3

Technology and International Institutions

In this chapter, I will expound the broader theoretical framework which underpins the analysis in this book. In line with the preceding discussion, this framework is organized around the notion of different promises and perils that can be associated with TNTs, with international institutions playing different roles in realizing the former and avoiding the latter. The chapter accordingly starts out by explaining the different ways in which international institutions matter for the realization of promises and the avoidance of perils. Afterwards, I elaborate upon the theoretical considerations that underpin the four interrelated questions at the core of this text.

The first question is about *how* international institutions respond. This is an empirical question that addresses the challenge of finding common benchmarks for the systematic comparison of institutional responses across disparate technological and political contexts. As I will elaborate, I conceptualize and measure institutional responses in terms of their *scope* (i.e. their range of application in regards to a TNT and its associated promises and perils) and *depth*, the latter being a compound concept that comprises the precision and bindingness of a given response, as well as the magnitude of supporting components such as domestic implementation support or compliance mechanisms. Behind this is a central assumption which is crucial for assessing and comparing the *effectiveness* of different institutional responses. This assumption is that, in general terms, we should equate 'broader' and 'deeper' with 'better'. That is, institutional responses which are broad and deep should make larger contributions to the realization of technological promises and the avoidance of perils than responses which are narrow and shallow. As I will discuss, there are strong theoretical reasons for making this assumption, though some important caveats should be borne in mind.

The second and third questions are closely connected: *when* do international institutions respond to the emerging promises and perils of TNTs? And *why do*

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they do so in different ways? The former question is about the conditions that explain the manifestation of institutional responses in some cases, their absence in other cases, as well as the methodological criteria for identifying non-responses as something that did not happen despite reasons suggesting it should (or might likely) have happened in principle. The latter question addresses the phenomenon that institutional responses show wide variation in scope and depth. This variation is of considerable interest, not least under the assumption that it corresponds to variations in the degree to which institutions facilitate the realization of technological promises and the avoidance of perils. I develop three theoretical perspectives that may help to illuminate both when international institutions respond and why their responses vary. These perspectives are deliberately broad and intend to capture, at an abstract level, a wide range of theorization on international institutions and cooperation. In the respective conclusions to Chapters 4 to 6, I will probe to what extent these perspectives shed light on the variations in institutional responses that we can observe. This requires the specification of how variations in the key causal mechanisms respectively associated with these perspectives should drive variations in the scope and depth of institutional responses.

The fourth and final question is *how institutions might respond in better ways* than those that we can observe empirically. In other words, how should institutions respond for the more effective realization of promises and avoidance of perils? To some extent, the different potential answers to this are of course biased towards responses which are 'deeper' and 'broader' than those that we find empirically. While there are solid reasons to assume that this would generally hold in most cases, my conceptualization of institutional responses in terms of depth and scope is intentionally reductionist, whereas institutional design is intricate and complex. While 'deeper' and 'broader' should generally be understood to be 'better', this does not happen automatically and the precise ways in which responses are designed irrespective of their scope and depth matters a great deal for their effectiveness. While my overall argument prioritizes breadth over detail, in the context of this fourth question I will put slightly greater emphasis on the nuances of institutional responses beyond questions of scope and depth.

But before delving into all these matters, let us begin with some general considerations on 'institutions', 'institutional responses', and associated notions of 'institutional change'. Just as with 'technology' or 'environmental sustainability', these are slippery, notoriously fuzzy terms. The term 'institution' may refer to diverse patterns and arrangements across all scales of social organization, from the global level all the way down to small group settings. We can conceive of institutions as standards of appropriate behaviour shared by the members of a given

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community. Such a conceptualization of institutions in terms of their normative pull force over actors that strive to be regarded as compliant with collective standards of good or acceptable behaviour leads to an understanding of international relations as a society similar to those that we can identify at lower scales. On the other end of the spectrum, we may understand institutions as formal rule systems that create rights and obligations for participating actors that attempt to maximize their gains by weighing the costs and benefits of rule compliance against those of non-compliance. On a different note, we can also understand institutions as organizations that have different degrees of corporate agency and behave in accordance with the norms, incentive structures, or other factors in their organizational environment. Institutions can exist at different levels, from communities to nation states to the international system. They can operate at timescales of months, years, or centuries. What constitutes an institution also comes down to choices regarding analytical granularity. Subject to theoretical or methodological considerations, we might choose to identify an institution at the macro-scale or we might opt to decompose it into distinct, separate institutions at lower scales. Other issues are philosophical in nature. Are institutions merely an epistemological construct that abstracts from observable patterns in human behaviour? Or are institutions such as states, societies, or political parties ontologically 'real' in ways similar or identical to the ways that living beings and material objects are 'real'? Do they have distinct causal powers that are irreducible to the actors that create and operate them? These and myriad other issues notwithstanding, at the most fundamental level, the notion of 'institutions' presumes that social behaviour is patterned.

My own understanding of the term 'institution' is in line with an intellectual tradition that considers the international system as a distinct domain due to the absence of a central authority that would facilitate cooperation by making obligations effectively enforceable. In this line of thinking, international cooperation may often confer potential benefits through which all participating states improve on the status quo (albeit typically to different degrees). However, without different types of institutional solutions, problems of international collective action will usually prevent or complicate the negotiation or implementation of cooperative outcomes. In other words, I understand institutions as formal intergovernmental arrangements of various types that are created and operated by states to facilitate international cooperation. This approach is broadly situated within the tradition of regime theory which conceptualizes state behaviour in terms of gain maximization on the basis of the (more or less) rational calculation of the costs and benefits expected to result under different decision alternatives, in terms of adjusting to normative pressure to act consistent with collectively shared understandings of appropriate behaviour, but also in terms of trying to work out shared problem definitions and understandings for the new and unexpected issues that tend to arise with relative frequency in world

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politics.[1] From the outset, I should note that notions such as problems of collective action or joint gains from international cooperation are central to this text. At the same time, I consider the overall regime-theoretical framework more as a platform compatible with a variety of approaches, including from beyond the orthodoxy of rationalist institutionalism, rather than a closed, comprehensive, and conclusive system of thought. Institutions can thus be understood as sets of rules that shape the incentive structure within which states operate, as normative structures that define standards of appropriate behaviour in the international system, and as cognitive frameworks that enable the collective definition, conceptualization, and demarcation of the various issues that may constitute the objects of international cooperation. These three approaches are all capable of operating within a broader regime-theoretical framework that considers international cooperation as beneficial, collective action problems as pervasive, and institutions as imperfect solutions. To a large extent, they are also compatible with each other. That is, we may well explain the behaviour of states or other actors as the result of multiple causal mechanisms that operate in parallel but, depending on context, can vary in their relative efficacy. The causal effect of norms on behaviour, for instance, is greater where material incentives for non-compliance are weak. Ambiguities in the collective framing of governance objects can create uncertainties regarding which specific norms apply in a given context and thus weaken the effects of shared behavioural standards. At the same time, and as I will discuss in greater detail, a crucial element of the argument I develop in this book is the assessment of the explanatory value which each of these theoretical perspectives, in isolation, offers for making sense of the observable variation in institutional responses to TNTs. While a lot is to be said for interaction effects, one overarching concern of mine is to aim for conceptual sparsity – that is, a theoretical construction that requires relatively few foundational assumptions yet, hopefully, can make sense of a wide range of empirical observations.

Before delving into more operational considerations, a final issue that deserves a few words is the bidirectional causality between technology and institutions. As the preceding discussion already suggests, my approach centres on the effects that technologies have on institutions (by creating demand for institutional responses that facilitate the realization of promises and the avoidance of perils associated with a given technology) as well as the effects that institutions have on technologies. On the one hand, this latter aspect relates to conventional regulatory functions, such as international obligations for the management of certain technological risks, mechanisms for the transfer of clean technologies, and financial arrangements for compensating victims of technological harm. On the other hand, international and other institutions are of fundamental importance for shaping the emergence of novel technologies and the ways in which they subsequently become part of

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wider socio-technical systems. This second aspect of institutional effects on technology, central to the field of transitions research, cannot readily be integrated into regime-theoretical accounts without various conceptual adjustments and lengthy theoretical considerations that are beyond the scope of this text. Given these practical considerations, I return to the concept of socio-technical systems and associated issues of temporality and path dependence as part of the broader outlook that I provide as part of Chapter 7.

3.1 The Functions of International Institutions

Why do states create international institutions? This is a question that harks back to bitter controversies in those days when the scientific discipline of international relations was relatively neatly divided between two opposed camps, the first answering 'to realize gains from cooperation' and the second that 'it does not matter'. While international relations is significantly less dogmatic nowadays, in terms of substance the debate has made only marginal progress. From the outset, it is clear that states do not, in general, create institutions capriciously. Negotiating international institutions may require many years as well as valuable technical and legal expertise, while often entailing substantial political risks. To the extent that international institutions possess some sort of administrative structure, this will require regular and possibly indefinite financial support. Such institutions, moreover, create various types of rights and obligations which, as it so happens, can have unpredictable effects (or at least unpredictable legal implications). Governments are acutely aware of how uncontrollable international institutions may become, which is a major reason why they might hesitate to create them in the first place. Then, of course, there is domestic implementation, which often requires expensive and challenging changes to national laws and administrative procedures.

Given these and similar factors, we can thus assume that, generally speaking, states create new institutions because they consider this to be useful for themselves – an assumption that is, in turn, based on two deeper assumptions: that states actually 'create' (or 'design') institutions, and that they do so in order to maximize their respective utility functions. Both of these deeper assumptions are controversial and face significant theoretical challenges from the side of social constructivism. Norm compliance, rather than utility maximization, might drive state behaviour. Institutions might also be the unintentional result of decentralized and uncoordinated agency.[2] Collective action problems, one of the central terms in rationalist cooperation theory, presume both the existence of a problem as well as a widely shared understanding among the relevant actors regarding what, exactly, this problem *is*. Yet, in some sense, the failure to find agreement on problem definition and framing

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may also contribute to the challenges that states can encounter in international cooperation.

But let us briefly take a step backwards and consider the relevance of institutions as such, instead of *international* institutions in particular, for the wider problem domain of technological promises and perils in the context of environmental sustainability. As discussed in Chapter 2, one way of thinking about TNTs and their implications for the environment is in terms of promises such as impact management, informational commons, and enhancement of justice, as well as perils such as environmental harm, the crowding out of feasible alternatives, and the aggravation of global injustice. All of these attach to different technologies in different configurations, yet the ways in which they ultimately manifest themselves crucially depends on *governance*. Consider environmental harm from technological risk. Such risk is not an innate characteristic of technology as a particular material artefact. Rather, technological risk originates in the complex interactions of technological artefacts with actors and broader social structures. The risks that nuclear power poses for the environment and for human societies cannot be reduced to the technical details of nuclear fission, but rather emerge out of wider ensembles of technologies, actors, and structures that include large technical systems from power stations to waste storage sites, sectoral interest groups, public policies and regulations, discursive contestations of social licence, social safety norms and risk tolerance, as well as myriad other factors that also include international rules regarding nuclear safety and the duty to notify and consult with other states in case of large-scale accidents.[3] 'Governance', as the deliberate attempts of political authorities to align social processes with the norms and objectives that are understood to define an imagined community, is one crucial aspect of these wider ensembles – and governance operates through various types of *institutions* that regularize behaviour, sanction deviance, stabilize expectations, define standards of rectitude, and make the world intelligible by defining and delineating natural and social kinds. In other words, institutions matter for the emergence and integration of technologies as part of entire social systems in all their complexity, rather than being mere end-of-pipe interventions for holding operators liable for industrial accidents, or for assessing the risks of GM potatoes. While my argument adopts a somewhat formal approach to (international) institutions as sets of rules, norms, and principles that affect the modalities of international cooperation on TNTs,[4] these broader issues need to be borne in mind, although they are mostly outside the scope of this text.

The contributions of international institutions to the regulation of TNTs are specific and vary across issue areas. Not every (actual or potential) technology will require the same types of governance interventions from the side of international institutions. At a fundamental level, though, international institutions here

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serve the partially overlapping purposes of resolving collective action problems between states while also contributing to societal transitions towards sustainability. They can do so by providing guidance and signals, rules and standards, and transparency and accountability; by enabling collective learning; and by providing technical, financial, or other means to support the domestic implementation of international commitments.[5] We can conceptualize the role of international institutions for the realization of technological promises and for the avoidance of technological perils, as discussed in the previous chapter, along those lines.

International institutions can facilitate the supply of *impact management* as a global public good.[6] In other words, they can contribute to a wider distribution of technologies, or technological benefits, that provide human societies with leverage for reducing their harmful environmental impacts or for better adapting themselves to adverse processes of environmental change. Notable mechanisms include technology transfer, technology mandates, and market signals. Technology transfer means making beneficial technologies directly available for others to use. For instance, the United Nations Convention on the Law of the Sea requires parties to assist developing countries and others 'which may need and request technical assistance' in building up their marine technological capacities, including for the better protection of marine ecosystems.[7] Technology mandates means obliging governments to use technologies with public good characteristics. Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL) creates technical standards for the reduction of vessel-source air pollution, with the concomitant benefits for oceans and the climate system constituting a global public good par excellence. Market signals entail credible commitments to specific technologies with public good characteristics and thus signal that relevant research, development, and innovation is likely to become increasingly commercially feasible. The Paris Climate Agreement, for instance, signals through its net zero target the feasibility of long-term investments into renewable energies while dissuading investments into fossil fuels.

International institutions can contribute to the *information commons* by facilitating or mandating the creation and sharing of information. On the one hand, this can pertain to information that *derives* from specific technologies – for instance, from satellites in the context of disaster risk reduction under the UN Sendai Framework.[8] Various international initiatives for creating and operating open-access genetic sequence databases (to be discussed in Chapter 4) also fall into this category. On the other hand, institutions can also facilitate the creation and sharing of information to reduce uncertainties associated with technology *itself*, such as through the international clearing-house mechanism of the Cartagena Protocol on biosafety. As with the supply of impact management as a public good, international institutions can help to resolve the challenge of undersupply.

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Generating information and making it openly available entails costs (including in the form of potential disadvantages to domestic industries from the disclosure of commercially relevant information) that may be dissuasive to states. International institutions can offer solutions to this problem by creating normative expectations or legal obligations on data-sharing; by enabling diffuse or specific reciprocity, whereby states that share data can expect to receive diffuse or specific benefits in return; or by helping to overcome collective action problems that may arise in contexts where data-sharing implies economic or other disadvantages unless other states are sharing data as well.

International institutions can serve to *prevent or remedy transboundary harm* from adverse technological effects. This can take place through international safety standards, rules regarding risk assessment and risk management, or provisions on liability and redress. Instances of such institutions can be found in fields such as nuclear technology, with agreements such as the Convention on Nuclear Safety, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, as well as the Vienna Convention on Civil Liability for Nuclear Damage. Often, instances of potential transboundary harm involve negative externalities, meaning that activities that are potentially harmful to some states are beneficial to others. In addition to the avoidance, reduction, or compensation for transboundary harm, international institutions in these cases require additional elements to induce cooperation on the side of perpetrator states.[9]

International institutions can address the *peril of unproven technologies crowding out conventional policy approaches* by encouraging, facilitating, and mandating diversification in public policy instruments. This can include curtailing the extent to which governments can pursue their international commitments by relying on future technological solutions with unproven feasibility. Real-world examples of this peril are difficult to find simply because crowding out is a phenomenon that specifically applies to TNTs and not necessarily to technology as such. One possible example is the now-defunct Clean Development Mechanism, through which various industrialized countries were able to comply with their international obligations under the Kyoto Protocol by financing projects for the reduction of greenhouse gas emissions in developing countries. Among such potential offsetting projects was afforestation and reforestation (A/R), a method for carbon sequestration that is often framed as a nature-based solution yet also entails 'standardized, engineered, machine-like, enclosed systems'.[10] These measures have always been extraordinarily controversial, including due to questions about the permanence of biomass-based carbon storage and about the scalability of A/R projects in light of the adverse social and environmental spin-off effects which they may generate.[11] While this is a debate of extraordinarily complexity and well beyond the scope of this text, the Clean Development Mechanism capped the extent to which the

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industrialized countries listed in Annex I of the Kyoto Protocol were able to draw on A/R projects for ensuring compliance with their national emissions targets.[12] The practical effect of this cap was likely marginal, as the myriad problems of carbon offsets via A/R would have probably prevented their large-scale use in any case. At the same time, the feature highlights how institutions can prevent over-reliance on technological, or hybrid, solutions with uncertain feasibility at scale.

Finally, international institutions can also regulate technology from a perspective of distributional justice, either in order to leverage it for *enhancing global justice* or to reduce its capacity for *intensifying injustice*. In practice, these two sides will tend to overlap so that it is not always clear whether we are looking at institutional solutions for realizing promises of justice or for avoiding perils of injustice. Various international mechanisms that aim at the fair and equitable sharing of different benefits that arise from the biotechnological utilization of genetic resources, in plant breeding or pharmaceuticals (to be discussed in greater detail in Chapter 4), exemplify the difficulty of drawing the conceptual boundary: on the one hand, we might argue that these mechanisms aim to compensate for (some) of the additional global injustice that biotechnology has brought about; on the other, we might understand them as leveraging the potential of biotechnology for improving global justice. In addition, the other promises and perils discussed herein will usually have some direct or indirect bearing on questions of justice as well. In this regard, a notable function that international institutions can perform is to provide rules, norms, and procedures that enable prioritization or differentiation on behalf of vulnerable groups or societies with specific developmental needs. The aforementioned provisions under United Nations Convention on the Law of the Sea (UNCLOS) regarding the transfer of marine technology to developing countries and others that 'need and request' assistance is an example of this.

3.2 How Do International Institutions Respond?

The first question at the heart of this text is 'how' international institutions respond to the emergence of TNTs – that is, the ways in which they react to facilitate the realization of novel promises and the avoidance of novel perils. This means that we require a conceptual framework for describing and classifying institutional responses in a systematic manner. This issue also harks back to how we ultimately understand the concept of 'institutions' as such. If we understand institutions as 'organizations', we grant them (limited) agency which they may or may not directly exert in regards to a TNT. From a perspective of institutions as organizations, we would thus focus on immediate organizational action, such as the requisition of novel technologies for direct use inside the organization, or attempts to directly intervene with technology developers, users, or regulators. However, if we

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understand institutions as sets of rules, as I do here, the notion of 'responses' relates to changes to existing rules or the creation of novel rules. From that perspective, institutions do not have agency. Instead, they exert various types of causal influence over states, which create and operate them to facilitate international cooperation, but which may not always be able to fully control, predict, or understand the ways in which institutional influence feeds back on themselves.

Institutional 'responses' are a type of institutional 'change', a notoriously tricky concept in the social sciences at large. As such, a fundamental choice for conceptualization, operationalization, and measurement is whether we conceive of institutional responses in terms of *degrees* or in terms of *discrete types*. A broad literature, particularly in comparative political economy and historical sociology, deals with typological theories of institutional change. These approaches, for instance, differentiate change processes that are driven exogenously from those that are endogenous, or distinguish rapid and discontinuous from gradual and incremental change.[13] This engenders various discrete types of change, such as institutional layering, conversion, drift, and displacement,[14] or higher-order concepts such as path dependence, critical junctures, and punctuated equilibria.[15] Such concepts have also made inroads into the field of international relations, where scholars have parsed the implications of transposing theoretical constructs developed for institutions at (mostly) national and subnational levels to the international level.[16] Discrete categorizations offer a great deal of analytical clarity yet can be tricky to operationalize for empirical cases that straddle conceptual boundaries. Moreover, we often find little agreement on what precisely different types of institutional change refer to or at what level they operate, meaning that different researchers might be using the same concepts in quite different ways.[17]

Much can be said for thinking about institutional change in terms of discrete types. Here, however, I understand institutional change as a matter of degree. The rationale for this choice is not primarily related to the description of institutional responses but rather to the explanation of observable variation along the lines discussed in the next section. The approach to causality that underpins my theoretical argument assumes that causal mechanisms operate through the creation of tendencies that are operational and observable to different degrees. Rather than determining whether institutional responses constitute one or another distinct type, the assumption is that causal mechanisms can push responses into different directions that differ in degree rather than type.

Against this background, I conceptualize institutional responses along two dimensions. The first dimension is the *depth* of a given response, a concept which is here closely linked to the notion of 'legalization', an approach that has been developed for describing and measuring the uneven process towards a law-based international order.[18] The depth of an institutional response broadly indicates its

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'strength' or 'stringency'. I understand depth as an aggregate concept comprising three dimensions. The first one is in the normative substance of an institution. To start with, we need to think of institutions not just as sets of rules but rather as rule *hierarchies*. Institutional rule hierarchies usually take the form of 'primary' rules that set out general rights and obligations and their practical implementation through 'secondary' rules.[19] In international institutions, the top of the hierarchy often consists of some legally binding international agreement that spells out broader aims and objectives as well as associated rights and obligations. At lower levels, we may find legally binding protocols intended to implement specific primary rules, governing body decisions that operate on and within the legally binding institutional rules but are generally not considered as legally binding themselves, as well as technical guidelines or advisory documents adopted at the level of subsidiary bodies. While 'almost all nations observe almost all principles of international law and almost all of their obligations almost all of the time',[20] the normative pull of institutional rules depends on their place in the hierarchy. While some instances of institutional change will be limited to lower-level guidance or governing body decisions, in other cases we will see full-fledged treaty revisions or the adoption of legally binding protocols.

The second dimension is change in rule precision. Some rules operate purely in the abstract, others provide detailed behavioural norms for particular contingencies, still others are somewhere in between. The degree of rule precision affects the discretion which states enjoy in fulfilling their normative commitments. Rules that are less precise are more flexible with regard to unforeseen contingencies but also give states greater latitude for slacking – that is, for carrying out their commitments in ways that are at odds with the overall institutional objectives. Rules that are more precise limit the scope for slacking yet are more difficult to apply to novel and unanticipated situations.

The third dimension, which is where larger differences to the concept of legalization can be found, regards compliance, broadly understood to also include transparency, monitoring, reporting, and enforcement, as well as facilitative mechanisms such as technical and financial assistance. This dimension covers the variety of mechanisms intended to increase rule compliance, regardless of how precise these rules are and regardless of their normative substance. The approach to compliance which I take in this book is somewhat open ended. Theoretically, understandings of compliance hinge on whether we conceptualize state behaviour primarily in terms of rational gain maximization or in terms of adherence to collectively accepted behavioural standards.[21] Whereas the rationalist perspective implies biasing states towards compliance by making non-compliance more costly, the sociological perspective implies facilitating states in complying with rules which they generally tend to accept as legitimate. Between this 'enforcement'

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and 'management' approach to compliance, the notion of 'social enforcement' has been gaining traction recently to describe how international peer pressure might operate on governments to shame them into complying with collectively agreed goals.[22] While my approach gravitates towards a largely rationalist view on states as gain maximizers, I do not consider these different perspectives to be inconsistent or mutually exclusive. As with the other theoretical components of this text, I will simply assume that the influence of social standards of appropriateness decreases as issues related to the distribution of material gains become more urgent, and that it increases when material stakes are less pressing.[23] From this perspective, enforcement-based institutional mechanisms (revolving around reporting, monitoring, and sanctioning) will be more effective at ensuring compliance where material incentives for non-compliance are strong, and that management-based mechanisms (revolving around transparency and facilitation) will be more effective where these incentives are weak.

The second dimension for conceptualizing institutional responses is their *scope*. This concept is significantly more straightforward, merely amounting to the regulatory coverage of a given response. Here, we may find variation between institutional responses that zoom in on a narrow, distinct, and isolated aspect of a TNT, and responses that are so comprehensive in scope that they apply to a large issue bandwidth. As with depth, this notion of scope is intended as a heuristic device for approximating and differentiating variation in institutional responses. It does not allow for accurate measurement and it is not intended to do so. The key challenge here is the lack of robust criteria for defining the extent, limits, and content of 'issues' and 'issue areas', notably because these definitions amount to social constructions that are frequently ambiguous, uncertain, or contested.[24] While precise measurements of the scope of an institutional response are impossible, we can broadly classify them as 'broader' or 'narrower', thus allowing for a more systematic description as well as the explanation of observable variation. Both 'broader' and 'narrower' are here to be understood relative to the issue at hand: an institutional response that ends up addressing only a subset of the problem at hand will have more limited scope than a response that addresses this problem in a comprehensive manner.

Together, depth and scope provide a yardstick for approximating and comparing the responses of international institutions to TNTs. This, in turn, enables inferences regarding the extent to which these institutions facilitate the realization of associated promises and the avoidance of perils, based on the assumption that, very roughly, 'deeper' and 'broader' responses will contribute more towards this end than 'shallower' and 'narrower' ones. It is important to note that this association likely holds at a general level, but in every single case will 'deeper' and 'broader' necessarily translate to 'better'. In other words, binding, precise, and enforceable

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treaty law with broad regulatory coverage is not the universal solution to each and every technological governance challenge. This likely holds as a general guideline, though. Intuitively, it would appear that 'underregulation' is a more serious problem in the global governance of environment and technology than 'over-regulation'. In addition, collective action problems frequently hamper the realization of promises and the avoidance of perils. These problems are generally easier to overcome through 'deeper', rather than 'shallower', institutional solutions: by definition, collective action problems mean that collectively optimal cooperation outcomes are not self-enforcing due to the presence of incentives to defect. Solutions that are 'deeper', in the sense of having relatively high bindingness and specificity, combined with effective mechanisms for monitoring or enforcement, are more conducive to optimal collective outcomes than 'shallower' ones. Solutions that are 'broader' have greater reach for the resolution of collective action problems than those that are 'narrower'.

3.3 When Do International Institutions Respond and Why Do They Do So in Different Ways?

The preceding discussion on the *how* of institutional responses gives us a general yardstick for describing responses in a coherent way across different technological contexts. We now need to look into questions of causality. On the one hand, this means explaining *when* international institutions respond to technological promises and perils – and when they do *not*. On the other hand, we need to be able to explain why the institutional responses that *do* take place typically show great variation in scope and depth. This section develops a common conceptual framework that is intended to address both of these issues. In other words, I elaborate three different theoretical perspectives, broadly revolving around interests, norms, and knowledge, that may help to elucidate both the conditions under which institutions do and do not respond to technological promises and perils and the variation in their responses. More to the point, I propose three independent variables for explaining variation along a continuum that ranges from institutional responses that are both broad and deep, to responses that are both narrow and shallow, to *non*-responses. What drives institutional responses towards narrow scope and low depth, in other words, may ultimately intensify to the point where it precludes *any* response from taking place.

Before going further into this, I will start out with some general considerations on the demand for, and supply of, institutional responses. At the most general level, international institutions respond to technological promises and perils if there is some degree of demand for such a response among the actors that operate the institution (i.e. states), and if those actors are able to mobilize the necessary diplomatic, intellectual, financial, or other capabilities to supply such a response

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through that institution. The demand for an institutional response depends on the expectation of improvements over the status quo among (at least some of) the states that participate in that institution. The expected costs and gains associated with an institutional response can be smaller or larger and are prone to vary between states. Some states might expect substantial net gains, others might see themselves as benefitting only marginally from a potential institutional response, whereas still others could face the prospect of net losses of different magnitudes. The overall configuration of expected net gains and costs is a central determinant of the structure of the associated collective action problem. When a proposed institutional response is bound to impose net losses on some member states of an institution, they will tend to oppose that response in the absence of overriding considerations of one sort or the other. When all member states are bound to realize net gains under a given institutional response, the collective action problem is less malign, although the challenge of coordinating on one among several pareto-superior options is not necessarily trivial either.

In the context of my overall theoretical argument, I situate technological promises and perils on the demand side of things: the existence of promises that have not (yet) been realized and of perils that have not (yet) been avoided creates demand for various types of institutional responses among those states expecting to benefit from the promises or to suffer from the perils. Yet demand for institutional responses must find some correspondence on the supply side: it is not enough that (some) states would *want* (some type of) change; they will also need to mobilize adequate resources for actually *effecting* a response. This can cause costs that differ in size and type. It may require diplomatic efforts: for convincing others of the beneficial aspects of a proposed response, for negotiating larger package deals to buy off hesitating states by offering them concessions on other issues, for initiating and maintaining structured processes of political negotiations or expert-level consultations that might take years and may well end up proving inconclusive, and so forth. The supply of institutional responses can also require financial resources, including for the creation of new organizational capacities (such as standing committees or expanded secretariat functions) within the framework of a given institution. Broader political factors may play a role. States might be required to put their reputation on the line to sway indecisive cooperation partners. They might also possess large degrees of moral authority or issue-specific credibility which they could leverage towards the supply of their preferred institutional response, or they might take unilateral action at the domestic level to provide an example for others to follow. There are also legal considerations: how would a proposed response fit into the legal structure of a given institution and how might it interact, in positive or negative ways, with the rules, norms, and procedures of *other* international institutions?

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There is thus a vast range of factors on the demand and supply sides that can determine whether or not an institution responds to the promises and perils of a TNT, or any other object of international cooperation for that matter. I will return to the issue of theoretical explanations later in the chapter. For now, I wish to return to the matter of institutional *non-responses*. These are a frequent issue of concern among observers of international politics: why do institutions *not* respond to one or the other challenge even though we *expected* them to do so? Such an expectation can be based on different reasons. First, some novel political issue may fall unambiguously within the scope of an international institution and there is a clear mandate to address this issue in one way or another. The charter of the United Nations, for instance, mandates the Security Council to take various types of actions for maintaining or restoring international peace and security, meaning that situations in which there is a threat to, or disruption of, international peace and security yet the Security Council fails to respond are of theoretical interest. The second category of institutional non-responses consists of negotiation failures: states create an international process that is formally geared towards the adoption of some type of institutional response yet, for one reason or another, this process subsequently falls apart, typically leading to intense attempts to attribute, avoid, or deflect blame. The third category is slightly more complex and may at times overlap with the first one: here, strong theoretical reasons exist to assume that a given institution *should have* responded to some issue yet, empirically, this has turned out not to be the case – or at least not to be the case *yet*. For instance, we might make the theoretical case that international institutions have incentives for expanding their scope of activities in order to demonstrate their relevance to their stakeholders or to assert their authority against other international institutions – something that is often referred to as 'mission creep'. Against this theoretical background, we might for instance expect a response by the United Nations Framework Convention on Climate Change to the political problem of solar geoengineering (see Chapter 5). As the lack of such a response is inconsistent with our expectations, these and other cases of institutional non-responses are matters of theoretical interest. Methodologically, the inclusion of such 'negative' cases serves an important function since, otherwise, our theoretical constructs would be based on biased empirical samples. Institutional non-responses are instances of *institutional drift*, meaning that changes in external conditions are not being matched by changes in institutional rules.[25] This alters the impact which those rules have in the real world, as institutions are gradually becoming irrelevant as a result of them not adjusting to changing circumstances. While such instances of institutional non-responses can be difficult to identify, they are a central aspect of the empirical analysis in Chapters 4 to 6.

The dynamics of supply and demand can also account for variation among the institutional responses that *do* take place. As noted earlier, the demand side is

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defined in terms of technological promises and perils: demand thus represents the expectation of (some) states that an institutional response will be net-beneficial for themselves.[26] Frequently, however, there is a mismatch between the demand for institutional responses and their supply. There are arguably many issue areas in international politics where various types of institutional adjustments would lead to obvious, direct, and tangible benefits. However, the mere theoretical existence of status quo-improving institutional solutions is not sufficient for these solutions to automatically materialize.[27] Instead, we will typically observe supply deficits of differing sizes. Institutional responses will sometimes get rather close to the theoretical optimum of what might be achieved in terms of promises and perils. In other cases, institutional responses will be gravely deficient. The supply deficit is largest, of course, for cases of institutional non-responses.

The supply deficit is only partially related to the formal structure of the cooperation problem in a given issue area. Intuitively, it does make sense to assume that supply failure can be a result of opposition to institutional change from states concerned about net-loss outcomes. Still, distributional implications do not categorically prevent cooperative outcomes that entail net gains for all participants, as institutional design (and issue linkage in particular) can serve to overcome or at least mitigate the zero-sum elements that characterize a given cooperation problem. Conversely, supply failure can result even for institutional solutions that are clearly and demonstrably pareto superior. While some cooperation problems are more likely to result in supply failure than others, the occurrence of such failure is also influenced by factors that are exogenous to international cooperation.

Even where institutional changes would unambiguously improve the status quo for all actors involved, the supply of institutional change is subject to a variety of costs and risks, in terms of both the negotiation of institutional change and the subsequent implementation of new and additional institutional operations. Costs might express themselves in financial terms, in terms of the need for diverting scarce legal, technical, and scientific expertise towards international negotiations and the subsequent operational oversight, but also at a more abstract level in terms of political capital, with governments having to prioritize where to engage their limited capacities. Risks can entail the possibility of reputational harm from negotiation failure as well as various types of blowback, for instance with novel rules causing unpredictable and undesired legal effects in the future. The existence of a collective action problem in the supply of institutional change aggravates these issues: even where states expect to gain from institutional change, they prefer *other* states to shoulder the associated costs and risks, the aggregate effect thus quite possibly being inaction.

The supply of institutional change is thus a non-trivial problem which is partially independent from the question of to what extent change would be beneficial.

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We thus need a conceptual framework for understanding how technology-induced demand for change filters through to the level of institutional outcomes. The problem is thus: given a configuration of technological promises and perils on the demand side, which factors can explain variation on the supply side? To emphasize once more, I conceive of this variation along a continuum that ranges from non-responses, to responses that are both shallow and narrow, to responses that are deep and broad. As discussed in Section 3.2, the working assumption behind this, which should be expected to hold in *most*, though probably not *all* cases, is that greater depth and scope in institutional responses corresponds to greater shares of promises being realized and perils being avoided. The corollary is that the supply deficit increases with decreasing scope and depth of institutional responses and reaches its maximum in instances of non-responses. Naturally, this is a somewhat schematic way of looking at things. At the same time, it provides a rather parsimonious way of thinking through the relations between institutional responses, on the one hand, and technological promises and perils, on the other. With the demand side of institutional responses being characterized by the configurations of promises and perils, I now turn to three theoretical perspectives for characterizing the supply side. As a final word of caution, I wish to stress that the analytical distinction between 'supply' and 'demand' that underpins this conceptualization should not be taken too literally. As a seminal paper on the matter puts it, the notion of supply and demand provides a metaphor for the analytical distinction between 'phenomena that . . . affect the desire for regimes, on the one hand, or the ease of supplying them, on the other'.[28] We should thus expect some endogeneity, as the factors that shape the demand side can partially overlap with the factors shaping the supply side.

The first factor is the international constellation of interests as *the* working-horse concept of rationalist cooperation theory. Interests take the form of preference rankings over a given set of decision alternatives regarding cooperative and non-cooperative outcomes. Within a given political context, these interests can diverge to different degrees. Minimal divergence indicates that participating states have similar or identical preferences and can thus coordinate on a common course of action with relative ease. Such situations are commonly referred to as *integrative bargaining*.[29] They are characterized by wide latitude for potential positive-sum outcomes under which all participating states improve on the status quo, although they may well do so to different degrees. While situations of integrative bargaining are thus highly amenable to cooperative solutions, they can nevertheless pose complex political challenges, as states will usually need to coordinate on one among several potential positive-sum outcomes. In the end, everybody wins, but some are bound to win more than others, and the central bargaining problem is to figure out *who* and *by how much*. By contrast, instances of distributive bargaining involve decision alternatives that create clear winners and losers, meaning that

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cooperative outcomes create net gains for some and net losses for others. The zero-sum logic of such situations dims the political prospects of finding cooperative solutions. States may still find ways to arrive at negotiated outcomes: by linking together disparate issues within one negotiation package, states can trade mutual concessions, with each of them offsetting the losses they incur on some issues with gains which they receive on others.[30] States may also be willing to tolerate *some* losses as a result of cooperative outcomes because they expect that, in the long run, their acquiescence will be reciprocated by others in a manner that is mutually beneficial.[31]

Constellations of interest vary in accordance with the relative dominance of integrative versus distributive bargaining. In general, as the weight of distributive elements increases, the scope of the resulting institutional responses should decrease: as the zero-sum logic in a given bargaining context intensifies, the range of issues for which states can negotiate mutually beneficial outcomes shrinks. The crucial caveat here is that situations with a strong tendency towards distributive bargaining may lead to the deployment of issue linkages, leading to outcomes of considerable scope at the level of broader negotiation packages. That is, a strong zero-sum logic may imply that issue-specific institutional responses will tend to be narrow in scope, yet this may be obscured by the broader package deals under which they are tied together with a host of other, disparate issues.[32] Conversely, situations with a strong tendency towards integrative bargaining may also result in surgical solutions that are highly circumscribed in scope, depending on what precisely states want and are attempting to achieve. As with other elements of my theoretical framework, the decreasing scope of institutional responses as the corresponding constellations of interest shift away from integrative and towards distributive bargaining should be understood as a *tendency* that characterizes a wide range of institutional contexts yet can be subject to countervailing factors as well as exceptions. What this means is that, as with other elements of the explanatory framework, context matters: the proposed linkage between scope and the international constellation of interests gives us some guidance on how the role of interests may elucidate the nature of institutional responses, yet we should be wary of applying abstract theoretical constructs to complex empirical situations in a mechanistic fashion. The same caveat applies for the other elements of my proposed framework.

Analogous to scope, as distributive elements become dominant in the international constellation of interests, institutional responses tend to become shallower: as interests become more heterogeneous, negotiated outcomes gravitate towards the lowest common denominator. There is a robust relation between interest diversity and cooperative depth: as increasingly diverse interests need to be accommodated, resulting outcomes will become less ambitious, elements for ensuring

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subsequent state compliance with those outcomes will become weaker, and the normative force of resulting rights and obligations under international law will decrease.[33] In a similar vein, constellations of interests that tend more towards integrative bargaining will be associated with deeper institutional responses, meaning that they mandate greater behavioural status quo deviations via rights and obligations that carry greater legal force and/or are supported by more extensive mechanisms for facilitating or enforcing state compliance.

The second perspective for explaining the depth and scope of institutional responses is the degree of *normative fit* between a novel technological challenge and the pre-existing set of applicable international rules. This concept of 'fit' has previously been applied to assess the degree to which the design of institutions corresponds to the properties of the policy issues or natural resource systems which they address.[34] Here, the notion of normative fit represents the ease with which new technologies can be integrated into extant regulatory structures. We can conceive of these structures at multiple levels of abstraction: from operational rules that entail highly situation-specific prescriptions for a narrow class of situations (e.g. on the international trade of animal products) to general rules, including principles of international law, that provide unspecific guidance applicable to a broad class of situations (e.g. the 'polluter pays' principle). All of these rules embody common understandings of appropriate behavioural standards – that is, 'institutionalized practices of a collectivity, based on mutual, and often tacit understandings of what is true, reasonable, natural, right, and good'.[35] The notion of normative fit captures the direction and purpose which pre-existing international rules prescribe for the regulation of novel issues, technological or otherwise, on the basis of shared understandings. It refers to the degree to which pre-existing rules provide unambiguous and authoritative guidance regarding how novel issues should be regulated and for what underpinning rationale. This can take place at fairly abstract levels, for instance when the no-harm principle in customary international law mandates regulatory approaches that limit or eliminate the risk of adverse transboundary effects from certain risk technologies. It can also take place at a more concrete level – for instance, when various international agreements on nuclear energy provide clear guidance for the regulation of small modular reactors, a next-generation type of nuclear reactor.[36] In either case, there is a shared understanding of 'how' and 'why' pre-existing rules matter for the regulation of a novel issue. This does *not* mean, though, that this issue can automatically be subsumed under these pre-existing rules without further action. Rather, the normative fit of a novel issue indicates the ease with which governance gaps can be closed through the extension of pre-existing international rules. Under conditions of strong normative fit, such an extension can take on a commonsensical character. As normative fit increases, more and more of the subcomponents that jointly constitute a novel issue can

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comfortably be accommodated by bringing them under the purview of pre-existing rules, and the authoritative guidance which those rules provide gives states more confidence to commit to deeper institutional responses.

Conversely, where normative fit is weak, pre-existing rules provide little guidance and thus leave ample space for political contestation and interpretative differences. Accordingly, actors' understandings regarding the modalities of, and justifications for, international technology regulation increasingly diverge, resulting in contestations over which pre-existing rules apply, and how.[37] With pre-existing rules not providing sufficient guidance, actors will gravitate towards regulatory models that align with their respective interests while simultaneously proposing ultimately unconvincing justifications for why their preferred models are the natural outgrowth of the pre-existing rules.[38] Weaker normative fit thus aligns with institutional responses that tend towards narrow scope and low depth. The limiting effect on scope results because, as normative fit decreases, fewer and fewer subcomponents of a novel issue can be feasibly accommodated within the extant regulatory structure. Similarly, the depth of institutional responses decreases in line with normative fit because states tend to shy away from strong legal and political commitments that might be at odds with the established international rules that already exist in a given issue area. Shallow responses are thus also a hedging strategy for avoiding the emergence of inconsistencies in international rules. With extremely low levels of normative fit, novel (technological) issues become disparate with pre-existing regulatory structures. These issues present governance challenges that are so outlandish and unprecedented that they cannot simply be integrated into the available governance systems. In such cases, we might, however, see lengthy and complex processes of de novo regime formation, resulting in the adoption of genuinely new sets of international rules rather than responses under pre-existing international institutions.

The third factor is the degree of *governance object constitution*. Whereas the previous two perspectives respectively revolved around interests and norms, this one relates to knowledge. Governance objects, such as novel technological challenges, do not suddenly come out of nowhere to emerge as full-fledged and clearly defined items on the political agenda. Rather, governance objects emerge from complex and contingent interactions across the dividing line between science and politics. They are 'entities or practices that have been constituted as self-contained units distinct from other objects',[39] although the degrees to which they are 'self-contained' and 'distinct' may vary. The constitution of governance objects typically involves the definition, characterization, and demarcation of natural kinds that exist mind-independently; the identification of the attached cause-and-effect relationships; and the transcription into specific policy problems in wider contexts of political norms, interests, and institutions. At the core of this theoretical perspective

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is cognition: how and why do we decompose reality in one way rather than another? For instance, how did it happen that climate change came to be understood as an *environmental* problem rather than an *economic* one?[40] Why are transgenic crops understood as unnatural and dangerous in many parts of the world, yet cisgenic crops, where genetic mutations have been induced through exposure to radioactive cobalt-60, are not? The processes behind how and why we come to perceive the world in the ways we do, and not in others, can be of great historical complexity. Why did we increasingly come to understand the solar system as heliocentric rather than geocentric after the sixteenth century? How did mainstream economics shift towards understanding the monetary supply, rather than the structure of aggregate supply and demand, as the primary driver of inflation during the 1970s? Other cases may be simpler, of course. The reasons why excessive salt consumption increasingly came to be seen as a public health risk since the 1960s while sugar got away largely unscratched are largely related to the smart public relations manoeuvres of the sugar industry that played down its own negative impacts on public health.[41]

The key issue here is that political problems do not simply exist. While there is arguably an objective and mind-independent reality, there is nothing particularly natural about how we see the world. We come to define, characterize, and delineate governance objects in one way rather than another and as a result of various factors that can operate at different historical scales. Afterwards, we simply consider them to be facts of life. Yet we also find variation in the degree to which entities can be understood as distinct and self-contained. Some governance objects have clear conceptual boundaries, are well-characterized, and are politically actionable. Others are fuzzy, ill-defined, and difficult to transcribe into concrete policy problems. Stronger constitutions, wherein governance objects have clear boundaries, are enmeshed in well-characterized causal chains, and are politically actionable, enable deeper institutional outcomes in contrast. Similarly, the scope of institutional outcomes will be greater in line with the relatively large cognitive bandwidth that states enjoy over a given issue. Weaker governance object constitution leads to shallower institutional outcomes: as states tend to be risk averse, they are prone to avoiding ambitious and precise commitments, possibly even backed by strong compliance mechanisms, on issues that are not well understood and that might subsequently lead to unexpected costs as well as legal and other complications.[42] Weaker object constitution also leads to a narrower scope of institutional outcomes, as governments zoom in on those subcomponents of a given issue that they are capable of cognitively pinning down. As governance objects become increasingly blurry and difficult to isolate, the propensity for institutional non-responses increases even when, in principle, gains would be available from the realization of technological promises or the avoidance of technological perils.

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These three perspectives, respectively centring on interests, norms, and knowledge, offer different explanations for the conditions under which international institutions do (and do not) respond to technological promises and perils, as well as for the variation in their responses. As constellations of interests become dominated by zero-sum elements, the scope and depth of institutional responses tends to decrease and the propensity towards non-responses increases. The same applies for decreasing normative fit and for the weakening of governance object constitution. Thus, as interests diverge, as the fit between novel technologies and pre-existing regulatory frameworks becomes more tenuous, and as they become more diffuse and ambiguous objects of international governance, we should expect the depth and scope of institutional responses to decrease and, accordingly, to become increasingly misaligned with the scale of the technological challenge. As noted, these conceptual relations need to be understood as broad *tendencies* that are likely to hold in most (albeit not all) instances, as they are bound to be enmeshed with diverse contextual factors that can potentially have offsetting effects. Moreover, there is significant interaction between interests, norms, and cognition. For such reasons, the three theoretical perspectives outlined earlier should not be mistaken for testable hypotheses. Rather, they are intended to provide guidance and orientation when trying to come to terms with the complexities and ambiguities of institutional responses to technological promises and perils. Or, to put it differently, they amount to proposed causal mechanisms that may be operational regardless of whether their respective effects can be observed empirically.

3.4 How Could International Institutions Respond in Better Ways?

The fourth question regarding institutions and technology which I follow in this text is normative in nature: in which ways *should* contemporary institutions be changed in order to align technological change with environmental sustainability? This perspective requires us to conceptualize the ways in which international institutions can affect technological developments in the first place. Indeed, when it comes to guiding, facilitating, enabling, and encouraging, but also monitoring and regulating, technological change for sustainability, we would naturally rather look at *national* institutions, especially in states with strong national innovation systems. Yet we may well accept the claim that national institutions have a comparatively greater impact on technological change than do international institutions, while simultaneously acknowledging that international institutions fulfil additional and complementary functions.

International institutions deal with the promises and perils of technological change in a transboundary context, from research to development to actual deployment. They can contribute to the supply of technological promises (impact

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management capacities as well as knowledge and information) as global public goods by facilitating diffusion and transfer. This can take place via mechanisms that encourage, reward, or even mandate such diffusion and transfer, via the removal of legal and regulatory obstacles, and indirectly by defining the international sharing of technological promises as appropriate behaviour that states and other stakeholders are generally expected to engage in. They can reduce injustice by shielding vulnerable groups from harmful technological impacts or by leveraging technology for benefitting these groups. The same analogously applies to the avoidance of technological perils. The first one, environmental harm, is perhaps the most obvious one. In the absence of adequate institutional arrangements, different types of transboundary harm can be difficult to detect, attribute, measure, prevent, reduce, or reverse. As they can take highly specific forms, abstract rules such as the 'polluter pays' principle or the harm principle are often insufficient. Rather, there is a need for specialized institutional arrangements designed with one particular issue area in mind. Institutional rules that enable effective risk assessment and risk management of novel chemical entities are unlikely to be effective for GM organisms or nanoparticles. Wherever there is the possibility (or the reality) of transboundary technological harm, dedicated and custom-tailored international institutional frameworks are indispensable. The same applies to the peril of injustice. Left unchecked, new and emerging technologies can easily produce injustice at the global scale, often along the conventional North–South divide. This is a consequence of global asymmetries, whereby high-innovation economies appropriate large shares of the gains associated with technological innovation and, in turn, generate negative externalities for other places on the globe. While this problem can be politically difficult to rectify, the global asymmetry in the distribution of technological gains and costs implies a need for rule-based responses through international institutions. With regard to the peril of crowding out feasible alternatives, the main governance challenge is to strike an appropriate balance between the risk of irreversible commitment to technologies that ultimately turn out to be infeasible and the risk of irreversible commitment to solutions that are feasible in principle yet end up failing because of the underpinning politics. The solution to this problem is, accordingly, the avoidance of overcommitment, something that can be incentivized through appropriate institutional design. For instance, international institutions can combine national targets with specifications regarding the means of implementation for achieving these targets. A cap on the extent to which negative emissions technologies may compensate national greenhouse gas emissions in line with international commitments would be an example of this. In this or other ways, by keeping the decision space open as wide and as long as possible, international institutions would mitigate the peril of the crowding-out effect.

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The preceding discussion is intended as a rough guideline for estimating how, in principle, international institutions might do a better job of leveraging the beneficial aspects of TNTs while mitigating their downsides. As I will discuss in Chapter 7, there are various additional complexities that figure into this once we take into account temporality and trade-offs.

3.5 Beyond International Institutions

The focus of this book is squarely on international institutions in the context of intergovernmental cooperation. There are good reasons for this. States are the most important actors in world politics, and international institutions are the primary means through which they can achieve cooperation on matters of collective interest under constraints that relate to problems of collective action and other factors. International institutions are always imperfect and frequently deficient, yet there are no alternative models that could deliver solutions superior in terms of effectiveness and fairness. At the same time, this is the appropriate moment to say a few words about the vast scholarly literature on transnational governance and related concepts that has emerged over the past three decades, and how that literature relates to the argument which I develop here.

The notion that non-state actors and non-state governance play a crucial role in world politics is nothing new. Arguably, the most important early contributions to the debate originated in neo-Marxism, notably from neo-Gramscian international political economy, which conceives of world order in terms of the interlinkages between ideas, institutions, and material capabilities that jointly constitute a larger 'historical bloc'.[43] Private actors form part of such larger social and historical structures just as state actors do, making any categorical distinctions between the two specious. Both here and in the wider debates in international political economy that commenced during the 1980s on the matter of globalization, theoretical approaches were primarily structural in nature.[44] Private actors, notably multinational corporations, mattered mainly in terms of their diffuse effects on the interests, incentives, and ideas that shape global politics, and much less in terms of their own agentic qualities. Only in the 1990s did scholarly attention towards private actors *as actors* increase and sustained engagement with the role of governance, both beyond the nation state and beyond international cooperation, emerge. That same period also saw the beginnings of widespread academic interest in non-state actors other than big business, particularly civil society organizations and the many ways through which they shape global politics. From the 2000s onwards, then, more sustained scholarly engagement with transnational governance emerged – that is, with the modalities of cooperation between non-state actors across multiple national jurisdictions.[45] Scholars also directed increasing attention

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to the role of non-state actors in international public policy, such as the influence of business on international environmental politics or of civil society in international arms control.[46] More recently, some scholars began theorizing the ways in which international organizations can leverage private actors and private governance initiatives in order to better achieve their various international policy objectives – a process referred to as 'orchestration'.[47] Others have looked at the differential growth dynamics of international organizations and private transnational organizations, as well as possible interactions between these institutional populations, from a framework known as organizational ecology.[48] Transnational governance, in other words, has gradually emerged as a booming paradigm in the study of world politics.

There is absolutely nothing wrong with this – in fact, given the spotty track record of 'conventional' international institutions (i.e. institutions operated by states and based on agreements that are binding under international law), it is worthwhile to also assess the capacity of alternative governance models to deliver on collective goals and interests from areas ranging from climate change to arms control. It is also certainly true that transnational governance has, at least in the most recent decade or two, been a much more dynamic field of study than conventional intergovernmental institutions. With this in mind, we may well ask whether the analysis of conventional international institutions has become anachronistic, both in terms of broader scholarly trends as well as in the context of real-world developments. This is a legitimate question. The answer to it defines the wider significance of the analysis and the findings presented in this book. Given the emergence of transnational governance, but also other developments such as the increasing trend towards the use of 'soft law' or 'low-cost institutions' in international politics,[49] why does it matter what conventional international institutions do (and what they do *not* do) regarding technologies that might become key to the sustainability of the global environment in the twenty-first century? If international institutions usually do not 'work', if they are systemically ineffective, if alternative models are showing much greater dynamism and possibly promise, why should we care?

These are legitimate issues to address. What needs to be borne in mind, though, is that the shortcomings of conventional international institutions, in terms of securing collective goals and interests in diverse areas of world politics, do not primarily result from deficits in the model of governance, but rather from the extraordinary difficulty of devising fair and effective global solutions in the context of incompatible interests and divergent norms as well as scientific, technical, economic, and other uncertainties. Conventional international institutions are not failing because they are conventional international institutions, but rather because they are attempts at solving problems with high degrees of intractability. What this means is that, in the end, whatever happens to be the governance model *du jour*

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is highly unlikely to offer better performance than the conventional approach revolving around formal international institutions based on binding international agreements. For instance, it is difficult to avoid the conclusion that the Kyoto Protocol has failed to deliver a global greenhouse gas emissions reduction pathway that is compatible with sustainable, safe, and equitable human development. However, it is another thing entirely to expect that alternative models, based on transnational initiatives and voluntary mitigation commitments of private actors, would deliver results that are in any way superior. This is because, to some extent, the structure of the problem matters a great deal more than the formal characteristics of its potential solutions – and, in fact, conventional international institutions at times do not get the credit which they deserve in an academic discourse that sometimes appears to be driven primarily by the predilection of novelty. The normative force of (binding) international law, the significant procedural legitimacy of multilateral cooperation through conventional institutions, and the credible commitments and expectations of diffuse reciprocity that those institutions engender are all unmatched by any other type of cooperative arrangement. For the issues discussed in this book as well as beyond, the emergence of transnational governance is a fascinating development, yet one that is unlikely to play more than, at best, a supplementary role to the functions performed by conventional international institutions, with all their well-known deficits.

3.6 Methodological Considerations

Before turning to the empirical application of the aforementioned conceptual framework in the following chapters, some methodological considerations are in order. First, the empirical focus of this text is on three broad technological fields: biotechnology, climate engineering, and mineral extraction beyond national jurisdiction. Within these fields, we find different TNTs that, to different extents, hold promises and pose perils. This case selection does not claim exclusivity: with varying degrees of plausibility, TNTs also exist elsewhere, such as in the field of artificial intelligence or in energy technologies such as hydrogen or, more speculatively, cold fusion. Two reasons inform my case selection. On the one hand, the three cases are characterized by high degrees of political salience as well as technological readiness. For each, there are sustained and contentious discussions on adverse and beneficial environmental implications, as well as associated issues of global governance. On the other hand, this case selection presents large variation in terms of technological promises and perils, but also in respect to institutional responses. In principle, this should facilitate the derivation of broader implications and insights that hold for TNTs beyond those discussed in this text. I return to the issue of generalization in Chapter 7.

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Second, the case studies in Chapters 4 to 6 revolve around institutional responses (and non-responses) to technological promises and perils. Given a limited number of relevant international institutions, institutional responses can easily be identified at the levels of formal legal amendments, of political decisions in institutional governing bodies or subsidiary bodies, as well as of technical and other guidance. Non-responses, which we can understand as 'institutional drift',[50] require a different approach. Some instances of such non-responses can be directly observed: this is the case when processes aimed at one or another type of institutional response end up failing, either because states are unsuccessful in pushing for a response or because intergovernmental negotiations collapse. Other instances are unobservable: this is the case when states do not even attempt to effectuate an institutional response, mostly because they consider the political prospects to be too limited, yet there are strong theoretical reasons for inferring that, in principle, demand for a response should exist. Unobservable non-responses are, in other words, instances where political demand for an institutional response can be inferred despite states not taking action towards that end.[51]

With this in mind, the case studies in the following three chapters are structured as follows. I begin each with an overview and introduction centred on the respective technological promises and perils. I then elaborate on the wider political debates that revolve around specific technological applications. I then discuss the pertinent institutional responses (which I describe in terms of scope and depth) as well as non-responses. In the chapter conclusions, I discuss how institutional outcomes are explicable in terms of the three theoretical perspectives outlined previously (interest constellations, normative fit, and object constitution). I close by considering hypothetical institutional designs that might facilitate the realization of promises and the avoidance of harms more effectively than is the case under the status quo. Chapter 7 then pulls together the different strands and develops broader implications on the basis of a cross-case analysis.

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4. I use the terms 'rules', 'norms', and 'principles' somewhat loosely and interchangeably. In my understanding, these do not differ in kind but rather refer to behavioural prescriptions at different levels of abstraction. Whereas 'rules' have an operational nature, 'norms' are more diffuse codifications of what states should (and should not) do, with 'principles' providing conceptual frameworks for interpreting the degree to which rules and norms do (and do not) apply to different issues in international politics. For the most part, I will be using the term 'rules', only invoking 'norms' and 'principles' to specifically refer to, respectively, abstract and decontextualized behavioural prescriptions or interpretative frames.
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