation in the first decade, stabilises at around 0.2 for the next thirty years before beginning a steady increase through the 2000s.

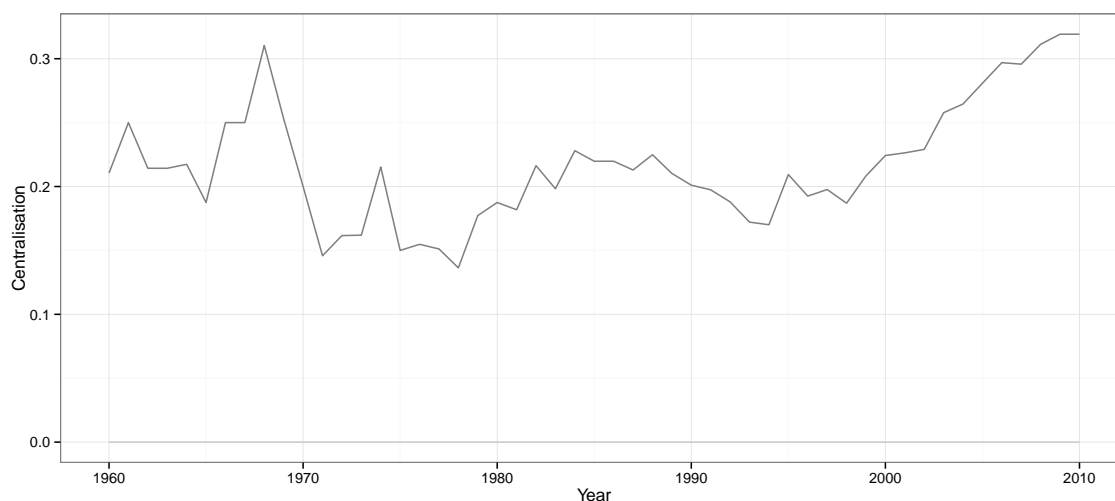


Figure 3.9: Centralisation: The lower line (at 0) provides the centralisation of a graph of the same size and density in which ties are distributed at random.

This evolutionary path indicates that one RFMO gradually developed dominance, particularly in the last decade, through attracting more members than any other institution. This RFMO is ICCAT. While ICCAT has a tuna-specific mandate, it suggests that this organisation, by virtue of its broad membership, may provide an (underutilised) site by which general fisheries management issues may be most efficiently introduced to the system.

3.3.2 Typology

Explicating these two dimensions serves multiple functions. First, these topological measures can be used to describe and analyse how the governance complex has evolved. During the presentation of these dimensions above, I have shown how we can describe and analyse the narrative of the global fisheries governance complex using each measure individually. But these dimensions can also be intersected to produce a two-by-two typology for even more analytic leverage.⁷²

⁷²Being deductively derived, analytic typologies cannot be right or wrong. See Snidal 1985b.

Two-by-Two

Table 3.1 lays out this “topological typology” with exemplar case depictions.⁷³ I use three institutions and thrice that number of actors to resemble the nodeset asymmetry of the global fisheries governance complex. The circles on the lower level represent actors and the squares on the upper level represent institutions.

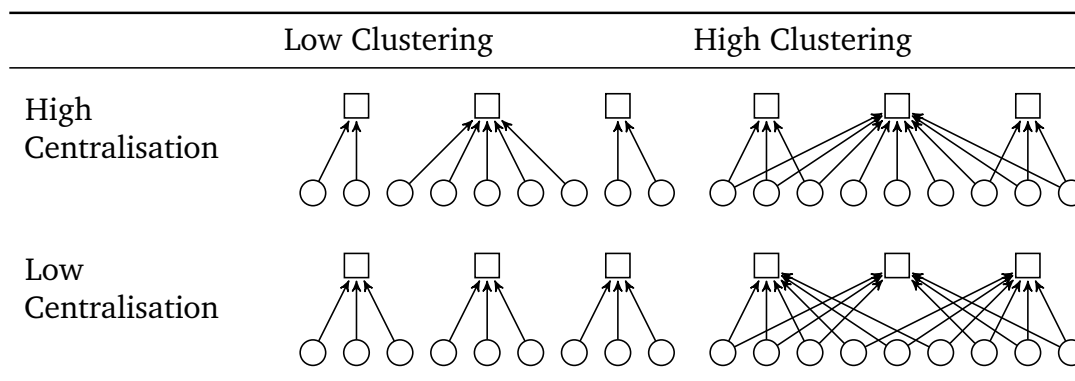


Table 3.1: Topological Typology

The vertical dimension expresses the degree centralisation of the networks. Compare for example the graphs on the left-hand side, each with the same number of actors, institutions, and ties. In other words, the graphs have the same size and density. However, they have a different structure. In the graph on the bottom left, each institution has three members. We may therefore think of these institutions as largely equal in resources and obligations (all else equal). We call this low centralisation. In the graph on the top left, however, one institution has more than twice the members of the other two institutions. This larger institution dominates, even if all institutions are formally the same. We call this high centralisation. Note that in this bipartite case, centralisation concerns *dominance vis-à-vis* peers and not *direct* hierarchy necessarily.

The horizontal dimension covers the degree of clustering present in the graph. Comparing the bottom two graphs now, we can see that while in both graphs all nodes have the same degree, in the right there is considerably more clustering, overlap, or shared membership between the institutions. There is also a high degree of clustering in the graph in the top right; however, again, one institution has a larger membership, meaning that this graph is both highly clustered and highly centralised. Indeed, in this latter case, it appears that the institutions with

⁷³Maximally central bipartite graphs are notoriously difficult to express visually and this is the clearest representation possible. See Carrington et al. 2005, p. 66.

fewer members may be subsidiary, more specialised institutions to the larger one, suggesting a more or less implicit institutional hierarchy.

Lastly, I also provide a provisional labelling of the resulting four types here.⁷⁴ A process leading to the bottom left type is how we might imagine *fragmentation* occurring: separate institutions are set up, each with their own sets of actors. A process leading to the bottom right type is leading to the *overlapping* of those institutions by shared membership. Where increased clustering is matched with increased centralisation, this leads to the *nesting* of smaller institutions within the broader membership of a dominant institution. Lastly, a process leading to the core-periphery type shown in the top left suggests *domination*.

State-Space

Since the dimensions of this matrix are based on formal, *continuous* network measures—differences in degree (CENTRALISATION) and number of four-cycles (CLUSTERING)—interacting them need not only produce a two-by-two typology, but also a two-dimensional state-space through which we may track the evolution of the global fisheries governance complex.

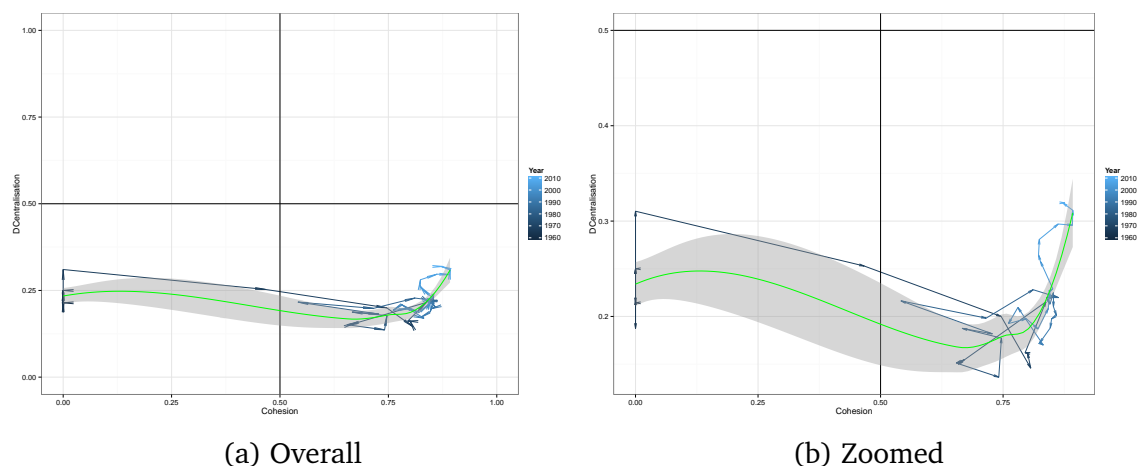


Figure 3.10: Evolution of the GFG Complex Through the Topological State-Space

Figure (a) in fig. 3.10 shows the trajectory that the GFG complex has taken from 1960 to 2010 through the state-space parsed out analytically in table 3.1. The actual trajectory is messy, but shown by the direct lines with small arrows to indicate the direction of travel through time. The plot on the right zooms in on the active part of the topological state-space so that the trajectory may be more clearly observed.

⁷⁴See also Thompson et al. 1990.

To emphasise the overall trend, a smooth local regression line has been added, with shading to represent the standard errors.⁷⁵

We can see from these plots that the GFG complex started out lowly centralised and lowly clustered. Its centralisation then increased somewhat, but exclusively; there was still no clustering. There was then a rapid growth in clustering, at some small cost to centralisation. There was then some shifting around for a while, before centralisation once again began to rise from this new, more highly clustered position.

What this suggests is that the global fisheries governance complex has developed from a structure similar to that in the bottom-left of table 3.1 to something more resembling the bottom-right. This suggests that, at first, the architecture involved relatively independent institutions but that by 2010 RFMOs shared many members and were each thus quite embedded in the overall structure. Such high clustering may facilitate learning between RFMOs but possibly at the cost of leaving space for innovation. The definite up-turn on the trend line also hints that the GFG complex is beginning to become more ‘hierarchical’, with some RFMOs’ membership nested within that of another. As mentioned above, this RFMO is ICCAT, indicating that ICCAT’s high membership is beginning to have topological effects.⁷⁶

Note that this finding—that the global fisheries governance complex has become *more* clustered and, more recently, *more* centralised—stands in marked contrast to those that despair at the fragmentation of global fisheries governance. Whether this is a common trajectory or not will require further research, but it does demonstrate the potential for novel insight that can be gained by such a “topological typology”.

In the meantime, these dimensions, CENTRALISATION and CLUSTERING, will return as key themes in this dissertation. The next chapter, for example, converts the summary statistic versions of these dimensions into expressions of sociorelational mechanisms for modelling the evolution of these networks, which are then re-employed in later chapters. It also uses their distributional forms as auxiliary statistics for evaluating the goodness of fit of these models; in other words, for testing the adequacy of an explanation of this evolution.

This topological typology has utility beyond this dissertation, however. Certainly, the formal quality of these dimensions should assist in comparative analyses of governance complexes, whether static or dynamic. The dimensions are general, and

⁷⁵In both these plots, centralisation and clustering is calculated with the isolates removed from the network. This does not change the narrative, but accentuates both centralisation and clustering.

⁷⁶Note that the architecture was becoming more hierarchical earlier on too.

the measures chosen are versatile, including both unipartite and bipartite, as well as summary statistic and distributional forms. It would be interesting to see whether, for example, the global trade governance complex takes the same evolutionary path.

Future studies may also relate these topological dimensions to other outcomes of interest in turn. There is already some interest in ecological studies in relating network topological features to architectural resiliency, for example,⁷⁷ and relating architectural topologies to the effectiveness of whole governance complexes seems reasonable. The topological typology may even be useful in evaluating how “complex” a governance complex is, which can then again be related back to systemic outcomes such as effectiveness, resiliency, or robustness.

3.4 Diagnostics

Describing the overall topology is not the only contribution network analysis has to offer the study of governance complexity. It also offers tools by which we can analyse the governance complex along different dimensions and diagnose potential issues or problems. As Oran Young defines it, diagnostics are about probing “the nature of the problem, the overarching political setting, the character of the actors or players, and the prevailing practices”.⁷⁸ To demonstrate the potential of network analysis to support such diagnostic purposes, I turn to Young’s well-known triad of “analytic themes” in global environmental governance: fit, interplay, and scale.⁷⁹

Young’s triad has attracted a great deal of scholarship since it was first floated.⁸⁰ Much of this literature is broadly supportive of the importance of these themes. However, as Vatn and Vedeld admit, in scholars’ attempts to apply these themes, many have necessarily had to make further distinctions and conceptual refinements to gain analytic purchase on their particular empirical problems.⁸¹ In their review piece, Vatn and Vedeld offer their own considerations.⁸² They argue that, although it may not have been Young’s aim to create a common, mutually exclusive, or coherent set of variables, the concepts are overlapping and this poses problems for Young’s expressed goal of a consistent specification of variables.⁸³ Vatn and Vedeld

⁷⁷Janssen et al. 2006.

⁷⁸Young 2008, p. xv.

⁷⁹Young 2002; Young 2008.

⁸⁰Folke et al. 2007, See for example; Galaz et al. 2008; Ekstrom and Young 2009; Paavola et al. 2009; Vatn and Vedeld 2012.

⁸¹Vatn and Vedeld 2012.

⁸²Vatn and Vedeld 2012, p. 9.

⁸³Young 2002, p. xxii.

argue that a useful, progressive conceptual framework needs to join fit, interplay, and scale with “institutions, actors, and physical environments/resources”.⁸⁴

This section aims to provide such utility by developing the concepts of fit, interplay, and scale, and relating them to precise network measures. I argue that network analysis offers measurement tools and a consistently defined relational ontological basis with which to transform these concepts into effective diagnostic tools.⁸⁵ So that they are not confused with Young’s own concepts, I call these conceptual products *architectural* fit, linkages, and overlap respectively. Since fit is perhaps the most familiar concept, I address this first. Next I investigate interplay, with a special focus on horizontal interplay. Lastly, I consider scale and, arguing with Vatn and Vedeld that many relevant aspects of scale are subsumed in the concepts of fit and vertical interplay, I reinterpret scale as the equally common and related concept of nesting/overlap.

3.4.1 Architectural Fit

For Young, the “problem of fit is a matter of the match or congruence between biophysical systems and governance systems” as defined as single resource regimes.⁸⁶ The sense here is that “contextuality is central. Hence, an institutional arrangement with excellent match for one resource may be a failure for another”.⁸⁷ The literature on fit pushes at this concept in three directions, which I will review here.

First, as Vatn and Vedeld note, this notion of fit invokes a “hand–glove” metaphor that demands at least the analytic distinction of the biophysical system (i.e. the hand) from the resource regime (i.e. the glove).⁸⁸ While I personally find it more confusing that the biophysical system is the more anthropomorphic ‘hand’ in this analogy, I accept that the division is perturbing for those who advocate the study of an integrated social-ecological system.⁸⁹ Still, I see no reason why an *analytic* division cannot prove fruitful, provided that the analytic division does not preclude but indeed facilitates the study of how interconnected these systems are, and so I retain this division for analytic purposes here.

⁸⁴Vatn and Vedeld 2012, p. 9.

⁸⁵See Vatn and Vedeld 2012, p. 5.

⁸⁶Young 2008, p. 26.

⁸⁷Vatn and Vedeld 2012, p. 3.

⁸⁸See Vatn and Vedeld 2012, p. 5.

⁸⁹See for example Folke et al. 2007.

Second, there is a competing notion of fit in the literature which, instead of considering fit as between biophysical and governance systems, focuses on how new institutions must instead ‘fit’ the extant institutional landscape.⁹⁰ This latter definition is certainly a completely legitimate use of the term fit.⁹¹ However, it is quite different from Young’s “systems-oriented perspective” that concentrates on the fit between and not within systems.⁹² More problematically though, I think, is that it shifts attention from Young’s central purpose of elaborating diagnostic tools applicable across time to the genesis and immediate consequences of institutional creation.⁹³ I therefore do not take up this development here for the current purposes.⁹⁴

Third, while Young and others usually use ‘fit’ with respect to a single regime,⁹⁵ Vatn and Vedeld argue that a concept is needed for “how the combined set of institutions, that is, the various resource regimes in Young’s sense plus all the other institutions that affect relevant action, fit the resources”.⁹⁶ In particular, they recommend the development of a more “narrowly defined”, “structure-oriented” concept of fit that concentrates on the “overarching [...] relationships between institutions and the biophysical systems that make interplay and scale into specific aspects of the then more-encompassing concept of fit”.⁹⁷ This conceptual development I do support here and propose that network analysis offers precisely the concepts and methods by which we can narrowly define and measure structural relationships.

There is however an additional aspect to Young’s definition and the way that it has often been employed that I have found difficult practically and often overlooked. The concept of fit has been disaggregated in many ways, including spatial, temporal, and functional (mis)fit.⁹⁸ But fit is typically about one or more institutions matching the biophysical system.⁹⁹ However, just as institutional borders are socially constructed, so are the borders of these biophysical systems. In other words, there

⁹⁰Paavola et al. 2009; see also several of the contributions in Aggarwal 1998a.

⁹¹Though it could equally reference interplay.

⁹²Vatn and Vedeld 2012, p. 6.

⁹³This relates to the anthropological concept of (institutional) bricolage, a process by which new institutions draw inspiration from and must be inserted into an existing landscape of institutions. See Cleaver 2002.

⁹⁴Though it is difficult to see exactly how one might analytically define such a notion of fit, given that the entrance of a new institution also changes the institutional landscape in important ways.

⁹⁵Ekstrom and Young 2009.

⁹⁶Vatn and Vedeld 2012, p. 6.

⁹⁷Vatn and Vedeld 2012, p. 9.

⁹⁸See Folke et al. 2007; Young 2008; Galaz et al. 2008; Paavola et al. 2009; Vatn and Vedeld 2012.

⁹⁹For an example, using network analysis, see Bergsten et al. 2014.

is no “pure” biophysical system for the governance system to match.¹⁰⁰ To avoid reifying the socially constructed systemic limits of so-called biophysical systems, I instead opt for the notion of relating governance architectures to the architectures of exploitation, extraction or economic activity in relation to a resource in a concept I call “architectural (mis)fit”.

I define architectural fit as the degree to which two architectures, actor-institutional participation and actor-resource economic activity, coincide. This thus captures how well a governance architecture covers a economic architecture. However, since governance architectures rarely match their socio-economic referents perfectly, it may be more appropriate to speak of architectural *misfit* for analytic purposes instead. In this case, the definition of architectural misfit is the *difference* between the governance and economic architectures. Here I use the actor-resource and actor-institutional architectures introduced in the previous chapter.

This notion of architectural (mis)fit can be used in at least four ways. First, we can look at how local patterns of participation diverge from patterns of economic activity for each institution. Figure 3.11 on the following page provides a visual representation of the extent of the misfit by the end of the study period (2010). This graph presents the difference between two bipartite graphs—FISHING (economic activity) and COOP (governance participation). It shows which RFMOs struggle with the most misfit, and where RFMOs share potential free-rider issues.

Immediately apparent is that, even in 2010, there remains considerable architectural misfit (279 ungoverned ties). For example, South East Atlantic Fisheries Organization (SEAFO) and ICCAT can be seen to suffer considerable misfit. Each has many remaining fishing ties once those fishing ties that are governed have been removed. For ICCAT this means that it only ‘fits’ just over half of the fishing activity within its mandate, by state party. Some of these are overlapping too; we see that there is a group of states that fish ungoverned in both ICCAT and SEAFO. Then there is a dense cluster of states fishing in the Indian Ocean around IOTC, SIOFA, CCSBT, and Regional Commission for Fisheries (RECOFI). This reveals that this oceanic area is in dire need of concerted governance. Several other RFMOs are also haunted by misfit, including NPAFC, NEAFC, and NASCO.

Still, we also see variation. CCAMLR is plotted separate from the main network because the data does not reveal any states fishing within its mandate that are not

¹⁰⁰Vatn and Vedeld 2012, p. 6.

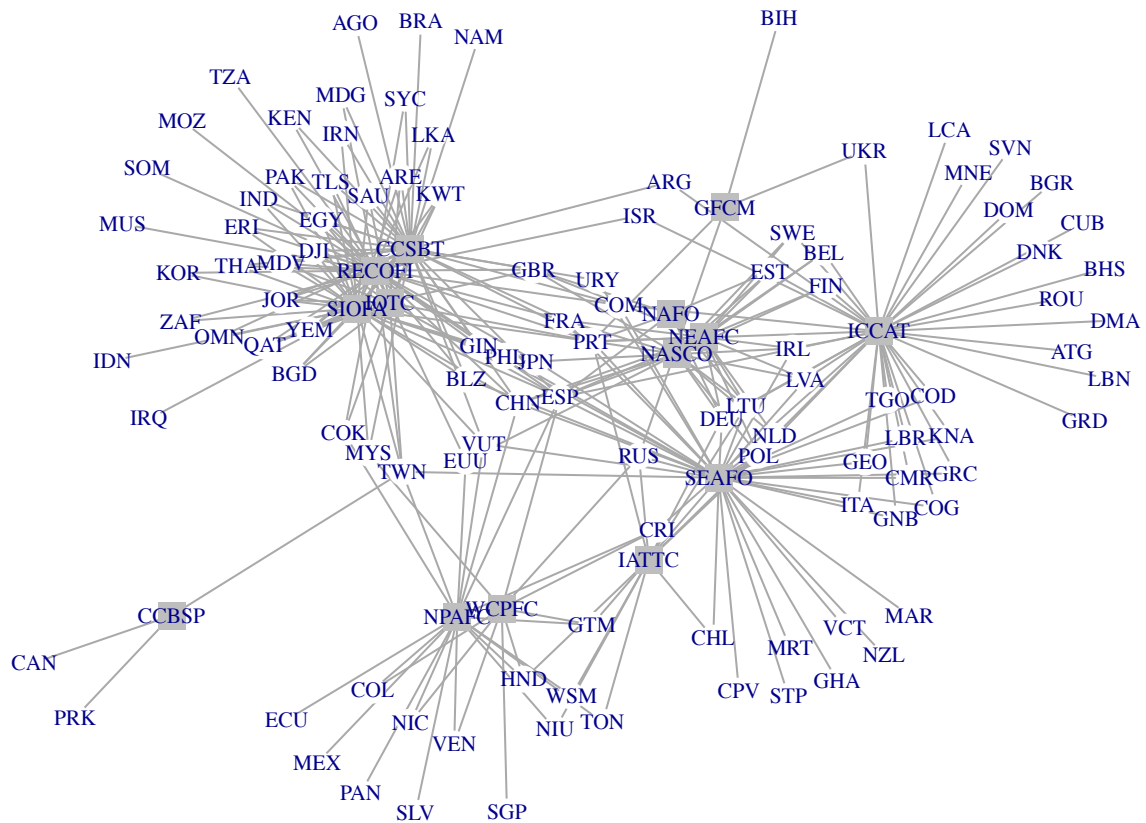


Figure 3.11: Architectural Misfits (2010): The network shows ties from states to RFMOs only where states fish within the RFMO's mandate without at least cooperating with the RFMO.

already at least cooperating with the RFMO.¹⁰¹ Similarly, CCBSP, GFCM, and NAFO (in the middle of the network) all have very few misfits and are thus close to having excellent fit.

Second, we can identify cases of gross architectural misfit to assist in targeted recruitment. In this case, it is sufficient to simply delete all referent relations/activity for which there is a corresponding governance tie, and then

¹⁰¹Indeed, from further investigation it appears that CCAMLR may even enjoy overfit, with nearly three times as many members as states fishing within its governance area. This suggests that states may also have aspirational or normative reasons for joining these institutions.

explore only those ties beyond a certain threshold. Table 3.2 provides the top 3 cases of outstanding architectural misfit for 2010 as an illustration.

	State	RFMO Mandate	Tonnes of Fish
1	CHN	NPAFC	2728445
2	CHL	IATTC	2128733
3	IND	SIOFA	2018205

Table 3.2: Gross Architectural Misfit (2010)

China perhaps unsurprisingly tops the list, for while it is both a DWFN and lands the most tonnes of wild fish per annum,¹⁰² it is not a member of all RFMOs. Still, by 2010 it has joined a number of relevant RFMOs. One outstanding case is the North Pacific Anadromous Fisheries Commission. China’s fishing is most heavy in the waters of the north Pacific, especially for pelagic fish, and yet it has never officially joined the NPAFC. It has made efforts to cooperate at least bilaterally with NPAFC members on fishing in the area,¹⁰³ and since 2006 has participated in ‘Operation Driftnet’,¹⁰⁴ but there continue to be cases of illegal fishing in the area by Chinese vessels.¹⁰⁵ NPAFC would thus benefit from increased participation by China.¹⁰⁶

Chile’s relationship with the Inter-American Tropical Tuna Commission is complicated. IATTC stands in the fortunate position of having most coastal states to its mandate either as members of the institution in some capacity, or as an official cooperating party. Chile is the exception.¹⁰⁷ While some of the tonnage of pelagic fish recorded as landed from IATTC’s regulatory area (as defined here) is probably from the more coastal anchovy and not within IATTC’s mandate, Chilean longliner fishing vessels also catch considerable quantities from IATTC-governed swordfish fisheries. Because Chile is not a member, it is not subject to the same restrictions

¹⁰²Though some doubt has been expressed as to the validity of these figures. See Watson and Pauly 2001.

¹⁰³Most notably a bilateral ship-rider and boarding agreement with the USA in 1993. See Guilfoyle 2009, p. 119.

¹⁰⁴See <http://www.dfo-mpo.gc.ca/international/mcs-npafc-eng.htm>.

¹⁰⁵See for example Davis 2014.

¹⁰⁶Vladimir Radchenko, personal communication, 3 April 2015.

¹⁰⁷Allen et al. state that the exceptions are Canada, Honduras and Chile, but accept that Canada is a cooperating party “so that the longer term question is what allowance to make for the likelihood that Chile and Honduras will eventually become parties to the Antigua Convention”. See Allen et al. 2010, p. 112; since 2013, however, Honduras has recovered its earlier cooperating status, leaving Chile as the single exception.

on gear that IATTC members are, resulting in both high swordfish and bycatch mortality.¹⁰⁸ IATTC would thus benefit from increased participation by Chile.

India is also not a member of the South Indian Ocean Fisheries Agreement in 2010. To be fair, no states were; SIOFA had not come into force by then and so the only “obligation” on those that had signed the Agreement (concluded in 2006) was to cooperate and act in accordance with the principles of the Agreement. However, despite increasing fishing in the Indian Ocean and its regional aspirations, India has not signed or ratified the Agreement. By 2010, India was landing over two million tonnes of fish from across the Indian Ocean. SIOFA would thus benefit from increased participation by India.

Third, we can measure the overall architectural misfit. This is measured as the number of ties left after we subtract COOP from FISHING. In other words, this represents the number of parties required to match the COOP architecture to the FISHING architecture, so that all relevant economic activity is governed. The advantage of architectural misfit as a measure is that it allows us to evaluate whether a governance complex including multiple institutions nonetheless ‘fit’ the structure of the economic system it governs.

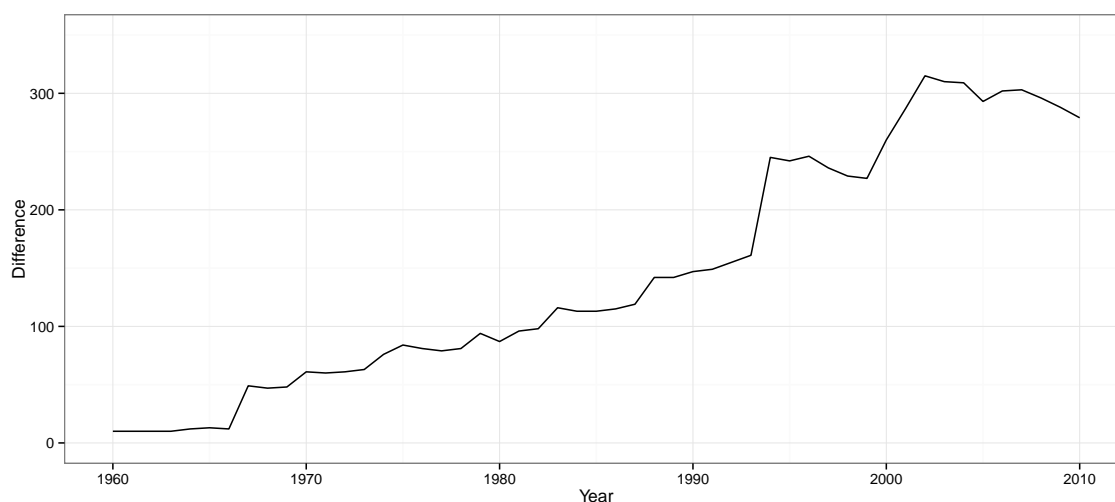


Figure 3.12: Global Architectural Misfit

Figure 3.12 shows that misfit has been steadily growing in the system. In the 1960s there were few RFMOs and few states fishing the high seas; architectural misfit was low. Then, while the establishment of new RFMOs brought with it the promise of more governed high seas fishing, often this promise was not met.

¹⁰⁸For example, albatrosses are caught on longliner hooks. See Anderson 2009.

More states began fishing in areas governed by RFMOs, often without joining the relevant institution. Still, this was a steady growth in misfit to about 150 instances of ungoverned fishing relations in the early 1990s. In the mid-1990s though, there was a step-change in misfit to about 250 instances of ungoverned fishing relations. By the 2000s, this had jumped up further to around 300. In sum, this suggests that architectural misfit, i.e. ungoverned fishing, is a growing problem and that, while there seems to be some evidence that it can periodically plateau, such architectural misfit does need to be reduced.

Lastly, we can explore dependencies between the two networks. This is typically achieved within a modelling framework, such as that used in chapter 4 and chapter 5. Such an approach involves assessing the degree to which the participatory architecture follows economic activity.¹⁰⁹ I call this measure ECONOMIC ENTRAINMENT to capture the notion that the governance architecture follows, is entrapped, or assumes the same periodicity as that of its referent network.

3.4.2 Architectural Interlinkages

Another major theme in Young's work is interplay. Young defines interplay as occurring "when the operation of one set of institutional arrangements affects the results of another or others".¹¹⁰ This rather vague definition has allowed scholars to treat interplay as synonymous with similar concepts such as interaction, interlinkages, interconnection, and overlap.¹¹¹ Young divides the concept into horizontal and vertical interplay.¹¹² For Young, horizontal interplay concerns interplay at the same level of social organization, whereas vertical interplay appears to be between different levels of social organization, such as the international, regional, national, and local levels.¹¹³

As defined in the previous chapter, a global governance complex has (at least) two levels: (state) actors and (international) institutions. Therefore, vertical interplay is already implicated in the bipartite analysis above. But network analysis

¹⁰⁹Or vice versa. However, contemporary modelling constraints limit our ability to model 'weighted' networks such as fishing effectively.

¹¹⁰Young 2008, p. xvi.

¹¹¹Stokke 2000, See e.g. Stokke 2001; Stokke and Coffey 2004; Young 2002; Young 2006; Young 2008; Paavola et al. 2009; Gehring and Oberthür 2009; Oberthür and Gehring 2011; see also Vatn and Vedeld 2012, p. 1.

¹¹²He also distinguishes between functional and political interplay, but I do not pursue this distinction here.

¹¹³Vatn and Vedeld 2012, p. 4.

also includes a method called ‘projection’ for converting a bipartite network into two unipartite networks. This extensively used method compresses the structural information contained in a bipartite graph into a weighted unipartite graph. Such an operation can be simply carried out through matrix multiplication.¹¹⁴ That is, by multiplying a two-mode affiliation matrix, M , by its transpose (i.e. the same matrix flipped along its diagonal, M^T), resulting in two one-mode networks AA and II . These one-mode networks have only one set of nodes and ties between them are weighted by the number of shared affiliations (in the case of the actor projection) or the number of shared members (in the case of the institutional projection). These weighted ties then represent the horizontal interlinkages between states or between RFMOs.

These ‘projections’ of horizontal interlinkages are shown in fig. 3.13 on the next page and fig. 3.14 on page 82. Tie width is proportional to how many members or RFMOs two nodes share, respectively. However, with these projections, we may also consider how these dyadic relationships cluster together into *communities*. Communities are defined as the subgroups of a network that are densely connected internally but themselves sparsely connected.¹¹⁵ Identifying appropriate communities within graphs is not easy.¹¹⁶ However, it is an important problem in complexity or network science more generally, and has resulted in a burgeoning literature proposing and discussing a host of community detection algorithms.¹¹⁷ It is not the purpose of this dissertation to review these algorithms here, and so I employ one of the simpler and most well-known algorithms: “edge-betweenness”.¹¹⁸

This algorithm seeks to maximise the internal density and external sparsity of ties or edges in subgroups by iterative removal of edges into communities.¹¹⁹ Candidate ties for deletion are identified by their “edge betweenness”, defined as the number of shortest paths between all pairs of nodes that run along each tie or edge. This measure is thought to favour those edges that lie between communities and disfavour those within, because ties between communities would lie on shortest paths between any pairing of nodes from either community. The tie with the

¹¹⁴Borgatti and Everett 1997; Everett and Borgatti 2013.

¹¹⁵Girvan and Newman 2002.

¹¹⁶Many clustering problems are so-called NP-hard. See Fortunato 2010, p. 83.

¹¹⁷Lancichinetti and Fortunato 2009.

¹¹⁸Newman and Girvan 2004.

¹¹⁹Girvan and Newman 2002; Newman and Girvan argue that this divisive procedure performs better than agglomerative alternatives, see Newman and Girvan 2004, p. 2, but agglomerative procedures continue to be popular too.

highest edge betweenness is removed and the procedure is repeated iteratively until internal density and external sparsity is maximised.¹²⁰ An advantage with the edge betweenness algorithm is that it can take into account edge weights, such as we have here when projecting the bipartite network.

Note that, as mentioned above, most community detection algorithms suffer from resolution limits.¹²¹ While this restricts the use of community detection as a way to measure clustering, it does not rule out its utility for diagnostics.¹²² Since Breiger argues that we should in principle always be interested in *both* projections from a bipartite graph,¹²³ I explore them both here, starting with the institutional projection.

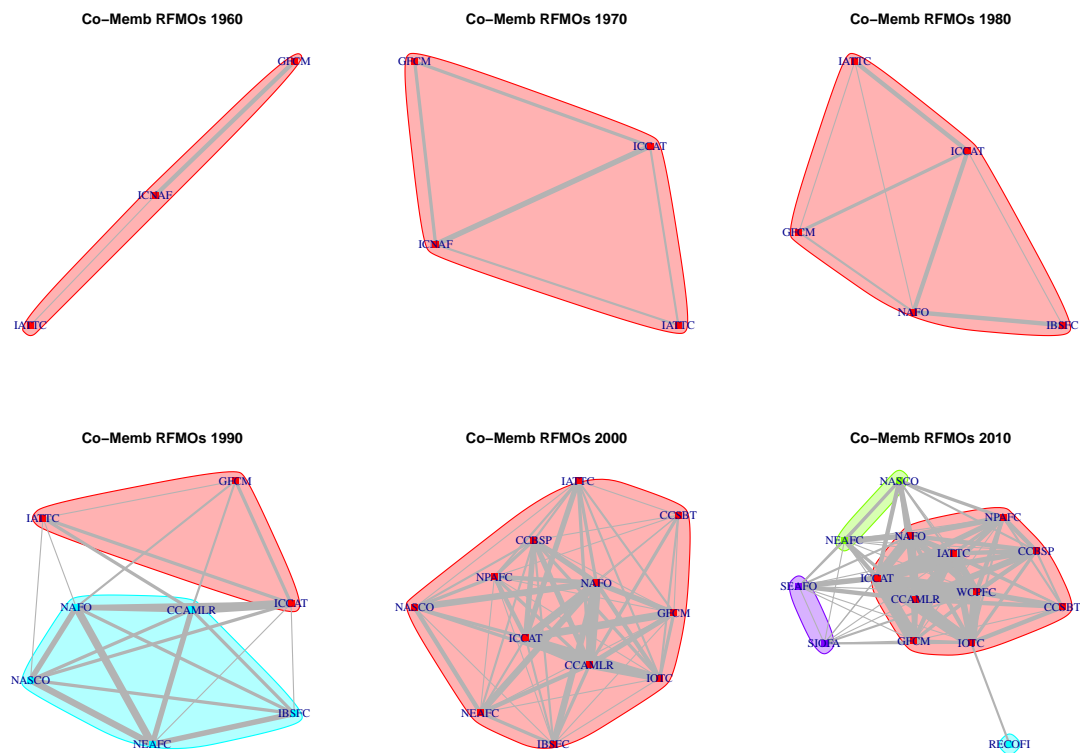


Figure 3.13: Institutional Interlinkages: Tie width proportional to number of shared members; communities bounded by coloured polygons.

¹²⁰This quality criterion is called ‘modularity’. For more see Girvan and Newman 2002; Newman and Girvan 2004.

¹²¹Fortunato and Barthélemy 2007; Lancichinetti and Fortunato 2011.

¹²²Future studies may evaluate the comparative utility of edge betweenness over other community detection algorithms for the purposes of diagnosing architectural interlinkage and the communities produced by those interlinkages. For now, however, I proceed using just edge-betweenness.

¹²³Breiger 1974; see also Everett and Borgatti 2013.

Figure 3.13 on page 79 shows how the bipartite MEMB network has evolved in terms of institutional interlinkage, defined as the number of shared members. We see that the three RFMOs existing in 1960 were already linked into a single community by shared members. However, the weighting of the tie also shows that the link was stronger between GFCM and ICNAF than between ICNAF and IATTC, and there was no shared members between GFCM and IATTC. This is perhaps not surprising, since the IATTC regulatory area lies in the Pacific, whereas the GFCM area is the Mediterranean. What this means though is that, if we presume that inter-institutional influence is best carried by members who can act as advocates for new practices in other institutions, institutional influence taking place in one of these two ‘ends’ of the governance chain must pass through another institution first. This makes inter-institutional influence between GFCM and IATTC more difficult. Another implication of this structure is that ICNAF is afforded certain advantages by bridging the ‘structural hole’ that would otherwise exist between GFCM and IATTC.¹²⁴ These advantages may include ICNAF being able to identify what works in either of the other institutions, or manage learning between the other two institutions. Note that this argument is potential only; the architecture provides a conduit through which inter-institutional transfer *may* take place.

In 1970, ICNAF had to share this bridging role with the newly formed ICCAT. While GFCM and IATTC still do not share any members, some of their members share two other institutions. The doubling of routes between IATTC and GFCM means increased redundancy and opportunity for practices to diffuse. Indeed, these two institutions are most strongly connected. IATTC is the most weakly connected, probably due to its regulatory area being in another ocean. By 1980, NAFO had replaced ICNAF and was connected to all three other institutions from 1970. This results in a dense cluster of four RFMOs that all share some members. A fifth RFMO, IBSFC, was connected to the core institutional part of the governance complex through ICCAT and especially NAFO. This puts IBSFC in the least advantageous position to learn from members’ experiences in other institutions, and the core in the position of being further away from any developments in IBSFC.

After UNCLOS, the institutional part of the governance complex became a lot denser. For the first time, we begin to see two communities of RFMOs emerge. The three oldest remaining RFMOs, IATTC, GFCM, and ICCAT, form one community, and the newer RFMOs form the other, larger community. This larger, newer community includes CCAMLR, NEAFC, NASCO, NAFO, and IBSFC. This shift happened because

¹²⁴Burt 1992b.

of the rush in the 1980s toward polar fisheries. 2000 sees this division implode as the core becomes more dense, with a particularly strong centre of CCAMLR, NAFO, ICCAT, CCBSP and NPAFC becoming evident. This heralds the other trend or switch, from the Atlantic to the Pacific.

By 2010, this core becomes even more pronounced, resulting in a single dense 'core' community and three peripheral communities. The core consists of all of the tuna RFMOs (IATTC, ICCAT, IOTC, CCSBT, WCPFC), as well as CCAMLR, CCBSP, NAFO, NPAFC, and GFCM. Two more specific northern Atlantic RFMOs, NEAFC and NASCO have become a separate community, as have two RFMOs surrounding southern Africa (SEAFO and SIOFA). Lastly, RECOFI stands alone, separated from the core group of RFMOs with only a few shared members with IOTC. This puts RECOFI in the position of potentially having to learn about successful practices primarily through its shared members with IOTC. While these plots have suggested that there is some community structure developing, for the most part there is an evident and dominant core. For the most part, then, global fisheries is a single governance complex.

We can also investigate the horizontal interlinkages between actors in fig. 3.14 on the following page. Because of the asymmetry in the sizes of node sets in the global fisheries governance complex, states' positioning is more homogenous. In 1960 and 1970, for example, we find two major ventricles, representing the memberships of GFCM and ICNAF (as well as later ICCAT). Four states bridge these two institutions: in 1960, these are the UK, Italy, Spain, and France; in 1970, these are Morocco, Italy, Spain, and France (the UK had withdrawn from GFCM). France and Spain appear to have claimed the core here through the membership in three of the four RFMOs. There is also a third community, representing most of the membership of IATTC. Here the USA and later Canada operate as the bridges between this membership and that of ICNAF and ICCAT. Whether this structural equivalence is competitive or collaborative is unclear.

By 1980 the picture has become more complicated though. Now no single set of states hold the most central position. Instead, three sets of states mediate between different RFMOs, forming a sort of triangle in the middle of the plot. First, Romania and Bulgaria mediate between IBSFC and GFCM. Second, Russia, Portugal, Cuba, and Canada mediate between IBSFC and ICCAT. Note that Canada comes closest to holding a central position in this network due to its continued membership in IATTC. Lastly, Spain, France, and Morocco mediate between GFCM and ICCAT. Still there are two main ventricles, but the remaining membership of IBSFC also

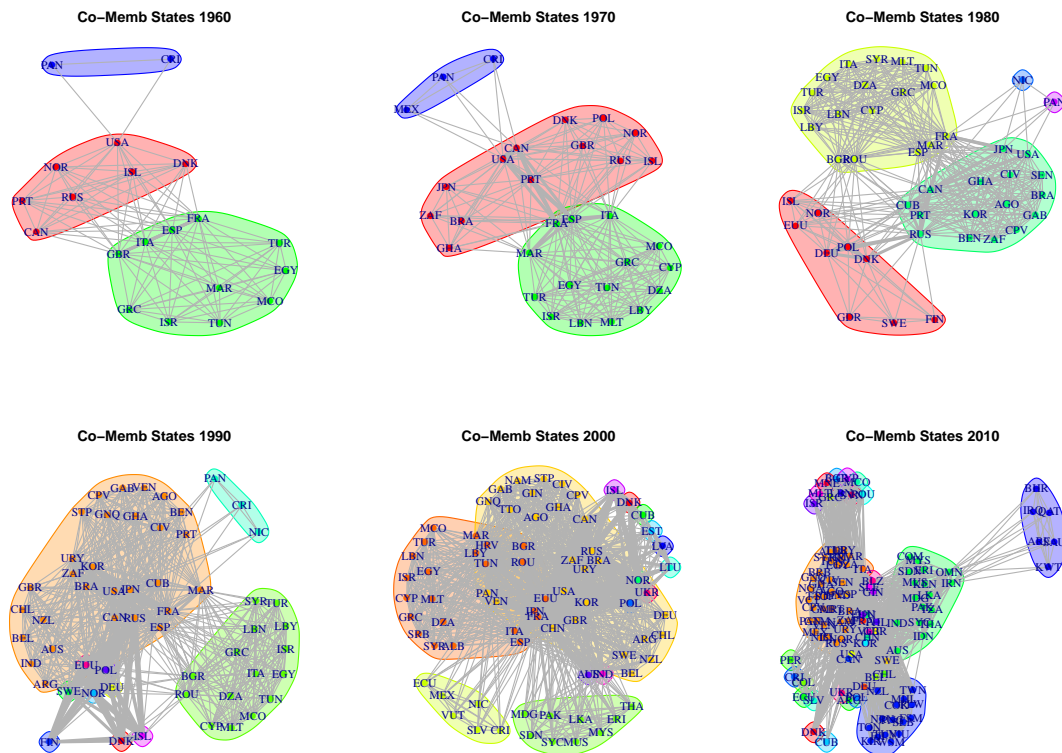


Figure 3.14: Actor Interlinkages: Tie width proportional to number of shared RFMOs; communities bounded by coloured polygons.

form a community, and the residual membership of IATTC are effectively isolated compared to the rest of the IATTC membership which is deeply implicated in the rest of the global fisheries governance complex.

In the plot for 1990, we see that one of the ventricles has engorged. While the GFCM-based ventricle, based around Greece and Italy, remains pretty stable in size, the memberships of most other RFMOs at this time have collapsed into a single, complex community. There remains a periphery though. The residual membership of IATTC (Panama, Costa Rica, and Nicaragua) form a community, and many of the members of the IBSFC (the EU, Poland, Germany, Denmark, Sweden, Finland, Norway, and Iceland) end up in rather distinctive positions from this main ventricle. Note that France and Spain have reclaimed their central position in the network.

In 2000, balance has been restored and we see three overlapping communities form in the centre, with several peripheral communities arrayed around it. The density of this system means that the labels are largely illegible by now, but the kernel in the middle of the core is constituted by France, Japan, the USA and EU.

Despite there being 12 RFMOs by now, these four states appear to be managing the global fisheries governance complex through them. Identifying these states is important because, as Alter and Meunier advise: “Once we have found out which actors guide states through international regime complexity, we can then investigate if and how repeat interactions across a small number of closely and multiply connected actors shape their interpretation and behavior”.¹²⁵

By 2010, this complexity has compacted, with a deepening core and centrifugal forces drawing the periphery outwards. By now the nodal labels are entirely illegible, but the core consists of a similar set of states. The advent of the WCPFC and IOTC have created another two semi-cores however. The IOTC community, and in particular Iran and Oman, serves as the bridge for the peripheral RECOFI community to the rest of the governance complex.

These two sets of projections, expressing both how actors or institutions are interlinked through actors’ institutional choices as well as communities defined on the network of those interlinkages, are key to the argument of this dissertation. The communities identified can be said to represent a state or RFMO’s ‘reference group’ when deciding the rationality or appropriateness of an action in a complex and uncertain setting. Moreover, where these communities are the outcome of strategic collaboration to manage an issue area across multiple institutions, we might call these intersecting social circles ‘governance circles’.¹²⁶ Of course, it remains to be seen whether these reference groups actually affect actors’ choices, but that is the purpose of the following chapters.

3.4.3 Architectural Nesting

The vague edges to the definitions of fit and interplay come to a head in the definition of scale. Young admits that scale, defined as different levels of social organisation, is closely related to interplay and in particular vertical interplay. He distinguishes scale, however, as stressing “the transferability of institutional knowledge from one level of social organization to another”.¹²⁷ Vatn and Vedeld have commented that this choice of linking scale to knowledge is a strange analytic move,¹²⁸ but I suggest that it may be this transferability or influence across levels

¹²⁵Alter and Meunier 2009, p. 19.

¹²⁶On the original notion of intersecting social circles see Simmel 2009, 363ff.

¹²⁷Young 2008, p. 33.

¹²⁸Vatn and Vedeld 2012, p. 8.

which is the key part of the concept, rather than the rather ambiguous term “scale”.¹²⁹

This points to how it is the sum of institutions that influences human action. It is the relative position of the “signals” sent from various institutional structures—as perceived by the actors—that shapes the final impacts. Understanding this “sum of motivations” is demanding.¹³⁰ Here we note that the different institutional structures may support different types of motivations. This aspect is not well captured in the literature on interplay because agents are typically assumed to have uniform motivations across regimes. The dynamics of interplaying regimes may be heavily influenced by the various and competing appeals they have to acting “individually rational” vs. “ecologically responsible”.

One scholar who has been working on such problems is Stephanie Hofmann. Hofmann asks: “how can we systematically study such inter-institutional effects?”¹³¹ Hofmann identifies three main dimensions of overlap in the pre-existing literature: mandates, membership, and resources. Mandates is “the tasks and functions that the institutions have subscribed to”; membership is “all formal members of international organizations”; and resources highlights the zero-sum game institutions play for “the common and pooled resources of each institution”.¹³² Here I focus only on the first two; the third is often part of what is expected from institutional members, and occasionally related to an institution’s mandate, but in any case does not have to be kept separately unless the purpose of the analysis is to focus on resources.

We can consider architectural nesting both against institutions’ objects (the empirical referent, in this case fishing activity) or what I call ‘scope-nesting’ and subjects (the participatory referent, in this case membership) or what I call ‘access-nesting’.¹³³ For the latter I focus on the COOP architecture, simply because it is the more expansive of the two participatory architectures studied here.

For operationalising overlap, I rely on the ‘NODF’ measure developed in ecological studies. NODF is an acronym and stands for Nestedness metric based on

¹²⁹Which may be temporal or spatial Young 2002; and may reference local, national or international policies and institutions Vatn and Vedeld 2012, p. 4.

¹³⁰See Vatn and Vedeld 2012, p. 8.

¹³¹Hofmann 2011, p. 103.

¹³²Hofmann 2011, p. 103.

¹³³I use the terms nesting and overlap interchangeably. Nesting can also occur across issue areas (Aggarwal 1998b, pp. 5-6). Since the primary focus of this dissertation is on a single issue area, I do not extrapolate this out here, but in principle this would involve a rather trivial extension to either the nesting or fit approaches given in this chapter.

Overlap and Decreasing Fill.¹³⁴ Unlike other metrics, it makes use of both concepts—decreasing fill and paired overlap—to measure not only whether there is an overlap in institutional membership, say, but whether one institution’s membership is largely contained *within* that of another, larger institution’s membership. By combining these concepts in a single measure, it is able to measure the degree to which a bipartite system such as the global fisheries governance complex resembles the top-right graph in table 3.1 on page 67.

The NODF measure works like so. Taking a matrix of A rows and I columns, decreasing fill (DF) is measured for each row or column pair as 100 where row/column r has a higher marginal total than the lower/further-right row/column s , respectively. This is then multiplied by the percentage of 1s in s that correspond to 1s in r to provide a M_{paired} score for each row or column pair that ranges between 0 in the case of no decreasing fill or no overlap and 100 where s is contained wholly within r . The NODF measure then sums these scores and normalises over all possible combinations. The equations are thus:

$$\text{NODF} = \frac{\sum_{rs} \text{DF}_{rs} \times \text{PO}_{rs}}{\left[\frac{A(A-1)}{2}\right] + \left[\frac{I(I-1)}{2}\right]} \quad (3.4)$$

where:

$$\text{DF}_{rs} = \begin{cases} 100, & \text{if } \sum r > \sum s \\ 0, & \text{otherwise} \end{cases} \quad (3.5)$$

$$\text{PO}_{rs} = \frac{\sum (s \times r)}{\sum s} \quad (3.6)$$

Because PO captures a (unidirectional) form of clustering, and DF captures a (clustered) form of centralisation, this means that a low NODF score captures the architectural structure identified in the bottom-left quadrant of table 3.1 and a high NODF score captures the structure identified in the top-right of table 3.1. It thus suggests that architectural nesting operates as a sort of dimension cross-cutting the topological typology diagonally, ranging from independence to hierarchy. Low architectural nesting means that institutions are relatively independent and regional. High architectural nesting means that despite multiple institutions coexisting, some appear as simply more specific sub-regimes. This accords with how the literature increasingly relates nesting to hierarchy.¹³⁵

Figure 3.15 on the following page plots how the NODF measure has changed over time for the COOP, MEMB, and MANDATE networks. All have increased

¹³⁴Almeida-Neto et al. 2008, p. 1229.

¹³⁵Aggarwal 1998a; Hooghe and Marks 2003, p. 236; Alter and Meunier 2006, p. 363.

in terms of architectural nesting over the study period. What is immediately recognisable, however, is how COOP and MEMB architectural nesting (i.e. NODF) is outstripping the architectural nesting in RFMOs' MANDATES. This means that, while RFMOs may address different mandates, through overlapping participation they are becoming increasingly embedded and, contrary to those suggesting the global fisheries governance complex suffers from fragmentation, it is becoming more hierarchical in the form of the structure in the top-right of table 3.1 on page 67.

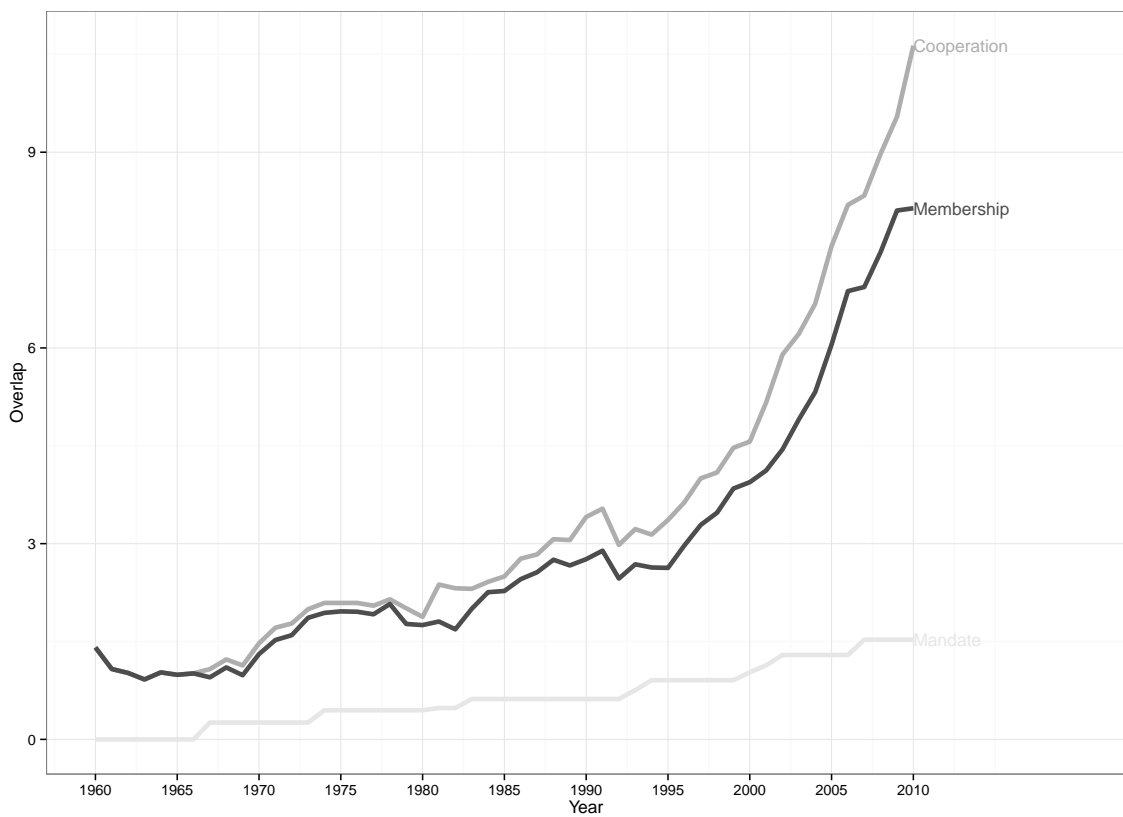


Figure 3.15: Nesting/Overlap

It also shows us how architectural overlap has risen markedly from the end of the Cold War. This suggests that, from around 1990 onwards, states were increasingly subjected to competing influences on their fishing industries and policy from exposure to multiple RFMOs. Moreover, it suggests that some RFMOs are effectively “nested” in other RFMOs, both in terms of mandate but especially in terms of the participatory architectures. This finding of increased nesting supports the suggestion above that there has been an upswing in topological hierarchicalisation,

but precedes it somewhat in time, suggesting architectural nesting may provide an ‘early warning’ diagnostic tool for this.

3.5 Catch of the Day

This chapter concludes the descriptive part of this thesis. A lot has been learned that will both motivate and inform the chapters of the following explanatory part. In the previous chapter, we have defined and described each of the distinct components of the global fisheries governance complex: actors, institutions, and the architectures of relations between and among them. These are the main characters of the narrative of this thesis and, as the introduction argued, including explicit institutions is a first for relational institutionalism in IR and endogeneising actors into a bipartite network is a first for institutional complexity in IR.

This chapter then moved the attention from data to method and in particular network methods. The introduction of this chapter discussed network approaches in IR and reviewed some common misconceptions that might otherwise discourage scholars of governance complexity from using networks. The following section visualised and gave a qualitative narrative to the evolution of the global fisheries governance complex using network graphs.

Then, in the third section of this chapter, I moved to a more precise, quantitative description of how the topology of the global fisheries governance complex has evolved. In contrast to the current mode of topological description, which consists of a single spectrum ranging from more fragmented to more integrated systems, I proposed a two-by-two topological typology constructed by the intersection of two dimensions, operationalised in terms of the network measures of centralisation and clustering. I argued that this typology is powerful yet flexible. It revealed that, despite suggestions that the fragmentation of the global fisheries governance complex is to blame for the failure to save the fish, the governance complex is not fragmenting but instead becoming more clustered and even somewhat more centralised. It is also flexible: it can be used with both the unipartite networks that are currently more common in IR as well as the bipartite networks that are more appropriate for governance complexity; the underlying dimensions could be expressed as summary statistics or distributions; and the intersection of them can be represented as a two-by-two analytic typology or as a state-space. Such a typology has many potential uses, but in the coming chapters its main utility is for assessing the fit of an explanation of this architectural evolution.

The penultimate section of this chapter offered architectural level operationalisations of three key analytic themes in the international environmental political literature: fit, interlinkages, and nesting. This resulted in three diagnostic tools, each related but distinct.

First, *architectural (mis)fit* was operationalised as the subtraction of a governance participation network from an economic participation network. This leaves only international fishing that remains ungoverned, which I call 'misfits'. The diagnosis shows that architectural misfit has been growing since 1960 and, while it appears to have plateaued somewhat, there were nearly 300 instances of ungoverned but reported fishing in 2010. Some of these are particularly gross examples of misfit, with states landing huge numbers of fish from within RFMOs' mandates. This diagnosis motivates the following chapter, which seeks to discover what attracts states to join RFMOs. By modelling this in such a way that we can explain why states join RFMOs, we learn how we might rectify at least the grossest cases of misfit.

Second, *architectural interlinkages* was operationalised as the unipartite projections of the network of states' membership in RFMOs. These interlinkages reveal which states share the most RFMOs and which RFMOs share the most state members, but utilising community detection methods, we can also identify where subgroups of these nodes form natural clusters or communities. The diagnosis shows that, while RFMOs tend to belong to a single group, states have a more complex structure of subgroups. Whereas during the first half of the study period there were two main ventricles or clusters of states, more recently this has become a dense core community and more peripheral groups. Do these subgroups have an impact on behaviour? All the following chapters reference the subgroups identified here, calling them 'reference groups' or 'governance circles'.¹³⁶ They form a particularly potent part of chapter 5 however, which considers the influence that an actor or institution's reference group has on their policy activity.

Third, *architectural nesting* was operationalised as the degree to which participatory or mandate overlap could be arranged so that one institution could be nested in another. The diagnosis was that the global fisheries governance complex is becoming increasingly nested and hierarchical, particularly in terms of participation but also in terms of mandate. This observation has strong implications for how we think about effectiveness. No longer can we maintain the fiction that institutional impacts on actors' behaviour operates independently of

¹³⁶Merton 1968a; Simmel 2009.

other, convergent or divergent institutional influences. But how can we measure institutions' independent influence if there is nesting? Of course, this is not something that can be solved per se, but does require the introduction of methods that can take account of this. Therefore, in chapter 6 I propose the use of network methods that can take the network or multilevel character of these competing influences into account and show how one might better (and differently!) evaluate institutional effectiveness once we take overlapping and indeed nested mandates and members into account.

So while descriptive network analysis has helped to describe and identify patterns in the where, when, and who of the evolution of the global fisheries governance complex—a useful contribution in its own right¹³⁷—it has also raised some outstanding questions that demand the employment of more inferential, explanatory network methods. The next part of this dissertation attempts to go beyond description, and models the evolution of the global fisheries governance complex longitudinally.

¹³⁷Sikkink 2009, p. 244.

Part III

Explaining Governance Complexity

*“Design is a funny word. Some people think design is how it looks.
But of course, if you dig deeper, it’s really how it works.”*

Steve Jobs

4

Other Fish

4.1 Why Do Actors Join Institutions?

INSTITUTIONS CANNOT BE EFFECTIVE WITHOUT PARTICIPANTS, and the analysis of the previous chapter has shown that most RFMOs suffer from some kind of participatory gap. These gaps or ‘misfits’ consist of states free-riding RFMO governance efforts by fishing unregulated within these RFMOs mandate. While the overall ‘architectural misfit’ of the global fisheries governance complex appears to have plateaued, it is still much higher than earlier levels and there are numerous cases of ‘gross misfit’, where the catch landed from an RFMO’s mandate by an unregulated state is very high.

Most observers would agree that this is a significant problem for global fisheries governance. Setting aside until later questions of institutional effectiveness or compliance, no institution can hope to be effective unless those actors the institution is established to govern are members. Indeed, the contractual nature of the international system of sovereign states means that, apart from a few exceptions, international institutions are voluntary and states (the primary actors of world politics) must first accede to multilateral institutions if they are to be bound by them.¹ How can RFMOs attract states fishing within their mandate but not currently members to join the institution?

Fortunately, other findings of the previous chapter suggest a way forward. For one, that the global fisheries governance complex is becoming more centralised means that, by the definition of centralisation employed here, some RFMOs are more popular (in the sense of having more members) than others. By explaining

¹Reus-Smit 1997.

this variation in participation, this chapter hopes to gain some insight into what motivates states to participate in RFMOs. The high clustering may also be useful here. If RFMO participation are not isolated decisions, then there may be ways to leverage the current architecture for targeted recruitment drives.

This chapter returns to the two central narratives first introduced in chapter 1. First, it considers institutional design as an explanation for variation in RFMO popularity. As alluded to in chapter 2, RFMOs vary not only in the number of states cooperating with or participating as full members in them, but also in scope, structure, and other design features. States, it is thought, design international institutions differently to satisfy their preferences in certain situations.² However, once negotiated, variation in institutional design may be responsible for attracting states to join some institutions they fish in and not others. Such design features may communicate to states whether an institution is likely to be effective or not, or satisfy any other preferences they have. This chapter will examine which institutional design features matter for states' decisions to join RFMOs and what their general preference on those features are.

Institutional design is not the only leverage we have on the problem of participation however. Most studies on institutional 'popularity' have engaged with a country's choice to affiliate with a particular institution as if it were a choice made independently of the structure of existing affiliations. But "institutional choice is not frictionless but protracted; and it is not independent of prior choices but deeply embedded in institutional legacies".³ This *architecture* of existing institutional choices is as important a source of information and influence as design. For example, RFMOs that are particularly popular (having many current members) may be more likely to be perceived as worthy of states' resources than smaller RFMOs. In other words, there may be an endogenous mechanism at work: popularity breeds popularity. Similarly, RFMOs with members that are similar in some respect to a state—say, similar geographic location, capacity, or other RFMO choices—may reap the rewards of that validation in further participation. Such socio-relational mechanisms are important because, while institutions' design is malleable through reform, often key features (such as problem settings) are generally persistent. Yet, as new states enter the interstate system and old states begin fishing in new fisheries, states face choices of which, if any, RFMOs they will join.

²Koremenos et al. 2001.

³Jupille et al. 2013, p. 215.

Therefore, the answer this chapter provides to the question ‘why do actors join institutions’ is a complex one. It marries both exogenous mechanisms, such as features of RFMOs’ design, and endogenous mechanisms, such as RFMOs popularity. It thus has a twin focus. First, it is interested in institutional *design* as a manipulable institutional feature. RFMO design could be reformed in such a way that it attracts the right participants or at least does not dissuade them from joining. Second, it is also interested in how institutional design plays out as the relational *architecture* institutions’ initial attractiveness creates impacts on successive participatory decisions. This second part is a particular contribution and the argument of this chapter is central to this thesis: it maintains that it matters what other actors—“other fish in the sea”, so to speak—are doing around you and in particular those others to which you are already tied.

This chapter proceeds as follows. In the following section, I address why it is necessary to *model* the process of actors joining institutions as a network, and explain the statistical network model used both here and in the following chapter. I also provide some more detail about how the dependent variables, here the evolution of COOP and MEMB networks, are specified. Next I turn to the two main narratives of the chapter: design and architecture. Under each, several mechanisms are implicated, and as I present each mechanism in turn, I describe the effect and discuss the theoretical justifications for including it here. Then, with the model, outcome and explanatory variables explained, I present the results of the modelling exercise, interpreting them in a manner fitting the question, data, and assumptions of the model. Lastly, I conclude by reviewing the ‘catch’ of the chapter.

4.2 Why Model? (And How?)

Why should we *model* participation? After all, the influence of both design and (sociorelational mechanisms that rely on) architecture can be investigated through qualitative case study. Indeed, why do we model at all? Joshua Epstein’s retort to the last question has gained some notoriety: anyone imagining how a system of any type or size did, would have, or might unfold is already modelling implicitly.⁴ It pays to do it explicitly though, he argues. Explicit models allow for the clarification and alteration of assumptions, the generation and replication of results, and abstraction and reapplication of findings. Epstein goes on to consider that many may be allergic to modelling due to its association with

⁴Epstein 2008b, p. 1.2.

prediction. But models are useful for myriad other purposes, including explanation (quite distinct from prediction); challenging existing theory; suggesting dynamical analogies; illuminating core uncertainties; educating practitioners, policy-makers, or the general public; discovering new questions, and more.⁵

This part of the dissertation touches on many of these purposes. Indeed, the aim here is not to predict participation but to explain and explore why actors choose to join institutions (this chapter), why actors and institutions choose to legislate or regulate as much as they do (chapter 5), and how much more effective some institutions are than others (chapter 6).

How then should we model state participation in RFMOs? Following on from the previous chapter, this section argues that statistical network models currently offer the most appropriate way of proceeding. Network models allow us to make inferences about the mechanisms underlying network patterns where an adequate explanation involves some interdependency among observations. An example of such interdependency might be that we expect states to cluster around particular RFMOs in a way that is self-reinforcing or endogenous. In this way, each observation of cooperation or membership is not independent as is often assumed with traditional statistical inference, but its explanation may be conditional on its local network environment and it may in turn provide part of the explanation of other observations. Network modelling therefore quickly becomes complicated in terms of model specification, convergence, fit, selection, and interpretation because relationships are all intertwined. But since governance complexity appears to involve precisely such complex interdependencies, the modelling strategy chosen ought to be at least sensitive to such accounts.

The last decade has seen the development of several statistical network models sensitive to such dependencies and capable of studying network evolution.⁶ Among these though, the Stochastic Actor-Oriented Model (SAOM) is the most apt model available for current purposes because it is both state-based and actor-oriented.⁷ First, while there are a growing range of actor-oriented statistical network models, some are appropriate only for studying *events* such as email communication behaviour that occur at a particular time.⁸ This is conceptually quite different to the state-based ties we have here of states' participatory affiliations with RFMOs,

⁵See Epstein 2008b, p. 1.9.

⁶For a comparison of models see Robins et al. 2012; see also Robins 2013.

⁷The best introductory text is Snijders et al. 2010; see also Snijders 2005.

⁸Butts 2008; Stadtfeld 2012.

something that SAOMs do explicitly.⁹ Second, while there are two main classes of state-based statistical network models, the actor-oriented SAOM and the tie-based Exponential Random Graph Model (ERGM), SAOMs are more appropriate here because we are interested in modelling states' (i.e. actors') *choices* to join RFMOs. In principle, these are simply two different ways of modelling networks: as a function of actors choices (actor-oriented) or as a propensity for ties to form (tie-based). Tie-based models are generally more spare in terms of assumptions, but here the assumptions of the SAOM align well with the assumptions of the theoretical framework.¹⁰

SAOM

A SAOM is a longitudinal network model that models how (at least) one network evolves from its structure at one time point through to different structures at later time points as a function of a series of actors' choices.¹¹ Although these networks are only observed at particular time points, SAOMs model the differences between these observed waves as an unobserved process of sequential tie changes. These changes occur at so-called 'mini-steps' in continuous time in the evolution of one observed network observation to another.¹²

There are two core functions of a SAOM. As an actor-oriented model, tie changes are modelled as the choice of actors as they seek to maximise an *evaluation function*. How many times on average actors are given the opportunity to make a change to maximise their objective function is governed by a *rate function*. In effect, there is a two-step process: first, an actor is chosen to consider making a change to their local network (according to the rate function); second, the actor decides which, if any, tie to change (according to the evaluation function). However, here I explain the choice component first, and then the opportunity component of the model.

The *evaluation function* is really the core of the SAOM.¹³ When an actor is

⁹Note the two uses of the word 'state' here: the former is related to the concept of stasis; the latter is a unit in the inter-state system, a synonym for country.

¹⁰Nonetheless, tie-based models may be more appropriate for some other IR contexts, such as where there is considerable degree heterogeneity.

¹¹Technically speaking, a SAOM is a continuous time Markov chain that models how a network, and behaviour within the network, change from one observed wave to later observed waves through simulated tie changes at 'ministeps' along the way. See Steglich et al. 2010; Veenstra et al. 2013.

¹²I am reminded of a quote in *The Bastard of Istanbul* by Elif Shafak: "Because time is a drop in the ocean, and you cannot measure off one drop against another to see which one is bigger, which one is smaller".

¹³Previously called an objective function and can also be thought of as a utility function. Only evaluation functions are used here and not creation/endowment functions.

provided with an opportunity to change their ties, the selected or focal actor evaluates the utility gained by changing one relationship to any of the possible targets—whether this involves creating a new tie, deleting an existing tie or, if the current state is maximal, keeping the current state—and takes the action (or inaction) that maximises that utility. Among all possible tie changes, the actor decides which one results in the most attractive network from its perspective and, with some random error, executes this change.

In the end, actors trade off many different considerations and are under the influence of many factors when they make changes to their local network. The evaluation function combines various different factors, or ‘effects’, that influence an actor’s decision to prefer ties to particular others. These indicate to whom an actor prefers to make ties to in relation to both their attributes and their structural position. For example, a state may find one RFMO attractive because it is strong on a design feature that states value, but another RFMO might be more attractive because, despite its design, it appears to be a popular choice with other states. If the parameters for those effects are positive, a state is more likely to create or maintain a tie to an RFMO that is attractive because of its design or popularity, respectively. Each change only depends on the current state of the network, i.e. actors in the networks are assumed to neither act strategically nor dependent on historical choices (the residual states of which are no longer present).¹⁴ Estimating which relative valuation of these factors (and more) would be responsible for networks changing from their first observation through to their last observation is the purpose of the SAOM. Parameters that attach relative importance to different effects are estimated from the series of mini-steps that connect the empirical network observations.¹⁵

The model also relies on actors being granted opportunities to exercise this evaluation function. Which actor should be offered an opportunity to change their tie is governed by the *rate function*. The rate function is important because it is responsible for generating and distributing a number of ministeps to actors. These ministeps are randomly determined and follow Poisson processes, with waiting times for each individual actor being modelled by exponential distributions. A rate parameter is thus estimated for each period alongside the parameters in the

¹⁴The idea of modelling social (though not network) processes as Markov processes even if data are only available as panel data dates back to: Coleman 1964, 132ff.

¹⁵For more details about the method, including specifications on different methods of parameter estimation, see Snijders 2001; Snijders 2005; non-technical introductions to the method are given by Steglich et al. 2006; Snijders et al. 2010.

evaluation function to provide actors with an appropriate amount of opportunities to change ties given the complexity of their evaluation such that the dependent network can evolve from the start of the period to the end of the period.¹⁶ Rate parameters will usually be higher than are strictly necessary to produce the most efficient chain of tie changes between two networks because the model allows for non-changes and changes that get reverted during the period too.¹⁷

Ordinarily, a ‘constant’ or universal rate function is employed for each period. This means that all actors receive a similar number of opportunities to reconsider their satisfaction with their local set of ties and make changes as necessary each period. The implicit assumption is that actors are at least homogenous in their opportunities; it is only in their preferences that they differ. As far as I am aware, every substantive study employing SAOMs to date has invoked such an assumption.¹⁸

However, it is possible to specify effects not only for the evaluation function but also for the rate function.¹⁹ Such effects do not influence which RFMOs states choose to join, but which states are given more opportunities to consider joining RFMOs. I submit that specifying parameters for the rate function can be particularly useful where a large number of stable isolates exist in the network. This is certainly the case here as there are a number of states that *could* join the global fisheries governance complex but almost never do. Many of these isolates are landlocked states, and yet there are some landlocked states that do play a role in global fisheries governance and some states that only have small maritime areas and are not involved in global fisheries governance. Therefore, simply removing all landlocked states would be too heavy-handed. The solution used here, including a variable of states’ EEZ in (logged) square kilometres into the rate function, is more sophisticated and subtle. Without affecting *whether* a state chooses to join an RFMO nor which RFMO it chooses, including states’ maritime area into the rate

¹⁶While there has been little work so far interrogating exactly how the rate function in a SAOM behaves, it is thought that a more complex evaluation function may require more minimesteps to be given to each actor so as to come closer to disambiguating the various effect. However, it may also be that a more complex evaluation function ensures that there are fewer “wasted” opportunities to make changes that bring the process state closer to the next observed network and thus a smaller ‘rate’ is required. More research is required here.

¹⁷Snijders et al. 2010, p. 51; one study found an additional 7–10% of changes that were hidden inbetween observations because they cancelled each other out. See Steglich et al. 2010, p. 338.

¹⁸Certainly all those within IR, such as Warren 2010; Manger et al. 2012; Kinne 2013; Manger and Pickup 2014; the only exception I am aware of, though outside of IR, is Light et al. 2013, who model behavioural initiation through innovative use of the rate parameters.

¹⁹Ripley et al. 2015.

function means that the most maritime states will be offered the most opportunities to change their ties in the simulation and those that are landlocked very rarely so.

SAOMs are currently underused in IR, but there are signs of a sea change. Warren uses SAOMs to investigate patterns of amity and enmity in interstate military alliances.²⁰ Manger, Pickup and Snijders employ SAOMs to study patterns in PTA formation.²¹ Kinne expands these studies to a number of other bilateral cooperative arrangements, including fisheries.²² However, no IR text has yet studied the evolution of multiplex bipartite architectures using SAOMs.²³ The present study's extension of SAOMs to bipartite networks in IR thus represents a natural next step in the evolution of this model's use in IR. I now turn to how these networks are defined in the model.

Dependent Variable

There are two dependent networks to be explained here, COOP and MEMB, each bipartite and evolving across five periods through six waves. The dependent data are thus $2 \times A \times I \times T$ arrays (A being 198 states, I being 17 RFMOs, and T being the six waves). While there are no missing values (I assume that the public data collected and validated through archival research is effectively complete), I take states joining and leaving the system into account. This means that, during the simulated ministeps between waves, only states existing at the time (calculated proportionally over the simulated ministeps) are given opportunities to update their ties and only RFMOs that are existent at the time are available to be joined. This means that some of the dyadic observations within these arrays are not available and thus hold no information for the model.

Indeed, because this is a model of network evolution, and the goal is not to predict ties but to explain changes, strictly speaking the units-of-analysis are not ties but tie changes. In other words, "It is not the purpose to explain X(post) given X(pre) but to explain the dynamic process between observations, given that it starts at X(pre) and results in X(post) (or in a network similar to X(post))".²⁴ As such the model gets its primary information for estimating parameters from the dyadic

²⁰Warren 2010.

²¹Manger et al. 2012; Manger and Pickup 2014.

²²Kinne 2013.

²³Though Hollway and Koskinen do study multilateral fisheries treaties using multilevel ERGMs. See Hollway and Koskinen 2015a; Hollway and Koskinen 2015b; in organisational sociology see Koskinen and Edling 2012.

²⁴Indlekofer and Brandes 2013, p. 281.

observations that differ between each $A \times I$ matrix. In the middle four columns of table 4.1 and table 4.2, I report the number of different types of tie changes for the COOP and MEMB networks, respectively, for each period. The rows count the ties that stay null, are created, maintained, or deleted, respectively, in each period. At the bottom of each table, the distance sums the ties created and deleted in each period. These are the changes that provide the most information to the model.

Changes:	1960	→ 1970	→ 1980	→ 1990	→ 2000	→ 2010
0 → 0		3105	3073	3038	2979	2861
0 → 1		21	33	49	65	130
1 → 1		24	31	58	95	145
1 → 0		1	14	6	12	15
Distance		22	47	55	77	145
Jaccard		0.522	0.397	0.513	0.552	0.500

Table 4.1: Coop Tie Changes 1960–2010

Changes:	1960	→ 1970	→ 1980	→ 1990	→ 2000	→ 2010
0 → 0		3108	3075	3045	2988	2912
0 → 1		18	34	44	63	88
1 → 1		24	28	56	88	136
1 → 0		1	14	6	12	15
Distance		19	48	50	75	103
Jaccard		0.558	0.368	0.528	0.540	0.569

Table 4.2: Memb Tie Changes 1960–2010

Since SAOMs break down when there is too much or too little change relative to the size of the network it is also necessary to describe their stability. The Jaccard coefficient, below the distance, describes this stability. Generally speaking, the Jaccard coefficient should lie somewhere above 0.3 to ensure that the successive network has some semblance of the former.²⁵ In this case, ten-year periods provide a good balance of change and stability for the model, with Jaccard coefficients above 0.3 for all periods and both networks, and 346 changes to explain in the COOP network evolution and 295 changes to explain in the MEMB network evolution.

Note that the most basic form of the evaluation function, used here, basically treats $0 \Rightarrow 0$ and $1 \Rightarrow 0$ as the same and $0 \Rightarrow 1$ and $1 \Rightarrow 1$ as the same. In

²⁵Ripley et al. 2015.

other words, it makes no distinction between the reasons why a state would join or stay in an RFMO, nor between why a state would exit or avoid an RFMO. As such the results can be read in the same way as a (conditional) multinomial logit, where the choices are to toggle ties to any of $M + 1$ nodes. The choices are between $M + 1$ nodes rather than M because an actors choice to tie to themselves is considered as a choice to keep their ties as they are. Significantly positive parameter estimates can thus be interpreted as factors that drive countries to make or maintain ties in the network to which the parameter relates. Significantly negative estimates can be interpreted as factors that drive countries to drop or stay away from RFMOs.

Fit and Interpretation

As opposed to many other statistical techniques, no single number such as R^2 , AIC , or BIC has been developed for comparing model fit for statistical network models. In recent years though, related solutions have been proposed for ERGMs and SAOMs.²⁶ The sufficiency or goodness of fit of a SAOM is established by measuring the differences in auxiliary (i.e. unmodelled) statistics between the observed network array and a number of network arrays simulated from the final parameter estimates on auxiliary statistics.²⁷

Here I employ auxiliary statistics related to the two dimensions of the topology typology presented in the previous chapter: centralisation and clustering.²⁸ In other words, I consider the actor-oriented choice model sufficient if it replicates the centralisation and clustering of the network around particular RFMOs. Lospinoso included two metrics for evaluating sufficiency. First, a Mahalanobis distance score sums the distance between the observed point and simulated distribution of an auxiliary statistic.²⁹ Second, a p -value is also provided. Note here, however, that since we are trying to align a simulated range *over* the observed statistic, and not testing whether the range significantly differs from 0, *higher* p -values represent *good* fit. Where the nodes in simulated networks have very similar patterns of ties to the observed network, i.e. good fit, we can state with reasonable confidence that we have identified the micro or local factors influencing actors choices that account for global network properties such as the pattern or distribution of ties.

²⁶The general statistical argument was proposed by Hunter et al. 2008; for ERGMs, see also Wang et al. 2009; and for SAOMs, Lospinoso 2012.

²⁷For an example of this goodness-of-fit check in usage, see Conaldi et al. 2012.

²⁸The latter is a new contribution to the range of auxiliary statistics available for SAOMs.

²⁹Lospinoso 2012; see also Wang et al. 2009.

Converged, sufficiently well-fitting results may then be interpreted. To recap, SAOM coefficients represent the weightings given to various network statistics in log-odds form and may be interpreted as if they were the output of a conditional multinomial logit.³⁰ The multinomial categories are the $m + 1$ choices a state actor may make (toggling a tie via-à-vis each of m RFMOs or making no change). We can then evaluate whether these parameter estimates are statistically significant in the ordinary way.

However, it should be noted that the complexity of SAOMs generally makes the interpretation of results difficult. Ordinarily, one would evaluate the relative importance of an effect in a statistical model by measuring the amount of change in the outcome variable caused by a one-unit change in the corresponding explanatory variable. But while one may exponentialise SAOM coefficients into odds ratio form to compare the influence of effects *ceteris paribus*,³¹ comparing the relative importance of effects in the context of the model is difficult because the underlying data are often of different scales,³² correlated (especially with network effects), dynamic but only partly observed, and modelled as a multinomial rather than a binomial choice.³³

To facilitate such comparison, Indlekofer and Brandes propose a method for evaluating the relative influence or importance of effects on actors' choices in a SAOM taking into account coefficient sizes, the underlying data, and the complete model specification including possible correlations, and it is this solution that I employ for interpretative purposes here.³⁴ Since actors' choices in a SAOM occur at simulated ministeps, their method scores the influence of an effect on an actors choice by summing the differences in probability for each available choice with and without a particular effect.

Having explained how I intend to model states' choices to cooperate with or become a member of RFMOs and interpret the results, I now turn to a description of the major explanations invoked in the model.

³⁰McFadden 1973.

³¹See Snijders et al. 2010; Ripley et al. 2015.

³²This is a common and not insurmountable difficulty, but exacerbates the other challenges.

³³For a review of these difficulties in the context of SAOMs see Indlekofer and Brandes 2013, pp. 278-279, 283-284.

³⁴Indlekofer and Brandes 2013.

4.3 On Design and Architecture

As described above, I assume here that the evolution of changes in each participatory architecture—COOP and MEMB—is driven by a data generating process of multiple explanatory variables. This section specifies and defines these variables and explains the theoretical justification for including each mechanism in two subsections that correspond to the two main narratives introduced in the introduction: how (1) institutional *design* features and (2) the structure of the participatory *architecture* affect states' decisions to cooperate with or join RFMOs as members.

Before beginning, however, it is important to define a general propensity a state has to join an RFMO, irrespective of any preference (see fig. 4.1). This effect is known elsewhere as density, for it models the general and effectively random propensity for a focal actor a (where $a \in A$) to form a tie to any institution i (where $i \in I$). The contribution such an effect makes to the evaluation function can be defined as:

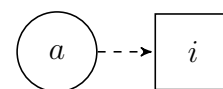


Figure 4.1: Density

$$s_{a1}^{\text{net}}(x) = x_{a+} = \sum_i x_{ai} \quad (4.1)$$

That is, density captures the attractiveness to a of a network in which a has one more tie to any i . Note that density operates effectively randomly and thus in the context of a model provides a base tendency or INTERCEPT over which other mechanisms operate.³⁵

4.3.1 Design

The first set of mechanisms related to states' choice of RFMOs to join relates to properties or features of those institutions. Following the literature on international institutions, and the rational design literature in particular, I differentiate between institutional features that manifest the preferences of those establishing the institution, i.e. 'design', and those institutional features that reflect the particular problems or uncertainties the institution faces, i.e. 'problem structure'.³⁶ I first deal with the former before addressing the latter.

³⁵A model that includes only a density parameter is called an Erdős-Renyi or Bernoulli model.

³⁶Koremenos et al. 2001; see also Mitchell 1994.

Institutional Design Traits

International institutional design has long been the topic of normative study, inherited from international lawyers,³⁷ and maintained by political and critical theorists.³⁸ But the empirical study of international institutional design has also returned to prominence in the past decade and a half when projects such as the rational design of international institutions won a degree of independence from the institutional effectiveness literature.³⁹

The core, programmatic text in that project is the introduction to the 2001 *International Organization* special issue of the same name. In it, Koremenos, Lipson and Snidal contend that there is non-random variation in the design of the growing number of international institutions, which they argue can be explained as “the result of rational, purposive interactions among countries and other international actors to solve specific problems”.⁴⁰ Design is thus the dependent variable and the authors develop a non-exhaustive but useful fivefold classification of institutional design features: scope, membership, centralisation, control, and flexibility.⁴¹ They identify these on the basis that they are substantively important, resonant with scholars and practitioners alike, measurable, and applicable to a wide range of regimes.⁴² A key set of controls that might explain variation in institutional design besides states’ rational choices are variations in the problems with which institutions grapple, classified as: asymmetry, distribution and enforcement problems, and uncertainty about the world, others behaviour, or their preferences.

This dissertation makes strong use of this classification, but adapts these variables for the needs of the current project. First, neither design nor problem structure is the dependent variable here. Instead the participatory architecture of the global fisheries governance complex is the dependent variable in this chapter. Second, to simplify matters and because there is very little change in institutional design anyway (though the following chapter shows there is change in their practice), institutional design is considered static. I thus refer to them as design traits here rather than design features. This is not to suggest that RFMO design is not manipulable through reform; only that, historically, reform at the level these

³⁷As well as functionalists such as Mitrany 1945.

³⁸E.g. Held 1991; Held 2002; Habermas 2008.

³⁹Koremenos et al. 2001; see also Mitchell 1994.

⁴⁰Koremenos et al. 2001, p. 762.

⁴¹Koremenos et al. 2001, p. 763.

⁴²They are also few enough that they do not become burdensome to model. Cf. Ostrom 1990; Diez et al. 2002; Mancur Olson, for example, said that while ten is a good round number, parsimony demands a more elemental taxonomy Olson 1971, p. 867.

variables are specified here has been rare.⁴³ Third, I slightly re-specify the design features (detailed below) and relabel them to avoid any potentially confusing overlap with other terms used in this thesis. As such, the result is a fivefold classification of design traits including: SCOPE, ACCESS, ORGANISATION, CONTROL, FLEXIBILITY.

On the substantive side, several attempts have been made to catalogue the design features of RFMOs, usually in an attempt to distill best practices from them.⁴⁴ However, a dataset from a recent article in the journal *Marine Policy*, “Failing the High Seas” (FHS) offered the best available information on RFMO design and a more systematic, disaggregated and useful set of criteria for composing covariates along the lines of the rational institutional design literature.⁴⁵ While their purpose in constructing the dataset was to compare them with effectiveness scores,⁴⁶ this study repurposes this data to understand how the global fisheries governance complex has evolved. Table 4.3 on the next page shows how the FHS criteria were folded into the institutional design covariates identified above.⁴⁷

I explain each of the operationalisations in turn. First, Koremenos et al state that SCOPE means both an institution’s issue and area coverage.⁴⁸ This was operationalised as the maritime area an RFMO governs (in square kilometres) multiplied by the number of fish stocks it governs, divided by two and logged to bring the variable range into line with the other design variables.⁴⁹ One might expect RFMOs with large SCOPE to attract more members.

ACCESS is defined as an institutional property specifying how exclusive or restrictive an institution is in its membership.⁵⁰ Not all institutions aspire to

⁴³Among the RFMOs included here, only the older IATTC, GFCM, and ICCAT institutions have undergone any significant amendment. Mostly this involved updating some provisions to bring them into line with contemporary expectations, such as formally allowing the EU to represent its member states as a member (of sorts) in the RFMOs.

⁴⁴Lodge 2004; Lodge et al. 2006; Lodge et al. 2007; Lodge 2008.

⁴⁵Cullis-Suzuki and Pauly 2010; for methodological details see Cullis-Suzuki and Pauly 2009; indeed, these criteria were drawn originally from Lodge et al. 2007.

⁴⁶These scores are discussed in chapter 6.

⁴⁷Note that the present study and the FHS data do not precisely overlap in RFMOs. I do not include IPHC, IWC, PSC, or SPRFMO for the reasons outlined in chapter 2. I do, however, include ICNAF, IBSFC, and RECOFI, which were not included in the FHS study, and for which scores on FHS dimensions had to be created by following their methodology on archival material.

⁴⁸Koremenos et al. 2001, p. 770.

⁴⁹These figures were not drawn from the FHS dataset. The maritime area was recovered from their project’s www.searoundus.com website and the number of stocks governed was drawn from the extra materials in their working paper and complemented by online archival research. Cf. Cullis-Suzuki and Pauly 2009, p. 18.

⁵⁰Cf. Koremenos et al. 2001, p. 770.

Design Trait	Positive Criteria	Negative Criteria
SCOPE	Area Species	
ACCESS	Parties Participation	
ORGANISATION	Organisation	RFMO Cooperation IGO Cooperation
CONTROL	Mandate Budget Reviews Flag State Duties Incentives Disincentives Surveillance Catch Allowances	
FLEXIBILITY	Adaptation	Stated Commitments Referenced Commitments

Table 4.3: Design Trait Specification

universal membership and *Regional* Fishing Management Organisations are no exception. Indeed, the specification of an RFMO’s membership is one of the primary ways that states negotiating an RFMO attempt to balance between soliciting the involvement of states upon which the effectiveness of the RFMO relies and limiting access to avoid the operational difficulties associated with coordinating the collective action of many participants. Access specification can thus be the site of significant politics of inclusion and exclusion.⁵¹ This paper draws from two of FHS’ criteria to compose a membership score for each RFMO: how detailed its specification of parties eligibility to contract is and any mechanisms by which it is supposed to encourage full member participation.⁵² The higher an RFMO’s score on these two criteria, the higher its ACCESS score and the more defined and refined we may say its membership specification is. One might expect that tighter access provisions (i.e. a higher ACCESS score) will relate negatively to participation.

⁵¹Issues of RFMO participation are sometimes determined by consensus and sometimes by objective legal criteria. IATTC provides an excellent example of this. While China and the EU found it difficult to accede to the 1949 Convention because of the requirement of unanimous consent (Article V, paragraph 3: “[. . .] Upon receiving the unanimous consent of the High Contracting Parties [. . .]”), they eventually became members of the IATTC through becoming parties to the Antigua Convention which only requires the fulfillment of the objective criteria established in Articles XXVII and XXX of the Convention.

⁵²Cullis-Suzuki and Pauly 2009, pp. 18-23.

The next institutional design feature Koremenos and co-authors identify is centralisation.⁵³ Since this term has already been appropriated for describing an architectural state, I use the term ORGANISATION here to describe an internal, institutional condition or structure. Centralisation, Koremenos and co-authors say, does not mean centralisation of enforcement. Instead, it concerns the centralisation of any important organisational tasks by a single focal entity. Here this is operationalised as the more organised the RFMOs commission itself is, the more centralised it can be said to be.⁵⁴ However, internal centralisation may also be attenuated by external accountability. Indeed, centralisation and independence are closely related concepts.⁵⁵ As such, I also make use of criteria available in the FHS dataset concerning the degree to which the RFMO entangles itself in cooperative ventures with other RFMOs and, more generally, other intergovernmental organisations (IGOs).⁵⁶ Therefore, an RFMO can be said to be high in ORGANISATION when it is both high in organisation and low in RFMO and IGO cooperation. On the one hand, states may prefer RFMOs that are less highly organised because they are jealous of their sovereignty. On the other hand, states may prefer RFMOs that are more highly organised because they offer greater efficiencies.

CONTROL concerns how collective decisions are made and attempts at their enforcement.⁵⁷ Institutionalised decision rules and other procedural components can be crucial for an RFMO's ability to govern,⁵⁸ a theme that will be returned to in the following chapter. Control was the most composite measure, drawing on eight criteria from the FHS dataset: how the budget is allocated, the duties of flag states, the incentives and disincentives an RFMO has at its disposal to encourage compliance, the surveillance and monitoring mechanisms it can employ, whether target catch limits are publicly stated, and its actions towards strengthening its mandate and reviewing its own performance.⁵⁹ The higher an RFMO scores on all these criteria (unweighted), the more CONTROL it can be said to have institutionalised. Because states are jealous of their sovereignty, we might expect them to avoid RFMOs that promise high CONTROL. However, they might also see

⁵³Koremenos et al. 2001, p. 771.

⁵⁴Cullis-Suzuki and Pauly 2009, pp. 18-19.

⁵⁵Abbott and Snidal 1998.

⁵⁶Cullis-Suzuki and Pauly 2009, pp. 23-24; see also Ostrom 1990.

⁵⁷Koremenos et al. 2001, p. 772.

⁵⁸Stokke and Oberthür 2011, p. 2.

⁵⁹Cullis-Suzuki and Pauly 2009, pp. 18-24.

stronger RFMOs as worthy of their effort, particularly if they appear to be able to restrain free-riders.

Finally, FLEXIBILITY indicates how deeply institutions have thought about how they might adapt to new situations.⁶⁰ Three criteria from the FHS dataset are used here. First, the more an RFMO makes provision for adaptation and strategies for rebuilding fisheries or developing new ones, the more it can be said to be flexible.⁶¹ On the other hand, this is attenuated by the degree to which it makes explicit statements committing itself to the “overriding objective of conservation and management” and to hard law such as the United Nations Convention on the Law of the Sea 1982 (UNCLOS) and the United Nations Fish Stocks Agreement 1995 (UNFSA).⁶² Therefore the more an RFMO’s establishing treaty makes provision for adaptation and the less it is encumbered by explicit commitments to particular principles, the more FLEXIBILITY an RFMO can be said to have. One might expect that states prefer to join RFMOs that are flexible.

In terms of the model, each of these covariates is included in the evaluation function of an actors choice as v_i in the following equation:

$$s_{a2}^{\text{net}}(x) = \sum_i x_{ai}v_i \quad (4.2)$$

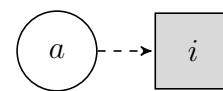


Figure 4.2: Design/ Problem Structure

Note how this formula is similar to that of density above, but now i are weighted by their value on the covariate (i.e. a particular design feature). This equation thus captures the contribution a particular design feature makes to the attractiveness of RFMOs.⁶³ The contribution operates on centred values for each of the RFMOs on each of the five covariates identified and operationalised above. They are centred because one cannot separate institutional choices from the environment of choices available. Centring means that we are interested in institutional designs that offer higher or lower values on a particular feature than found elsewhere. This is represented in fig. 4.2 as the shading of the RFMO.

Table 4.4 on the next page shows how RFMO design profiles vary. Most RFMOs have a unique design profile, defined in terms of which traits they are higher or lower on than the average, but there are a few pairings of RFMOs that are similar in

⁶⁰Koremenos et al. 2001, p. 773.

⁶¹Cullis-Suzuki and Pauly 2009, p. 21.

⁶²Cullis-Suzuki and Pauly 2009, p. 19.

⁶³The specification of problem structure elements are represented in the same equation and diagram.

direction, though not necessarily in terms of magnitude above or below the average. For example, ICCAT and IOTC are both high on SCOPE, ACCESS, ORGANISATION, and FLEXIBILITY, though rather low on CONTROL by design. NEAFC and NPAFC are high on everything but ORGANISATION. ICNAF and IBSFC are also similar, high on everything but SCOPE and ACCESS. Note that these two RFMOs are the only ones to have been disestablished. Lastly, GFCM and NAFO are low on everything but ORGANISATION and CONTROL.

	SCOPE	ACCESS	ORGANISATION	CONTROL	FLEXIBILITY
ICCAT	High	High	High	Low	High
IOTC	High	High	High	Low	High
WCPFC	High	High	High	High	Low
IATTC	High	High	High	Low	Low
NEAFC	High	High	Low	High	High
NPAFC	High	High	Low	High	High
CCSBT	High	High	Low	Low	Low
CCAMLR	High	Low	High	Low	High
SEAFO	High	Low	Low	High	Low
ICNAF	Low	Low	High	High	High
IBSFC	Low	Low	High	High	High
GFCM	Low	Low	High	High	Low
NAFO	Low	Low	High	High	Low
CCBSP	Low	Low	Low	High	Low
NASCO	Low	Low	Low	Low	High
RECOFI	Low	Low	Low	Low	Low
SIOFA		High	Low	High	Low

Table 4.4: RFMO Design Profiles

Other observations from this review of the design profiles include that RECOFI is lower on every trait than the average. CCBSP is lower on every trait but for CONTROL and NASCO is lower on every trait but for FLEXIBILITY. While no single RFMO has highest scores on all the traits, the WCPFC has particularly high scores on all traits except FLEXIBILITY. This may be due to its recent establishment, which means its higher scores may be because it more closely reflects the values embedded in the Chatham House and FHS studies.⁶⁴ In any case, there is substantial variation in RFMO design. The question of this chapter is whether these variations are related to variations in participation.

⁶⁴Lodge et al. 2007; Cullis-Suzuki and Pauly 2009; Cullis-Suzuki and Pauly 2010.

Institutional Problem Structure

Design is not the only dimension upon which RFMOs vary. While the global fisheries governance complex is global, RFMOs do not necessarily face the same structure of problems. Indeed, it may be this variation that is responsible for variations in state participation in RFMOs, and not the RFMOs' design. The relation between design and problem structure is by now well known.⁶⁵ It is therefore crucial to include elements of the problems RFMOs are established to combat into the model.

Unfortunately, no systematic data currently exists detailing the structure of problems each RFMO faces. The FHS dataset does however include criteria for eight institutional design features that indicate the challenges each RFMO was believed to face when they were negotiated and thus serve as proxies. To facilitate modelling, interpretation, and comparison, these criteria are mapped onto six the six problem structure variables Koremenos et al propose as independent variables:⁶⁶ ACTOR ASYMMETRY, DISTRIBUTION and ENFORCEMENT PROBLEMS, and UNCERTAINTY ABOUT THE WORLD, actor BEHAVIOUR and actor PREFERENCES (see table 4.5).

Problem Structure	Positive Criteria	Negative Criteria
ASYMMETRY PROBLEMS		Developing Country Provision
DISTRIBUTION PROBLEMS		New Country Provision
ENFORCEMENT PROBLEMS		IUU Fishing
WORLD UNCERTAINTY	Precautionary Approach	Science
BEHAVIOURAL UNCERTAINTY		Bycatch
PREFERENCE UNCERTAINTY		Data Transparency

Table 4.5: Problem Structure Specification

ACTOR ASYMMETRIES, a subset of the variable 'numbers',⁶⁷ concerns dispersion in actor interests in and capacities to deal with a particular governance problem.⁶⁸ I operationalise this as the more an RFMO makes specific provision for integrating developing countries, the less it has a problem of actor asymmetry. DISTRIBUTION PROBLEMS implies situations where there is a coordination game.⁶⁹ This is operationalised here as the more an RFMO makes provision for integrating new

⁶⁵Koremenos et al. 2001; Mitchell and Keilbach 2001; Mitchell 2002; Mitchell 2006.

⁶⁶Koremenos et al. 2001.

⁶⁷Which is divided here as the remainder of the variable is captured elsewhere in this model.

⁶⁸Koremenos et al. 2001, p. 778.

⁶⁹Koremenos et al. 2001, p. 775.

members, the less it has a distribution problem. ENFORCEMENT PROBLEMS refers to situations where actors sense it is more in their interest not to cooperate and instead access the resource unilaterally.⁷⁰ Here, it is considered the more an RFMO has addressed IUU fishing, the less enforcement problems it can be said to have.

Uncertainty here means the degree to which actors lack information about other actors preferences, their choices (behaviour), or the consequences of that behaviour or institutional intervention (the state of the world). Just as these variables are said to drive institutional design, they may also drive institutional selection and thus the contours of the global fisheries governance complex. Each of these covariates are formed by the conjunction of multiple criteria. PREFERENCE UNCERTAINTY can be said to be highest when RFMOs do little to foster transparency.⁷¹ BEHAVIOUR UNCERTAINTY can be said to be highest when RFMOs suffer poor provision of data.⁷² Finally, WORLD UNCERTAINTY can be said to be highest when RFMOs acknowledge the necessity of a precautionary approach, but lack detailed, respectable procedures for scientific input, and registering statistics for incidental interactions with threatened species, bycatch and ecological habitats.⁷³

Note that the operationalisation of these variables means that these institutional problems are *revealed* by what are effectively institutional design features. This is not unproblematic, for institutions could face problems that they do not account for (or because they do not account for them) or, by institutionalising responses to these problems they comprehensively overcome them. On balance though, I find the probability that RFMOs entirely master such intractable problems as these unlikely and at least utilising institutionalised responses gives us a smoking gun to provide some measurable element.⁷⁴

Table 4.6 on the next page shows variation in the structure of problems each RFMO faces. Here all RFMOs face a unique problem structure. CCSBT appears to enjoy relatively benign scores across all problem types. No RFMO faces a higher than average problem structure across all variables, but GFCM, WCPFC, SEAFO, and NAFO all struggle with higher than average scores on five out of six problems. Each is relieved of a different problem though. An interesting observation is that there are five RFMOs, ICNAF, NASCO, IBSFC, CCBSF, and CCSBT that do not seem

⁷⁰Koremenos et al. 2001, p. 776.

⁷¹Koremenos et al. 2001, p. 779.

⁷²Koremenos et al. 2001, p. 778.

⁷³Cullis-Suzuki and Pauly 2009, pp. 20-22.

⁷⁴An alternative would be a series of expert interviews to establish the problem structure each RFMO faces. This was not conducted here due to lack of resources and the availability of this next best alternative.

to face particularly pernicious *problems* per se, only uncertainties as things they need to face. There is thus sufficient variation here such that variation in RFMO participation may simply be due to the problem structure each RFMO faces. These centered scores are entered into the same equation as offered above for institutional design.

	PROBLEMS			UNCERTAINTIES		
	ASYMM.	DISTRIB.	ENFORCE.	WORLD	BEHAVIOUR	PREFERENCE
GFCM	High	High	High	High	High	Low
WCPFC	High	High	High	Low	High	High
ICCAT	High	High	High	Low	High	Low
SIOFA	High	High	Low	High	Low	High
SEAFO	High	Low	High	High	High	High
IATTC	High	Low	High	Low	Low	High
IOTC	High	Low	High	Low	Low	Low
NAFO	Low	High	High	High	High	High
NEAFC	Low	High	High	High	Low	High
CCAMLR	Low	High	High	Low	High	Low
RECOFI	Low	High	Low	High	Low	Low
NPAFC	Low	Low	High	Low	High	Low
ICNAF	Low	Low	Low	High	High	High
NASCO	Low	Low	Low	High	High	Low
IBSFC	Low	Low	Low	High	Low	High
CCBSP	Low	Low	Low	Low	High	Low
CCSBT	Low	Low	Low	Low	Low	Low

Table 4.6: RFMO Problem Profiles

Both the operationalisations of institutional design and problem structure are heavily inspired by the classifications of Koremenos et al.⁷⁵ However, they are adapted for the present study and to make the best use of available published data. The result are two sets of institutional variables, eleven in total, that represent considerable variation in elements expected to be salient to states' choices of which RFMOs to join. In the end, among these two sets of institutional variables only institutional design is amenable to reform; an RFMO's problem structure must be taken as given. But this dissertation also considers another set of mechanisms that may explain *how* differences in design may lead to complex governance structures: sociorelational mechanisms that operate on the participatory architecture of the global fisheries governance complex itself. We turn to these next.

⁷⁵Koremenos et al. 2001.

4.3.2 Architecture

The other part of the narrative concerns sociorelational mechanisms that operate on or from the structure of the architecture, defined here as the sum of relations of a particular type between actors and institutions. Here I present several such mechanisms, explain how they may be expressed as network effects, and discuss their grounding in sociological and other social scientific theory. I group them as relating to the two dimensions of the topology typology introduced in the previous chapter, centralisation and clustering.

Before beginning, however, we must consider the null hypothesis. It may be, for example, that centralisation and clustering may simply be driven by variations in states' activity in RFMO mandates. Some RFMOs may be more popular institutional choices because they have more states fishing their mandate, and thus interested enough to join the institution

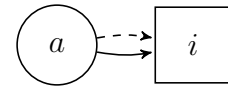


Figure 4.3: Entrainment

regardless of its design traits. Or there is increased clustering because overlapping RFMOs (by mandate) attract the same set of neighbouring states. This suggests a stricter null model than just a random intercept, for perhaps variations in institutional popularity may simple be explained by who fishes where. Indeed, this account most closely represents a realist critique of institutions in which institutions are effectively epiphenomenal to vested interests.⁷⁶ The network term for how one network simply tracks or replicates another is ENTRAINMENT. In terms of the model, it can be defined as:

$$s_{a3}^{\text{net}}(x) = \sum_i x_{ai} w_{ai} \quad (4.3)$$

where w is the network upon which x (the dependent network) is entrained. It thus operates similarly to the design equation above, but instead of ties being weighted by attributes of the RFMOs at the other end, the tie itself is weighted by the weight of that tie in another network of the same dimensions.

I consider two possible networks that the participatory networks of the global fisheries governance complex may be entrained upon. First, states may just be joining those RFMOs in which they fish or fish a lot. To capture this, I included an economic ACTIVITY ENTRAINMENT network consisting of ties between countries and RFMOs weighted by the logged tonnes each country is reported to have landed from

⁷⁶See e.g. Mearsheimer 1995.

the maritime areas each RFMO governs. This network was described in chapters 2 and 3.

States are not only interested in joining institutions in which they fish a lot though, but also in those institutions the mandate of which they border, and so fishing within that institutional mandate may affect their own domestic resources, irrespective of how much they actually fish on the high seas. Small, pacific island states provide excellent examples of this. While they do not fish much themselves, they have a vested interest in joining institutions that manage fisheries that straddle or migrate into their waters. I therefore also include a network where states are tied to RFMOs if some part of their coast neighbours the RFMO's mandated scope to capture COASTAL ENTRAINMENT.

I now turn to sociorelational mechanisms relating to centralisation and clustering.

Centralisation

First, states may not (only) select RFMOs based on any attribute of the institution itself, but simply because other states have. In other words, it may not be its design but its membership that matters.⁷⁷ For example, fig. 4.4 expresses how actor *a* chooses institution *i* because *b* and *c* are members. That *i* has many members makes it a more attractive institutional choice for *a*.

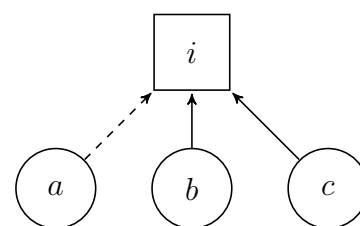


Figure 4.4: Popularity

In network terms, such an effect is called indegree POPULARITY and can be driven by several related mechanisms, such as preferential attachment,⁷⁸ cumulative advantage, and the Matthew effect.⁷⁹ The idea behind each is that the “rich get richer” or “success breeds success”. In the current context, this means that more popular RFMOs become more popular.⁸⁰ However, while these

⁷⁷Membership here being the affiliational/participatory tie from state to RFMO, which is quite distinct from the attributional quality referred to as membership in the rational design literature and referred to here as access.

⁷⁸Barabasi and Albert 1999.

⁷⁹Merton 1968b; Merton 1968a.

⁸⁰As mentioned in the previous chapter, centralisation could also refer to an expanding distribution or dispersion in states' *outdegrees*; that is, some states may be considerably more active in global fisheries governance than others. Such an effect has been included in robustness checks, but is not required to achieve convergence nor good fit. In any event, the emphasis is on social and institutional narratives.

are by now well-known social mechanisms, they are also rather unrevealing. At least three potential explanations could be put forward, corresponding to historical, sociological, and rational institutionalism.⁸¹

First, the historical interpretation is that there is simply a path dependency to RFMO popularity. Initial choices impose powerful externalities on successive choices to repeat this choice which then amplify this effect on later choices. The typical illustration of such “network externalities” is that of the QWERTY keyboard configuration. Modern myth suggests that this keyboard configuration was originally favoured for spacing out commonly used keys so as not to jam a typewriter, but despite this being unnecessary now with the ubiquitous personal computer and deemed otherwise inefficient or unergonomic, positive feedback loops surrounding its standardisation have edged alternatives, such as the DVORAK keyboard, out of the market. While this account has been questioned,⁸² the idea of the positive feedback loop is pervasive. Though this account sees some popularity in the literature as an endogenous mechanism, it has little traction in the context of the global fisheries governance complex because states did not establish RFMOs with the intention of developing a standard—they are regional institutions established to solve particular problems. While some RFMOs’ memberships have grown beyond their original intention, all are decidedly *regional* and none have the ambition to become a world fisheries organisation.⁸³ A historical institutionalist account of this mechanism is thus not as compelling here as the next two accounts.

Second, the sociological interpretation is that countries may like to ‘follow the leader’ in a global sense. That is, actors feel normative pressure to join institutions that many other actors have joined. They feel a pressure to conform. Take for example Solomon Asch’s classic work on line length.⁸⁴ In a series of experiments, Asch tested the conformity of students’ responses on a simple visual test where they were told to identify which of three lines depicted on the right of a card were the same length as a single line on the left of a card. They were given this test in

⁸¹For a recent review combining insights from each of these literatures see Jupille et al. 2013; see also Hall and Taylor 1996; Alter and Meunier 2009, p. 17.

⁸²Most criticisms tend to object to the depth of explication in the theory (i.e. doesn’t path-dependency just beg the question?), think the ad absurdum implications of the theory, that we all get stuck with inferior technologies, is implausible, point to the difficulties the theory has with explaining transition, or interrogate classic examples such as the QWERTY keyboard to demonstrate that the theory is far from having been empirically established. See Liebowitz and Margolis 1990; Liebowitz and Margolis 1995.

⁸³In other words, the notion that they are involved in a standards war is somewhat far-fetched. See Mattli 2001.

⁸⁴Asch 1955.

groups, but only one member was the test subject; all the rest were ‘confederates’. The subject was positioned toward the end of the line of responses and, after some time, the confederates began giving unanimously wrong answers. In a number of critical cases, the subject would end up giving the response that the rest of the group gave, despite their doubts. After interviewing these critical cases, Asch found subjects gave several justifications for this behaviour, including informational (other responses introduced doubt into and indeed sometimes changed their own perceptual frame) and normative (other responses changed what was an appropriate response, irrespective of what they considered the correct answer privately) justifications.⁸⁵ For the case of the global fisheries governance complex, this means that states choose RFMOs that others have chosen because it changes what they consider is the ‘right’ choice to make.

Third, the rationalist interpretation draws heavily on game theory. Game theory has been demonstrated to be a rich ground for developing theoretical assertions in relation to international security and cooperation.⁸⁶ International environmental problems have been most often associated with various forms of Prisoners’ Dilemma (PD) and coordination games, the “solutions” for which have been identified as institutional contracts and conventions.⁸⁷ For either game, increased numbers of actors are thought to inhibit cooperation, but once cooperation begins, there are several reasons why more popular institutions might be preferred. First, popular institutions provide clear focal points around which further cooperation may converge.⁸⁸ Second, popular institutions may more efficiently minimise transaction costs.⁸⁹ Third, more popular institutions offer more visible credible commitment devices for state actors than smaller, more regional institutions.⁹⁰ The audience for this commitment may not only be other state actors, but may also be domestic constituencies. Commitments to more visible institutions increase the reputational costs of repudiating institutional norms. Indeed, these commitment devices may be inter-related; democratic states may prefer to join popular institutions because the increased visibility to their domestic constituencies makes it more credible that they will uphold their commitments despite changing administrations. For the case of the global fisheries governance complex, this means that states choose more

⁸⁵Arguably the former is rational, but the latter is certainly sociological.

⁸⁶Snidal 1985b.

⁸⁷See Snidal 1985a.

⁸⁸Schelling 1960.

⁸⁹See Coase 1937; Williamson 1973.

⁹⁰Schelling 1960.

popular RFMOs because their larger membership increases their potential utility to the state.

There are thus a multitude of potential theoretical groundings to explain why the “rich get richer” or more popular institutions become disproportionately more popular. These theoretical strands are difficult to disentangle for they all ultimately make reference to the same outcome. This outcome or “target statistic” can be expressed as the utility an actor gains by joining institutions with a larger “indegree” or numbers of members. This is expressed as:

$$s_{a4}^{\text{net}}(x) = \sum_i x_{ai}x_{+i} = \sum_i x_{ai} \sum_b x_{bi} \quad (4.4)$$

where a is the focal state, i is the focal RFMO, b are other actors, and x is the tie variable. The equation weights a 's tie to i by the number of other actors (b) ties to i . Note that the effect is linear; each additional member increases the utility for a independent of whether it is the fourth or fortieth member. Often in social network research, POPULARITY is transformed by taking the square root of indegrees. This is justified as accounting for how cognitive or other resource limitations constrain humans tie accumulation.⁹¹ Here, however, there is no upper bounds on RFMO membership (except the number of states in the inter-state system) and a fortieth member may well be as easy to accommodate as the fourth.

There are *lower* bounds on RFMO membership, however. As multilateral institutions, the RFMOs studied here require at least three members to exist. In other words, the first three members are not like the others. If not adequately controlled for, this could skew the estimate for POPULARITY because the model would seek a parameter estimate that fit both the effect of the first three members to join and all additional members simultaneously. To avoid this situation, a multilateral “fix” was added that captured the effect of states wishing to tie to RFMOs that currently have an indegree of 2 and wishing to avoid severing ties to those RFMOs with indegrees of 3. Since this effect is fixed, it is not reported in the results but is taken into account in the interpretation.

Ultimately, the equation given for POPULARITY above can represent any of these explanations.⁹² Not only are these different accounts difficult to disentangle

⁹¹Simon recognised that humans are more serial than parallel information-processing systems and that they therefore could only maintain so many relationships. Institutions have rather more capacity for parallel information-processing. See Simon 1962, pp. 476-477.

⁹²The only exception is the notion of preferential attachment (Barabasi and Albert 1999). Though certainly related, Barabasi and Albert's model differs from the mechanism(s) detailed above because it operates on the attachment choices of *new* nodes. I have modelled this effect as a negative “out-in-

methodologically, but they are likely to be difficult to disentangle substantively too. Indeed, they are all likely to be present to some degree, and each institutionalist account simply highlights a distinct part of the process. Distinguishing them may require finding a warrant for a particular interpretation amongst the rest of the model, which may not be possible in every case.

Clustering

While the previous mechanisms operate generally, providing cues to all actors indiscriminately, in the social realm actors also often take cues for action from the choices of *particular* other actors. Which other actors' actions are salient can be expressed as several mechanisms, but they all bear some relation to Merton's concept of a 'reference group' and all can have the effect of driving clustering.

A reference group is simply a group providing a frame against which an individual or another group can be compared and evaluated.⁹³ In principle, reference groups are “almost innumerable: any of the groups of which one is a member, and these are comparatively few, as well as groups of which one is not a member, and these are, of course, legion, can become points of reference for shaping one's attitudes, evaluations and behavior”.⁹⁴ All the following mechanisms consider the choices of other actors from amongst an actor's reference groups as particularly influential on that actor's choices. Here I consider three different types of reference groups: those based on shared attributes (homophily), those based on propinquity or shared external foci (contexts), and those based on shared choices (closure). I address each in turn.

First, states may not just follow the choices of all states, as in POPULARITY, but only those of states similar to themselves on some dimension. This mechanism is known as HOMOPHILY and is colloquially referred to with the phrase “birds of a feather flock together”.⁹⁵ It captures the notion that actors prefer to make and keep ties to actors that are similar. They might have this preference because ties rely on the compatibility and complementarity of actors' attributes. States may expect that an RFMO containing similar states as current members will be more effective, more

assortativity” effect—that is, an assortativity between low outdegree and high indegree nodes—but this is not included here as the additional complexity this introduces was not required to adequately recreate the evolution of the networks. Such an assortativity effect better represents Barabasi and Albert's logic than indegree popularity because it captures the low outdegree of (new) actors make their first choice(s).

⁹³Merton 1968a.

⁹⁴Merton 1968a, p. 287.

⁹⁵McPherson et al. 2001; Goodreau et al. 2009.

likely to accept them, or easier to work within because they might expect other states to hold beliefs that affirm their own, thereby mitigating potential conflicts, misunderstandings, and monitoring costs.⁹⁶ Repeated homophilic choices can then result in clustering or even segregation—as argued by Thomas Schelling.⁹⁷ In other words, states assortative preferences sorts them into groups or clusters.

Ordinarily, homophily is modelled as the propensity to form and maintain connections due to the dyadic similarity between actors' attributes or, in a multinomial choice model, is expressed as the utility an actor gains from choosing connections that minimise dissimilarity. Irrespective of this, homophily has typically been expressed *dyadically* and thus modelled in unipartite networks such as friendship networks. However, here we have a bipartite network of states joining RFMOs, which means that actors can never be closer than two ties away

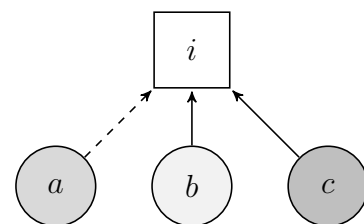


Figure 4.5: Homophily

from one another. Take fig. 4.5 for example. In it, actor a is two ties away from b and two ties away from c . This is a non-trivial change in the structure of the effect, for it means not only that the actor whose attributional similarity matters is two choices away (say ai and bi) but that, as i is a multilateral institution, a may only be interested in joining i if all current members— b and c —are similar to it. To convert homophily into an effect useful for modelling bipartite networks, I define HOMOPHILY as the sum of centred similarity between a 's value on a covariate and the average of i 's members (excepting a) on that covariate:

$$s_{a5}^{\text{net}}(x) = \sum_i x_{ai} (\text{sim}(\check{v})_{ai} - \widehat{\text{sim}}(\check{v})) \quad (4.5)$$

where $\text{sim}(\check{v})_{ai}$ is defined as

$$\text{sim}(\check{v})_{ai} = \frac{\Delta - |v_a - \check{v}_i^{(-a)}|}{\Delta} \quad (4.6)$$

with $\Delta = \max_{ai} |v_a - v_i|$ being the observed range of the *original* covariate v and $\check{v}_i^{(-a)}$ ensures that the covariate value for a is removed from its own homophilic calculation. This leaves $\widehat{\text{sim}}(\check{v})$ to be defined as the *observed* mean of all similarity scores \check{v}_a . This is calculated by averaging the \check{v}_a values for each of the observations t_1 to t_{T-1} , where T is the number of waves. Ultimately, this effect captures the

⁹⁶For a review of these mechanisms see Rivera et al. 2010, p. 94.

⁹⁷Schelling 1969; Schelling 1971.

attractiveness to a state of an RFMO with members that are more similar to the state (on some dimension to be defined below) than the average RFMO’s members.

Of course, there are some grounds here to consider an opposite effect—heterophily—the more likely. There is some evidence that homophily is more common when considering close, strong, or intimate ties,⁹⁸ which the contingent affiliation ties here are not. Moreover, organisations may substitute trust for contracts in their relations, and they do not require the expressive or confirmatory interactions humans often do.⁹⁹ Indeed, it has been found that organisations often build up a diverse set of collaborators by seeking out dissimilar partners.¹⁰⁰ Alternatively, they may want to constrain, balance, or otherwise exert influence on different others.

In the end, states, like individuals, probably seek a balance of similarity on some dimensions and dissimilarity on others, while remaining ambivalent about others. Here I consider four potential dimensions of homophily: CAPABILITY, DEVELOPMENT, REGIME, and INTEREST. The first three were chosen to maintain a modicum of comparability with previous work.^{101 102} These are operationalised as GDP, GDP per capita, and the regime scores from the Polity dataset respectively. The fourth dimension, INTEREST, is operationalised as the total amount of fishing a state reports annually,¹⁰³ and thus captures a state’s revealed preference for fishing.

Note that for all of these HOMOPHILY effects both OWN(state) and OTHER (RFMO)-average effects are also included. In part, this is to ensure that we are not misattributing an effect to homophily that is actually driven simply by the distribution of a covariate, but they may have substantive interest too. A state may find CAPABILITY essential to maintain many memberships, for example, or only be interested in joining RFMOs with generally democratic members, irrespective of their own regime state. Therefore, all three forms of each covariate—HOMOPHILY, OWN, and OTHER—are included.¹⁰⁴

Second, while HOMOPHILY defines the reference group as those that are similar to an actor on some

⁹⁸Duijn et al. 2003.

⁹⁹Granovetter 1985.

¹⁰⁰Powell et al. 2005.

¹⁰¹See Kinne 2013.

¹⁰²Like Kinne, I also considered a broad range of additional potential covariates.

¹⁰³Irrespective of species or area. A more targeted interest is captured in the ENTRAINMENT variable below.

¹⁰⁴These are called similarity, ego and alter effects in common network parlance, but to avoid ambiguity I use the terms above.

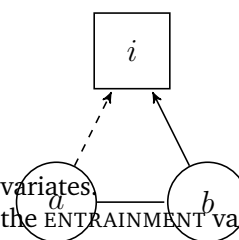


Figure 4.6: Context

attribute, a reference group may also be defined as those other actors that share a certain CONTEXT. These contexts may range from geographic proximity to shared membership in other organisations. The former mechanism is known as propinquity, whereas the latter mechanism is known under the label social foci. Each mechanism acts on a different kind of tie—spatial and social, respectively—but each results in a similar type of configuration and so are treated together here. Such a configuration is presented in fig. 4.6 on page 119. This figure represents the mechanism that, because *i* and *j* are tied on one dimension, they are more likely to make similar choices in other dimensions.

Propinquity is the most obvious example of this. As Bossard quipped in relation to the remarkable geographic clustering of marriages: “Cupid may have wings, but apparently they are not adapted for long flights”.¹⁰⁵ In the context of global fisheries governance, we might expect states that are adjacent to one another (CONTIGUITY) or simply closer to one another (DISTANCE) to be more likely to make similar choices because those institutions are relevant to each or that they are co-opted into those institutions by neighbouring states. Moreover, more proximate partners also influences the persistence of ties by moderating the effort required to maintain them.¹⁰⁶

Geographic propinquity is not the only proximity of relevance here though.¹⁰⁷ Social interaction is also organised into foci: “social, psychological, legal, or physical entit[ies] around which joint activities are organized”.¹⁰⁸ Sharing such foci affects tie generation beyond physical proximity because common experiences in these joint activities may promote positive sentiments through mutually rewarding interaction,¹⁰⁹ moderate status or role asymmetries,¹¹⁰ and emphasise shared interests over discordant ones,¹¹¹ such that cultures are developed that induce the creation of further social relationships and institutions in other contexts.¹¹² In

¹⁰⁵Bossard 1932, p. 222.

¹⁰⁶Proposed in the context of maintaining friendships in Martin and Yeung 2006.

¹⁰⁷Indeed, as technological advances make communication—by correspondence or in person—cheaper and easier, distance may become less relevant and other mechanisms, such as social foci, become more relevant. See Hampton and Wellman 2001; see also Rivera et al. 2010, p. 107.

¹⁰⁸Feld 1981, p. 1016.

¹⁰⁹Feld 1981, p. 1017.

¹¹⁰Moody 2001.

¹¹¹Uzzi and Dunlap 2005.

¹¹²Entwisle et al. 2007.

other words, shared contexts may generate externalities for other relational choices, resulting in further clustering. As Rivera et al so eloquently put it: “If networks are the fabric of interpersonal interaction, social foci are the looms in which they are woven”.¹¹³

International life has a broad range of potentially relevant social foci. Here I include four potentially relevant contexts that may generate externalities to drive clustering. The first three are used in the bilateral context by Kinne. States that TRADE with one another, are ALLIES, or share membership in many IGOs may find that these shared contexts operate as foci for establishing further shared contact.¹¹⁴ To this list I also add BILATERALISM as a foci, since bilateral fisheries treaties have been found to affect both multilateral centralisation and clustering.¹¹⁵

For each of these variables, I test the assumption that they provide contexts for clustering and shared institutional membership. The effect of states moving towards such configurations can be defined as:

$$s_{ab}^{\text{net}}(x) = \sum_r x_{ai} w_{ab} x_{bi} \quad (4.7)$$

where w is whichever network above acts to focus similar behaviour. In other words, the statistic captures the attractiveness of sharing an institutional choice with a partner on a different dimension, whether this be geographical proximity or shared foci. Note that CONTEXT is different from ENTRAINMENT: whereas ENTRAINMENT operates as a parallel process and may explain degree dispersion, CONTEXT operates as a process of closure and may explain clustering.

Lastly, actors may not only take cues from those other actors with whom they share external FOCI, but also those with whom they share foci *internal* to the system, i.e. other RFMOs. In other words, it is through other members in their current set of institutions that states gain information about the utility offered by new institutions, and it is these shared members that also stabilise RFMO participation. An example might be New Zealand ‘following’ Australia into CCSBT, CCAMLR, and other RFMOs from joint participation in a first RFMO. I refer to this effect here as CLOSURE to capture the notion that the three-path of

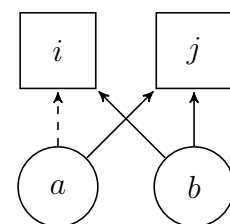


Figure 4.7: Closure

¹¹³Rivera et al. 2010, p. 106.

¹¹⁴For more details on how these variables are specified see Kinne 2013.

¹¹⁵Hollway and Koskinen 2015a; Hollway and Koskinen 2015b.

$ajbi$ in fig. 4.7 on page 121 is being closed into a four-cycle by the tie ai .¹¹⁶ Such bipartite closure may be defined as:

$$s_{a7}^{\text{net}}(x) = \sum_{b,i,j} x_{ai}x_{bi}x_{aj}x_{bj} \quad (4.8)$$

Note that, like POPULARITY, this effect has been defined linearly; each co-member of another institution in an institution an actor is considering joining affects the actor's choice in the same way, no matter whether it is the fourth or the fortieth.

Closure has been found in many different contexts and has deep roots in sociological theory.¹¹⁷ Simmel originally suggested that joint membership in groups would lead to closure in social networks,¹¹⁸ but a range of potential explanations for this closure have been proposed. First, Fritz Heider proposed balance theory to account for closure. He argued that actors tend to evaluate the choices of their friends more positively and those of their enemies more negatively as a way of avoiding the cognitive dissonance associated with the otherwise 'unbalanced' situation.¹¹⁹

Second, Granovetter argued that connections can provide better quality information about potential choices, reducing uncertainty and risk. As Granovetter remarked: "Better than the statement that someone is known to be reliable is information from a trusted informant that he has dealt with that individual and found him so".¹²⁰

Third, Kinne suggests that closure can be driven not only by information but also externalities.¹²¹ In the context of a unipartite network, he argues that a two-path (a tie abc) generates negative externalities for a and c that incentivise their closing of this two-path into a triangle $abca$. The extension of this externalities driven argument to the bipartite case here is straight-forward: a state that shares an RFMO with a state participating in a second RFMO in which the first state does not has an incentive to close this 'three-path' by joining the second RFMO (i.e. fig. 4.7

¹¹⁶This effect also sometimes goes under the labels clustering or transitivity. The first is already used here to describe a network-level property, and so is not used here to avoid confusion. The second refers exclusively to unipartite networks. See Robins and Alexander 2004.

¹¹⁷For a review see Rivera et al. 2010, p. 100; though closure is not found in every context. In sexual networks, for example, four-cycles are rare. As Rivera et al quip: "Independent of their personal attractiveness (or not), Billy Bob Thornton is unlikely to date Jennifer Aniston because their exes, Angelina Jolie and Brad Pitt, became a couple first" Rivera et al. 2010, pp. 102-103.

¹¹⁸Simmel 1955.

¹¹⁹Heider 1946; note that this psychological theory stands in contrast to Feld's more sociological theory of shared foci. See Feld 1981, p. 1017.

¹²⁰Granovetter 1985, p. 490; see also Burt and Knez 1995.

¹²¹Kinne 2013.

on page 121) to mitigate the structural advantage conferred on the second state by this structural imbalance.

Fourth, a slightly different rationalist interpretation is inspired more by work on bipartite networks in organisational sociology, and in particular the literature on interlocking directorates. There the closure mechanism of peer referral has been proposed as driving closure in bipartite networks.¹²² This mechanism suggests that shared members in one institution not only provide information about a second institution to the focal actor, but also actively promote or facilitate the focal actor's involvement. An extension of this argument is that an observation of closure or clustering represents the outcome of what may be called 'collaborative governance', where states cooperatively, collaboratively or jointly manage different issues through multiple institutions. Indeed, their common experience and expertise drawn from shared membership in one institution facilitates further collaborative behaviour.¹²³ In other words, although co-membership in multiple institutions entails deeper constraints, they also provide opportunities for integrated "cross-institutional political strategies".¹²⁴

Lastly, closure is not only responsible for creating ties, but also their maintenance. Actors who share several common choices may be said to be structurally embedded and embedded ties have been found to be more resilient because they promote collectively oriented norms, minimising opportunism,¹²⁵ and mitigating conflict.¹²⁶ In other words, even if randomly or at least incidentally produced, once four-cycles are produced, ties within it are less likely to be dropped and thus clustering proliferates through asymmetric retention.

4.4 Two Models

This section reports results from modelling the evolution of the two, core participatory architectures of the global fisheries governance complex using a longitudinal statistical network model called a stochastic actor-oriented model (SAOM, see section 4.2). The two networks are the COOP network of states signing or joining RFMOs as observers and the MEMB network of states ratifying

¹²²Koskinen and Edling 2012.

¹²³Cohen and Levinthal 1990.

¹²⁴Alter and Meunier 2009, p. 17.

¹²⁵Granovetter 1985; Uzzi 1997, p. 48.

¹²⁶Simmel 1950, p. 135; Krackhardt and Handcock 2007.

and becoming full members of RFMOs.¹²⁷ I am modelling them using SAOMs so as to evaluate the comparative influence of features of an RFMO's design and various sociorelational mechanisms that depend on the structure of the architecture in influencing states' decisions to join RFMOs, controlling for other exogenous influences such as the problem structure an institutions is embedded in, various forms of regionalism, and so on.

Because this study investigates only one issue area, fisheries, statistical power was too low to ensure unambiguous estimates of the direction of influence for all effects. This problem was compounded by the kind of collinearities common in network research, such as groups of effects relying on the same variable (e.g. own, other, and homophily effects) or endogenous network effects (e.g. popularity and closure). Therefore, a backward stepwise strategy was employed where a "full" model including all effects was iteratively reduced by removing a single effect at a time, according to the criteria of multicollinearity, significance, and the relative importance of effect in the model until only significant effects remained. At each step, successive models were run in the R implementation for stochastic actor-oriented models, RSiena, until good convergence ($t < 0.1$) was reached.¹²⁸ With respect to those covariates that appear several times in the models, such as CAPABILITIES, DEVELOPMENT, and DEMOCRACY, I also conduct a multiparameter test to ensure that these effects are not jointly significant. These results are not reported here, but in no case are they jointly significant, and so I proceeded with backward model selection. The final model specifications after this process was completed for both COOP and MEMB as well as the parameters estimated for each effect are reported in table 4.7.

4.4.1 Results

As mentioned above, table 4.7 presents the final model specification for the evolution of COOP and MEMB networks, respectively. Recall that the presence of a tie in the COOP network means that a state or other fishing entity has at least either signed up to the establishing treaty of an RFMO or become an official observer at that RFMO's commission meetings. The presence of a tie in the MEMB network means that a state or other fishing entity has ratified the establishing treaty of an

¹²⁷Strictly speaking, these are ordered multiplex networks in which the opportunity to become a member depends on first cooperating. However, the considerable degree of network overlap posed methodological challenges. Therefore a more comparative research strategy was undertaken.

¹²⁸These models were run in version 278. See Ripley et al. 2015.

RFMO or become a full member at that RFMO’s commission meetings. The former is thus the broader of the two, with less demanding ties. Each is important for answering the question about how we can resolve cases of gross misfit. On the one hand, we need to understand why states choose to cooperate with RFMOs. On the other hand, we need to understand why states choose to become full members of RFMOs. The former helps us understand how to engage states *with* global fisheries governance; the latter helps us understand how to engage states *in* global fisheries governance.

I present the results from both models together as this is, at least in part, a comparative exercise. I begin by discussing the rate effects, then the “null” model of entrainment, then the institutional variables of design and problem structure, and then lastly the sociorelational mechanisms.

First, however, it is important to note that the fit of these models on the two dimensions of the topological typology are excellent. At the bottom of table 4.7, the goodness of fit for centralisation and clustering (both around RFMOs) is listed. These are *p*-values and the typical threshold of 0.05 still applies. However, here we are not interested in testing how *unlikely* a value lies within a distribution but how *likely* it is. Therefore, a *p*-value *over* 0.05 is good. Here the fit far exceeds this threshold on all relevant dimensions.¹²⁹ Nonetheless, centralisation is best represented in the COOP model and clustering is best represented in the MEMB network. Fit for clustering was particularly strong.

	Coop Network	MemB Network
Rate 1960–1970	0.33 (0.10) ^{***}	0.29 (0.08) ^{***}
Rate 1970–1980	1.24 (0.64) [†]	1.15 (0.30) ^{***}
Rate 1980–1990	0.65 (0.15) ^{***}	0.63 (0.15) ^{***}
Rate 1990–2000	0.44 (0.09) ^{***}	0.47 (0.08) ^{***}
Rate 2000–2010	0.66 (0.10) ^{***}	0.58 (0.09) ^{***}
Opportunity	0.23 (0.03) ^{***}	0.21 (0.03) ^{***}
Intercept (Density)	−4.68 (0.77) ^{***}	−5.45 (0.80) ^{***}
Coastal Entrainment	2.99 (0.52) ^{***}	3.23 (0.54) ^{***}
Activity Entrainment	0.12 (0.03) ^{***}	0.16 (0.03) ^{***}
Flexibility Design	−0.53 (0.14) ^{***}	−0.85 (0.18) ^{***}
Access Design		−0.58 (0.20) ^{**}
Organisation Design		0.81 (0.25) ^{***}

¹²⁹The goodness-of-fit for centralisation and clustering around states was also tested and these were also adequate.

	Coop Network	Memb Network
Enforcement Problems	0.28 (0.07) ^{***}	0.21 (0.07) ^{**}
Preference Uncertainty	-0.13 (0.05) [*]	-0.24 (0.08) ^{**}
Architectural Popularity	0.34 (0.12) ^{**}	0.29 (0.12) [*]
Architectural Closure	0.12 (0.04) ^{**}	0.14 (0.04) ^{***}
Contiguity	0.88 (0.25) ^{***}	0.76 (0.22) ^{***}
IGO Foci	-0.05 (0.02) [*]	-0.04 (0.02) [*]
Interest Homophily	-1.88 (0.55) ^{***}	-2.55 (0.69) ^{***}
Own Interest	0.39 (0.16) [*]	0.39 (0.15) ^{**}
Own Capability	0.30 (0.14) [*]	0.25 (0.12) ^{**}
Others Capability	-0.11 (0.03) ^{***}	-0.10 (0.03) ^{***}
Others Polity	0.20 (0.08) [*]	0.17 (0.09) [†]
Centralisation GOF	0.451	0.106
Clustering GOF	0.641	0.898

^{***} $p < 0.001$, ^{**} $p < 0.01$, ^{*} $p < 0.05$, [†] $p < 0.1$

Table 4.7: Coop and Memb Results

First, I explain the results in the rate function (the first group of effects). The rate function includes a rate estimated for each period as well as the extra OPPORTUNITY effect associated with a state having a large marine area. Recall that the rate parameters represent the estimated number of opportunities to change ties each (country) actor is presented with for each period in each model. In general, the rate parameters are rather low; on average states have about a two thirds chance of being selected by the model to make a change to their ties per period in the COOP network and slightly less in the MEMB network.¹³⁰ This suggests that generally there is not much joining/leaving activity in the global fisheries governance complex.

However, the positive and significant marine OPPORTUNITY effect shows that this is only a default, and marine states are more likely to change their ties. This variable consists of the log of a states' EEZ in square kilometres and was centred on the average of 9.484. This means that the average rate only applies to states like Albania (EEZ: 13,691 km²); both landlocked and minimally marine states like Iraq (EEZ: 771 km²) almost never receive an opportunity to change their ties, whereas

¹³⁰The estimated rate parameter for the second period is at least another half minimestep higher than the average rate. Note that the rate refers to *chances* to change ties and does not necessarily mean a tie change will occur; an actor might evaluate that their current set of ties already satisfy their objective function and so no tie is changed or successive tie changes may cancel each other out within a particular period and are thus unobserved.

fairly marine-focused states like Iceland (EEZ: 751,345 km²) receive a whole extra opportunity to change their ties. The USA, which has the largest EEZ (11,351,000 km²), receives around 1.6 extra opportunities per period to change their ties.

The evaluation function includes many more effects than the rate function. Here the default is expressed by density, which acts as an INTERCEPT. Generally, states do not join RFMOs but for the factors expressed elsewhere in the model. Next, both COASTAL and ACTIVITY ENTRAINMENT are positive, highly significant, and very strong effects in both models. States bordering the mandate of an RFMO are nearly twenty times more likely to cooperate and nearly eighteen times more likely to become members than non-coastal states. This points to the strength of regionalism in global fisheries governance.

Still, while regionalism is strong, a number of states fish far from their coasts, and fishing ACTIVITY ENTRAINMENT captures the effect such activity has on their RFMO participation. This variable was coded as the log of the tonnes of fish each state landed from the mandate of each RFMO. It was not centred. This means that for every one unit increase in the logged tonnes of fish a state lands from the mandate of an RFMO, the odds of their cooperating with that RFMO increase by a factor of 1.13 and the odds of their becoming a member increase by a factor of 1.19. Ordinarily, this makes sense: states bordering or fishing a fishery have the most interest in its management. There are plenty of exceptions to this logic though. For example, Morocco, which reported fishing 1,034,613 tonnes in SEAFO's mandate in 2010, contravenes such odds by not at least cooperating. Clearly, there must be other things going on.

Next, there are a set of institutional factors. Despite testing for all five institutional design features, ultimately only three returned significant. For COOP, only FLEXIBILITY was significant and, interestingly, is negative. This means that states prefer RFMOs that do not make especial provisions for adapting the institution. This was unexpected, but may be because states prefer institutions that "lock in" their preferences and operate predictably; they would rather negotiate a new institution than have an institution that could run away from them. For MEMB, two additional design features were significant: ACCESS and ORGANISATION. Here the negative effect for ACCESS is not surprising. Because ACCESS is operationalised in terms of how *tightly* specified the institution is in terms of access, this negative valence simply means that states "prefer" (or can) become members of RFMOs in which access is more loosely defined. The positive effect for ORGANISATION is especially interesting though. It suggests that states prefer to become members of

RFMOs that are highly organised. The effect thus expresses a clear preference to join RFMOs with a particular design feature. Additionally, states appear to take into account at least two problem structure variables: RFMOs facing high enforcement problems but low preference uncertainty are most attractive to states considering either cooperating with or joining RFMOs.

States do not only join RFMOs because of institutional features though. Patterns in the architecture of ties surrounding these institutions also provide plenty of information or influence for states' decisions. I will start with the two structural effects. First, POPULARITY is significant for both networks, but is a stronger and more significant effect for COOP. This suggests that states are particularly susceptible to information or influence gathered from an RFMO's popularity when considering whether to sign up to a treaty establishing an RFMO or to cooperate with an RFMO already operating. Second, states do not always just follow any other state into RFMOs, but particularly those with which it already shares RFMOs (expressed in the CLOSURE effect). This effect is stronger and more significant in the MEMB network, suggesting that when it comes to actually join an RFMO, peer referral or the information or influence gained from a state's governance circle matters. Because parsing out the contributions of these somewhat collinear effects in the context of a network model is difficult, I return to evaluating the relative importance of these effects in more detail below.

Two contextual effects also retained significance. Unsurprisingly, one was a propinquity effect. This suggests that, over and beyond the two entrainment effects, states see the institutional choices of neighbouring states as particularly salient information on those RFMOs. States are 2.41 times as likely to cooperate in an RFMO when a neighbour does, and 2.27 times as likely to become a member when a neighbour is. Interestingly, the only foci effect that was significant was that of IGOs and this was negative. This is surprising, for it suggests that general multilateral cooperation does not always translate into cooperation in particular issue areas. Indeed, the statistically significant *negative* sign even suggests that the global fisheries governance complex is particularly distinctive from general multilateral cooperation.

Lastly, only one homophily effect came out significant: INTEREST HOMOPHILY. Again, interestingly, the effect was negative. This suggests that states prefer RFMOs with states that *do not* fish as much as they do. This may be driven by smaller states joining RFMOs to constrain larger fishing nations, or (more cynically) larger fishing nations populating commissions with smaller fishing nations to legitimate quotas

and other regulations. Beyond this though, several component effects (OWN and OTHER) also came out significant. States' OWN CAPABILITY enables them to both cooperate and join RFMOs as members, and their OWN INTEREST also drives their will to at least cooperate, possibly due to domestic lobbies. States also have certain preferences for cooperative partners or co-members in RFMOs. States prefer when its cooperative partners are democratic (OTHERS POLITY) but not particularly rich (negative OTHERS CAPABILITY), and when co-members are still developing (OTHERS DEVELOPMENT).

4.4.2 Interpretation

The results above provide us with two models for the factors influencing states' decisions to cooperate with and join RFMOs as full members. But which factors matter most for these decisions? As described above in the section on modelling, converting the coefficients into odds ratios provides us with the marginal effects, but we are interested here in the relative effects. What matters most for states in their decisions to participate in RFMOs? How should we "sell" RFMOs to those states required for the RFMO to function properly? To get at the *relative* importance of each effect for actors' decisions, a different approach will be taken: Indlekofer and Brandes' 'relative importance of effects' method.¹³¹

Let us start with what motivates states to cooperate with RFMOs. Figure 4.8 on the next page represents the relative importance of each effect in the model, excepting rate parameters, the intercept, and any fixed effects. For COOP, this leaves 14 effects. Figure 4.8 maps the relative importance of these effects over time. While the relative importance is only calculated at each observation wave, the line is smoothed to accentuate trends. The higher the line for each effect, as identified by the label closest to the line at the end of the study period, the more important it is for states' decisions relative to the other factors. To distinguish effects that have a negative influence on states' decision-making, a dashed line is used. All effects presented here were significant in the model.

We see here that, while IGO FOCI has a small coefficient size and is only significant at the $p < 0.05$ level, it appears that this is an important factor for states' decision-making. Interestingly though, it has an unexpectedly negative effect. This result suggests that the global fisheries governance complex presents a distinctive issue area for many states, with cooperation in this area traversing the

¹³¹Indlekofer and Brandes 2013.

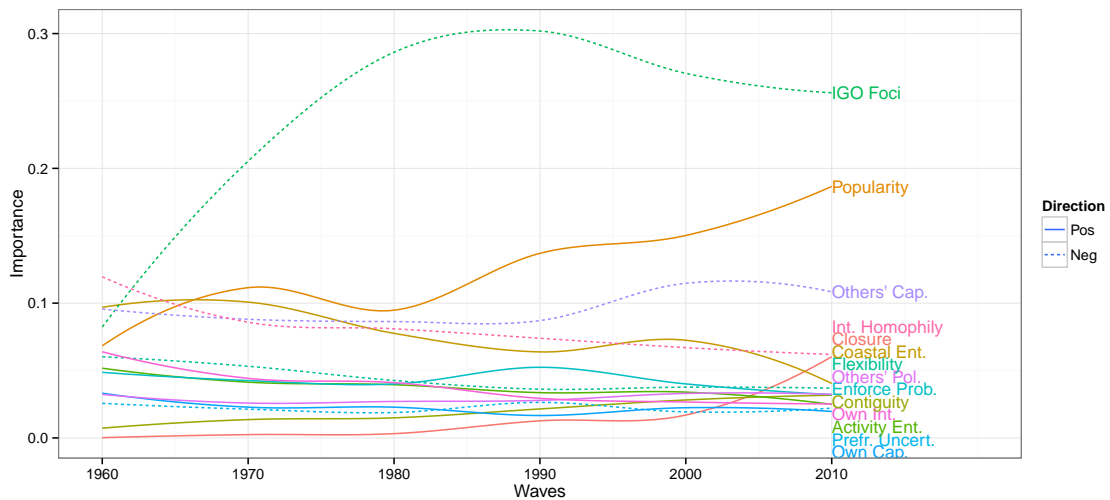


Figure 4.8: Relative Importance of Effects in Coop Model

usual cooperative foci. This effect is most important through the 1980s, dropping off after 1990. Future studies may consider whether this is a peculiarity of the global fisheries governance complex or there are other issue areas that are distinctive from such general cooperative foci.

POPULARITY is the next most important factor and appears to be increasingly important. Indeed, it appears that it is one of the most important factors driving states to choose particular RFMOs, and certainly more important than any single institutional feature. FLEXIBILITY, by contrast, is ranked seventh in importance, followed by ENFORCEMENT PROBLEMS and PREFERENCE UNCERTAINTY further down. This seems to suggest that an RFMO's overall popularity provides valuable signals to states considering cooperating.

Next, OTHERS' CAPACITY, i.e. the average GDP of an RFMO's member states, is third most important factor. This effect is negative, and appears relatively stable over time. This effect may well be driven by bandwagoning. It is interesting, though, that an effect based on the average attribute of *other* cooperating parties is more important than any effect based on a state's own value on that attribute, or the similarity (homophily) or difference (heterophily) between them.

The fifth most important effect is CLOSURE. For the average state, CLOSURE has only really become important in the last decade or so. No doubt this is in part driven by the increased opportunity for closure that more RFMOs brings. However, the link is not a necessary one, and so the increasing importance of this effect does suggest that this mechanism plays an important role within the model.

The situation for the MEMB model in fig. 4.9 is very similar. Again, POPULARITY is the most important effect, but for that of IGO FOCI, followed by OTHERS' CAPACITY and INTEREST HOMOPHILY. But there the resemblance fades. Before we get to CLOSURE, both COASTAL and ACTIVITY ENTRAINMENT as well as two of the three significant design features, FLEXIBILITY and ORGANISATION, are ranked higher.

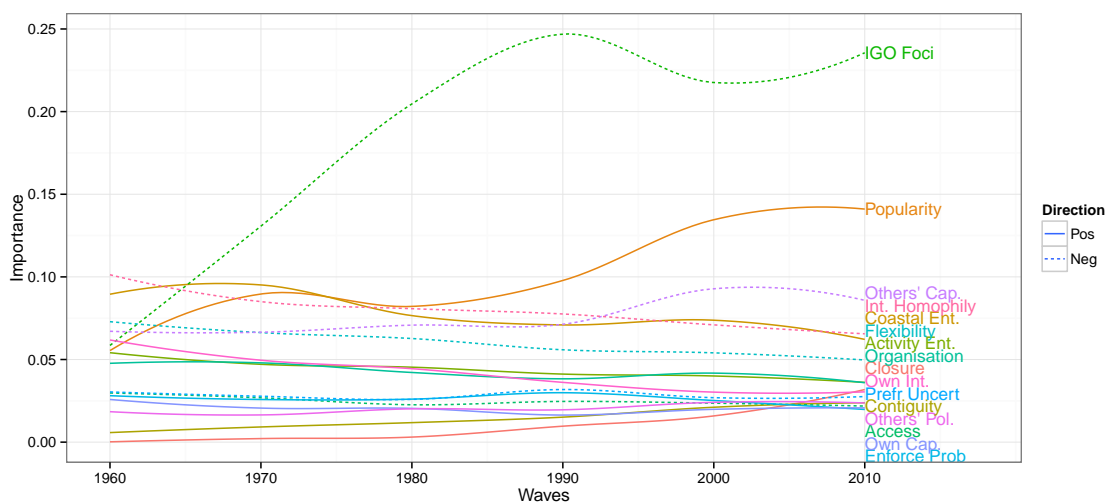


Figure 4.9: Relative Importance of Effects in Memb Model

What this means is that while sociorelational mechanisms, such as POPULARITY and CLOSURE, provide powerful leverage for eliciting states' cooperation with RFMOs, if the goal is to solicit *membership* then more attention should be paid to two design features in particular. Indeed, paying attention to the direction of these effects, reform that actually *strengthens* RFMOs by increasing ORGANISATION appears to be attractive to states. Interestingly, states also appear to be interested in RFMOs that are *inflexible*. This apparently counter-intuitive finding may be driven by the lower exit costs generally associated with flexible institutions.

These two graphs have helped us evaluate the average state's decision-making process when selecting institutions. However, to return to the problem set out in the introduction to this chapter and identified in the section on 'gross architectural misfit' in the last chapter, what we may really care about is not the *average* state's decision-making process, but the decision-making process of a particular state in a particular context—that is, those states that are conducting the most unregulated fishing. Over the next three graphs, I look at the relative importance of effects for the three states listed in the table on **gross architectural fit**: China, Chile, and India. To recap, these three states landed over two million tonnes of fish, unregulated,

from the mandates of NPAFC, IATTC, and SIOFA, respectively. How can we solicit their (increased) involvement in these institutions? Who should approach them about increasing their involvement?¹³²

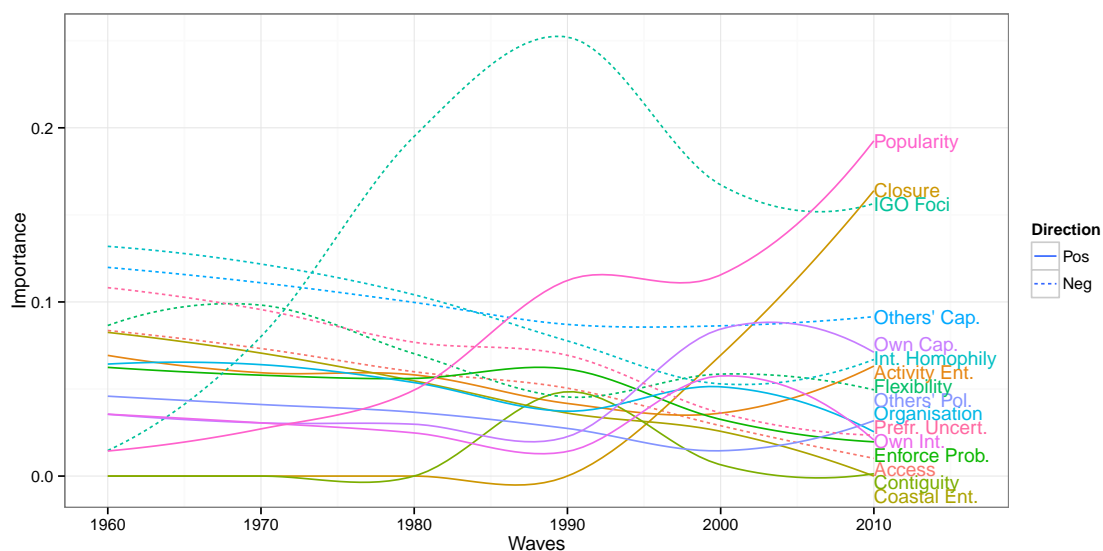


Figure 4.10: Relative Importance of Memb Effects for China

I use the disaggregated relative importance scores (i.e. not averaged) of Indlekofer and Brandes to answer these questions. Let us begin with how to get China to join NPAFC as a first example, as shown in fig. 4.10. Since China has already been cooperating somewhat with NPAFC, albeit mostly organised bilaterally, I will use the MEMB model here. What is important to see is that the influence of IGO FOCI is much reduced for China, particularly over the last decade or so. Instead, both POPULARITY and CLOSURE are the two most important effects influencing China’s RFMO choices. This suggests that a potential strategy for bringing China into NPAFC as a member is to go about attracting other relevant states to join NPAFC, for this will leverage the POPULARITY effect. Another, complementary strategy would be to recruit those states that already share another RFMO with China to leverage the CLOSURE effect, or impress upon current member states that already share other RFMOs with China to use those fora to relate the benefits of joining NPAFC to it.

Chile is also cooperating somewhat, albeit informally, with IATTC, and so an appropriate ambition might be to solicit their membership in IATTC. In fig. 4.11

¹³²Note that these three cases are only used as convenient examples. The goal is to remediate all misfit.

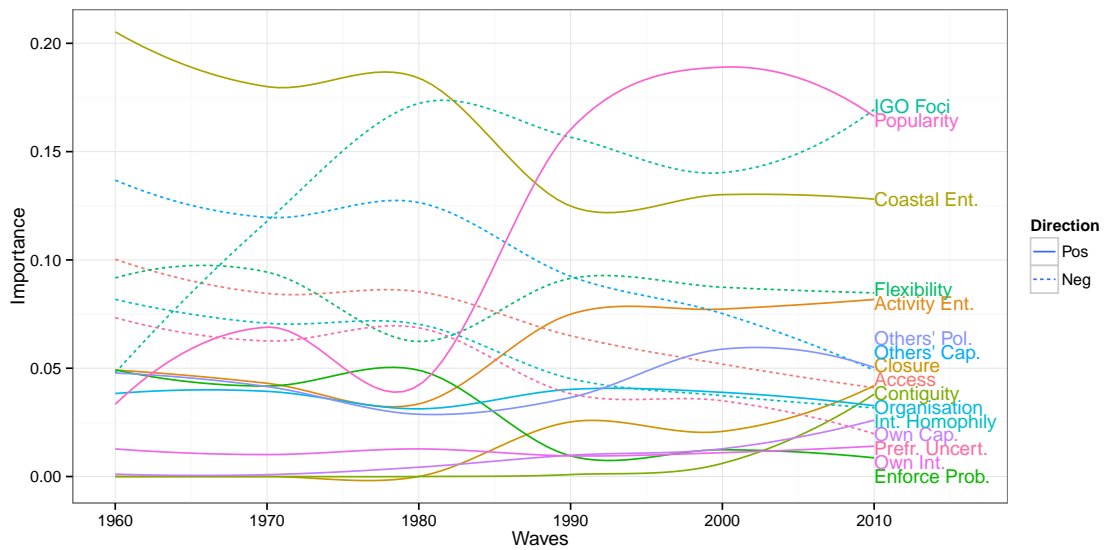


Figure 4.11: Relative Importance of Memb Effects for Chile

too, the effect of IGO FOCI is depressed and the POPULARITY effect is strengthened (though appears to be decreasing), but CLOSURE does not appear to be so important for Chile given its position in the network. Instead, a possible strategy from these results might entail relating to Chile its interests in or even responsibilities to the fisheries IATTC governs as a COASTAL state and as a state with considerable economic ACTIVITY in the area. One could also provide signals or assurances to Chile that joining IATTC will not result in their losing sovereignty by emphasising how INFLEXIBLE the institution ultimately is (see table 4.4 on page 108).

Lastly, so far India has not played much of a role in the development of SIOFA. An appropriate ambition here would therefore be to garner their cooperation. Figure 4.12 on the following page therefore shows the relative importance of effects for India in the COOP network. Here too sociorelational mechanisms play a prominent role. POPULARITY is the most important effect in 2010, ahead of IGO FOCI. This suggests that attracting other states to at least cooperate with SIOFA will, in turn, increase the attractiveness of cooperating with SIOFA for India. CLOSURE is another important sociorelational mechanism here, and also one that can be leveraged similarly to the strategy outlined for China above. What is interesting though is that the effect of India's OWN CAPACITY is the next most prominent factor, followed by OTHERS' CAPACITY. This suggests that what might be holding India back is the wealth of many of SIOFA's current members, including the EU, Japan, France, South Korea, and Australia. India may fear that its own influence on

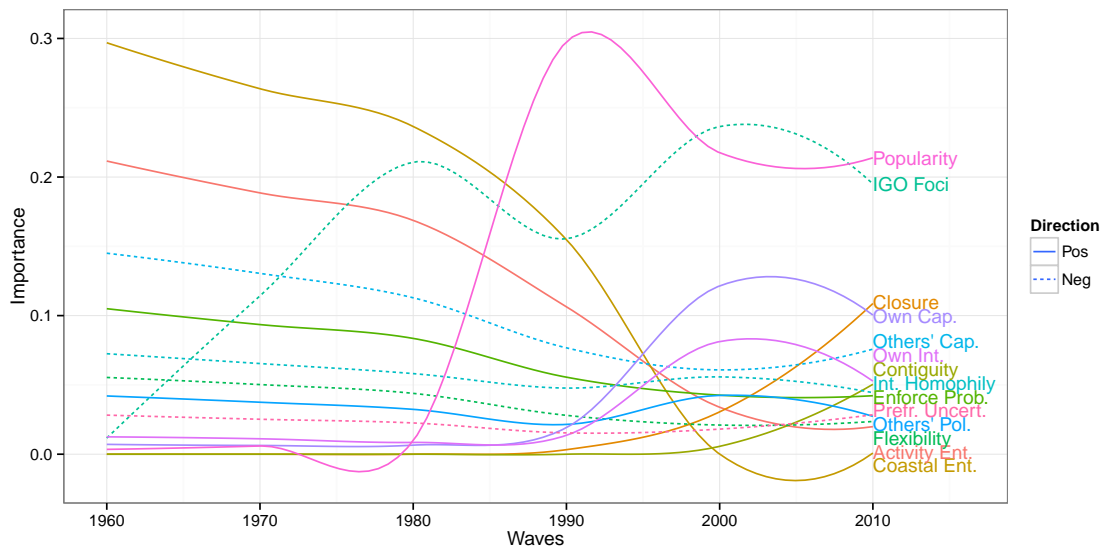


Figure 4.12: Relative Importance of Coop Effects for India

regional fisheries matters is being usurped. Finally, note that the model suggests that arguments based on COASTAL or ACTIVITY interests will not work as well as it may have in the past. This model can thus be used to identify not only potential strategies for soliciting greater involvement in global fisheries governance, but also those strategies that may not be so effective.

4.5 Catch of the Day

This chapter began with a problem. As analysis in the previous chapter identified, some RFMOs' efficacy is hampered by gaps in their membership. Even if effective in changing members' behaviour, free-rider fishing can undermine international cooperative processes and outcomes. Without a way to compel states to join RFMOs, we must ask: how can RFMOs (and by extension current member states) lure non-members to participate in RFMOs?

To answer these questions, this chapter has sought to model states' choices to cooperate with or become members of RFMOs to gain an understanding of which factors contribute most to these decisions. It has argued that there are two main classes of factors, called here 'design' and 'architecture'. The design narrative includes the usual exogenous factors expected in studies of institutional selection, such as how the institution is designed or what problems it must address. They are exogenous because they come from outside the model and are not explained by the

model. The architecture narrative consists of several endogenous, sociorelational mechanisms; mechanisms that operate on the architecture of existing ties between states and RFMOs, for example the current membership or popularity of institutions, or whether similar states have already joined. These mechanisms are endogenous because they involve a loop of causality between the independent variable, e.g. popularity, and dependent variable, e.g. degree centralisation.

The results show that institutional design is not as powerful a narrative as some architectural elements, particularly when it comes to eliciting states cooperation with RFMOs. POPULARITY stands out as a powerful mechanism here, but other sociorelational mechanisms such as CLOSURE (in the COOP model) and INTEREST HOMOPHILY also appear important. Indeed, it appears that states generally care more about the attributes of other states in the RFMO, such as their CAPACITY, than any individual design feature. Still, the results also point to particular design elements that RFMOs could reform or highlight to solicit new members, such as their ORGANISATION when attempting to lure new members. Of course, these models abstract from particular cases, but by applying them to the contexts of particular cases we may yet gain some leverage on the problem of luring new members.

In sum, this chapter has provided a model of multilateral institutional selection that is based not only on features of institutional design or problem setting, but one that also takes the decision-maker's social context or 'architecture' seriously as the fabric of several sociorelational mechanisms. However, this is, of course, only part of the story. Gaining new members is for nought if attracting them means compromising an RFMO's practical role to regulate. Does an institution's popularity frustrate its ability to act? The following chapter seeks to build upon this model of institutional selection with a model of institutional influence to assess how these interact.

“We shape our buildings; thereafter they shape us.”

Winston Churchill

5

Blueprints

5.1 Institutional Influence

JUST BEING ABLE TO ATTRACT NEW MEMBERS IS INSUFFICIENT for RFMOs to “save the fish”. They also need to at least fulfil their primary role of regulating their members.¹ Indeed, attracting new members may even be counter-productive if a larger membership results in regulatory “gridlock”. RFMOs, like other institutions, thus face the unenviable but common catch-22 of having to “deter non-compliance and non-participation” at the same time.² What may attract participation may not facilitate practice, and vice versa. The narrative in either direction is ambiguous though. States may shy away from institutions that are highly active regulators, but they may also prefer institutions that at least appear to be performing their central regulatory task. After all, even membership in ineffective institutions is costly, so states may rather “spend” efficiently. Similarly, while large memberships may choke regulatory activity in internal disagreements, they may also stimulate.

When we begin to see RFMOs “choosing” their regulatory activity, things become more complicated still for, like other Intergovernmental Organisations (IGOs), RFMO secretariats may be considered agents for the collection of principals that are their members. Their “choice” of how much to regulate may then simply reflect the legislative agendas of their members. Alternatively, either as vehicles of (global or regional) hegemonic influence, as a collective actor of pooled agency, or as secretariats accrete some agency for themselves, it may be RFMO regulation that instead leads, with members then being required to implement collective decisions

¹Even fulfilling this role may be insufficient. The following chapter investigates institutional effectiveness in some more detail.

²Barrett 2002, p. 355.

in domestic legislation. Do RFMOs with members that legislate a lot regulate a lot, do states in RFMOs that regulate a lot legislate a lot, or does one compensate for the other (and if so, in what direction)? Moreover, states' legislative activity may interact with their decisions to participate in RFMOs too, but it is unclear in which direction this might run. On the one hand, states may seek to express or transmit their domestic legislative agendas on the international level by joining RFMOs. On the other hand, states joining RFMOs may find this an impetus for increased legislative activity.

Influence may extend further still. While the mechanisms suggested above concern how the three dependent variables—states' membership in RFMOs (MEMB), RFMOs' regulatory activity (REG), and states' legislative activity (LEG)—interlock, I argue here that the MEMB architecture also provides the “plumbing” for more indirect influence.³ The idea that networks provide channels or conduits for influence is by now commonplace in the literature on international policy transfer or diffusion.⁴ This literature seeks to explain how and why policies similar to those found in one political entity at a point in time can also be found in another at a later point in time. While what I seek to explain here is the intensity of policy (i.e. regulatory and legislative) activity as a proxy for RFMOs productivity and performance,⁵ this literature suggests a range of potential mechanisms of direct and indirect influence, such as RFMOs adapting their regulatory activity to the number or legislative activity of its members, or states harmonising with or imitating the legislative activity of co-members in RFMOs. The architecture is thus important here.

The result of considering the many ways in which these three dependent variables, MEMB, REG, and LEG, interact presents a picture that is considerably more complicated than that of the previous chapter. Nonetheless, these questions can and should be investigated by building upon the model and modelling framework developed there.

First, the bipartite SAOM of institutional selection presented in the previous chapter is an ideal starting point. As Paterson et al argue, existing models of international policy diffusion miss an important part of the picture by only concentrating on the diffusion of policies among pre-existing, similar political units

³Podolny 2001, p. 33; Cao 2009; Cao 2010.

⁴Finnemore and Sikkink 1998; Slaughter 2004; Busch and Jörgens 2005; Simmons et al. 2006; Holzinger et al. 2008; Shipan and Volden 2008; Fuglister 2012; Graham et al. 2012; Ovodenko and Keohane 2012; Paterson et al. 2014.

⁵Alesina et al. 2005.

such as states in an interstate system or sub-states in a federal system.⁶ But diffusion so often implicates a micro- and a macro-level, as well as meso-level interactions between them. However, while Paterson et al consider micro- and macro-levels as “specific venues [...] where a policy is adopted” and “broad structural or normative logics”,⁷ the bipartite MEMB architecture studied here connects two different levels of policy agency. These different levels are not separate questions, but a duality demanding joint modelling.⁸ Both relational and network work make it clear that to obtain a deeper understanding of social action and structure, it is necessary to study both together so that one can understand how they mutually impinge on one another.⁹

Second, Paterson et al only model processes of influence and not selection.¹⁰ This is lamentable, because distinguishing between selection and influence can make all the difference. As an example, consider the substantive area that has driven most of the methodological advances on distinguishing selection and influence: adolescent delinquent behaviour, such as smoking or alcohol. The problem this literature faced was that, although there had long been an observation of homogeneity in delinquent behaviour amongst friends (i.e. groups of friends smoked together), it was difficult to establish the direction of this association: did smokers become friends, or friends influence each other to smoke?¹¹ The former process is known to us as homophily or homophilic selection,¹² whereas the latter sociological process is variably known as assimilation, contagion, or just influence.¹³ Researchers recognised that to address this problem adequately, a dynamic process using longitudinal data was necessary to parse out the ordering of changes.¹⁴ Steglich et al then proposed an extension to the SAOM that enabled statistical network models to distinguish between selection and influence by simulating the co-evolution of networks and behaviour.¹⁵ In this extension, dependent network and behaviour variables are modelled as statistically separate but joint dependent

⁶Paterson et al. 2014, p. 425.

⁷Paterson et al. 2014, p. 424.

⁸Breiger 1974.

⁹Padgett and Ansell 1993; Emirbayer and Goodwin 1994.

¹⁰Paterson et al. 2014, p. 426; indeed, even in network analytic circles, bipartite networks have only been modelled as *either* selection *or* influence. For an example of the former see Koskinen and Edling 2012; for an example of the latter see Fujimoto et al. 2012.

¹¹Ennett and Bauman 1994.

¹²McPherson et al. 2001.

¹³Friedkin 2001; Steglich et al. 2010.

¹⁴Valente 2003; Steglich et al. 2010.

¹⁵Steglich et al. 2010; see also Veenstra et al. 2013.

variables in a longitudinal framework to explicitly represent the mutual dependence between network and behaviour as they co-evolve in continuous time.¹⁶ Separate rate functions are estimated for each dependent variable,¹⁷ but all opportunities for change are interpolated during the simulation, which means a change in one dependent variable at a mini-step may change the local network–behaviour neighbourhood for a different focal actor on a different dependent variable at the next ministep. The three outcome variables may thus be called endogenous because they evolve as a function of one another.¹⁸

However, while the network–behaviour co-evolution SAOM represents a great step forward in terms of distinguishing selection and influence, it is currently restricted to settings such as studies of adolescent delinquent behaviour. This is because SAOMs, as *actor-oriented* models, currently lack the architecture to allow for multiple levels of agency. While models for bipartite network evolution are implemented, and one may even study the co-evolution of actors’ bipartite network choices and behavioural choices, there is currently no scope for the *targets* of ties in a bipartite network to have behavioural agency, even if collective. In other words, agency resides solely in the principals and not the agents in this model. A major methodological contribution of this chapter then is to propose what I call a “multimodal matrix solution” to this problem. This then enables us to make good on the promise of the governance complexity idea, endogeneising both actors and institutions around a multilevel, participatory architecture.

This chapter thus makes use of this extended SAOM to explain how these three parts of the picture interact. It argues that concerns that increasing an RFMO’s regulatory activity will scare away potential participants is unfounded and that neither RFMO regulation nor state legislation adapts directly to participation but that the participatory membership architecture does shape both regulatory and legislative activity by providing the “plumbing” through which member states harmonise with or imitate the legislative activity of co-members, which then has a coercive influence on RFMOs’ regulatory activity.

The remainder of this chapter is structured as follows. The next section outlines the structure of the three outcome or dependent variables, MEMB, REG, and LEG. Since the specification for MEMB is largely carried over from the previous chapter, special attention is paid to describing REG and LEG. The following section presents

¹⁶Steglich et al. 2010, pp. 330, 336.

¹⁷After all, one type of decision may be made more frequently than another. See Steglich et al. 2010, p. 348.

¹⁸Steglich et al. 2010, p. 346.

the effects considered in the evaluation function of the SAOM for the REG and LEG behaviour variables. After a brief review of some exogenous mechanisms that might affect levels of policy activity, I present six endogenous mechanisms inspired by debates in the policy transfer or diffusion literature. Before delivering the results, the next section defines the multimodal matrix solution employed here to enable the endogenous and co-evolutionary modelling of multiple levels of agency. The results are then presented by breaking the overall model into component parts to facilitate interpretation. The conclusion then reviews the “catch of the day”.

5.2 Participation and Practice

This section reviews the three dependent variables of this chapter: the architecture of states’ membership participation in RFMOs (MEMB), RFMOs regulatory activity (REG), and the legislative activity of states (LEG). Its focus is on description and the specification of the variables, particularly in the case of the behavioural variables introduced here.

5.2.1 Membership Participatory Architecture (MEMB)

The network dependent variable for this chapter is specified slightly differently than the previous chapter. First, only the MEMB network evolution is relevant here, for only full members can be expected to have a direct impact on the regulatory behaviour of RFMOs. Similarly, in many cases only full members are required to implement RFMO regulations domestically; cooperating states may have more discretion. Second, the network only ranges from 1982 to 2010. This foreshortening was necessary because earlier data on fisheries-related legislation and regulation is less reliable. Third, rather than the decadal waves employed in the previous chapter, here I use biennial waves. Biennial waves were used because this enables us to use as much data on activity changes on the two behavioural dependent variables, REG and LEG, as possible.

Table 5.1 on the next page shows the resulting number of changes in each period for this network dependent variable. Note that the rows and columns of this table have been flipped from the corresponding tables in chapter 4 to accommodate so many more periods. The periods are now the rows and the changes are the columns. The two main change columns ($0 \rightarrow 1$ and $1 \rightarrow 0$) are highlighted, as is the overall distance in terms of tie changes from the network in one wave to the next. In each

period there are multiple ties created, but there are sometimes no ties deleted. Both columns are dwarfed by static ties ($0 \rightarrow 0$ and $1 \rightarrow 1$). This results in much higher Jaccard coefficients, around 0.9, than in the previous chapter, which were around 0.5. This shows how the increased granularity of defining MEMB biennially also represents the evolution as more gradual and stable within each period.

Changes:	$0 \rightarrow 0$	$0 \rightarrow 1$	$1 \rightarrow 1$	$1 \rightarrow 0$	Distance	Jaccard
1982 \rightarrow 1984	3058	21	72	0	21	0.774
1984 \rightarrow 1986	3050	8	88	5	13	0.871
1986 \rightarrow 1988	3050	5	94	2	7	0.931
1988 \rightarrow 1990	3050	2	98	1	3	0.970
1990 \rightarrow 1992	3047	4	97	3	7	0.933
1992 \rightarrow 1994	3036	14	101	0	14	0.878
1994 \rightarrow 1996	3014	22	110	5	27	0.803
1996 \rightarrow 1998	3004	15	127	5	20	0.864
1998 \rightarrow 2000	3000	9	142	0	9	0.940
2000 \rightarrow 2002	2982	18	151	0	18	0.893
2002 \rightarrow 2004	2958	24	168	1	25	0.870
2004 \rightarrow 2006	2935	24	182	10	34	0.843
2006 \rightarrow 2008	2932	13	200	6	19	0.913
2008 \rightarrow 2010	2926	12	212	1	13	0.942

Table 5.1: Memb Tie Changes 1982–2010

The evolution of this network, explained in more detail in the previous chapter, provides the backdrop to the evolution of two behavioural variables: REG and LEG. It (MEMB) is modelled using the same effects as identified as most salient in the previous chapter, though with the reduced number of changes to model, statistical power is expected to be a further issue. It is to these behavioural variables that I now turn.

5.2.2 RFMO Regulatory Activity (REG)

Regulation speaks to the heart of the purpose of RFMOs. Their explicit management mandate is to set behavioural rules that “reflect the best available knowledge on how to achieve the social purpose” for which it was established.¹⁹ This section begins with a broad description of RFMO’s regulatory behaviour over the past few decades before formally describing how the variable is specified. But first I explain how the data was collected and coded.

¹⁹Stokke 2012, p. 18.

Data on RFMO regulatory activity was collected both from RFMO websites as well as through correspondence with RFMO secretariats. This resulted in a dataset of 1336 regulatory acts, decisions, resolutions, recommendations, or measures from 14 RFMOs. No regulatory acts were recovered for three RFMOs. First, ICNAF was dismantled before the period this chapter studies, and so no data was recovered. Second, SIOFA did not come into force during the study period, and so could not be a site of regulatory activity in any case. These two cases were treated as missing in the model so as not to affect the estimates. Due to how composition change was treated in the model, they can be effectively ignored.

The other RFMO for which no regulatory acts could be gathered is the NPAFC. The NPAFC is a tricky case for it maintains a table of decisions, i.e. its regulatory acts, in internal records of its annual meeting, but these are not fully publicly available. More precisely, documents submitted to the Committee on Scientific Research and Statistics are available, but documents submitted to the Committee on Enforcement or the Committee on Finance and Administration are not available to the public. This means that the actual number of regulatory acts passed each year is unknown and in any case, there is a systematic bias in the regulatory acts reported. As such, the NPAFC's regulatory activity is also coded as missing in this analysis.

The resulting dataset was then coded from RFMOs' own classification systems and titling conventions to capture their level of bindingness and which topics they concern. Coding them in such a way allows us to answer additional, descriptive questions about RFMO regulatory behaviour before proceeding with the modelling.

First, are Regional Fisheries *Management* Organisations living up to their strong management mandates? In other words, of these 1336 regulatory acts, how many are hard law (binding) and how many are soft law (non-binding)?²⁰ Answering this question is not straightforward. The language of RFMO regulatory activity varies; RFMOs may term their regulatory acts resolutions, recommendations, (conservation and/or management) measures, plans, guidelines, or (council) decisions. Moreover, the terminology is used inconsistently. For example, while IATTC resolutions are binding instruments and recommendations are non-binding (though compliance is of course encouraged), for ICCAT recommendations signal binding and resolutions non-binding instruments. The coding thus took these inconsistencies into account and found that RFMOs are generally meeting their management mandate by passing more than four times more binding regulations than soft (1050 binding compared with 257 non-binding).

²⁰Abbott and Snidal 2000.

Second, is this the case for all RFMOs? Or are some RFMOs managing more than others? Figure 5.1 presents the various RFMOs in their order of establishment from left to right in a stacked bar chart of hard and soft law regulatory output. Immediately apparent is that one RFMO is particularly prolific: ICCAT. Moreover, ICCAT is predominantly responsible for the soft law in this regulatory ecosystem (although it has still passed around twice as many binding measures as non-binding). We also see that, descriptively, those RFMOs established in or before 1982 (i.e. up to NEAFC) have regulated more and that the tuna RFMOs (IATTC, ICCAT, IOTC, WCPFC) also regulate more. Lastly, we see that while most RFMOs pass at least some non-binding measures, others (NEAFC, CCBSP, and RECOFI) appear to only pass binding measures.²¹

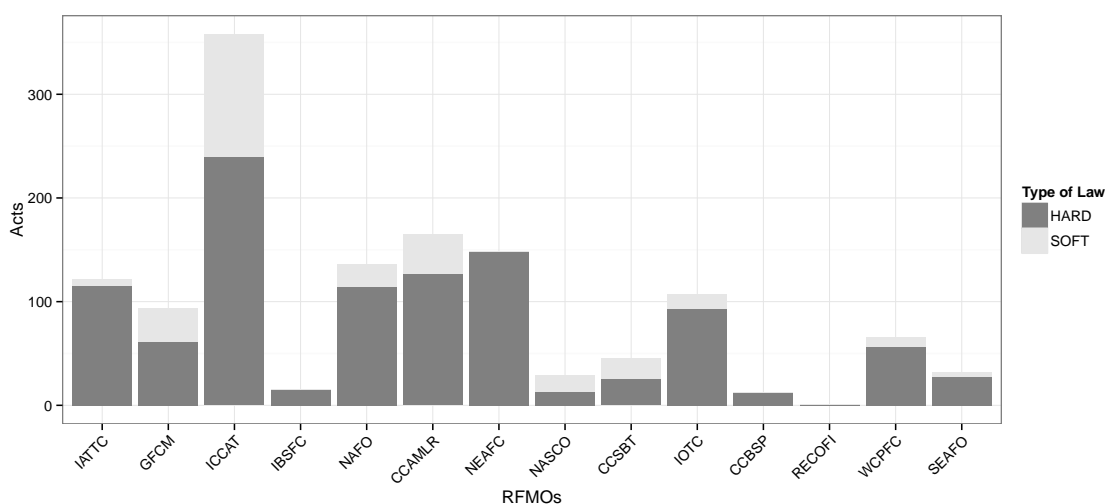


Figure 5.1: Hard or Soft Law by RFMO

Third, on which topics are these RFMOs regulating? In this next step, I look only at so-called “hard law”. These “hard” regulatory acts were then coded according to the design and problem structure classifications introduced in the previous chapter: i.e. scope, access, organisation, control, flexibility, asymmetry, distribution and enforcement problems, and world, behaviour, an preference uncertainties.

The codings for the design variables were as follows. Acts relating to scope primarily concerned which stocks and areas lay under the governance of these RFMOs. It included any new regulations passed concerning aquaculture or vulnerable marine ecosystems. In other words, acts relating to what was or was not under the jurisdiction of these RFMOs. Acts relating to access included the

²¹RECOFI has only passed one binding recommendation so far.

introduction and specification of provisions relating to any of three main categories of participants, observers, cooperating non-contracting parties or other special category, and full members. Acts were coded as relating to organisation where they concerned internal apparatuses such as internal legal affairs, finance, the delegation of tasks to subcommittees, and procedures for internal governance. Acts were viewed as referring to control where they involved regulating members' behaviour, monitoring their compliance with those regulations, or sanctioning deviations from these norms. And acts were viewed as implicating the flexibility of the institution where they involved strategic plans or principles.

The problem structure categories were coded similarly. Acts concerning asymmetry problems were evidenced by their provision for developing countries or concern for fleet size (where asymmetries are most evident). Distribution problems were evidenced by descriptions of specific allocation principles. Acts relating to enforcement problems were identified where they made reference to IUU fishing, transshipment, or the behaviour of non-contracting parties in general. Acts were considered to relate to uncertainty about the world where they concerned either gear restrictions or bycatch species, because these evidence a concern about broader ecosystem effects. Concerns of uncertainty as to members' behaviour was captured by programmes to track their behaviour, such as vessel lists, catch documentation schemes and, more generally, statistical data programmes. Lastly, acts were identified as relating to preference uncertainty where they addressed the explicit transparency (or confidentiality) and exchange of data.

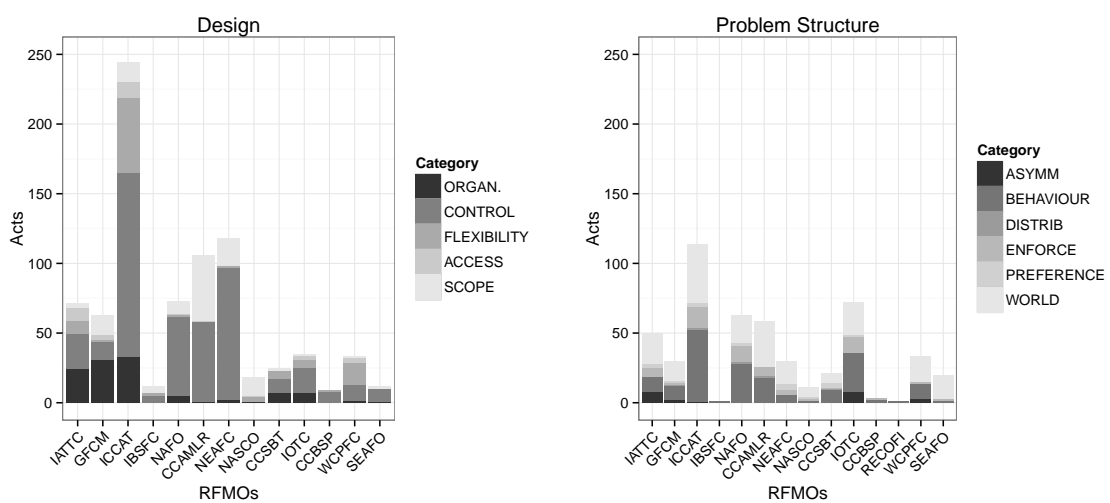


Figure 5.2: Hard Law by RFMO and by Category

Figure 5.2 on page 144 shows the distribution of these acts by category and by RFMO. The left-hand plot shows acts categorised by design and the right-hand plot acts categorised by problem structure. The two plots have the same y -axis scale. We see that RFMOs more frequently pass acts categorised by design, rather than as reactions to the problem structure. Moreover, we see how dominant “control” is as a category. This may be because control, as defined here, represents RFMOs’ primary roles: to regulate members behaviour, monitor their compliance and, where possible, sanction digressions. For this reason, I choose to concentrate on RFMOs’ control-focused regulatory acts here, and where I subsequently refer to RFMO regulation, I mean control-focused regulatory acts.

Fourth, how has this varied over time? Have RFMOs been managing more recently? Figure 5.3 shows a stacked area graph of the number of regulatory acts, both hard and soft, passed by RFMOs each year. This shows that regulatory activity across all RFMOs has risen steadily since the early 1980s with three spikes or bursts of activity in 1996, 2004, and 2009. As mentioned earlier, information prior to 1980 is patchy at best.

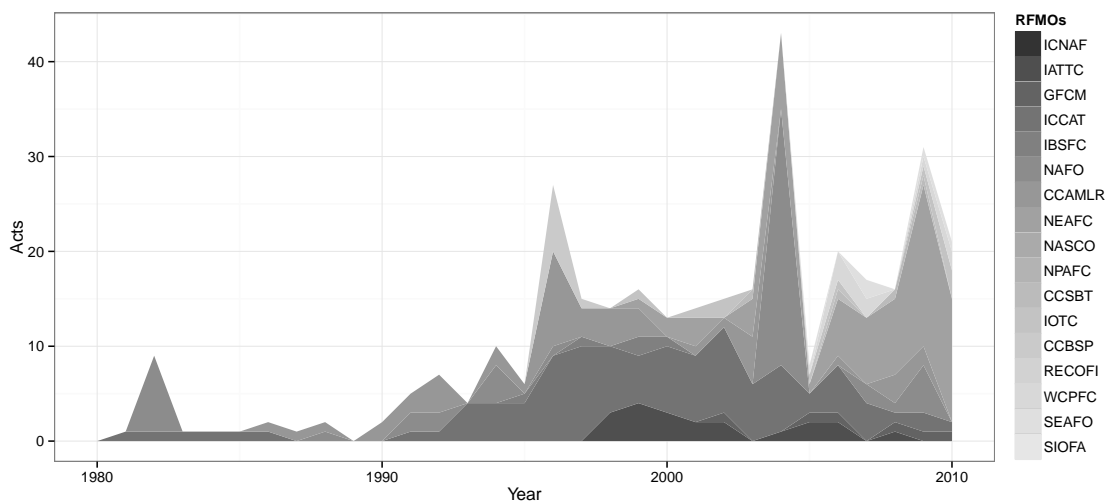


Figure 5.3: RFMO Regulatory Activity Over Time

Are these spikes because of particular policy issues that arise to which all RFMOs must react? In other words, are these spikes due to exogenous shocks? If they are, then these shocks do not appear to have global implications. For the most part, these shocks are driven by large spikes in activity from different RFMOs.

This leads us to a fifth set of questions: do RFMOs all regulate at the same time? Do they regulate steadily or in cycles (periodically)? Which RFMOs regulate when?

Figure 5.4 presents the trajectories of RFMO regulatory activity without stacking and with a transformed y -axis to enable closer inspection of each trajectory. While each RFMO's regulatory activity is scored in the background, the general trends for six representative RFMOs are highlighted by the thicker, smoothed local regression lines superimposed on the figure.

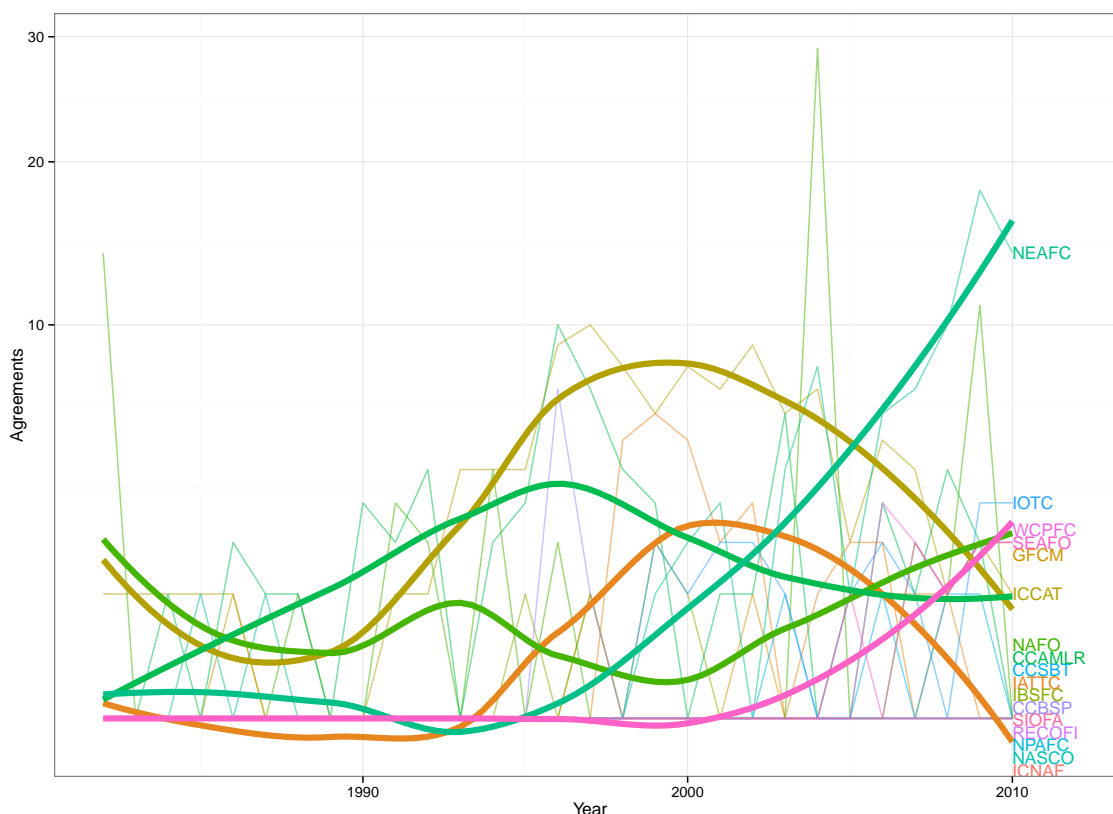


Figure 5.4: RFMO Regulatory Trajectories: Note that the y -axis is scaled by the square root of the frequencies

What is clear is that RFMOs do not all regulate simultaneously, nor do they follow the same policy cycle. Instead, some RFMOs have simply accelerated their regulatory activity, such as NEAFC and SEAFO with the trend lines increasing until 2010. Others, such as ICCAT or IATTC, appear to have had a hump of regulatory activity around 2000, which has then dropped off. And then there are those, such as NAFO or CCAMLR in the middle, that appear to follow an asynchronous and undulating policy cycle.

What is clear is that there is marked variation in RFMOs' regulatory activity that deserves explanation. This chapter thus seeks to explain changes in RFMO

regulatory activity alongside changes in the bipartite state-RFMO membership network in a coevolutionary model.

Unfortunately, however, there are two reasons why RFMO regulatory activity cannot be modelled annually. First, as hinted at above, there is insufficient change in the network to allow for an annual model. Second, spikes in regulatory activity such as can be seen for NEAFC in 2009 and NAFO in 1980 and 2004 are difficult to model.²² Instead it was decided to set the waves of both the membership network and regulatory behaviour to be biennial, averaging the scores across the previous two years. This smoothed out these spikes somewhat while retaining as much of the data's granularity as possible. Next, rounded square roots of these scores were then used to scale the distribution down to a 0–4 integer range. This was done for two reasons. First, currently only behavioural variables measured on a discrete, ordinal scale represented by integer values can be employed in a SAOM.²³ The model assumes that a given actor increments or decrements their score on the behavioural variable by one unit, within the observed range of the variable.²⁴ Second, by transforming the behavioural variable in this way, the exceptionally high activity of ICCAT, NEAFC and others is constrained to a range that can be practicably dealt with by the model. Changes in regulatory activity are therefore defined as individual step changes up or down in the (0–4) level of regulatory activity. Table 5.2 on the following page summarises the final dependent variable as specified here.

As one can see, there is not a lot of behavioural change here for the model to explain (68 step changes in total). This means that we cannot expect the data to be able to carry a very complex model. Nonetheless, I will turn to the mechanisms considered to explain this evolution in the following section.

5.2.3 State Legislative Activity (LEG)

RFMOs regulate, but ultimately their regulations are only effective when they are implemented into domestic legislation. For this reason, it is important to also consider why states' *legislate* as much as they do alongside the reasons why RFMOs regulate.

Data on states' legislative activity was collected from ECOLEX.²⁵ Only legislation relating to the subject of fisheries was considered relevant. In total, 11809

²²See Bjørndal 2009.

²³Steglich et al. 2010, p. 347.

²⁴Steglich et al. 2010, p. 350.

²⁵ECOLEX 2011.

Changes:	Down	Up	Distance
1982 → 1984	3	0	3
1984 → 1986	0	1	1
1986 → 1988	1	0	1
1988 → 1990	0	0	0
1990 → 1992	0	4	4
1992 → 1994	1	1	2
1994 → 1996	1	3	4
1996 → 1998	3	2	5
1998 → 2000	2	4	6
2000 → 2002	2	1	3
2002 → 2004	4	7	11
2004 → 2006	7	4	11
2006 → 2008	3	4	7
2008 → 2010	2	8	10

Table 5.2: Reg Changes 1982–2010

legislative acts were collected. Without a presumption to the contrary, all are considered hard law. Coding was constructed according to the same categories as with REG, however this time using tags given in the ECOLEX database. Since there were a number of rarer tags, I first limited the tags to the 98 tags used 100 or more times. Then I coded them into the categories given above.

Since states' fisheries agenda is not the main focus here, and we have already decided to concentrate on control-related regulation, I shall only explicate the coding of control-related legislation here and not present any further detail on states' (certainly broader than RFMOs) legislative agendas. Control legislation was defined as legislation tagged as concerning: *regulation* such as quotas, permits, and total allowable catch, as well as specifications of the appropriate area, species, season or size for fishing; compliance *monitoring* mechanisms; and *enforcement*, including offences and penalties given.²⁶

As with REG, LEG activity was smoothed and transformed by averaging biennial activity and taking the square root of the result. This resulted in a matrix of 198 states by 15 waves, with cells ranging from 0 to 5. For the most part this was sensitive enough; it only misses one state, Suriname, which had passed two orders and one decree in 2002, in the data.²⁷ There were 24 missing cases.²⁸ The states

²⁶While not the subject of the present study, correspondence, factor, and principal component analyses were conducted on the tags so as to best capture the underlying dimensionality in the data.

²⁷That is, in the data it appears as if it never passes any fisheries legislation.

²⁸These mostly include landlocked or developing states or fishing entities for which data is

that legislated the most over the period were the Soviet Union/Russian Federation, Chile, and Norway.

Changes:	Down	Up	Distance
1982 → 1984	39	34	73
1984 → 1986	29	38	67
1986 → 1988	37	37	74
1988 → 1990	32	34	66
1990 → 1992	29	48	77
1992 → 1994	35	35	70
1994 → 1996	23	50	73
1996 → 1998	35	54	89
1998 → 2000	50	35	85
2000 → 2002	34	44	78
2002 → 2004	37	40	77
2004 → 2006	48	39	87
2006 → 2008	39	43	82
2008 → 2010	33	36	69

Table 5.3: Leg Changes 1982–2010

Since what is most relevant for a SAOM are the *changes*, table 5.3 provides a table of the steps down and up in the ordinaly transformed legislative activity described here. As we can see here, the model has a lot more change to work with here than in the case of the REG variable described above in table 5.2. In total, the distance is 1067 changes.

5.3 Mechanisms of Policy Activity

What drives RFMOs to regulate as much as they do, and what drives states to legislate (on fisheries) as much as they do? The previous section identified some variation in both regulatory and legislative activity that demands explaining. This section reviews several exogenous and endogenous mechanisms to explain that variation.

difficult to collect: Haiti, Monaco, Romania, Afghanistan, Nepal, Mongolia, Iraq, Sri Lanka, Israel, Chinese Taipei, Laos, the German Democratic Republic, Sudan, Central African Republic, Burundi, Uganda, Lesotho, People's Republic of Yemen, Mauritius, Swaziland, Grenada, Antigua and Barbuda, Armenia, and the Republic of Macedonia.

5.3.1 Exogenous

This explanatory strand considers actors' and institutions' decision-making as independent and affected by exogenous factors. Many exogenous factors may affect the level of policy (i.e. regulatory or legislative) activity.²⁹ Here I present several factors included in the model that may either incentivise or enable higher levels of policy activity.

First, there are a couple of factors that may *incentivise* higher levels of policy activity. The first is of course SCOPE.³⁰ On the institutional side, higher RFMO regulatory activity may be associated with simply having more to govern. This variable is operationalised in the same manner as the previous chapter. The logic of how scope relates to higher policy activity is similar on the actor side. Here though, the underlying variable is the same as that of OPPORTUNITY in the previous chapter and in the MEMB part of the model below: states' EEZ in (logged) square kilometres.

Another factor that might incentivise higher levels of policy activity, at least on the institutional side, is the degree of uncertainty there is about the effects of overfishing on the broader ecosystem. Where RFMO members are particularly concerned about bycatch, for example, they will regulate more. This is captured here by the variable WORLD UNCERTAINTY, which is operationalised the same as in the previous chapter.

Second, there are also a couple of factors that may *enable* higher levels of policy activity. The first is that the structure of the political unit may facilitate greater policy activity. On the institutional side, this is captured by the design variable ORGANISATION. This is operationalised the same as in the previous chapter, and I suggest here that the more organised or centralised an RFMO is internally, the more it can and will be able to regulate. On the actor side, this is captured by the POLITY variable. This variable captures both a political and legal structure that may facilitate higher levels of policy activity, with the consequence that the more democratic a state is, the more it will legislate. This also suggests that as the inter-state system democratises, we will see more legislation.

Another factor that might enable or facilitate higher levels of legislative activity is a state's CAPACITY. This is then a resource -based explanation for high activity. In

²⁹Extensive robustness checks investigated a host of potential controls. In the end, the factors presented here were most commonly found once models were refined according to the backward stepwise model selection procedure defined in the previous chapter.

³⁰Koremenos et al. 2001, p. 770.

particular, richer states may be able to maintain a higher level of legislative activity across a wide range of issue areas, including fisheries.

5.3.2 Endogenous

This chapter argues that there are other, *endogenous* influences on policy activity too though. In this subsection, I outline six such mechanisms: EMULATION, LEARNING, COERCION, IMITATION, ADAPTATION, HARMONISATION.

Emulation

The first mechanism is EMULATION. As a mechanism for institutional influence, emulation is founded on a logic of social appropriateness.³¹ It is closely related to how actors or institutions are socialised and conform to social expectations. In terms of policy *activity*, rather than policy content, this would mean the upholding of a certain level of policy activity alongside all other members of the inter-state system. It is thus closely related to the search for conformity and status rather than efficacy.³² The most common way of operationalising emulation has been to include the number of previous adopters to indicate a general pressure to conform,³³ and it is this operationalisation that I employ here. In effect, it is considered a general linear effect, expressing the basic drive toward high policy activity, for all actors (or institutions in the case of regulation) are subject to the same *general* social pressures. Note that this effect operates effectively as an intercept for the other transfer effects. A positive value implies a drive towards high activity, a value close to zero implies a drift toward the midpoint of the range of the behaviour variable, and a negative coefficient suggests a retraction, *ceteris paribus*.³⁴

Learning

The second mechanism is LEARNING. Often, learning is defined as a mechanism that concerns how actors learn by observing others behaviour and altering their beliefs and behaviour accordingly.³⁵ This definition of learning is very general, and it is often difficult to distinguish learning from EMULATION and other effects.³⁶ The

³¹Elkins et al. 2006; Fordham and Asal 2007; Füglistler 2012.

³²Meseguer 2005.

³³Elkins et al. 2006; Gilardi 2005; Simmons and Elkins 2004; Saikawa 2013.

³⁴Steglich et al. 2010.

³⁵Simmons and Elkins 2004; Elkins et al. 2006; Meseguer 2005; Braun and Gilardi 2006; Gilardi 2012; Füglistler 2012.

³⁶Meseguer 2005.

general strategy scholars have used for distinguishing learning has been to relate it to behaviour that has been shown to be effective. That is, whereas emulation, imitation, or other related processes involve the adoption of examples of policies or practices wholesale, learning is thought to involve some bounded or unbounded rational appraisal of that example's effectiveness prior to adoption. This strategy is difficult to invoke here however because we do not currently have any good data on how effective each RFMO is (see following chapter). Modelling actors or institutions' *subjective* processes of policy evaluation would be even more difficult. Without any such information this definition of learning runs the risk of folding back into EMULATION or imitation.

Therefore, I take a different track and redefine LEARNING as an endogenous process of learning from the (presumed) efficacy of ones' *own* experiences.³⁷ While this definition no longer involves others as the definition above does, it is consistent with common language uses of *self*-learning where one might at least establish from one's own past experience whether high or low levels of behaviour (here policy activity) 'works' or not. In other words, I propose that this style of learning can be conceptualised as a feedback loop on past experience. From the actor or institutions' standpoint, this could be seen as positive or negative feedback—does high policy activity lead to still more policy activity (a positive feedback loop) or does it lead to exhaustion and a de-escalation of activity in the future (negative feedback)?

To capture this effect, I model LEARNING as a quadratic effect, i.e. the effect of the level of the behaviour on itself. Since this depends on the current level of behaviour anyway, it should always be interpreted together with EMULATION anyway, such as $\beta_{\text{emulation}}(z_i + \bar{z}) + \beta_{\text{learning}}(z_i + \bar{z})^2$.³⁸ Where LEARNING is positive, this suggests that the feedback mechanism is positive, so that changes in z_i are self-reinforcing and as actors or institutions engage in, say, higher levels of policy activity this promotes even more policy activity.³⁹ For policy activity, this could indicate learning the benefits of high policy activity for oneself, a deepening addiction to legislative or regulatory solutions to problems or, more cynically, that previous policy activity creates loopholes that demand yet more policy to fill. Where LEARNING is negative, this suggests a self-correcting mechanism: as z_i increases beyond the average, even higher values of z_i will become harder to achieve and

³⁷What Meseguer calls "own learning". See Meseguer 2009; also Gilardi 2012.

³⁸See Steglich et al. 2010.

³⁹Constrained in the model by the range of the variable.

as z_i decreases below the average, even lower values of z_i will become harder to achieve. It thus suggests a unimodal bias and a regression towards the mean.

Adaptation

The third mechanism is ADAPTATION. Like the following mechanism, adaptation is not necessarily an isomorphic mechanism, but may be responsible for differentiation in policy activity.⁴⁰ Actors and institutions may need to adapt their policy activity to their circumstances. One of the main circumstances that one might expect them to have to adapt to is their structural position in the MEMB participatory architecture. States may need to adapt their legislative activity to the number of RFMOs in which they are a member. One would naturally expect this to be a positive relationship, if at all. Being a member of more RFMOs means states are *generally* subject to more obligations (though see the next mechanism), which require adaptation. RFMOs may also need to adapt their regulatory activity to the number of members they have. Here, however, the expected direction of the effect is more ambiguous. On the one hand, more members may translate into a broader regulatory agenda, which requires more regulatory activity. On the other hand, more members may also frustrate the passage of any regulatory activity at all, as internal politics “locks” the whole institution up. This effect is operationalised as a relationship between degree, or the number of ties a node has, and high values on the behaviour.

Coercion

The fourth mechanism is COERCION. While many studies in the policy transfer literature have excluded coercion from those mechanisms considered, others consider it crucial.⁴¹ On the institutional side, DiMaggio and Powell’s famous piece on institutional isomorphism makes explicit reference to coercion as a central mechanism.⁴² Either way, coercion is typically said to express the exercise of power asymmetries by one node to influence the behaviour of another by shifting incentives and altering cost-benefit analyses.⁴³ Here, we have two different nodesets: state actors and RFMO institutions. In this bipartite context, I define coercion as the imposition of one nodeset on another through the MEMB

⁴⁰See Radaelli 2000, pp. 38-39; Elkins and Simmons 2005.

⁴¹Elkins et al. 2006; Shipan and Volden 2008.

⁴²DiMaggio and Powell 1983.

⁴³Tews 2005; Holzinger and Knill 2005; Simmons et al. 2006; Dobbin et al. 2007.

architecture. I therefore operationalise COERCION here as the influence RFMO regulatory activity has on the legislative activity of member states, and the influence states' legislative activity has on the regulatory activity of RFMOs in which it is a member. A positive coercion coefficient in the LEG context would suggest that the more RFMOs in which a state is a member of regulate, the more a state needs to legislate to keep up with their obligations. A positive coercion coefficient in the REG context would suggest that the more member states legislate, the more an RFMO needs to regulate to express these concerns regionally.

Harmonisation

The fifth mechanism is HARMONISATION. Harmonisation has traditionally been difficult to distinguish from coercion.⁴⁴ For example, whether EU pre-accession requirements represent harmonisation or coercion has engendered considerable debate implicating questions of intention and agency. On the one hand, candidates recognise that bringing their behaviour in line with that of others also brings value to them. On the other hand, candidates did not have a hand in negotiating these terms. This is a particularly tricky case, but easier cases where things are clearer, such as institutional members all agreeing to implement regulation for example, has often been ignored in diffusion studies due to its coordinated nature. What harmonisation and coercion share is that they concern influence through institutions; what differs is that harmonisation is considered to be a voluntary submission and usually concerns coordinated action with other member states. I therefore operationalise harmonisation as the effect of the average peer which, because the network is bipartite, is always at a distance of two ties from the focal actor or institution.⁴⁵ For states, this means that the effect is calculated on the back of the average LEG behaviour for each RFMO in which it is a member. For RFMOs, the effect is calculated on the back of the average REG behaviour for each state member.⁴⁶

Imitation

The final mechanism is mimesis or IMITATION.⁴⁷ Imitation has also traditionally been difficult to distinguish from another mechanism, EMULATION. Both are

⁴⁴See e.g. Tews 2005; Elkins and Simmons 2005.

⁴⁵Cf. Holzinger and Knill 2005.

⁴⁶Steglich et al name this effect 'assimilation' Steglich et al. 2010, p. 334; see also Friedkin 2001.

⁴⁷DiMaggio and Powell 1983.

forms of social learning. However, whereas emulation, at least as I have defined it, is indiscriminate as to its source because it operates on a logic of social appropriateness where the activity level is the general norm or expectation, often emulation is used to describe another mechanism in which actors adopt behaviour in *imitation* of particularly prestigious or high-performing others in their reference groups.⁴⁸ Like HARMONISATION, I take the MEMB architecture as the chief conduits through which influence runs.⁴⁹ However, the influence for states LEG comes not from the average members' behaviour, but the *maximum* behaviour amongst co-members of RFMOs. Similarly, we might expect RFMOs to imitate the regulatory activity of the most productive RFMO with which it shares members.

5.4 Results

Having described and discussed each of the three main dependent variables and reviewed the mechanisms considered, I turn to the results from the modelling exercise in this section. Before continuing, however, I first shortly describe a methodological innovation that was required before two dependent behavioural variables could be modelled as co-evolving with a bipartite dependent network in a SAOM framework. This next subsection is entirely of methodological import, and can be skipped for those more interested in substantive conclusions. I include it here on the grounds of transparency and comprehensiveness, but also because it represents a methodological solution that enables *both* actor and institutional behaviour to be co-evolve endogenously around a bipartite network, such as can be found in global governance complexes.

5.4.1 Multi-Modal Matrix Solution

Ordinarily, a bipartite SAOM would require the specification of one or the other nodesets as the “actors”, leaving the other nodeset simply as choices.⁵⁰ However, the three dependent variables outlined above implicate both nodesets of the bipartite network MEMB as agents in some sense. States are the natural actor set, choosing both which RFMOs to join in the MEMB network as well as their own level of LEGislative activity. But RFMOs are also the agents (to the principal states) in terms of REGulatory activity.

⁴⁸Elkins et al. 2006; Fordham and Asal 2007; Simmons et al. 2006.

⁴⁹See Podolny 2001; see also Füglister 2012.

⁵⁰Koskinen and Edling 2012; Snijders et al. 2013.

This dissertation proposes a flexible solution to this problem that I term here the multi-modal matrix solution. Again, here, we consider a normal bipartite network with two node sets or modes, A and I (for actors and institutions, respectively). Ties X emanate from nodes in A to nodes in I , as usual in a bipartite SAOM. However, instead of using this matrix alone, X is embedded into an off-diagonal of a larger matrix $(A + I) \times (A + I)$. The other quadrants of the multi-modal matrix, AA , II , and IA , are filled with structural zeros (10s for SAOMS) like so:

$$\begin{matrix} & A & I \\ A & \begin{pmatrix} 10 & X \end{pmatrix} \\ I & \begin{pmatrix} 10 & 10 \end{pmatrix} \end{matrix}$$

This matrix could easily be extended to involve multiple networks,⁵¹ but here the utility in doing this is that it enables the SAOM to treat all nodes as potential actors. This means that we can include behavioural variables not only for state actors (i.e. LEG), but also for RFMO institutions (i.e. REG).

Two tricks are required to make this work. First, it is necessary to specify the behavioural variables as $A \times I$ length matrices, rather than length A or I . More specifically, LEG consisted of A rows of data on states' legislative activity followed by I rows of missing data (NA), and REG consisted of A rows of NAs and I rows of RFMOs' regulatory activity.⁵²

Second, we still need to identify which are the agents for a particular network/behaviour variable, or we risk getting biased estimates. Here, I use the flexible rate function described in the previous chapter to influence which nodes receive opportunities to change their local network or behavioural level. More precisely, I use an inverse node set effect to ensure that those nodes who should *not* receive opportunities to make changes never do. That means that the MEMB and LEG parts of the model specifications include a term that ensures that RFMOs never receive opportunities to make ties or legislate, and in the REG part of the model specifications include a term that means that states do not get the opportunity to regulate. Since these effects have no substantive interpretation, they are not included in the following results tables for the purposes of clarity.⁵³

⁵¹See Snijders 2015.

⁵²The NAs are used so as not to influence variable centering.

⁵³For the same reason they are not reported in the previous chapter, where they were not strictly required but the same model specification was used in the interests of comparability.

5.4.2 Participation

First I address the results of the participation part of the model. Note that this part, explaining MEMB, represents the *selection* part of the model, which is important to model along with the influence parts of the model (LEG and REG) so as to be able to parse out the difference between selection and influence processes (recall the adolescent smoking example). The same backward model selection procedure as in the previous chapter was undertaken here. Three model fits are presented here to distinguish effects in the influence parts of the model; there is no difference in the specification for the MEMB, institutional selection part of the model. What small differences there are in coefficient sizes illustrate the interdependency model parts.

	Model 1	Model 2	Model 3
Rate 1982–1984	0.26 (0.07)***	0.26 (0.08)***	0.26 (0.07)***
Rate 1984–1986	0.09 (0.03)**	0.09 (0.03)**	0.09 (0.03)**
Rate 1986–1988	0.05 (0.02)*	0.05 (0.02)*	0.05 (0.02)*
Rate 1988–1990	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)
Rate 1990–1992	0.08 (0.03)*	0.08 (0.04)*	0.08 (0.03)*
Rate 1992–1994	0.11 (0.03)***	0.11 (0.04)**	0.11 (0.03)**
Rate 1994–1996	0.22 (0.05)***	0.22 (0.05)***	0.22 (0.05)***
Rate 1996–1998	0.13 (0.04)***	0.13 (0.04)***	0.13 (0.04)***
Rate 1998–2000	0.07 (0.03)**	0.07 (0.02)**	0.07 (0.03)*
Rate 2000–2002	0.12 (0.03)***	0.12 (0.04)**	0.12 (0.03)***
Rate 2002–2004	0.16 (0.04)***	0.16 (0.04)***	0.16 (0.04)***
Rate 2004–2006	0.21 (0.04)***	0.21 (0.04)***	0.21 (0.05)***
Rate 2006–2008	0.11 (0.03)***	0.11 (0.03)***	0.11 (0.03)***
Rate 2008–2010	0.07 (0.02)***	0.07 (0.02)**	0.07 (0.02)**
Opportunity	0.14 (0.04)***	0.14 (0.04)***	0.14 (0.03)***
Intercept (Density)	−6.25 (0.81)***	−6.35 (0.76)***	−6.34 (0.80)***
Coastal Entrainment	3.81 (0.40)***	3.85 (0.38)***	3.85 (0.41)***
Activity Entrainment	0.07 (0.03)**	0.07 (0.03)**	0.07 (0.03)*
Architectural Closure	0.09 (0.03)**	0.09 (0.03)**	0.09 (0.03)**
Architectural Popularity	0.29 (0.09)***	0.31 (0.08)***	0.31 (0.08)***
Multilateralism	10.00 ()	10.00 ()	10.00 ()
Proximity	1.23 (0.28)***	1.26 (0.27)***	1.25 (0.28)***
IGO Foci	−0.05 (0.02)**	−0.05 (0.01)***	−0.05 (0.01)***
Flexibility Design	−0.78 (0.15)***	−0.79 (0.16)***	−0.79 (0.16)***
Enforcement Problems	0.36 (0.08)***	0.36 (0.09)***	0.36 (0.09)***
Preference Uncertainty	−0.22 (0.07)**	−0.22 (0.07)**	−0.22 (0.07)**
Own Interest	1.83 (0.39)***	1.85 (0.36)***	1.85 (0.38)***

	Model 1	Model 2	Model 3
State Legislative Activity	-0.30 (0.22)	-0.28 (0.24)	-0.28 (0.24)
RFMO Regulatory Activity	0.13 (0.15)	0.14 (0.17)	0.13 (0.16)
Centralisation GOF	0.299	0.403	0.420
Clustering GOF	0.650	0.687	0.672

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $p < 0.1$

Table 5.4: Results (Memb)

While for the most part the model resembles the final MEMB model specification of the previous chapter, some effects had to be dropped as there was not enough statistical power to carry the same number of effects as in the previous chapter where another twenty years of change were included and there was less complexity in the model. These effects include ACCESS, ORGANISATION, ENFORCEMENT PROBLEMS, OWN and OTHERS' CAPABILITY, OTHERS' POLITY, and INTEREST HOMOPHILY. This is regrettable, but required to obtain satisfactory power for focal effects in other parts of the model.

As we can see, this did not adversely affect the goodness of fit though. Indeed, goodness of fit on centralisation improved three to four times, from 0.106 to 0.299–0.420.⁵⁴ Goodness of fit for clustering dropped from 0.898 to 0.650–0.687, but this was about as well as clustering was fitted in the COOP model in the previous chapter. In both cases, these fit statistics are excellent and give us no concerns.

The most interesting part of this model is the final two lines of the results. The absence of any significance for the two policy activity effects means that we cannot say that how much a state legislates (on fisheries topics) nor how much an RFMO regulates has any bearing on states' decisions to join RFMOs. This implies that RFMOs may regulate as much as they please (though see subsection 4) without fear of deterring potential members. It also suggests that states' participation in RFMOs is not driven by the desire to express a domestic legislative agenda abroad. Next, we turn to what drives that domestic agenda.

⁵⁴The lower p -value in the first model may be because the extra effects in the other parts of the model impacted how the parts of the model interact, resulting in somewhat different coefficients.

5.4.3 State Legislative Practice

The second part of the model concerns the factors driving states' domestic legislative activity. Unfortunately, here the fit was not good at all. For all three models, the p -value was 0, suggesting that the model never replicates the distribution of behaviour across all time periods. To better diagnose the source of this poor fit, I include fig. 5.5.

	Model 1	Model 2	Model 3
Rate 1982–1984	2.77 (0.73) ^{***}	2.72 (0.77) ^{***}	2.76 (0.74) ^{***}
Rate 1984–1986	2.29 (0.45) ^{***}	2.26 (0.54) ^{***}	2.28 (0.61) ^{***}
Rate 1986–1988	2.47 (0.64) ^{***}	2.46 (0.84) ^{**}	2.47 (0.49) ^{***}
Rate 1988–1990	2.01 (0.51) ^{***}	1.99 (0.54) ^{***}	2.01 (0.41) ^{***}
Rate 1990–1992	2.82 (0.73) ^{***}	2.78 (0.72) ^{***}	2.83 (0.74) ^{***}
Rate 1992–1994	1.64 (0.33) ^{***}	1.64 (0.33) ^{***}	1.64 (0.33) ^{***}
Rate 1994–1996	1.73 (0.35) ^{***}	1.74 (0.35) ^{***}	1.75 (0.31) ^{***}
Rate 1996–1998	2.28 (0.55) ^{***}	2.25 (0.39) ^{***}	2.28 (0.47) ^{***}
Rate 1998–2000	1.70 (0.27) ^{***}	1.69 (0.31) ^{***}	1.71 (0.23) ^{***}
Rate 2000–2002	1.61 (0.26) ^{***}	1.61 (0.27) ^{***}	1.60 (0.30) ^{***}
Rate 2002–2004	1.53 (0.29) ^{***}	1.53 (0.25) ^{***}	1.53 (0.29) ^{***}
Rate 2004–2006	1.79 (0.27) ^{***}	1.78 (0.29) ^{***}	1.80 (0.31) ^{***}
Rate 2006–2008	1.68 (0.35) ^{***}	1.69 (0.31) ^{***}	1.68 (0.33) ^{***}
Rate 2008–2010	1.19 (0.19) ^{***}	1.20 (0.21) ^{***}	1.19 (0.21) ^{***}
Own Maritime	0.04 (0.01) ^{***}	0.04 (0.01) ^{***}	0.04 (0.01) ^{***}
Own Polity	0.02 (0.01) ^{***}	0.02 (0.01) ^{***}	0.02 (0.01) ^{***}
Own Capability	0.09 (0.02) ^{***}	0.09 (0.02) ^{***}	0.09 (0.02) ^{***}
Emulation (Linear Trend)	−0.92 (0.07) ^{***}	−0.89 (0.06) ^{***}	−0.92 (0.06) ^{***}
Learning (Quad. Feedback)	−0.06 (0.02) [*]	−0.06 (0.02) [*]	−0.06 (0.02) [*]
Adaptation (Memb)	−0.03 (0.03)	−0.00 (0.02)	−0.04 (0.03)
Coercion (Reg)	0.06 (0.06)	0.07 (0.06)	0.07 (0.06)
Harmonisation (Mean Dist2)	0.10 (0.13)	0.22 (0.08) ^{**}	
Imitation (Maximum Dist2)	0.05 (0.05)		0.08 (0.03) ^{**}
Goodness of fit	0.000	0.000	0.000

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $p < 0.1$

Table 5.5: Results (Leg)

Figure 5.5 on the following page shows the cumulative distribution function (CDF) of the count of behavioural values (listed along the x -axis) for the whole

observed evolution (the solid line with points labelled at the observed frequency) superimposed on violin plots of the distribution of the statistic across all the simulations.⁵⁵ This plot helps to diagnose poor fit by showing where observed and simulated graphs deviate most. In this case, we see that the model is not as poor as the p -values make out. It underestimates states not legislating at all (i.e. the violin plot resides mostly below the observed point for $x = 0$) and overestimates states legislating at level 1. These are probably related. By overestimating (lowly) active states, fewer states are considered to not be active at all than is the case in the observed system. Note that this is despite the inclusion of three covariates that quite strongly impact states' legislative activity. Indeed (as one might expect), rich (CAPABILITY), democratic (POLITY), maritime (MARITIME) states are the ones that legislate most on fisheries affairs. This suggests that future work may need to employ more innovative routes to modelling when states begin legislating on fisheries at all.⁵⁶

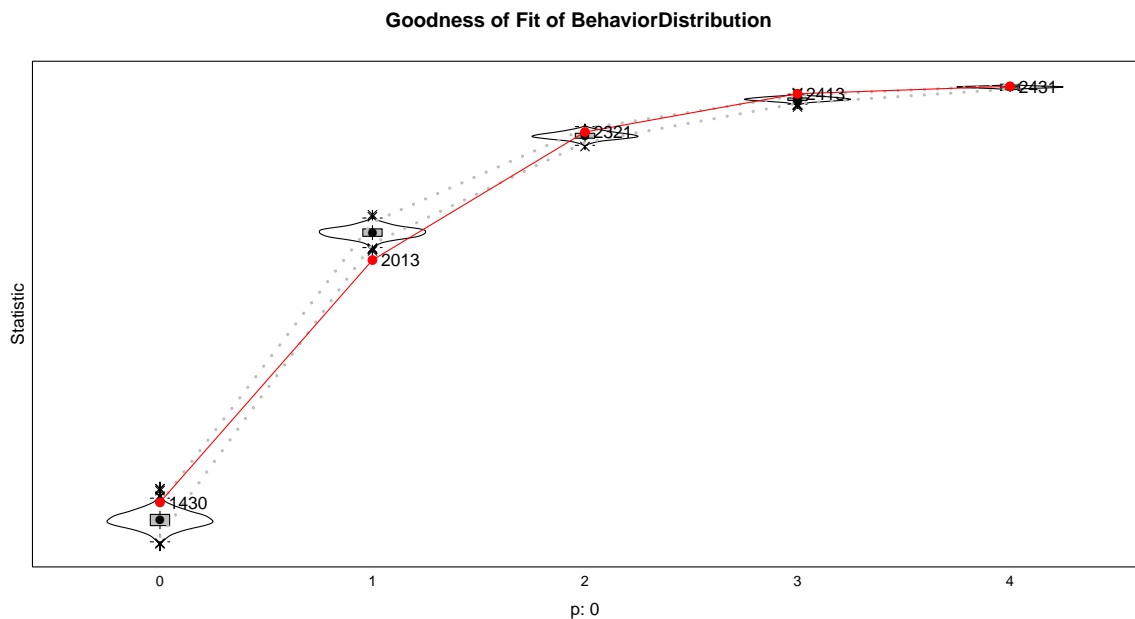


Figure 5.5: Leg Goodness of Fit

Nonetheless, there are some interesting results in the remainder of the model. There is a clear effect for emulation, for example, though as this parameter also operates as somewhat of an intercept for the rest of the model, its negative valence

⁵⁵Violin plots are adaptations of box-plots in which the information available from local density estimates are added. See Hintze and Nelson 1998.

⁵⁶One promising avenue is suggested by the OPPORTUNITY parameter in the MEMB/participation part of the model. The judicious use of a rate interaction may be useful here.

should not be interpreted alone. At a minimum it ought to be interpreted together with LEARNING, which was also significant and negative. As explained above in the section on learning, these effects together can be read as a general tendency for lower levels of legislative activity and for higher levels of legislative activity to be harder to achieve or maintain. In other words, there is no positive feedback (learning) effect.

Next, there is no evidence of any adaptation or coercion. States do not adapt to their RFMO commitments by increasing their legislative activity, nor do they do so when those RFMOs in which they are a member increase their regulatory activity.

The last two effects are more interesting though. While when they are both included, neither are significant, in the second and third model where only HARMONISATION and IMITATION are included, respectively, each is significant and positive. This means that, while they are hard to distinguish from one another empirically, either account works. On the one hand, states' legislative activity is influenced by the average legislative activity of its peers, where peers is defined as its co-members in RFMOs in which it participates. On the other hand, states' legislative activity also seems to be influenced by the maximum legislative activity amongst its co-member peers. Which is the better explanation is hard to tell when the goodness of fit is equally poor, but the differentiation and operationalisation of these different mechanisms should assist in future research here.

5.4.4 RFMO Regulatory Practice

Fit is much better for the REG part of the model. In each case, the fit is substantially above the suggested threshold of $p = 0.05$, though not as high as the fit in the MEMB part of the model. Again, the first model includes both HARMONISATION and IMITATION but, in an effort to reduce the collinearity of these two parameters, models 2 and 3 fit models with only HARMONISATION or IMITATION, respectively. In the end, neither was significant in any of the three models. Nonetheless, the model including only IMITATION provided the best model fit, also in terms of MEMB centralisation.⁵⁷ I therefore proceed on the basis that model 3 presents the best overall specification.⁵⁸

⁵⁷Although clustering was slightly less than in model 2, the difference is much less than the combined improvement on MEMB clustering and REG goodness of fit.

⁵⁸With the caveat that there does seem to be some degree of exchangeability between HARMONISATION and IMITATION, especially with respect to LEG.

	Model 1	Model 2	Model 3
Rate 1982–1984	3.01 (3.05)	2.93 (3.07)	2.52 (2.47)
Rate 1984–1986	0.51 (0.61)	0.56 (0.69)	0.61 (0.74)
Rate 1986–1988	0.41 (0.51)	0.42 (0.47)	0.44 (0.57)
Rate 1988–1990	0.60 ()	0.60 ()	0.60 ()
Rate 1990–1992	2.77 (3.13)	2.85 (3.81)	4.11 (4.89)
Rate 1992–1994	0.81 (0.68)	0.83 (0.72)	0.75 (0.66)
Rate 1994–1996	2.71 (3.57)	2.75 (2.90)	2.46 (2.12)
Rate 1996–1998	1.81 (1.15)	1.74 (1.36)	1.67 (1.19)
Rate 1998–2000	5.26 (4.80)	4.53 (5.66)	4.54 (6.99)
Rate 2000–2002	0.83 (0.55)	0.81 (0.60)	0.81 (0.63)
Rate 2002–2004	6.00 ()	6.00 ()	6.00 ()
Rate 2004–2006	6.00 ()	6.00 ()	6.00 ()
Rate 2006–2008	2.90 (2.60)	2.72 (2.22)	2.79 (3.07)
Rate 2008–2010	6.00 ()	6.00 ()	6.00 ()
Scope	0.80 (0.35)*	0.78 (0.34)*	0.85 (0.33)**
Organisation	2.21 (0.88)*	2.30 (0.89)*	2.13 (0.77)**
World Uncertainty	0.81 (0.34)*	0.84 (0.35)*	0.83 (0.31)**
Emulation (Linear Trend)	−1.60 (0.94)	−1.83 (0.92)*	−2.28 (0.68)***
Learning (Quad. Feedback)	−0.12 (0.14)	−0.11 (0.13)	−0.09 (0.11)
Adaptation (Memb)	−0.02 (0.02)	−0.02 (0.02)	−0.02 (0.02)
Coercion (Leg)	1.49 (0.72)*	1.56 (0.70)*	1.32 (0.63)*
Harmonisation (Mean Dist2)	−0.43 (0.45)	−0.33 (0.40)	
Imitation (Maximum Dist2)	0.06 (0.11)		0.03 (0.10)
Goodness of fit	0.197	0.173	0.223

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $p < 0.1$

Table 5.6: Results (Reg)

Before interpreting the results, it is important to first explain the four rate parameters without standard errors. As fig. 5.3 on page 145 shows, there are some low points and spikes in regulatory activity. In the fourth period there were no changes in regulatory activity at all. In the eleventh, twelfth, and fourteenth periods, there was a lot of change, especially compared to previous periods. Such abrupt changes can make a SAOM quite unstable. To avoid model degeneracy, I constrained these parameters by setting a rate on the low end of the scale of estimated rates for the fourth period, and a rate on the high end of the scale for the other periods that were challenging for the model.⁵⁹

⁵⁹I erred on the generous side, because the model does allow for self-cancelling tie toggling.

In terms of why RFMOs regulate, it seems that SCOPE, ORGANISATION, and WORLD UNCERTAINTY all affect RFMO regulation positively. This means that RFMOs with more to manage (SCOPE), more concern about how to manage (WORLD UNCERTAINTY), and a more internal structure through which to manage (ORGANISATION), will manage more.

Together, these effects mitigate the general trend toward lower levels of regulation by RFMOs.⁶⁰ This generally low level (EMULATION) may be because states are jealous of their sovereignty and reluctant to facilitate or enable high levels of international-level regulation. Most other endogenous processes, such as IMITATION, LEARNING, ADAPTATION and HARMONISATION were not significant. This may be because it is difficult to distinguish reference group effects like IMITATION and HARMONISATION from general or universal effects like EMULATION when a governance complex consists of or converges on a single reference group or community as we have seen in fig. 3.13 on page 79 on institutional interlinkages.

One process endogenous to MEMB was significant though: COERCION. This suggests that RFMOs with member states that themselves legislate a lot on fisheries-related topics tend to also regulate more. I interpret this as the joint *coercive* influence of organisational members on the overall activity of the organisation. What this means is that, while states do not *select* RFMOs on the basis of their regulatory activity (see the MEMB part of the model above), these choices nonetheless create an architecture through which their individual legislative behaviour has some COERCIVE influence on RFMO regulatory behaviour. This can be as simple as each member state bringing their own legislative/regulatory agenda to the organisation.

This may be because states are jealous of their sovereignty, and reluctant to facilitate or enable high levels of international-level regulation. That is, unless they themselves legislate a lot, it seems: COERCION is both significant and positive. This means that RFMOs that have members that have highly active legislative agendas in relation to fisheries will also be *coerced* into higher levels of regulatory activity. States' choices to become members of RFMOs on other bases than the RFMOs regulation can nonetheless subsequently affect RFMOs' regulatory behaviour.

These results suggest that generally RFMOs regulate roughly the same amount, but for particular conditions (SCOPE and WORLD UNCERTAINTY) as well as how ORGANISED they are internally and how legislatively active their members are (COERCION). But there is also some variation in the importance of each of these

⁶⁰There does not necessarily seem to be any kind of feedback or learning effect.

factors across the RFMOs.⁶¹ This variation is not great and does not vary too much over time, and so I choose to present this information here as a table. Table 5.7 shows the top three factors as well as the least important factor for each RFMO. I include all 15 RFMOs (ICNAF and SIOFA were excluded) in the table.

RFMO	Most Important			Least Important
	1st	2nd	3rd	
GFCM	Emulation	Organisation	World Uncert.	Learning
CCSBT	Emulation	World Uncert.	Organisation	Imitation
NPAFC	Emulation	World Uncert.	Coercion	Imitation
IBSFC	Emulation	Scope	Coercion	Learning
ICCAT	Organisation	Emulation	Scope	Imitation
RECOFI	Organisation	Emulation	Scope	Imitation
WCPFC	Organisation	Emulation	Scope	Imitation
NASCO	Organisation	Emulation	World Uncert.	Learning
IATTC	Organisation	Coercion	Emulation	Learning
NAFO	Organisation	Coercion	Emulation	Imitation
CCAMLR	Coercion	Emulation	Scope	Imitation
NEAFC	Coercion	Emulation	World Uncert.	Adaptation
SEAFO	Coercion	Emulation	Harmonisation	Imitation
CCBSP	Scope	Emulation	Organisation	Imitation
IOTC	World Uncert.	Emulation	Organisation	Imitation

Table 5.7: RFMOs by Most Important Effect on Regulatory Activity

Table 5.7 emphasises many of the observations from table 5.6. For all RFMOs, EMULATION appears an important factor and in most cases either IMITATION or LEARNING is the least important factor of those factors remaining in the model after the backward model selection. Similarly, the other factors appearing in the top three for the RFMOs is consistent with the results. What is possible, however, is to classify RFMOs into groups based on which factors appear paramount in influencing their regulatory activity.

The first group are all “emulation high”. This group includes GFCM, IBSFC, NPAFC, and CCSBT. Since emulation appears important for all RFMOs though, this is not terribly revealing. Perhaps the most that can be said is that these RFMOs tend to follow general regulatory trends.

The second group, and also the largest, is “org high”. This group can be further split up into those RFMOs for which their regulatory activity is at least in

⁶¹On the method for evaluating the relative importance of each effect for each actor see the previous chapter or Indlekofer and Brandes 2013.

part influenced by the scope of their management mandate (ICCAT, RECOFI, and WCPFC) or those for which this factor does not appear so important (IATTC, NAFO, and NASCO). This is important, because it suggests that for a large group of RFMOs, high ORGANISATION not only attracts members (see the MEMB part of the model) but also facilitates or enables higher regulatory activity—higher regulatory activity that does *not* appear to dissuade future members.

The next group involves three RFMOs (CCAMLR, NEAFC, and SEAFO) for which their regulatory activity appears to be most influenced by the legislative behaviour of their members. This suggests that these RFMOs are most susceptible to the policy agendas of their members; as their members increase or decrease their legislative activity—which the LEG model suggests is partly harmonised or imitative—this “coerces” (i.e. influences) a corresponding increase or decrease in their regulatory activity. Determining whether this represents these RFMOs being “captured” or “responsive” agencies would require further, qualitative investigation.⁶²

What is most interesting here is the classificatory leverage we get on RFMOs through the effects that matter most for them in the model according to the data. There are three main groups: those RFMOs whose regulatory activity tends to EMULATE the general level; those RFMOs whose regulatory activity is driven by their ORGANISATIONAL design; and those RFMOs that are most easily COERCED by the legislative agendas of their members.

5.5 Catch of the Day

This chapter has extended the model of states’ decisions to participate in RFMOs developed in the previous chapter by adding two further components: states’ decisions to legislate as much as they do, and RFMOs’ (as collective agents) decisions to regulate as much as they do. The legislation and regulation of interest was that of policy activity that dealt with controlling fisheries behaviour. These three parts of the model were modelled jointly in a coevolutionary version of the model used in the previous chapter, a SAOM.

Employing a SAOM to model three dependent variables, one network and two behavioural, where the behavioural variables were spread over two distinct node sets, required a methodological innovation that I call here the multimodal matrix solution. The solution is set up by concatenating the two node sets, and embedding the bipartite network in the off-diagonal of a matrix where both the rows and

⁶²Stigler 1971.

columns are both of the two node sets and embedding the behavioural variables in a matrix of the same length. This provides the model with data flexibility that is then exploited through innovative use of the rate function in SAOMs to select only those actors or institutions that ought to receive opportunities for a given dependent variable.

This methodological innovation then enables the substantive study of long-theorised but understudied concepts such as structuration and morphogenesis. Indeed, this model is especially important in the progression of the dissertation for demonstrating the advantages of a governance complexity approach by showing how one can endogenise both actors and institutions.

While this means that we are *sensitive* to how actors' and institutions' behaviour coevolve with architecture, it does not mean that the data will enable us to unambiguously define the direction of influence in each case. For example, it seems that neither states' legislative activity nor RFMOs' regulatory activity matter for states' choices to become members in RFMOs. The implication is that those states already members of RFMOs can seemingly regulate as much as they want without fear that they will turn away states. Therefore, the model presented in the previous chapter remains a solid model for explaining and understanding state-RFMO participation.

Nonetheless, while participation may not be affected by policy activity or practices, policy activity does depend on the architecture constructed by these choices. First, RFMOs' regulatory activity is affected by the legislative activity of its members. This means that the MEMB architecture provides the conduits of coercion. Second, a state's legislative activity is affected by the legislative activity of co-members of its institutional affiliations. This means that, while states may be choosing RFMOs because of particular design preferences or the influence of the local architecture, the architecture then also provides the pipelines by which their legislative activity is then influenced. Whether this influence is more about harmonisation or imitation is difficult to discern from this data, but it is nonetheless a finding deserving of further investigation.

The story is thus not simply mimetic or coercive, but entails a complicated loop of influence. States choose RFMOs based on design preferences and the information and influence provided by peers' choices, their legislative activity is then at least partly imitative of peers in the **governance circles** provided by their RFMO choices, and then this legislative activity drives the regulatory activity of RFMOs. But does this regulatory activity translate into effectiveness? How can we even tell whether

an institution is effective or not if all the institutions overlap in membership and mandate? It is to solving this problem that the next chapter turns.

“The balloon problem that underpins the shortcomings of regional management of ocean fisheries happens precisely because the commons nature of global fisheries means that people closed out of fishing in one fishery can move to another one.”

J Samuel Barkin and Elizabeth R DeSombre in
Saving Global Fisheries (2013)

6

Net Effectiveness

6.1 The Balloon Effect Expands

IMAGINE A BALLOON sitting on your desk full of air. When depressed with a finger, the air inside does not disappear but is displaced to the sides. Over several recent works, Barkin and DeSombre have argued that this analogy can be used to describe how even effective fisheries institutions (the finger) may only be displacing fishing capacity (the air) rather than addressing the underlying pressure on fish stocks.¹ As Barkin and DeSombre put it: “We call this phenomenon a balloon problem because when fishing capacity is squeezed in one place, it balloons out somewhere else”.² The consequence of this is that overall pressure on global fish stocks is not reduced, only displaced: institutions “may succeed at protecting individual species or regions, but at the cost of shifting existing capacity to new fish stocks or regions”.³

This appears an attractive explanation for why the global fisheries governance complex is failing. First, fishing capacity and indeed overall fishing levels have remained relatively stable over the past couple of decades. In other words, the balloon has roughly the same amount of air in it. Second, there is not a single finger or institution in global fisheries governance, but more than a dozen so-called Regional Fisheries Management Organisations (RFMOs), each with a relatively strong management mandate by global public policy standards. This management mandate is exercised by the passing of over 1300 regulatory acts in total, over a

¹DeSombre and Barkin 2011, p. 158; Barkin and DeSombre 2013, p. 3; DeSombre 2014, p. 468.

²Barkin and DeSombre 2013, p. 3; see also Stokke et al. 1999; Stokke 2002; the analogy was originally invoked in the context of international drug enforcement policy: Seccombe 1995; Mora 1996.

³Barkin and DeSombre 2013, p. 3.

thousand of which are defined as binding.⁴ Rather than a finger then, there appears to be a whole hand pushing down on fishing capacity.

Third, the performance of this system “has not lived up to expectation”.⁵ Despite their strong management mandate and high regulatory activity, the RFMO system is considered generally ineffective. The evidence appears damning. Biennial FAO reports have reported decreasing catches since the 1990s, resulting in nearly 30% of Earth’s fish stocks classified as overexploited or collapsed.⁶ Another 57% are already at their limit, meaning nearly 90% of global fish stocks are fully- or over-exploited. The proportion of stocks overfished is even greater among those straddling or migrating across national maritime borders or into the international waters of the high seas, suggesting that the extra governance challenges there from common, ‘global’ access and the difficulties in excluding over-fishers or free-riders translate into even poorer performance.⁷ These three elements seem consistent with the balloon problem narrative.

This chapter argues, however, that there is no evidence of a simple or systemic balloon effect of RFMO regulation pushing members’ fishing activity to fisheries in which they are not regulated. Rather than a negative correlation between governed stocks and increases in fish landed and a positive correlation with ungoverned areas, there is little to no correlation. Moreover, a qualitative review of the catch profiles of major fishing nations in each fish area shows that cases of states compensating for catches forfeited in fisheries where they are subject to regulation by increasing catches in fisheries in which they are unregulated are rare and atypical. While some states may cap catches on some regulated stocks, they also rise for other regulated stocks—sometimes markedly after joining an institution—and reduce in unregulated stocks. Overall this story is more consistent with RFMOs successfully excluding free-riders and legitimising the high catches of their “club” members than a systemic balloon effect. There is thus little evidence of the whole governance complex of RFMOs and states displacing members’ fishing to fisheries where they can escape regulation.

One should not necessarily throw the balloon out with the bath water, however. Variance in institutional pressures on fishing may displace fishing *among* regulated

⁴See the previous chapter.

⁵Lodge et al. 2007, p. vi; see also Cullis-Suzuki and Pauly 2010.

⁶In the face of uncertainty about the current and historical condition of stocks, fisheries scientists operationalise overfishing through catch rates. When catch rates fall to 10% of their historical ‘high’, the stock is considered depleted or collapsed. See FAO Fisheries and Aquaculture Department 2012.

⁷Mora et al. 2009.

areas instead. In other words, the system may be better conceptualised as a set of balloons in various states of proximity, each with one or more fingers pressing down upon them with differing force. The result is that variance in pressure on one balloon has implications for the pressure required to depress neighbouring balloons effectively. To return to the specific subject of fisheries, states' fishing capacity may be shifting from those fisheries that are well regulated to those that are less well regulated, relatively speaking, and not from regulated to unregulated fisheries. The opportunities for this mechanism to operate are high, for the global fisheries governance complex is not only becoming denser, but also more overlapped in both mandate and (especially) membership, as has been seen in chapter 3.

The implications for this small alteration in the application of this analogy are wide-reaching, especially for how we relate institutional design to institutional effectiveness. The interdependence of institutional effects significantly complicates the story about each institution's effectiveness by affecting the malignancy of the problem structure each institution faces. One RFMO may appear comparatively ineffective, but face extra pressure from members relocating their fishing from geographically or socially neighbouring institutions. Conversely, another RFMO may appear comparatively effective, but enjoy the rather benign conditions of their members already modifying their behaviour from their membership in other institutions.

Without taking into account these interdependencies, we may be making poor estimations about these institutions' effectiveness, with corresponding implications downstream on the inferences we make about the relationship between institutional design and effectiveness. Indeed, in the best case scenario, we would only have an estimation of an institution's *gross effectiveness*. Instead, what I propose is the development of what I call "*net effectiveness*".

This chapter has a somewhat unorthodox structure. First, I show that there is little evidence for a systemic level balloon effect in the case of global fisheries governance complex. Following that, I propose a development in our conceptualisation of effectiveness that I call "*net effectiveness*" and discuss how one might investigate this here and in the future. I then provide a brief example of how one might employ this here. I conclude by discussing how this research programme, while difficult, is worthy of attention.

6.2 A Red Herring

DeSombre and Barkin argue that one of the reasons why global fisheries governance has been so ineffective is that even effective governance only pushes the problem elsewhere rather than addressing the underlying causes: “Even the most successful cooperative efforts regionally to conserve some fish stocks have suffered from the global nature of the fishing industry, in which capacity can move from one area to another in response to restrictions or opportunities”.⁸ This section argues that there is no evidence of a systemic version of this “balloon effect” in which states’ fishing activity escapes regulation and compensates for the loss of fish by increasing catches in unregulated areas.

I make this argument over three subsections. First, I summarise key aspects of the data and render them as networks. They provide the reader with an overview of which states are catching more or less fish from which fisheries, and whether those states are also a member of one or more RFMOs that govern those fisheries. Next I show how there is no correlation between these networks, which suggests that, generally, states’ fishing is not being depressed in those fisheries where they are members and increasing where they are not members. Since this is only general evidence, I then qualitatively examine how several major fishing nations’ fishing profiles adapt—or does not adapt—to changes in their membership in RFMOs governing fisheries in which their fishers fish.

6.2.1 Data

The main dependent network for this chapter is no longer states’ membership in RFMOs, but CHANGES in states’ fishing in the oceanic FAO fisheries. These weighted networks were formed by subtracting the AREAFISHING architecture defined in section 2.4.1 from the following year in each case. Note that since the dependent network is defined by changes in states’ fishing activity rather than the potential for institutional participation, we no longer need to include those states that do not fish at all. I therefore removed landlocked states and those states for which we have no information on fish landed, such as North Korea. Instead, I focus on the 137 states that fish in FAO fisheries over the course of a twenty-year study period, 1990–2010, for which data is most robust.

The result is an array of valued matrices giving so-called weighted networks of 137 states by 30 fisheries. The CHANGE network for 2010 is depicted in fig. 6.1.

⁸DeSombre 2014, p. 468.

Fisheries are represented as grey squares, and states are arranged around them. Solid lines represent cases where a states' reports tonnes landed higher than the previous year and dashed lines represent cases where catch landed was less than the previous year. Though the scale does not reveal much difference, these edges also have a width proportional to the change values (i.e. thicker lines represent greater changes).

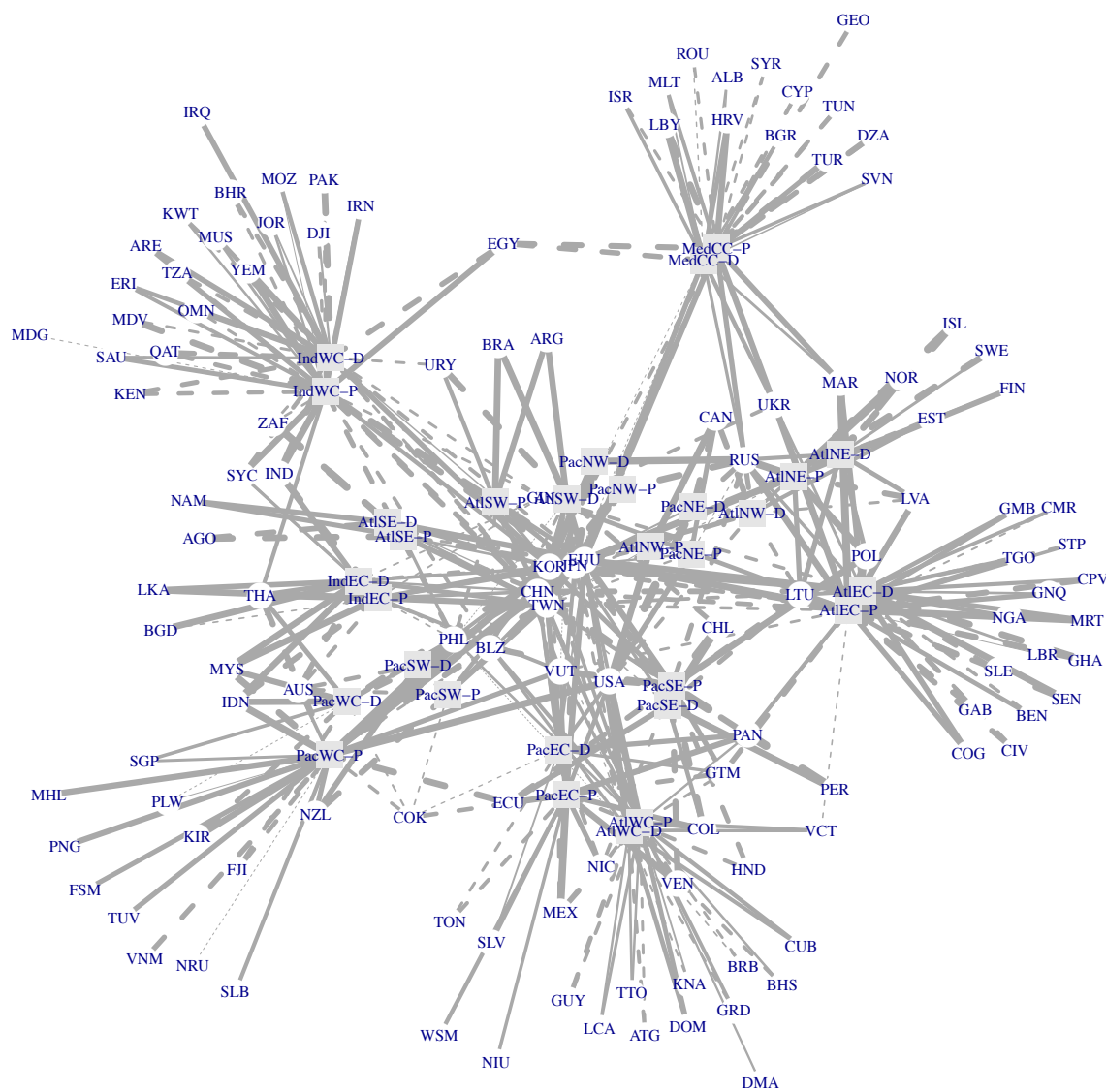


Figure 6.1: CHANGES 2010

While this graph represents just one year, the graph communicates several important messages that are general features of previous years too. First, while all fisheries endure seasonal variations, the range varies and can include dramatic increases of over two-and-a-half million tonnes. These particularly dramatic

changes tend to come from the especially seasonal anchovy fisheries off the coast of Peru and Chile. Second, whereas many states fish rather regionally, as can be observed by their being arranged by the plotting algorithm around pelagic and demersal pairs of fisheries, others are DWFNs that fish more globally, such as the EU, Japan, Korea, China, Taiwan in the centre of the graph, and the Philippines, Belize, Vanuatu, USA, and Chile just a little further out.

This fishing is not wholly ungoverned however. As we have seen in the previous chapters, many states have entered into cooperative or membership affiliations with RFMOs that govern many of these oceanic fisheries. Still, not all fisheries are governed by RFMOs (see fig. 2.5 on page 37) and not all states are members of RFMOs that govern fisheries in which they fish (see fig. 3.11 on page 74). Therefore another array of matrices was constructed with cells that count the number of RFMOs a state (a row) is at least cooperating with that govern a particular fishery (a column). This results in an valued array with the same dimensions as CHANGES above, which I call RFMOS, giving weighted bipartite graphs such as that shown in fig. 6.2 on the next page.

All of the nodes in fig. 6.2 on the following page are positioned identically to in fig. 6.1 to facilitate comparison. Tie width shows of how many RFMOs governing that fishery a state is a member. Again, a few things are immediately apparent. First, as we know from our architectural fit diagnostics, not all states fishing in a fishery are members of RFMOs governing that fishery, even when there is one or more RFMOs with a mandate for that fishery. Indeed, this network appears sparser than the first. Second, there are overlapping mandates. A number of ties are thicker than the baseline (of one RFMO), and especially those DWFNs that represent the core of the CHANGES network are also heavily implicated in global fisheries governance with many thick ties.

Of course, it may be that it is not *how many* RFMOs governing a fishery a state is a member of that may affect whether it increases or decreases its fishing in that fishery, but whether it is a member of any RFMO governing that fishery at all. I therefore also dichotomise the valued RFMOS into a binary array, which I call RFMO.

6.2.2 Does Fishing Escape Regulation?

This subsection asks a rather simple, descriptive question: is there a correlation between states being a member of one or more RFMOs governing a fishery (RFMO and RFMOS, respectively) and reductions in fishing in that area (CHANGES)? The

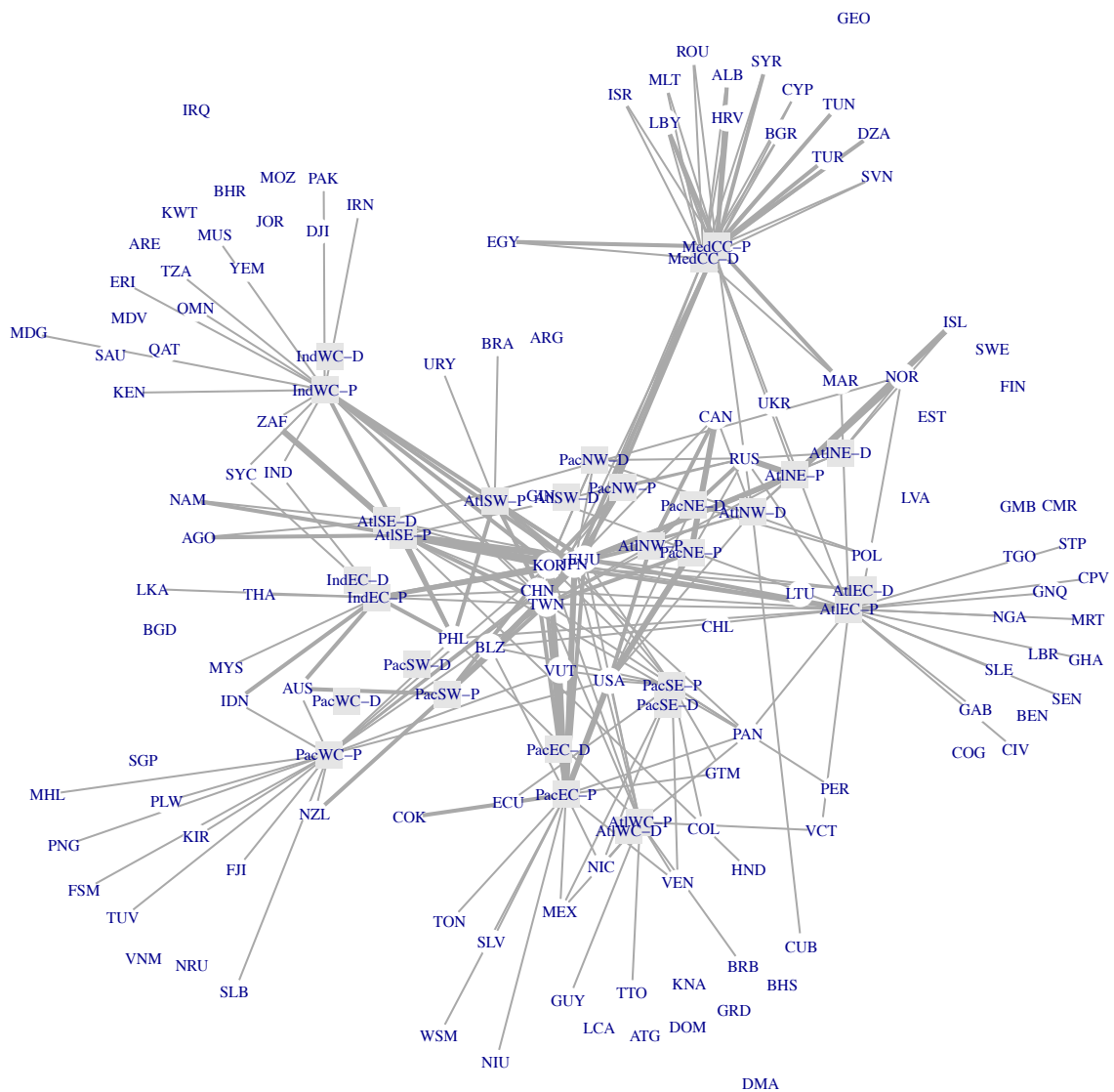


Figure 6.2: RFMOs 2010

argument here is that, if there were a systemic balloon effect, we would expect to see, generally, reductions in governed fishing and compensatory increases in ungoverned fishing; in other words, a systematic *negative* correlation between RFMO or RFMOs and CHANGES.

In fig. 6.3 on the next page I show the correlations between the RFMO and CHANGES and RFMOs and CHANGES graphs, respectively.⁹ Since there is often seasonal fluctuation in fishing, and a systemic version of the balloon effect may be becoming more or less evident, I iterate this process over the past two decades.

⁹These tests were conducted controlling for the matrix structure of the data and thus row and column dependencies. I elaborate on this methodological point later.

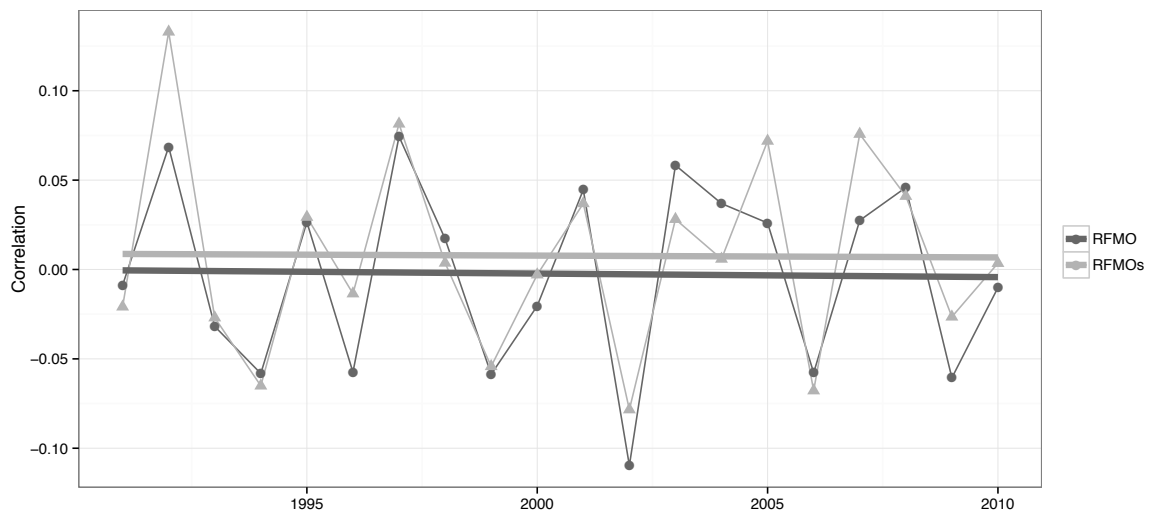


Figure 6.3: Correlations Between CHANGES and RFMO and RFMOs 1990–2010: Thicker, straight lines represent trend lines.

Figure 6.3 shows that there is little systematic correlation between RFMO governance and catch changes. This is true both of the correlations between CHANGES and RFMO as well as CHANGES and RFMOs networks. Only twice over forty observations are they correlated more than 10 %, and one of these suggests a positive correlation (i.e. that the more RFMOs a state is a member of, the *more* fish landed from those fisheries). There appears to be some fluctuation that could frustrate analysis, but a linear model fitted to each set of correlations shows that there is no underlying trend. Ultimately, there is little significant correlation and thus little *prima facie* evidence of the overall RFMO governance complex simultaneously driving fishing in regulated areas down and fishing in unregulated areas up, as one would expect if the systemic balloon effect were true.

6.2.3 Do States Compensate?

The past subsection suggested that there is no systemic balloon effect. The correlation analysis also showed considerable fluctuation however, partly driven by seasonal variations and extreme outliers that characterise global fishing. Before dismissing the notion of a systemic balloon effect then, we should also take a closer, more qualitative inspection of how particular states’ fishing profiles react to their joining RFMOs within the study period.

Of course, to review the fishing profiles of all 137 states would be cumbersome in such a format. Here I select seven large “distant water fishing nations” (DWFN);

states with fishing industries that have the capacity to fish far from their coasts. These include Russia, the United States, Japan, China, South Korea, Chinese Taipei, and the EU. It therefore offers somewhat of a hard test to the notion of a systemic balloon effect: if any states were to substitute “lost” catch in fisheries subjected to regulation with increased catch in fisheries that they are not subjected to regulation in, it would be states with fishing industries capable of fishing far from domestic coasts.¹⁰

A graph showing the trajectories of these seven DWFNs’ fishing in each of the thirty oceanic fisheries is represented in fig. 6.4 on the next page. To simplify the plot somewhat, rather than showing the actual data, which is characterised by considerable fluctuation, linear regressions of this data are shown to improve the clarity of the narrative. Where there is considerable fluctuation, grey bands representing the standard errors of the regression are included.¹¹ In each cell of this plot, a single line shows how fishing by the state in that fishery has increased or decreased over the past two decades. These lines are then also coloured by how many RFMOs governing that fishery the state is a member of for each year. Where states’ fishing in fishery drops to zero, this is excluded, as is missing data. Finally, the margins of this table capture the average fishing profile of each state by the number of RFMOs it is governed by (the bottom margin, shown in more detail in fig. 6.5 on page 178) and the average fishing profile in each fishery by the number of RFMOs the fishing is governed by (the right margin, shown in more detail in fig. 6.6 on page 180). Rows are scaled to the range of fishing in those fisheries.

A careful review of fig. 6.4 tells us several things. First, the bottom margin suggests that even here there is little evidence of a balloon effect. It shows that these states do not appear to be markedly reducing fishing in governed fisheries and compensating for this loss by ramping up fishing in non-governed areas. This is despite some fisheries, such as demersal stocks in the southwest Atlantic (AtlSW-D) and western central Pacific (PacWC-D) and Indian Oceans (IndWC-D), being entirely ungoverned. Indeed, these ungoverned fisheries are, on average, seeing stable or even decreasing catches from these DWFNs.

Where these DWFNs do tend to increase their catches is in *governed* fisheries. An obvious example of this is China’s fishing in several Atlantic pelagic fisheries, which has increased markedly since they have joined ICCAT (an Atlantic-wide tuna

¹⁰While only these states are depicted here, I have reviewed most states fishing profiles and these trajectories are otherwise typical.

¹¹Note for example how much fluctuation Russian fishers experience from pelagic fisheries in the south Pacific in fig. 2.4 on page 36

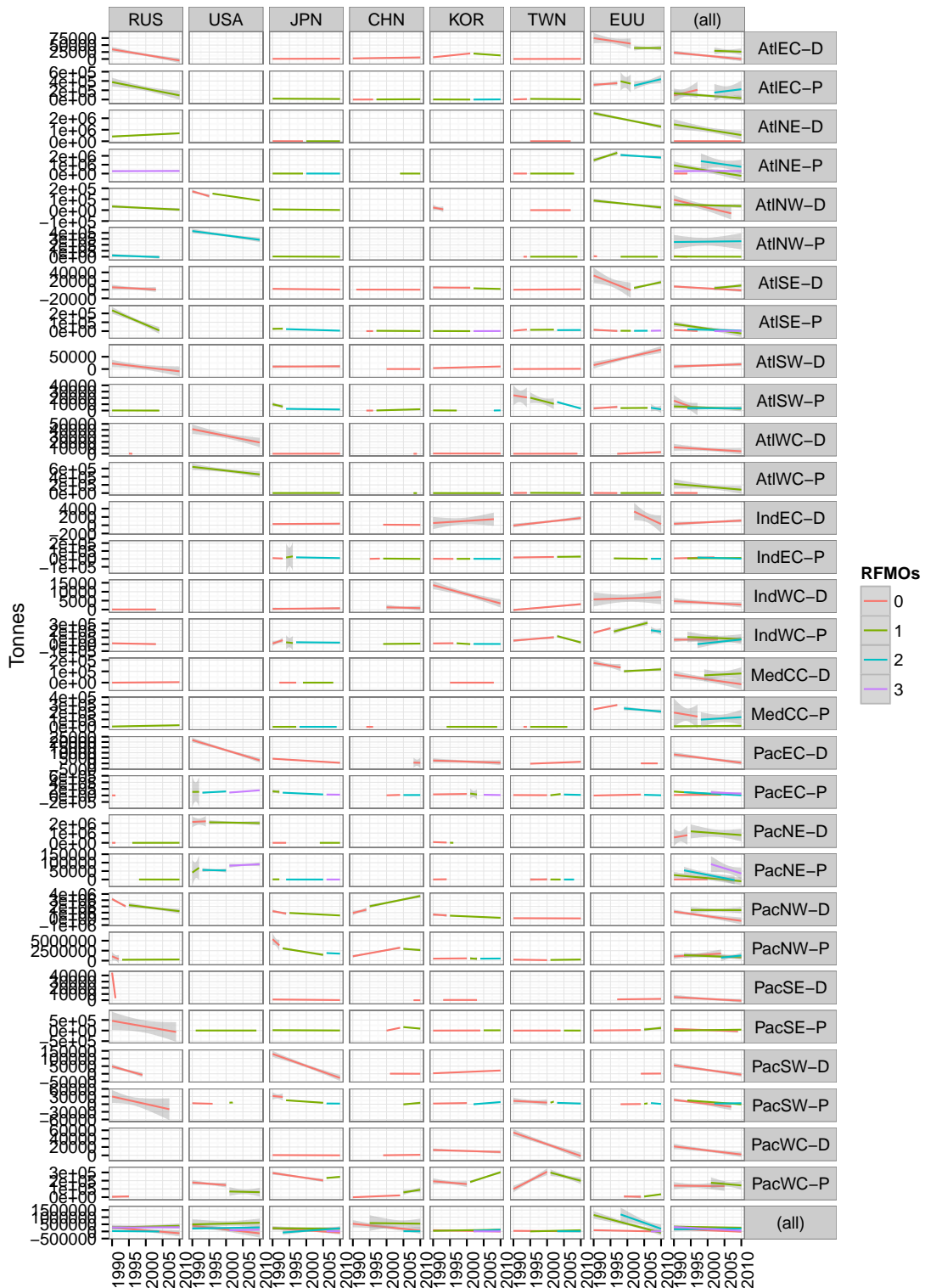


Figure 6.4: Fishing Profiles: Local regression trend lines for seven DWFN across thirty oceanic fisheries, coloured by how many RFMOs with mandates over that fishery each state is in. Bands indicate standard errors. Y-axes are scaled by the range of each row. Margins are included that average the trajectories of each row or column.

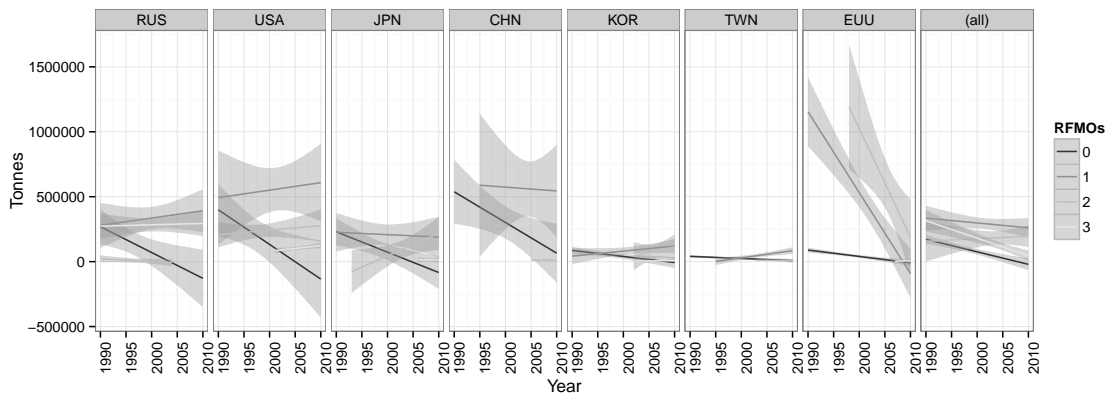


Figure 6.5: DWFN Fishing Profiles: Bottom margin summaries.

organisation). This is not the only case (though others are more subtle changes compared to the scale of fishing): Russia's fishing in the northwest Pacific pelagic fishery (PacNW-P) has stopped decreasing after joining the NPAFC and almost returned to earlier levels; Taiwanese fishing in the eastern central Pacific fisheries have increased somewhat since joining the WCPFC and IATTC; and EU fishing in the western central and southeast Pacific pelagic fisheries (PacWC-P and PacSE-P) have increased since joining the WCPFC and IATTC respectively. This suggests that rather than displacing fishing effort, some institutions may be attracting it.

In terms of the table margins, the bottom margin summarises the fishing profile of each state, and therefore whether there is a balloon effect is recognisable. Since nowhere does unregulated fishing appear to increase proportionally to any decreases in regulated fishing, again there appears little evidence of a systemic balloon effect.

The right margin summarises the fishing profile of each fishery. If unregulated fishing were to increase in proportion to decreases in regulated fishing, this would suggest a free-rider effect. However, this appears to be rare. In several fisheries we see decreases in unregulated fishing along with and sometimes vis-à-vis regulated fishing (e.g. AtlEC-D, AtlNE-D, AtlNW-D, AtlWC-P, IndWC-P). Only in PacEC-P and PacNW-P does unregulated fishing trend unambiguously upwards while regulated fishing trends downwards. In each of these cases though, unregulated fishing in this table ends abruptly as those unregulated states join relevant RFMOs, suggesting that these free-riders are eventually integrated into responsible institutions.

This section has shown that there is little evidence for a systemic balloon effect in which fishing effort escapes regulation imposed by the RFMOs of the global fisheries governance complex to fish where they are not regulated. Instead, if anything,

several notable examples of unregulated fishing decreasing and regulated fishing increasing suggests that at least sometimes the opposite is occurring: fishing is agglomerating under the aegis of legitimacy afforded by RFMOs. Therefore, while there is little evidence of a *systemic* balloon effect, there may be some shifting of activity from one fishery to another. The notion of a balloon effect may still have some conceptual leverage then as we seek to understand the displacement of fishing activity *between* RFMOs.

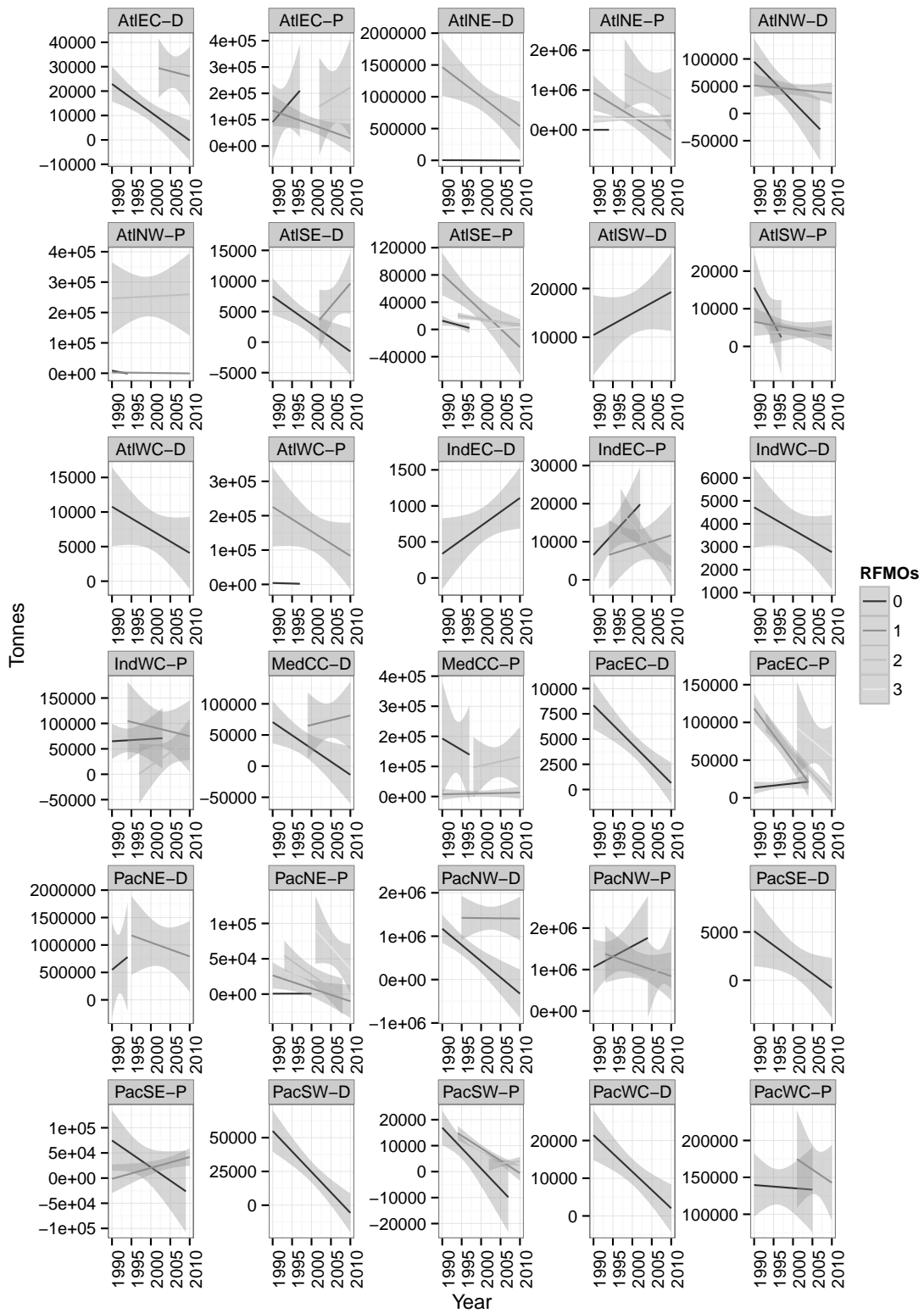


Figure 6.6: Fishery Fishing Profiles: Right margin summaries.

6.3 Net Effectiveness

While there may not be any *systemic* balloon effect here, an alternative form of the balloon effect may yet yield some conceptual leverage for studying institutional effectiveness. Rather than a single balloon on the desk, imagine several balloons placed in proximity to one another, each with a finger on it. Depressing a balloon that abuts others exerts extra pressure on these other balloons, raising the fingers on these other balloons, *ceteris paribus*.

What is captured here is the notion of “spillovers” or “externalities” resulting from institutional interactions, a topic that has attracted several scholars. Aggarwal, for example, asked about institutional interlinkages and how states modify nested institutions so that they are compatible with one another.¹² Andersen extended this agenda temporally by considering how institutional compatibility considerations are influenced by institutions’ differing developmental stages.¹³ Oberthür and Gehring concerned themselves with conceptualising the conduits by which operational institutions interact and influence each other’s operation.¹⁴ Then, more recently, Johnson and Urpelainen seek to understand when spillovers result in institutional integration.¹⁵

While these and other works are evidence of increasing scholarly attention to inter-institutional externalities, most of this work has concentrated on the causes rather than the consequences of institutional complexity and has demurred from discussing how one might develop a notion of effectiveness that explicitly takes into account such institutional interaction.¹⁶ Indeed, it is “widely recognised that the effectiveness of specific institutions often depends not only on their own features but also on their interactions with other institutions” but,¹⁷ despite recognition that assessments of institutional effectiveness are confounded by interdependencies, few scholars have engaged with the question: “how can we systematically study such inter-institutional effects?”¹⁸

In this section, I discuss a formulation of institutional effectiveness that is sensitive to the core issues of this literature: the multiplicity and dependency of institutional effects. I call this formulation “net effectiveness” for two reasons. First,

¹²Aggarwal 1998a.

¹³Andersen 2002.

¹⁴Oberthür and Gehring 2006.

¹⁵Johnson and Urpelainen 2012.

¹⁶See also e.g. Keohane and Victor 2011; Biermann et al. 2009a.

¹⁷Young et al. 1999/2005, p. 60 cited in Oberthür and Gehring 2011, p. 25.

¹⁸Hofmann 2011, p. 103.

it invokes the familiar distinction between gross and net income to communicate the central idea of discounting the impact other, overlapping institutions have on an institution's mandate and members as well as adding the impact the institution has on its members outside of its mandate. In this sense, an institution's net effectiveness is its "take-home" effectiveness once we've accounted for its position in the broader governance complex.

Second, it references statistical network methods as promising routes to taking into account the dependencies that characterise governance complexes. The use of statistics has been promoted as a useful tool for the study of institutional effects,¹⁹ and I argue here that statistical network methods and other statistical methods with a focus on relaxing the traditional statistical assumption of independency of observations can be particularly useful here.²⁰

I propose an approach for studying institutions' net effectiveness that runs along the lines of Bernauer's three-step strategy for research on institutional effectiveness:²¹ First, a dependent or response variable must be defined that makes sense in the context. This is often no easy task, even where there is data.²² In the following subsection I review the alternatives in terms of their applicability in this context. Second, considerations must be given to how one might estimate or infer the effects of an institution on the dependent variable, *ceteris paribus*. Third, this should be converted into an unambiguous score that can provide utility in analysing how, for example, institutional design relates to institutional effectiveness.

6.3.1 Dependent Variable

First, however, I will take a short digression to discuss what the appropriate response variable for measuring effectiveness should be.²³ To be clear, by effectiveness I do not mean the range of associated but distinct criteria by which one may also evaluate institutional performance, such as efficiency, equity, robustness,

¹⁹Mitchell 2002; Bernauer 2009.

²⁰Note that this chapter is not concerned with network effectiveness, *per se*, but rather the use of networks to better study institutional effectiveness. For more on the former see Provan and Milward 1995; Provan and Milward 2001.

²¹Bernauer 2009, p. 364.

²²Bernauer 2009, p. 352.

²³Note that I refer here to the response variable rather than a measure of effectiveness *per se* because changes in the response variable may occur for many reasons, and it is only by controlling for these alternative explanations for changes in the response variable that we can make more accurate inference about institutional influence on this response variable. See Mitchell 2002.

resilience, and sustainability.²⁴ Instead I mean the effects institutions have related to their purposes.

RFMOs' purposes are somewhat varied, but a review of the purposive statements drawn from these RFMOs' establishing documents, listed in table 6.1 on the next page, suggests "management" and "conservation" are the most typical keywords.²⁵ These keywords may still be expressed as several forms of response variable, however, including outcome, output, implementation, compliance, and behavioural change.²⁶ It is not the purpose of this chapter to review these forms in any great detail, so here I will simply explain why this chapter concentrates on behavioural change and its specification here compared to the common outcome and compliance alternatives.²⁷

First, the notion of "conservation" might suggest that the primary purpose of an institution is to affect the quantity and health of the resources under its mandate; in other words the response variable would be operationalised as progress towards the "saving the fish" outcome expected of institutions.²⁸ This is the approach undertaken by the fisheries scientists Cullis-Suzuki and Pauly, for example.²⁹ In their article, Cullis-Suzuki and Pauly evaluate the effectiveness of each RFMO by assessing their stocks in terms of the biomass levels capable of supporting a maximum sustainable yield and the levels of fishing reasonable for sustaining that yield. While their exercise is impressive, it affords little utility for current purposes however. They scored RFMOs only cross-sectionally, which imposes limits on how one might study the dynamics of institutional effectiveness in the future. To replicate their scoring for past years would demand considerable subject-area expertise. Moreover, the scores are only given in aggregate and do not take into account overlaps in institutional coverage and membership. As Stokke argues, we may need to disaggregate institutional influences to be able to gain leverage on questions of effectiveness.³⁰

A second alternative would be to consider state actors' compliance with the outputs (i.e. the regulations) of RFMO governance. The concept of

²⁴Young 2008, p. 21.

²⁵A second tier of common keywords include "restoration", "utilisation", "exploitation" and "development".

²⁶Mitchell 2002, p. 69; see also e.g. Young 2008.

²⁷I examine how RFMO output and state implementation of those regulatory acts are affected by the structure of the global fisheries governance complex elsewhere, for example.

²⁸On the use of environmental progress measures see Mitchell 2002, p. 69.

²⁹Cullis-Suzuki and Pauly 2010.

³⁰Stokke 2012.

RFMO	Mandate
IATTC	“...responsible for the <i>conservation</i> and <i>management</i> of tuna and other marine resources in the eastern Pacific Ocean”
GFCM	“...promote the development, <i>conservation</i> , rational <i>management</i> and best utilization of living marine resources, as well as the sustainable development of aquaculture in the Mediterranean, Black Sea and connecting waters”
ICCAT	“...responsible for the <i>conservation</i> of tunas and tuna-like species in the Atlantic Ocean and adjacent seas”
NAFO	“...to contribute through consultation and cooperation to the optimum utilization, rational <i>management</i> and <i>conservation</i> of the fishery resources of the Convention Area”
NEAFC	“...maintain the rational exploitation of fish stocks in the Convention Area”
NASCO	“...to conserve, restore, enhance and rationally <i>manage</i> Atlantic salmon through international cooperation taking account of the best available scientific information”
NPAFC	“...promote the <i>conservation</i> of anadromous stocks in the Convention Area”
CCSBT	“...ensure, through appropriate <i>management</i> , the <i>conservation</i> and optimum utilization of the global SBT fishery”
IOTC	“...promote cooperation among its Members with a view to ensuring, through appropriate <i>management</i> , the <i>conservation</i> and optimum utilization of stocks covered by this Agreement and encouraging sustainable development of fisheries based on such stocks”
CCBSP	“...restore and maintain the Pollock resources in the Bering Sea at levels which will permit their maximum sustainable yield”
WCPFC	“...address problems in the <i>management</i> of high seas fisheries resulting from unregulated fishing, over-capitalization, excessive fleet capacity, vessel re-flagging to escape controls, insufficiently selective gear, unreliable databases and insufficient multilateral cooperation in respect to <i>conservation</i> and <i>management</i> of highly migratory fish stocks”
SEAFO	“...ensure the long-term <i>conservation</i> and sustainable use of the fishery resources in the Convention Area through the effective implementation of the Convention”

Table 6.1: RFMO Purposes

compliance has proven a compelling but tricky to operationalise topic.³¹ It has attracted debate leading to theoretical distinctions that have shaped the literature,

³¹Downs et al. 1996; Simmons 1998; Simmons 2000; Simmons and Hopkins 2005; Simmons 2010; see also Stein 2005; Raustiala and Slaughter 2005.

such as the distinction between enforcement and management perspectives on compliance.³² Yet the deployment of compliance as a response variable in this context is particularly tricky. Generally, compliance is operationalised as behaviour that conforms with legal rules, such as RFMO regulations and state fisheries legislation.³³ This might suggest that one could operationalise compliance as fishing behaviour consistent with these regulations. However, RFMOs use diverse instruments to manage and conserve, employing restrictions on the equipment or amount of effort used in fishing, the sectors or seasons fished, and of course the species, sizes, and overall quantity of catch allowed.³⁴ Some RFMOs negotiate catch quotas, but others do not; some set many legal rules and others do so only rarely, and so on. These myriad methods of governance mean that, even if there were reliable data on compliance on all forms, it is difficult to commensurate compliance in one institution with compliance in another.³⁵

The third alternative does not speculate on how many fish are actually in the sea and does not require the commensuration of RFMO rules. Instead it simply concentrates on whether observed behaviour is consistent with institutional purposes or not. After reviewing the options of environmental progress and compliance as potential response variables, Mitchell advocates using behavioural change operationalised as annual percentage change in the relevant behaviour.³⁶ I choose to follow this advice here, but operationalise it as raw changes for two reasons. First, annual percentage changes—even if smoothed or indexed in some way—are sensitive to the underlying quantities for interpretation. A 10% drop in fishing involves a negligible quantity in the case of smaller states compared to global fishing, whereas the same percentage change for larger fishing nations would have profound ramifications for the rest of the governance complex. Indeed, smaller states are generally more likely to have more volatile trajectories, with implications for how RFMOs with many smaller states ought to be studied in this way.³⁷ Second, since we are interested in inter-institutional balloon effects, we are interested in interdependencies between observations. A state's fishers may compensate for catch lost in increasingly regulated fisheries with increased catches in fisheries where regulation is weaker. These kinds of observations are difficult to reconcile where

³²Tallberg 2002; see also Chayes and Chayes 1991; Chayes and Chayes 1993.

³³Mitchell 2002, p. 69.

³⁴See also Tyler 2006.

³⁵On the social process of commensuration see Espeland and Stevens 1998; Espeland and Stevens 2008.

³⁶Mitchell 2002, p. 71.

³⁷Peru is obviously the exception here.

annual percentage changes refer to different quantities. I therefore advocate using raw behavioural change as the response variable for studying inter-institutional balloon effects. The next subsection considers how one might study this.

6.3.2 Measure Effect

Having chosen a dependent variable, it remains to be discussed how one should estimate or infer the effect of an institution on variation in that dependent variable, in this case the raw changes in catch from year to year. Recently, the statistical approach to evaluating the effectiveness of international environmental institutions has seen favour.³⁸ In many respects, statistics is an excellent choice for studying institutional effectiveness in the context of multiple overlapping institutions. While statistics generally does a poor job of explaining particular institutions at particular time-points, it has two redeeming qualities that are especially useful here.

First, statistical tools may be leveraged to gain a probabilistic understanding of general trends and central tendencies.³⁹ This “smoothing” of the historical record may mean forgoing insights into particular events or institutions,⁴⁰ but offers the potential to not only interrogate our general assumptions about how institutions have evolved, but also provides a formal space to consider how they might evolve in the future under different scenarios based on historical tendencies. Second, statistical tools also allow researchers to control for alternative explanations that may explain variation in the dependent variable in a rigorous way. These advantages are by now well known, and increasingly sophisticated studies of institutional effectiveness have made use of them.⁴¹

But traditional statistical methods generally hold a core assumption that makes them an ill-fit in this context: that observations are at some level independent.⁴² Dependencies between observations are common in social contexts, and one would expect that the global fisheries governance complex, in which fishing in one area may be dependent on another, may be full of them. It has been shown that without taking into account even modest levels of interdependencies in the data, the inference afforded by statistical tools may be unreliable.⁴³ This is because the

³⁸See Mitchell 2002; Bernauer 2009, p. 372.

³⁹Mitchell 2002, p. 59.

⁴⁰Which can and has been provided elsewhere. As we have seen in section 2.1, there is currently a reasonably robust case study literature on individual RFMOs. What we lack is a more general understanding.

⁴¹See for example the exchange: Simmons 2000; Stein 2005; Simmons and Hopkins 2005.

⁴²Robins et al. 2012.

⁴³See Krackhardt 1988.

frequent presence of autocorrelation on rows and columns (when social data is arrayed in matrix form) means that generally standard errors are too small and p -values too optimistic. This makes classic null hypothesis tests generally suspect.

Statistical network methods do not make such an assumption. Instead, they allow for one observation to be dependent on another.⁴⁴ Robins et al summarise several of these methods and how they might be useful for the study of policy networks, including SAOMs as discussed in chapter 4 and utilised in chapters 4 and 5. However, here the dependent network is weighted or valued and not binary, to which SAOMs are currently limited. Therefore, I propose that one of the alternatives they review, Quadratic Assignment Procedures (QAPs), provide a relatively straightforward way of proceeding.

A QAP is essentially a linear regression that tests for associations between two or more matrices rather than two or more vectors.⁴⁵ The linear regression part of the QAP performs a standard OLS regression on vectorised forms of the matrix, attempting to fit the model:

$$M_y = \beta_0 M_1 + \beta_1 M_{x1} + \beta_2 M_{x2} + \dots + Z \quad (6.1)$$

where M_y is the dependent matrix, M_{xi} is the i th independent matrix, M_1 is a matrix of 1's, and Z is a matrix of independent normal random variables with mean 0 and variance σ^2 .

However, as mentioned above, vectorising these matrices and using OLS regression would leave us with misleading standard errors and p -values if we do not take into account autocorrelation across rows and columns of the matrix.⁴⁶ Therefore we want a null hypothesis generated by a distribution of random associations between the matrices that nonetheless maintain these row and column dependencies. QAPs thus permute the rows and columns of the matrix, which scrambles the data randomly while maintaining these dependencies, and providing a more pertinent empirical sampling distribution against which to test the significance of the actual relationships between the variables.⁴⁷ What this means for current purposes is that QAPs represent a form of linear regression where the

⁴⁴Robins et al. 2012; see also Robins 2013.

⁴⁵On the utility of regression for the study of institutional effectiveness see Mitchell 2002.

⁴⁶Matrices allow some distributional assumptions regarding dependencies on matrix rows and columns to be retained, whereas vectors typically treat observations as independent. See Krackhardt 1988.

⁴⁷To be precise, Dekker et al's double semi-partially method of permutation is recommended here: Dekker et al. 2007.

null hypothesis for significance tests is sensitive to how observations of behavioural change per state and per fishery may be dependent.

6.3.3 Evaluate and Score

With a dependent variable and a way of studying it that respects dependencies in its structure, we may finally turn to defining how to evaluate and score the effectiveness of particular institutions. The general idea here is consistent with that proposed by Mitchell and Bernauer:⁴⁸ to consider the coefficients of a linear regression or other statistical model the effect of an institution, controlling for alternative influences on change in the dependent variable.

What distinguishes the approach of net effectiveness though, beyond the use of QAP or some other statistical method that adequately controls for dependencies in the data, is that it not only controls for the influences of geographically (mandate) and socially (membership) overlapping institutions, which both good qualitative and quantitative research do, but also includes the effect that an institution might have on its members' behaviour elsewhere into the equation.

This latter element—adding institutional effects on members' behaviour outside its mandate—is key to both understanding inter-institutional effects as well as capturing the sociological effects of an institution on its members. Operationally, it involves the inclusion of further matrices that take a 1 for cells of a row referencing its members and a column referencing a resource outside its mandate.

Then to calculate the “net effectiveness” of an institution, I propose combining the coefficients from the QAP for an institution's direct effect (the matrix where a 1 in a cell indicates both a member and a resource within its mandate), or β_{iR_i} , and an institution's indirect or balloon effect (the matrix where a 1 in a cell indicates a member utilising an analogous resource outside its mandate), or $\beta_{i\setminus R_i}$. In both cases, these coefficients will represent the variation in behavioural changes explained by these effects, controlling for the influences of other institutions and other salient features for the context studied. Where reduction is the intended behavioural change, such as in this case, the lower this sum the better. For example, in this case the equation for net effectiveness would be:

$$NE_i = -(\beta_{iR_i} + \beta_{i\setminus R_i}) \quad (6.2)$$

where

$$i \in I, \text{ where } I = \text{Institutions}$$

⁴⁸Mitchell 2002; Bernauer 2009.

$$R_i \subseteq R, \text{ where } R = \text{Resources}$$

The result is a score that more accurately represents the “take-home” influence of an institution both within and beyond its mandate.

6.4 A Brief Example

As an example, let us consider the effectiveness of RFMOs in 2010. Two QAP models were run with a relatively sparse set of effects in addition to the direct and indirect effects of RFMOs, so as simply to make an illustration of the logic. Apart from the intercept, these included the changes in catch for *all* states fishing in the mandated area, whether or not they are a member. This was deemed to provide evidence of the general STOCK TREND in terms of whether this was a boom or bust year for fishing that stock. I also included two effects that captured changes in how many people were employed in fisheries (a SUPPLY-side argument) and changes in how much fish were consumed (a DEMAND-side argument). The results are given in table 6.2 on the following page.

Unfortunately, the results are not terribly impressive as a complete model for RFMO effectiveness. Few effects are significant and neither the R^2 for the direct nor indirect model is very high. This may be because the QAP gives us a more robust null hypothesis against which to test the statistical significance of parameters in the model. In any case, the purpose here however was not to provide an excellent explanatory model, for which a more complex model would no doubt be necessary,⁴⁹ but to demonstrate how net effectiveness should be evaluated and how it may lead to different evaluations than simply using what I call here a “gross effectiveness” approach. This demonstration is possible because a lack of significance does not mean that there is *no* effect, only that the direction of the effect cannot be unambiguously distinguished.

I will highlight the importance of these indirect or balloon effects by scoring two RFMOs: ICCAT and GFCM. Indeed, these two RFMOs are related, for they have overlapping mandates. The mandate of ICCAT, a tuna-organisation, stretches across the Atlantic Ocean but also into the Mediterranean. GFCM’s mandate is limited to the Mediterranean, but covers all species within that area, including tuna. Generally, GFCM defers to ICCAT on tuna, and even incorporates ICCAT recommendations into

⁴⁹Much larger and more complicated models were tried, however this did not have an improved effect, and so it was decided to stick with a more parsimonious model for the purposes of illustrating the concept.

	Direct	Balloon
Intercept	-1589.61	-8996.83
Stock Trend	0.08*	0.08**
Supply	0.50	3.28
Demand	0.01	0.00
IATTC Direct	-44653.92	-73703.53*
ICCAT Direct	-1114.43	32298.90
CCSBT Direct	-2147.93	-30956.01
CCBSP Direct	83690.35	47991.01
GFCM Direct	2510.41	-9717.77
IOTC Direct	2726.72	915.49
NAFO Direct	239.94	-46364.98
NEAFC Direct	21055.59	5495.00
NASCO Direct	-13411.07	-25714.48
NPAFC Direct	10136.81	4867.96
SEAFO Direct	10064.84	1546.49
WCPFC Direct	20347.14	30946.08
IATTC Indirect		-45124.03
ICCAT Indirect		58608.59*
CCSBT Indirect		-22574.66
CCBSP Indirect		-7486.70
GFCM Indirect		-33544.12
IOTC Indirect		4118.95
NAFO Indirect		-16055.57
NEAFC Indirect		22345.01
NASCO Indirect		-27301.94
NPAFC Indirect		21023.82
SEAFO Indirect		12667.26
WCPFC Indirect		20631.61
R ²	0.16	0.17
Adj. R ²	0.11	0.09
Num. obs.	301	301

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 6.2: Gross and Net Results

its regulatory corpus. Not only their mandate overlaps, but so do their membership, especially with regards to states such as Spain, France, and Morocco.

First, let us evaluate the gross effect of ICCAT. Here ICCAT would be considered to have a positive effect, for $GE_{ICCAT} = -(-1114.43) = 1114.43$. This would mean that ICCAT is generally depressing the fishing activity of its members in its mandate, *ceteris paribus*, by influencing them to fish over a thousand tonnes less than they would otherwise. However, when we take into account externalities, the picture reverses. The *net* effectiveness of $NE_{ICCAT} = -(32298.90 + 58608.59) = -90907.49$. This result suggests that ICCAT is not actually having a positive influence on its members, but is merely influencing members to fish elsewhere and enjoying the benefits of members adapting their behaviour from other RFMOs.

Compare this to the story for GFCM. GFCM's gross effectiveness score appears rather grim. A score of $GE_{GFCM} = -(2510.41) = -2510.41$ suggests that it is having a negative impact. Generally, its members are fishing more within its mandate than the year before. However, this poor score is revealed as illusory when we take into account how it must address the negative externalities of other institutions and how many negative externalities it, in turn, generates. The *net* effectiveness of GFCM is $NE_{GFCM} = -(-9717.77 + -33544.12) = 43261.89$. This means that, despite appearances, GFCM is ultimately making a positive contribution to global fisheries governance, a contribution that could be being obscured by ICCAT's failures with respect to their overlapping mandate.⁵⁰

Our evaluation for other RFMOs would also sometimes differ (see table 6.3 on the next page). NAFO, for example, is also evaluated much more generously when taking into account inter-institutional balloon effects. Some RFMOs continue to struggle with managing their members in their own mandates, but at least do not generate negative externalities, such as CCBS. We can thus use such models to evaluate with what part of governance RFMOs are struggling most. Other RFMOs' scores differ mostly in magnitude. IATTC appears to do nearly three times better, CCSBT twenty times better, and NASCO about four times better under a net effectiveness rubric.

Of course, these scores should be taken with a grain of salt because the model itself is not yet an adequate explanation of the variation. What has been shown, however, is the promise of the concept of net effectiveness for better evaluating institutional effectiveness.

⁵⁰This suggests a puzzle that would require qualitative investigation.

	Gross	Net
IATTC	44653.92	118827.56
ICCAT	1114.43	-90907.49
CCSBT	2147.93	53530.67
CCBSP	-83690.35	-40504.31
GFCM	-2510.41	43261.89
IOTC	-2726.72	-5034.44
NAFO	-239.94	62420.55
NEAFC	-21055.59	-27840.01
NASCO	13411.07	53016.42
NPAFC	-10136.81	-25891.78
SEAFO	-10064.84	-14213.75
WCPFC	-20347.14	-51577.69

Table 6.3: RFMO Effectiveness Scores

6.5 Pour Oil on Troubled Waters

This chapter has sought to make two contributions. First, it has argued that the notion of a “balloon effect”, proposed by Barkin and DeSombre to explain why RFMOs have strong mandates but global fisheries remain overfished, finds little evidence in the data at least in a systemic version. Governed fishing does not appear to correlate strongly with reductions in fishing, and a closer inspection of the fishing profiles of major fishing states provides little evidence that they are not systematically compensating for fish forfeited to regulatory constraints in fisheries where they are not subject to regulation. However, while there may not be any evidence of a *systemic* balloon effect, I find utility in the analogy for conceptualising externalities among or between the many institutions of the global fisheries governance complex.

The chapter’s second contribution consists of a discussion about how one might convert this analogy into a research strategy for studying inter-institutional effectiveness. In this section, I first discussed why behavioural change is an appropriate choice of dependent variable here. I then discussed a method by which institutional effects could be reliably estimated that takes into account dependencies in observations across each state’s fishing behaviour and within each fishery. Finally, I discussed how model specification should include both institutional effects on members’ activity with respect to resources under their mandate as well as how they more indirectly influence their members’ activity with

respect to resources beyond their mandate. Because the method relies on statistical network methods, and the notion of discounting contributions to behavioural change within an institution's mandate from overlapping institutions, and add the externalities the institution generates for other institutions, I call this development "net effectiveness". I illustrated how this would work with a toy example.

In sum, I argue that such a conceptual development will help us make more accurate inferences about the relationship between institutional design and behavioural change, such that we can better design future institutions, and better reform current ones.

Part IV
Conclusion

“Governing a state is like cooking small fish. It has to be done with a very light touch.”

Chinese proverb

7

A Sea Change?

7.1 Assessing the Haul

RETURNING TO PORT, it is evident how ambitious this thesis has been. It has sought to describe and explain how the global fisheries governance complex has evolved in terms of participation, practice, and performance, using advanced network methods to identify relational mechanisms for an *institutional* relationalism that can be used to gain purchase on other governance complexes. In so doing, it has covered a lot of theoretical, methodological, and substantive ground. Rather than summarising each chapter then, this chapter begins by reviewing the chief contributions of this thesis along these three dimensions. The next section considers the status of the knowledge produced here, followed by a section considering questions that this thesis does not cover. I then briefly list some other governance complexes to which the relational approach developed here could apply and consider some scope conditions for its application. Lastly, I conclude with a word on the practical lessons one may derive from this thesis.

7.1.1 Theoretical Contributions

First, the main theoretical purpose of this dissertation has been to work towards the development of an ‘institutional relationalism’. The institutional relationalism envisaged here employs relational theory to better understand the evolution of “governance complexes”. Governance complexes were defined by this dissertation as systems of actors, institutions, and the relational “architectures” between and among them. The relational theory part is emergent, but based on straight-forward assumptions that actors care about what other actors are doing, particularly those

to which they are already tied, and especially as complexity and uncertainty grow. The foundational assumption of the relational theory expressed here is that the architectural patterns beneath the often complex surface of social systems are important for understanding and explaining social and political dynamics. To develop this theory, a number of conventional mechanisms were polled from IR, sociology and political science and parsed into precise relational terms and/or with international content. A host of potential relational mechanisms have been identified here. In terms of institutional selection, these include popularity, closure, homophily, foci, and propinquity. In terms of institutional influence, these include emulation, learning, adaptation, coercion, harmonisation, and imitation. Almost all of these mechanisms were found here (there was no evidence of adaptation here), suggesting that an institutional relationalism ought to find space for all of them. Still, modelling these relational mechanisms provides us with information about which are important, at least here in the context of global fisheries governance. These results are reviewed in more detail in the subsection on substantive contributions, but it appears that shared foci, popularity and closure are particularly important for institutional selection and emulation, coercion, and imitation are important for inter-actor or -institutional influence. Future research will need to establish which of these mechanisms are generally important and where the scope conditions are.

Though it serves this thesis more as a point of orientation, the topological typology explicated in chapter 3 is also another major theoretical contribution. On one level, the topological typology seeks to update the current single-spectrum typologies of the topology of institutional complexes with an analytic based on the intersection of two, underlying dimensions: centralisation and clustering. Because there are *two* dimensions, each relating to precise network measures that can be specified for both unipartite and bipartite graphs, this typology is more nuanced, precise, and powerful than current “fragmentation” alternatives. But on another level, it can be used not only to describe and compare governance complexes, but also evaluate the sufficiency of an explanation of its structure. The topological typology thus runs right through the thesis and offers plenty of scope for further elaboration.

7.1.2 Methodological Contributions

The main methodological purpose of this dissertation was to provide scholars studying institutional or governance complexity with an analytic and diagnostic

tool kit to facilitate comparison and theoretical growth. While network methods are certainly not *required* by the theoretical apparatus developed above, this thesis nonetheless makes heavy use of both descriptive network analysis and inferential network modelling to that purpose. Indeed, during the course of this dissertation, several methodological contributions, extensions, or innovations to either or both IR and network analysis more generally have been made.

First, within IR, the extended development of typologies, diagnostics, and models for *bipartite networks* represents a methodological as well as a theoretical contribution. Until now, most network IR scholars have focused on unipartite network models. This dissertation thus stands as an example of how one might expand the range of networks in use in IR. Second, using either unipartite or bipartite networks, I have shown how tools or measures in the network toolbox, such as Hamming distance, community detection, and NODF, can assist in refining diagnostic tools for governance complexity. Third, the proposed use of quadratic assignment procedures to control for dependencies amongst observations when modelling institutional effectiveness is a key contribution. While there may be more robust—though also more complicated—alternatives available, QAPs have the advantages of being straightforward to employ and interpret. IR should certainly make more use of such simple but effective tools.

Fourth, beyond IR now, while the possibility of using non-constant rate parameters in SAOMs has long been available, this dissertation represents the first example of its use on the evolution of a network of which I am aware. I found that employing it aided particularly in fitting a network evolution to data in which there were many isolates. Future research could extend upon this and develop relational theory for rate variability. Fifth, the use of SAOMs to study the coevolution of network and behaviour across both levels of a bipartite network represents another first. In particular, the multimodal matrix solution that enables this is also flexible and powerful enough to enable even more complex models of multilevel agency if required.

7.1.3 Substantive Contributions

The main substantive purpose of this dissertation was to explain the evolution of the global fisheries governance complex. Indeed, we now know a lot more about what the state of the global fisheries governance complex is now and how we got there. First, we know what it looks like now. It is full of actors and

institutions and architectural relations, and all appear to be in a state of growth. However, though there are multiple institutions, this does not necessarily mean that the system is fragmented, as some have suggested. Instead, the global fisheries governance complex can be better characterised as rather densely clustered and increasingly centralised. Moreover, RFMOs are actually generally fulfilling their mandate, especially over the last 15 years or so of the study period. They pass a lot of regulations and most of them are both binding and directed at controlling members' behaviour. Nonetheless, there is some variation and fluctuation and a suggestion that different RFMOs have quite different policy cycles (if at all). Then, there is no evidence of a (at least systemic) balloon effect of RFMOs pushing fishing activity into unregulated waters. In other words, states do not appear to respond to regulatory pressure by RFMOs in which it is a member by fishing in unregulated areas. Even free-riding is relatively rare. Instead, it appears that in some cases a state's fishing will increase once it joins an RFMO.

Indeed, the development of a new "GFG" dataset constitutes another contribution of this thesis.¹ While much of the data used in this dissertation was the result of merging or repurposing existing datasets such as IEA and ECOLEX or FHS, this data was complemented by online and archival research and correspondence that extended the data and improved its comprehensiveness. There was also a significant amount of coding and re-coding, with the result that the full extent of the global fisheries governance complex dataset has not yet been tapped.

Second, our models give us a pretty good idea of how we got there. For each, the explanation has been split into two complementary parts: design and other exogenous covariates, and endogenous, relational mechanisms that depend on the existing architecture. Here I do not summarise all the results, but cherry-pick some of the most interesting findings.

First, institutional design does matter. In particular, it seems that the internal organisation of an RFMO matters for states' membership and its regulatory activity. Those considering RFMO reform should increase internal organisation. Despite some concerns, it is effectively priceless because more regulation will not scare states off. Moreover, there is some evidence that organisation may be related to RFMO effectiveness. Of the five RFMOs that were identified as net effective in chapter 6 (see table 6.3 on page 192), IATTC, NAFO, and NASCO were "org high" in chapter 5 (see table 5.7 on page 164). For GFCM and CCSBT, ORGANISATION also appeared as an important factor governing their regulatory activity. Having

¹For another part of this dataset, see Hollway and Koskinen 2015a; Hollway and Koskinen 2015b.

regulatory activity influenced by ORGANISATION does not necessarily *lead* to net effectiveness though; ICCAT, RECOFI, and WCPFC were also “org high” and were not identified as net effective. The regulatory activity of these three RFMOs is also influenced by their SCOPE though, which does not appear in the other RFMOs. Future research should certainly explore this relationship.

Second, architecture matters too. Indeed, the statistical significance of relational mechanisms were found to be both resilient to complex models with many controls and to be preferred over these controls during a backward stepwise selection procedure. This suggests that these mechanisms are present as heuristics in the evolution of the global fisheries governance complex. One such mechanism was that of popularity. This mechanism suggests that part of the explanation of the evolution of the participatory architecture of the global fisheries governance complex was simply other states’ choices. While other states may have chosen an RFMO on the basis of its high organisation, say, a subsequently higher membership makes it a more attractive choice, all other things equal. Whether this is due to a logic of appropriateness or consequentialism cannot be parsed out here and will require further research. It does seem to become more important as the governance complex becomes larger and more complex though. A version of popularity was also included in the behavioural evolution part as adaptation, but this was not statistically significant. The model did find that the legislative activity of an RFMO’s members did have a coercive influence on RFMO regulatory activity though.

A similar mechanism that appeared was homophily. Here though, the expectation from interpersonal networks that the influence would be positive was not borne out. Instead, it seems that states prefer RFMOs with members that are *dissimilar* in terms of how much they fish. I speculated that this could be because multilateral institutions offer the means by which states with different interests in the resource—some fishing a lot, some only fishing a bit—may cooperate. For those states only fishing a little, multilateral institutions promise a way to collectively balance and constrain the fishing of those states that fish a lot. For those states fishing a lot, larger multilateral institutions might promise a way to legitimise high catches. Which promise is ultimately fulfilled may differ across institutions, but we have seen in the previous chapter that at least some times RFMO membership appears to legitimise or enable increasing catches. Whether this finding of interest heterophily is prevalent in other issue areas is a question for further research. A version of homophily (or rather assimilation) was also included in the influence part

as harmonisation. This effect did matter for states' legislative activity, suggesting that co-members of RFMOs harmonised legislative activity.

Another mechanism, closure, also appears here and on top of the previous mechanisms. This suggests that actors follow co-members of one institution into other institutions. This may be because the choices of high-participating co-members operate as a useful heuristic when it comes to a state making its own choices in a complex and uncertain world.² A cognate effect, imitation, operates on the behavioural influence side. There states' legislative activity takes cues from the state legislating the most in its governance circle of RFMO co-members. It is thus more aspirational than harmonisation.

7.2 Does it Hold Water?

How robust are these conclusions? What is the status of the knowledge produced? First, the models of institutional selection presented in chapter 4 should be considered complete. Network evolutions simulated from the parameter values estimated produce excellent representations of the observed network evolution. Moreover, the model specification is about as spare as it can be without dropping significant effects.

Second, the models of institutional influence presented in chapter 5 generally fit well but for the part of the model explaining states' legislative activity (LEG). A closer look at a plot of the fit shows us that the fit is not as poor as the fit statistic suggests and that the higher number of non-active states in the data may be responsible. Future research may want to explore the distribution of this activity in more detail. However, it was deemed sufficient here that the fit on the two parts of the model that were most important—MEMB and REG—was most important. As such, the poor fit here is not of concern for the purposes of that chapter, but should remind us to be cautious about how we interpret the results.

Third, the model of institutional effectiveness presented in chapter 6 was only ever meant to be a toy model for demonstrating how one might use QAPs to study net effectiveness. As such, the poor fit here is not of concern for the purposes of that chapter, but should remind us to be cautious about how we interpret the results.

More generally, some concerns cut across these models. One is that there may be observation errors in the data. Most currently available statistical network methods assume that observation is perfect. While the data here is more comprehensive

²As with popularity, closure typically grew in importance over the study period.

than any other single source, and I have gone to some lengths to fact-check ties in particular, inaccuracies cannot be ruled out. There is often no way to ensure this, but more extensive data collection always helps.

Another is the problem of correlated unobservables. For example, there may be non-observed variables that co-determine the probabilities of change in network and/or behaviour. Since global fisheries governance is a large, complex and importantly *open* system, there are undoubtedly omitted variables to be discovered. As Steglich et al counsel, “The royal road to solving [this problem] is the development of better theory”.³

Lastly, there is the possibility of dependence on past events. The SAOMs presented here rely on a Markov assumption in which change probabilities depend only on the current state, whether observed or simulated, of the network. This is required by the model as a necessary simplification as it relies so heavily on simulation through continuous time. However, the Markov assumption is flexible enough to allow the incorporation of “historical” information into a “current” choice decision.⁴ This is a promising avenue for future research. There is also a possibility of past dependence in the previous chapter. Changes in fishing may depend on long-running historical trends, or be pegged to historical highs. While QAPs are typically static models, a dynamic QAP model has been proposed that may yet yield some promise.⁵ Failing this, a sophisticated specification of a mixed effects model may work.

7.3 Flotsam and Jetsam

Other aspects of the story of the evolution of the global fisheries governance complex have been jettisoned to lighten the load as it makes its way or left as wreckage. Of course, as in any study, the list of missing ideas is much longer than that of those included. Here I will review just a few notable omissions.

Perhaps the most obvious is the absence of any account of institutional creation and dissolution. The models presented here only account for how states select and are influenced by RFMOs while they exist. But the negotiation and establishment of RFMOs are an important factor in which states join them and when. I have partially taken this dynamic into account by using the ‘multilateralism’ fix, which effectively

³Steglich et al. 2010, p. 385.

⁴Steglich et al. 2010, p. 386.

⁵Dekker et al. 2003.

models the unlikelihood that a multilateral treaty would ever have only two parties and the early “rush” to at least three members. Nonetheless, this does not account for when RFMOs appear and disappear, a process which may itself be dependent on institutional design and architecture.

Another major underdeveloped idea is that of *governance* complexity. As I explained in chapters 1 and 2, governance complexity has been deliberately defined broadly enough to comprise not only the states and RFMOs captured here, but also potentially other actors and institutions, both old and ‘new’. This means that a great deal of the approach developed here will be able to be ported across to new contexts, though there is also important information in the adaptations required to make this generalisation.

7.4 A Drop in the Ocean

While this thesis has focused on fish, this has only been as a typical case of institutional or governance complexity.⁶ Future research may turn to other issue areas, both within international environmental politics and without to see whether the relational mechanisms found here may also be found elsewhere. Only after observing some regularities in the relevance of these relational mechanisms can an institutional relationalism be formally explicated.

The concept of governance complexity is potentially applicable to many issue areas, both less politically salient issue areas within environmental politics and higher politics such as security, however the relational approach may have some important scope conditions. In particular, I expect the relational approach to be most useful across longer time periods, such as the half century studied here, where architectures (and actors and institutions within them) change sufficiently. States regularly establish international organisations with the stated aim of collectively managing transnational problems in various issue areas. Within international environmental politics, these may include energy, waste, oceanic and freshwater pollution. Beyond international environmental politics, international political economy has recently become a popular venue for network analysis. Another is the study of the international judicial architecture. A relational story may play a role in explaining why there is no human rights court in Asia, for example.

⁶Oberthür and Gehring 2011, pp. 26-31.

This thesis has demonstrated how taking a relational approach can provide an analytically grounded but fresh perspective and some advanced tools for studying complex empirical governance systems.

7.5 How to Save the Fish

I conclude this dissertation by considering how lessons learned may be converted into practical advice.⁷ First though, it is important to note that the problem those seeking to “save the fish” face is not governance complexity, but what to do in it. Global governors are now presented with so many ‘solutions’ that it is difficult to understand which path, combination of paths, or compromise to take. Should there be a ‘world fisheries’ or ‘environment’ organisation?⁸ Should we close part of or even the whole High Seas to fishing?⁹ Or reform and add to the RFMO-based governance complex that we currently have?

This thesis does not have the hubris to presume to solve what is ultimately a social, democratic question. But no matter which path is chosen for global fisheries governance, those steering the ship should have a good model in mind of how actors and institutions may relate along the way; in other words, how their institutional changes may affect the overall architecture and thus further participation, RFMO practice, and performance. Which design features facilitate participation, practice *and* performance? What relational mechanisms matter for how participation, practice and performance proceed? This thesis can assist there by helping us understand how actors and institutions have co-evolved in the past.

For example, we have found that RFMOs that are highly organised attract members (though not necessarily cooperation), regulate more, and may be more effective. Note also that there does not appear to be any catch-22 here; RFMOs may reform in a way that increases regulation without fear that they will discourage potential members. Moreover, the boost in popularity associated with increased RFMO organisation may lead to even broader membership. All other things equal, states join popular RFMOs resulting in a system becoming more and more centralised, even in the absence of an overarching world fisheries organisation. Where multiple institutions coexist within an issue area, we may expect another heuristic, closure, to come into play, resulting in an organic clustering, overlapping

⁷After all, the goal here is use-inspired basic research. See Stokes 1997.

⁸See Oberthür and Gehring 2004; Biermann and Bauer 2005; Biermann et al. 2012; Stokke and Oberthür 2011, p. 13.

⁹White and Costello 2014.

and (if also centralised) nesting of institutions within one another. While we do not yet know whether these features are also responsible for more *effective* institutions, we do now know how to distinguish effective from ineffective institutions, even where their influence overlaps in mandate and membership. Although caution is therefore recommended, it seems as though some RFMOs are doing better than others, and it is not necessarily the ones identified at first blush.

Therefore, regardless of whether a reform or revolution perspective is taken, this thesis offers at least to better inform “the reflexive discussion of values and interests” in debates about how to govern global fisheries in the future.¹⁰ Richard Falk suggests we are entering a “Grotian moment” in world politics, where emerging ideas will shape the system for some time to come.¹¹ I would argue that this is certainly the case for the seas, given the furore over Rio+20’s failure to settle the question of how to preserve ocean biodiversity. We are at a point in global fisheries governance where currents diverge; we need the best chart to assist in deciding on the appropriate direction.

¹⁰Flyvbjerg 2001, p. 3; see also Ney and Verweij 2014.

¹¹Falk 1997.



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“So long and thanks for all the fish”

— Douglas Adams