

Uncertainty in times of ecological crisis: a Knightian tale of how to face future states of the world

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Abstract

How do we face uncertainty in times of crisis? Debates in International Relations often struggle to disentangle the processes involved in turning the uncertainty of a crisis into decisions and actions. Drawing on the analysis of Frank H. Knight, we argue that decisions and actions taken by international actors in times of crisis are underpinned by the way that information is accessed, interpreted, and evaluated in order to claim reliable knowledge for shaping future states of the world. We illustrate our argument with the global politics of the ecological crisis and three contrasting methods used by international actors to convert the time of the crisis into decisions and actions: United Nations agencies, financial accounting standard-setters and central banks.

Keywords

Crisis, environment, International Political Economy, International Relations, risk, uncertainty

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We live in a world full of contradiction and paradox, a fact of which perhaps the most fundamental illustration is this: that the existence of a problem of knowledge depends on the future being different from the past, while the possibility of the solution of the problem depends on the future being like the past.

Knight, 1921: 313

Introduction

The war in Ukraine, the resumption of open conflict in the Middle East, a renewed danger of nuclear escalation, the COVID-19 pandemic, market meltdowns, climate change and the destruction of ecosystems on a planetary scale, all share common characteristics despite being distinct phenomena. They describe a situation of crisis in which political actors face a threatening situation that demands vital decisions and actions, the full consequences of which remain highly uncertain. This is especially true when individual situations interact in potentially unexpected ways, giving rise to feedback loops and overlaps – which is now happening to such an extent that the term ‘polycrisis’ has gained currency to define the world we live in (Tooze, 2022). Shaping international political action in such conditions raises the question: How do international actors face uncertainty in times of crisis?

While uncertainty is often recognized as the key challenge in times of crisis (Blyth, 2002; Nelson and Katzenstein, 2014), debates in International Relations and International Political Economy struggle to disentangle the processes involved in turning the uncertainty of a crisis into decisions and actions. The concept ‘crisis’ comes from the Greek word *Kairos*, which means a moment of decision in which it is important that something be done (Castoriadis, 1986: 7). As Hay points out, drawing on Koselleck’s conceptual history, situations of crisis are ‘moment[s] of decisive intervention’ (Hay, 1999: 317) during which actors ‘have to “choose,” to “judge,” to “decide”’; as a means of “oneself,” to “quarrel” [. . . which involves] a verdict or judgment’ (Koselleck, 2006 [1972]: 358–359). When political action is taken under such circumstances, those responsible claim some form of knowledge in support of that course of action. In this article, we propose to disentangle the processes involved in turning the uncertainty of a crisis into decisions and actions. We argue that the decisive moments of intervention by international actors in times of crisis depend first on different ways of accessing information, and second, on the ability to interpret and evaluate this information to we claim reliable knowledge about uncertain future states of the world.

To sustain this argument, we draw on the analytical framework devised by the economist Frank H. Knight (1921) in his book *Risk, Uncertainty and Profits* to distinguish between risk and uncertainty – the former likely to be measured, the latter remaining unmeasurable. While Knight’s well-known distinction was devised to understand why an imperfect knowledge of future changes can form a core explanation of the origins of profits in a capitalist economy, his analysis can also be applied to many other dimensions concerned with an anticipation of future states of the world, including in international relations. According to Knight, examining the meaning of uncertainty in a changing world requires nothing less than ‘some inquiry into the nature and function of knowledge

itself' (p. 209). Recent scholarship of *Risk, Uncertainty and Profits* posits that Knight 'held that uncertainty implies political and economic complexities far beyond any planner, and . . . saw institutions, not as reducing uncertainty, but as evolving guides that aid individual actors in the navigation of their own uncertainty' (Faulkner et al., 2021: 869; see also Packard et al., 2021). Here we are interested in the specific methods used to enable such navigation, given the uncertain future state of the world. The three methods devised by Knight to reduce uncertainty are based on distinct probabilistic calculus likely to project and anticipate future states of the world, and on the limits of such reasoning. The first one relies on statistical probability calculus; the second on estimates of probability; and the third on mere judgement with limited ability to reduce uncertainty, the latter remaining unmeasurable.

It is from this particular perspective that we believe Knight's methods for coping with risk and uncertainty provide fruitful insights for scholars of International Relations and International Political Economy in understanding how international actors come to claim reliable knowledge as a basis for decision and action in times of crisis. Some other authors have brought Knight's concepts of risk and uncertainty back into global politics (Dannreuther and Lekhi, 2000; Jarvis, 2011; Maechler and Graz, 2022) including an examination of how international actors may face the limits of their own rationality in times of economic and financial crises (Best, 2008; Blyth, 2002; Clarke, 2021). These studies remain, however, at a high level of abstraction, with a focus on distinguishing between measurable risk and unmeasurable uncertainty. Here, we look at the concrete methods proposed by Knight to face uncertain states of the world and how these can inform our understanding of contemporary crises.

We illustrate our argument with the global politics of the ecological crisis. By ecological crisis, we mean not only climate change but also biodiversity loss and all ecosystems degradation, and the ways these changing ecological processes interact with each other and with political, economic and social factors at a global level, creating potentially non-linear and unexpected transformations. Such a comprehensive, holistic and global understanding of the ecological crisis and of its interactions with human societies makes it very difficult to fully grasp, or to anticipate, or, in other words, to turn into manageable risks. As Chenet and his co-authors underscore regarding the sole case of climate change, 'this involves a situation where many options are "possible" or "plausible"' (Chenet et al., 2021: 3); it entails 'a coupling of complexity and multiplicity', so that it eventually 'becomes impossible to assign a probability to what is going to happen in the future' (Chenet et al., 2021: 5). The same goes for biodiversity, whose 'complexity and abstractness' (Bartkowski et al., 2015: 1) makes it 'subject to *radical uncertainty*' (Kedward et al., 2023: 772, original emphasis). If we add to this the interactions between biodiversity loss and climate change (IPCC and IPBES, 2021), predicting future states of the world in the age of ecological crisis becomes to all intents and purposes impossible.

In this article, we show that several propositions to shape a decisive moment of intervention out of a state of ecological uncertainty have been made since the 1980s. These proposals differ greatly in the way they foresee access to information on the ecological crisis and the way this information could potentially be interpreted and evaluated by political actors. We discuss three contrasting ways in which international actors could

claim reliable knowledge as a basis for converting the suspended time which characterizes a crisis into political decisions and actions, aligning with Knight's above-mentioned methods to face uncertain states of the world. The first method is biophysical statistics for environmental dimensions of economic activities; as an example, we discuss the estimates of probability used by United Nations agencies since the late 1980s. The second is sustainability reporting methods developed by financial accounting standard-setters over recent years, which bring the ecological crisis into the realm of statistical probabilities. The third reflects space left for true uncertainty and human judgement rather than risk calculus; we discuss this in the context of central banks, focusing especially on the landmark *Green Swan* report published in 2020 by the Bank for International Settlements (Bolton et al., 2020).

The analysis of these different ways to make sense of the uncertainty of the ecological crisis draws on three types of qualitative material. First, we conduct a documentary analysis of the reports, standards, methods and consultation documents, reflecting, in our view, the most important advancements in those different fields. Second, we build on 14 semi-directed interviews with policy experts, mainly personnel of the United Nations and of nature conservation organizations, and private-sector consultants (statisticians, economists and accountants). Finally, we draw on observations of meetings dedicated to the standardization, promotion, explanation or diffusion of these economic and financial tools designed to cope with the challenges of the ecological crisis (26 meetings ranging from 1 hour to several days, followed both online and in-person from March 2019 to October 2023). These meeting observations include, but are not limited to, the activities of the London Group of Environmental Accounting, which is an arena of national and international experts within the United Nations Statistics Division; the consultation processes for sustainability reporting standards organized under the aegis of the International Financial Reporting Standards Foundation; as well as conferences where the theme of green central banking is discussed, including the annual *Green Swan* conference and others organized by the Network for Greening the Financial System (NGFS). This diverse material allowed us to capture the different ways in which major actors of the global political economy propose to make sense of the uncertainty of the ecological crisis.

The article is organized around four sections. We start with the concept of crisis in International Relations scholarship. We then examine the relevance of Knight's work regarding the ability to claim reliable knowledge for decision and action in times of crisis. The third section starts by situating the global politics of the ecological crisis in the realm of uncertainty. This is followed by three sub-sections, which follow Knight's distinct methods to face uncertain states of the world, each reflecting one of our three above-mentioned illustrative cases. The conclusion wraps up the argument and suggests avenues for further research.

Making sense of crises

How does International Relations scholarship examine the ability of international actors to actualize a decisive moment of intervention in a situation of crisis marked by uncertainty? Unsurprisingly, scholars have given prominent attention to states' security concerns and potential system-wide consequences in such moments. As Brecher and Yehuda

(1985: 17, 21) showed decades ago with reference to the theory of international systems, crises are viewed as such great disruptions that they bring new ‘stages of conflictual behaviour among states’ and are likely to lead to ‘international earthquakes, that is, catalysts to system change’. As Allison remarked with explicit reference to uncertainty, the actions of states are aimed at establishing a negotiated and controlled environment, not just to ‘estimate the probability of future occurrences’, but to seek ‘uncertainty avoidance’ (Allison, 1969: 700, 701). Such actions are understood to be constrained by a bureaucratic structure, whose parties ‘differ substantially about what their government should do’ (Allison and Halperin, 1972: 42).

From the end of the 1990s onwards, crisis-thinking has been part of a perspective which views international relations as more unstable than during the Cold War, and as opening a ‘range of uncertainty and unpredictability about the present and foreseeable future’ of hegemonic transitions (Arrighi and Silver, 2001: 258). The 2008 financial crisis was a further prompt to scholars to look beyond mere calculative rationalities supporting the knowledge deemed reliable as the basis for political decision and action at such critical moments (Best, 2009; Kessler, 2009; Lockwood and Nelson, 2018; Nelson and Katzenstein, 2014). Such scholarship often draws on constructivist, post-structuralist and cultural political economy to shed light on what Samman (2015) describes as the historical imagination of crises: ‘Where early IPE scholars saw in crises the expression of objective forces and limits, contemporary theorists now also see the work of subjective interventions and historical myths, projections, or fictions’ (p. 966). Blyth (2002) emphasizes the social construction of a crisis as a narrative in which uncertainty plays a full part: crisis ‘becomes an act of intervention where sources of uncertainty are diagnosed and constructed’ (p. 10). Some studies push the subjectivity involved in actualizing the decisive moment of intervention a step further. They conceive moments in which political action copes with the uncertainty of crises as reflecting epistemic and discursive constructs: ideas, beliefs and imaginaries trump material constraints and structural contradictions (Aradau and van Munster, 2012; Mckeown and Glenn, 2018; Prozorov, 2021).

In contrast, Gramscian-inspired analyses seek to retain both the subjective and the objective dimensions of crises in appraising such decisive moments of intervention. Gramsci’s claim is well known: ‘the crisis consists precisely in the fact that the old is dying and the new cannot be born; in this inter-regnum a great variety of morbid symptoms appear’ (Gramsci, 1996: 283, § 34, Cahier 3; our translation). A crisis is an objective state of affairs resulting from a structural contradiction between opposing social forces supporting the production of goods and services in the capitalist accumulation regime. At the same time, it is a subjective representation of such a state of affairs which leads, as Cox (1987) points out, to ‘a disarticulation between social groups and their putative political leaders, in sum a crisis of representation’ (p. 273). Gramscian-inspired approaches see ‘organic’ intellectuals as the key actors when it comes to mobilizing knowledge to face such an uncertain future, and rebuilding the articulation between political organizations and new social forces in such a way as to give birth to a new order, that is, hegemony (Babic, 2020; Gill, 2011; Ougaard, 2016). Yet, as Babic (2020) points out, Gramscian-inspired approaches often stumble when it comes to disentangling such processes from the ‘macro-level of the global political economy’ (p. 771) or configurations of social forces. As a result, they fall short of considering how actors such as

‘organic’ intellectuals truly proceed when supporting political action and claiming reliable knowledge about the implications of that action for future states of the world.

Recent International Political Economy scholarship that draws on uncertainty in the analysis of crisis discusses in more forthright terms the status of knowledge used to take political action. An important aspect in this approach is the relationship between epistemic authority mobilized in such contexts and the institutional change expected to result from the crisis. During a crisis, agents are indeed ‘unsure as to what their interests are, let alone how to realize them’ (Blyth, 2002: 9). For Nelson and Katzenstein (2014: 362) crises are thus uncertain times during which actors rely on social conventions or ‘shared templates and understandings’ to make decisions. Conversely, Best (2010) has shown how subjective dimensions such as economic ideas, development beliefs and actions based thereon can lack the epistemic authority supposedly derived from ‘measurement and objective fact (assuming that we were ever in it)’ (Best, 2010: 42), using ignorance as a practical resource instead (Best, 2022). From such a perspective, uncertainty in its epistemic dimension becomes ‘an inevitable human condition’ (Kessler, 2011: 2181). Studies have shown that actors face such uncertainty by relying on their existing beliefs and worldviews, and fitting them to the new circumstances generated by the crisis (Carstensen, 2013; Golka and van der Zwan, 2022). But here again, studies struggle to sort out the processes underpinning the decisions and actions taken in such moments of decisive intervention marked by uncertainty. In the next section, we turn to Frank H. Knight’s method for facing uncertain future states of the world, and explain how it provides powerful heuristics to make sense of the processes involved in converting the suspended time of a crisis into political decision and action.

Knight, risk and uncertainty

Knight introduces a distinction between risk and uncertainty as a way to understand concrete processes that underpin market mechanisms. As Faulkner et al. (2021: 860) point out, Knight is ‘concerned with the problem businesspeople face when having to make decisions in the face of less than certain knowledge of what the outcomes of their actions will be’. However, his thinking extends well beyond business phenomena: uncertainty ‘is one of the fundamental facts of life. It is as ineradicable from business decisions as from those in any other field’ (Knight, 1921: 347). Aware of the philosophical, social and institutional dimensions impinging upon human behaviour, Knight belongs to what most scholars today would call the evolutionary tradition of economics. Evolutionary approaches in social sciences presume that scientific knowledge aims at providing explanations of the origins, developments and transformations of individuals and institutions. They thus put great emphasis on processes of change, including innovations, complex systems, institutional and non-linear dynamics and transformations (Dopfer, 2006; Gruszka et al., 2020; Hanappi and Scholz-Wäckerle, 2017). Knight (1921) stresses that it is ‘a world of change in which we live, and [consequently] a world of uncertainty’ (p. 199), and that ‘in an absolutely unchanging world the future would be accurately fore-known, since it would be exactly like the past’ (p. 313). From this view, it is precisely because situations of crisis entail a radical change from the past that they are characterized by a high level of uncertainty: ‘Conditions are subject to unpredictable fluctuations’ (Knight, 1921: 38).

The few scholars in International Relations – but more specifically in International Political Economy – who refer to Knight provide critical analyses of moments of crisis related to the rise of finance-led capitalism, neoliberalism, and globalization (Best, 2008; Blyth, 2002; Carstensen, 2013; Clarke, 2021; Dannreuther and Lekhi, 2000; Katzenstein and Seybert, 2018; Kessler, 2011; Lockwood and Nelson, 2018). For instance, according to Dannreuther and Lekhi (2000: 589), Knight helps us understand how different narratives on globalization are premised on distinct views of substituting risk for uncertainty and particular calculation techniques to transform threats into opportunities. Lockwood and Nelson (2018) underline the limits of calculative rationality in anticipating the future, since global financial markets are ‘realms of deep, “Knightian” uncertainty’ (p. 167). Finally, Blyth (2002: 32) emphasizes the role of Knightian uncertainty in ‘periods of economic crisis’, or ‘during the periodic breakdowns of capitalist economies’, when risk-based management becomes inoperative. While these scholars emphasize how financial governance enters the realm of Knightian uncertainty in moments of crisis, they overlook how Knightian concrete methods can inform our understanding of global crises, particularly when it comes to ways of facing the ecological crisis. In what follows, we refer to Knight’s reasoning by drawing as much as possible from the original text using direct quotations, although we are aware that a large body of scholarship exists on the contested historiography of Knight’s legacy,¹ notably the fact that his approach is ‘deliberately paradoxical’ (Burgin, 2009: 513).

As discussed earlier, crises describe moments of decisive intervention drawing on incomplete knowledge to face uncertain future states of the world. Political decisions and actions in such moments involve coping with similarly shifting situations and uncertainties. They can bring into play a risk calculus to manage, anticipate and objectify any future course of action through numbers: ‘[t]he fundamental fact of organized activity is the tendency to transform the uncertainties of human opinion and action into measurable probabilities’ (Knight, 1921: 311). In contrast, faced with the impossibility of factoring in all phenomena when appraising a future course of action, political decisions and actions can also rely fundamentally on subjective judgement.

The distinction that Knight makes between risk and uncertainty is based on just such opposing ways to project knowledge into the future and make use of quantitative and probabilistic reasoning to this end. Knight (1921) believed that it is indeed important to ‘estimate the given factors in a situation and also estimate the probability that any particular consequence will follow from any of them if present in the degree assumed’ (p. 214). In this context, Knight (1921) not only distinguishes between risk, ‘a quantity susceptible of measurement’, and uncertainty, which is ‘unmeasurable’ (pp. 19–20). He also introduces a pragmatic method for identifying the information required and how to treat it to devise a probabilistic reasoning. For this, he draws on well-known insurance markets, whose ability to function properly ‘depends upon the measurement of probability on the basis of a fairly accurate grouping into classes’ (Knight, 1921: 246). Such actuarial calculus is not only based on large and reliable numbers, but also on ‘classification of instances’, although as Knight points out, truly homogeneous classifications are rare. It is from this reasoning that Knight introduces his three-pronged typology to differentiate types of probability situations.

The first, a priori probability, characterizes numbers resulting from a fully homogeneous classification of instances such as multiple throws of a dice. Knight (1921) explains that ‘we hardly find in practice really homogeneous classifications (in the sense in which mathematical probability implies, as in the case of successive throws of a perfect die)’ (p. 246). This type of uncertainty reduction method thus hardly applies to the analysis of global crises; the latter are not only theoretical challenges. The second, *statistical* probability, rests on an ‘empirical classification of instances’ (such as fire hazards or life expectancy) (Knight, 1921: 225). This form of probability is widely used in insurance markets. It is based on a ‘high degree of confidence that the proportions found in the past will hold in the future’ (Knight, 1921: 225). According to Knight (1921), statistical probabilities are thus ill-equipped to deal with radical change, as they treat the future as if it was the past. Finally, *estimates* of probability rest on ‘no valid basis of any kind for classifying instances’ (Knight, 1921: 225). According to Knight (1921), it is, however, possible to reduce an estimate ‘to a probability of the second or statistical type’ (p. 225) by creating equivalences between instances. The difference between risk and uncertainty is thus only a matter of degree when it comes to the relation between statistical probability and estimates of probability. In contrast to this three-pronged typology of probabilities, all based on forward-looking projections of past data, *true uncertainty* cannot be measured. In such a case, one can only rely on judgement and sense-making:

The practical difference between the two categories, risk and uncertainty, is that in the former the distribution of the outcome in a group of instances is known (either through calculation a priori or from statistics of past experience), while in the case of uncertainty this is not true, the reason being in general that it is impossible to form a group of instances, because the situation dealt with is in a high degree unique. (Knight, 1921: 233)

Thus, Knightian uncertainty – or true uncertainty – cannot be turned into risk on the basis of probability calculus processing past experiences, no matter the amount of information available, since ‘the situation dealt with is in a high degree unique’ (Knight, 1921: 233). Here, judgement and ‘opinions (and not scientific [i.e. statistical] knowledge) actually guide most of our conduct’ (Knight, 1921: 233).

Knight’s distinction between risk and uncertainty and his methods to face uncertain future states of the world can also inform International Relations scholars’ conceptualization of crisis. Knight viewed future projection of knowledge based on risk probability calculus as dependent on the ability to gain access to data for ‘empirical classification of instances’. In the same way, decisive moments of intervention by international actors in times of crisis depend on access to information and the ability to interpret and evaluate this information in such a way as to claim knowledge about uncertain future states of the world. Actors facing a situation of crisis often take action in such moments by claiming the knowledge required to substitute risk for uncertainty. Yet, such situations also face limits. Actors may admit that they lack knowledge about the results of their actions in the future in a world of profound changes. It is in such cases that moments of decisive intervention may recognize true uncertainty by relying on judgement, which can (for instance) take the form of scripts and scenarios.

Our analysis draws on this framework to appraise how major actors of the global political economy imagine moments of decisive intervention to cope with the uncertainty involved in the global ecological crisis. Each of our three cases illustrates one of the three ways for actors to access information and evaluates it in order to take decisions and actions in times of crisis: estimates, statistical probabilities and judgement. But first, we situate the global politics of the ecological crisis in the realm of uncertainty, highlighting the limits of mainstream economic calculations in this regard.

Facing uncertainty in the global politics of the ecological crisis

Uncertainty has characterized the global politics of the ecological crisis right from the beginning. The Final Declaration of the 1972 United Nations Conference on the Human Environment (or Stockholm conference) set the roots of the ecological crisis in uncertainty: '[t]hrough ignorance or indifference we can do massive and irreversible harm to the earthly environment on which our life and well-being depend' (United Nations, 1972: 3). Conversely, the reduction of uncertainty was seen as part of the path towards a more desirable ecological future: 'through fuller knowledge and wiser action, we can achieve for ourselves and our posterity a better life in an environment more in keeping with human needs and hopes' (United Nations, 1972: 3).

Massive progress has been achieved in the biophysical knowledge of the ecological crisis, for which international political consensus has emerged (IPBES, 2019; IPCC, 2021). The same cannot be said for the global economic policies needed to deal with the crisis. Although limited to climate change, carbon pricing is a good case in point. This economic policy instrument has been promoted for years by the international climate regime, from Kyoto to Paris (Green, 2021). The models driving these policies are based on historic science–policy interactions (van Beek et al., 2020), in the spirit of statistical probabilities based on past data translated into single economic metrics. These models involve a pre-determined 'discount rate' which values the cost of climate change in the present as compared to the future. More precisely, it sets the outcome of an assumed economically 'optimal' level of carbon taxation in the present, which would result in an equally assumed 'optimal' level of climate change in the future. These models and the assumptions that underpin them are highly contested (Condon, 2023; Randalls, 2011), including among economists who use them to propose future economic pathways in the face of the climate crisis. The formula 'how much and how fast' from the recipient of the 2018 Nobel Memorial Prize in Economic Sciences, William Nordhaus, is basically a dispute with another illustrious economist, Nicholas Stern, regarding levels of taxation, and thus regarding the assumptions driving the models (Nordhaus, 2007; Stern, 2006). When political action for a carbon tax has claimed knowledge based on some specific economic analysis, it has rarely been productive. Carbon pricing has not produced the desired environmental outcomes when applied to multinationals; reductions on emissions are limited (Green, 2021). And when applied to individuals, France experienced unexpected social and political protests (Mehleb et al., 2021). More generally, the complex relationships between environmental, social, economic and political issues epitomize the difficulties faced by mainstream economic calculus, largely based on statistical

probability calculus, when it comes to informing political action in times of ecological crisis.

Political actors are often confronted with the predicament of acting despite the controversy of contested measurements. In this situation, they can either act in a state of uncertainty or wait for the ‘right measure’. This dilemma was well illustrated during the 2022 European Business and Nature Summit, dedicated to shaping the European business environmental agenda, when two panellists took opposite standpoints: ‘We live in a world of uncertainty, but we need to act now’, was the position of one, while the other argued that ‘if it doesn’t get measured, it doesn’t get to the point’, meaning that in the absence of measures, decisions and actions taken in a crisis situation will miss their pre-defined target.² We now present, in more detail, three cases that illustrate in different ways this tension between acting from different states of risk, or from uncertainty. More specifically, we discuss three ways in which the analytics of Knight provide insights into how international actors claim reliable knowledge about uncertain future states of the world so as to take decisions and carry out actions in times of ecological crisis.

Estimates of probability and biophysical international statistics

A number of methods have been developed since the early-20th century to make sense of the interactions between economic activities and the natural environment (Maechler and Boisvert, 2023a; Martinez-Alier, 1987). For instance, ‘energy flow accounting’ assesses flows of energy according to different scales and metrics commonly used in thermodynamics, providing a measure of ‘the amount of energy used by socioeconomic systems’ (Fischer-Kowalski et al., 2011: 856). The best-known ‘material flow accounting’ objectifies a multiplicity of metabolic relations that different nations, or regions, have with matter (Haberl et al., 2016). As a counterpoint, or as a complement, to the traditional ‘wealth of nations’ (based on Global Domestic Product), material flow accounting purports to reflect the ‘weight of nations’.

At the international political level, attempts to provide such measures of the environment and its dynamic relationship with the (macro)economy have been subject to intense debates since the late 1980s, involving many national and international statistical offices. Several options have been considered and discussed in Europe, in the United States and at international conferences under the aegis of the World Bank and the United Nations Environmental Programme (UNEP) (Ahmad et al., 1989; Lutz, 1993; Repetto et al., 1989; Uno and Bartelmus, 1998). Parties to the 1992 Rio Earth Summit decided to set up biophysical satellite accounts for the environment, viewed as ‘a complement to, rather than a substitute for, traditional national accounting practice’ (United Nations Conference on Environment and Development, 1992: 73).³ The United Nations Statistical Division (UNSD) followed suit with the development of the System of Environmental-Economic Accounting (SEEA). After difficult negotiations on methodological issues (Bérard, 2019), the SEEA gained international standard status in 2012 (United Nations, 2014). However, as we will see below, the existence of a methodology, even a recognized international standard, remains insufficient for providing knowledge and guiding decision and action.

The SEEA ‘puts statistics on the environment and its relationship to the economy at the core of official statistics’ (United Nations, 2014: vii). More precisely, the SEEA provides an empirical classification system for the environmental dimensions of productive economic activities, including air emissions, energy flows, ecosystems, lands, material flows or water. However, the SEEA encountered a number of practical problems in its operationalization (Holmes and Yarrow, 2023), starting with the collection of the vast amount of data required to ensure access to full information (Maechler and Boisvert, 2023a). Although a growing number of states have been developing such data collection capacities since the official enforcement of the standard in 2014, there are still only 66 states that have reached the final stage of ‘regular compilation and dissemination’ (United Nations Statistics Division, 2023: 5). While most European Union countries now comply with the standard, it is acknowledged, including by a Eurostat senior bureaucrat, that it takes ‘around ten years to change the data collection framework, then ten years for it to be properly implemented’.⁴

The SEEA is close to Knightian estimates of probability: it measures the environment according to various biophysical scales and metrics. This statistical system can theoretically be connected to traditional economic statistics, such as GDP as defined by the United Nations System of National Accounts (SNA). Experts try to stay as close as possible to already ‘agreed concepts, definitions, classifications and accounting rules’ (United Nations, 2014: viii). While comparable, however, the SEEA and GDP are not commensurable. This would require biophysical information to be turned into monetary equivalents to provide something like the ‘green GDP’ proposed in the early days of this accounting system (Repetto et al., 1989).

While political actors may in the future have access to the information provided by the SEEA, it is still not certain that they will be able and willing to interpret and evaluate such information. With its multiple metrics, the SEEA is often considered too complex,⁵ or, in Knightian terms, unable to provide a ‘classification [that] would be carried far enough on this basis to be of substantial assistance in simplifying our problems to the point of manageability’ (Knight, 1921: 206). In contrast, monetary metrics processed into cost-benefit analyses from which statistical probabilities can be made, remains an ideal of public rationality for dealing with more or less uncertain phenomena (Porter, 2007). An employee of UNEP involved in promoting the implementation of the SEEA suggested that monetary valuation is more ‘policy-relevant [than biophysical indicators]. It is important for fundraisers and policymakers who are familiar with it’.⁶ Others claim that ‘decision-makers want monetary valuations’, and that ‘it is much easier to communicate with decision-makers with monetary data’.⁷ From this viewpoint, economic valuation is ‘how the world operates’; money is ‘the language that people share’.⁸ This epitomizes a conflict among SEEA experts over two different methodologies: the original method (called the Central Framework) which focuses on biophysical dimensions of economic activities (United Nations, 2014); and a new method, which acquired the status of international standard in 2021, focused on the measurement *and* monetary valuation of ‘ecosystem services’ (United Nations, 2021).

Monetary valuation became increasingly popular in environmental governance debates following a process initiated in the 1990s and described as ‘valuation-centrism’ (Maechler and Boisvert, 2023b). Theoretically, monetary valuation entails a world of full

equivalences. It brings environmental issues into the realm of statistical probabilities, and environmental concerns closer to economic, or even financial, rationalities and instruments. This next step in reducing the ecological crisis to probability measurements was highly publicized in a speech delivered in 2015 at the insurance and reinsurance market Lloyd's of London by Mark Carney, successively governor of the Bank of Canada and then the Bank of England. In this speech entitled 'Breaking the tragedy of the horizon – climate change and financial stability',⁹ Carney underlined the uncertainty of climate change processes not accounted for – and thus not (yet) priced – by global financial markets. According to Carney, 'climate-related risks' could result in an unexpected 'climate Minsky moment' (Carney, 2018: 2) that 'even the [existing] most advanced models are not able to predict' (Carney, 2015: 6). He thus proposed the production of 'better [monetary] information', taking the form of climate-related risks equivalent to traditional financial risks, 'to allow investors to take a view' (Carney, 2015: 9). This proposition of reducing environmental issues to statistical probability calculus prompted financial accounting standard-setters to engage in the global politics of the ecological crisis. This is what we turn to next.

Financial accounting: statistical probabilities to substitute risk for uncertainty

In 2019, Carney's shadow hovered over the annual session of the Intergovernmental Working Group of Experts on International Standards of Accounting and Reporting (ISAR).¹⁰ Attached to the United Nations Conference on Trade and Development (UNCTAD), this body of experts promotes good practices in corporate accounting, and its annual session brings the global financial accounting community together to reflect on the future of accounting standards and practices. 'The discussion took on a whole new dimension [after Carney's 2015 speech]. Since investors realized that climate is a financial risk, it is also an accounting matter', explains the convenor of this international accounting conference.¹¹ 'Accounting matter' here refers to standards developed by the International Accounting Standards Board (IASB) and used in 144 countries across the globe. In recognition of this new dimension, the International Financial Reporting Standards (IFRS) Foundation, which governs the IASB, decided to include environmental issues within its mandate. In September 2020, the IFRS Foundation launched a project called 'sustainability reporting' that would provide 'a set of comparable and consistent standards [that] will allow businesses to build public trust through greater transparency of their sustainability initiatives' (IFRS Foundation, 2020). In March 2021, it announced the creation of the International Sustainability Standards Board (ISSB) to produce these new standards. Through the compilation and disclosures by companies of the data required by the future standards, the IFRS Foundation claims to provide its users, that is, investors, with reliable information to act against climate-related risks and, more generally, to contribute to an exit strategy from the ecological crisis (Maechler, 2023).

This system of 'sustainability reporting standards' is no different from traditional financial risk management. Indeed, the overarching principle to appraise the relevance of supposedly transparent information for financial calculus is derived from the accounting

concept of *financial materiality*. Although this concept is contested and subject to multiple interpretations (Puroila and Mäkelä, 2019), it is treated by the IFRS Foundation – and by financial actors in general – as an objective fact (Clark, 2019), reducing the information accounted for to that deemed relevant for the future decisions of investors (Kabureck, 2019), the latter being viewed as rational, calculative, predictive economic beings (Young, 2006).

More specifically, companies will have to identify and assess their exposure to climate change, and possibly in the future to biodiversity (loss),¹² and then translate this exposure into financial risk metrics.¹³ The target audience – ‘potential investors, lenders and other creditors’ (IFRS Foundation, 2022: 3) – will interpret the information in such a way as to make future projections based on these financial risk metrics easily comparable with other financial information, thus aligning with statistical probability calculus. In the IFRS language, investors will be able to assess the ‘enterprise value’ that is exposed to climate change, defined as the ‘expectations of the amount, timing and uncertainty of future cash flows over the short, medium and long term’ (IFRS Foundation, 2022: 10). The IFRS approach is thus fully in line with financial risk management, a domain where uncertainty is in fact ‘synonymous with risk’ (Clarke, 2021: 974), and sees decision and action related to the ecological crisis as depending on the disclosure and right pricing of risk for investors (Maechler, 2023). Yet, if ‘unpredictable fluctuations’ (Knight, 1921: 38) that cannot be captured by the calculation and pricing of probabilities occur in business life, this is all the more true of the global politics of the ecological crisis, including climate change, for which the future cannot be ‘conceptualised as a replication of the past’ (Chenet et al., 2021: 4). This applies to the IFRS standards that provide statistical probabilities associated with climate-related risks, but also to the above-mentioned SEEA, including when environmental information is presented under various forms of estimates of probability.

In the global politics of the ecological crisis, debates have been frozen since the 1990s on how to turn uncertainty into measurable risk. However – and this may apply even more to the global politics of the ecological crisis than to business – ‘it is only in very special and crucial cases that anything like a mathematical (exhaustive and quantitative) study can be made’ (Knight, 1921: 211). The other possibility is to decide and act without such quantitative reasoning, without claiming full access to information and knowledge, from a state of uncertainty. As argued by the Network for Greening the Financial System (NGFS), an international group of central banks and supervisors engaged in the global politics of the ecological crisis, ‘the lack of absolute certainty and perfect knowledge should not prevent us from acting now. Otherwise, we will almost certainly slide into a “too little, too late” scenario’ (NGFS, 2023a: 2). Acting from a state of uncertainty has also been proposed by the Bank for International Settlements (BIS) in its *Green Swan* report (Bolton et al., 2020), which took seriously Carney’s (2015) statement on ‘risks that even the most advanced models are not able to predict’ (p. 6).

Judgement based on true uncertainty: a Green Swan moment?

In January 2020, BIS, in close collaboration with the Banque de France, published the report *The Green Swan. Central banking and financial stability in the age of climate*

change (Bolton et al., 2020). The report specifies the role and actions that central banks should take against the global ecological crisis. If, as claimed by Carney, climate change is a threat to financial stability, it has ‘implications for central banks’ financial stability mandate’ (Bolton et al., 2020: vii).

The new mandate for central banks as set out in the *Green Swan* report has its origins in the 2017 creation of the NGFS which developed recommendations for central banks’ role in relation to climate change, and, more recently, to biodiversity loss and ecosystem degradations.¹⁴ Comprising 129 members at the time of writing, the NGFS has arguably initiated a ‘greening’ of central banks’ activities. A number of scholars in International Political Economy and cognate fields have recently turned their attention to what has been termed ‘green central banking’ (Deyris, 2023; DiLeo, 2023; Morris and Collins, 2023; Thiemann et al., 2023). Here, we focus more specifically on how central banks’ involvement in the global politics of the ecological crisis underpins a more or less explicit commitment to an uncertain future. Indeed, the NGFS’s approach contrasts starkly with that of the IFRS Foundation: as noted by Thiemann et al. (2023: 21), the NGFS draws on the ‘incremental realization that financial disclosures alone [i.e., the pricing of climate and nature-related risks] will not be able to green financial markets’, and regularly emphasize the deep uncertainty of socioecological challenges (NGFS, 2023b). By taking the NGFS recommendations as its starting point, the *Green Swan* report thus moves away from the IFRS’s view of environmental risks as statistical probabilities (Bolton et al., 2020: vii). It also goes beyond the recommendations of the NGFS by explicitly situating the action of central banks in times of ecological crisis within the context of an uncertain and non-probabilizable future, directly quoting Knight with its definition of uncertainty as ‘the possibility of outcomes that do not lend themselves to probability measurement’ (Bolton et al., 2020: 43).

Before examining the report in more detail, it should be noted that, unlike the two other illustrations used in this article, the *Green Swan* has not yielded to specific calculation standards or policy measures. What is primarily left over from the *Green Swan* is a yearly conference organized under the aegis of the BIS, the NGFS, the Banque de France and the International Monetary Fund (IMF) to coordinate and expand the so-called ‘green central banking’ agenda.¹⁵ The report’s fairly radical view of the global politics of the ecological crisis has faded considerably, especially as the inflationary context of recent times brought central banks back to what they see as their core business (Paterson and Best, 2023). However, the report still represents a special moment in conceiving decisions and action on the ecological crisis from a state of uncertainty, and remains an important epistemic source for the work of the NGFS.

Although central banks’ authority in financial markets stems largely from their ability to turn uncertainty into measurable, predictable risk (Thiemann, 2023), the 2020 report was an acknowledgement that the ecological crisis cannot be dealt with entirely from such a perspective. The green swan metaphor deliberately echoes the ‘black swan’ argument of Nassim Taleb (2007), which involves events that could hardly be imagined by most people. While the report underlines that green swans ‘present many features of typical black swans’, it nevertheless stresses that they are different in three regards (Bolton et al., 2020: 3). First, we know that the ecological crisis is happening, and that action is needed. Second, green swans ‘could pose an existential threat to humanity’

(Bolton et al., 2020: 3), which is not particularly the case for black swans. And third, the report highlights that ‘the complexity related to climate change is of a higher order than for black swans’, given that climate change entails ‘unpredictable environmental, geopolitical, social and economic dynamics’ (Bolton et al., 2020: 3).

From this observation, the report underlines that both historical and contemporary projects that consist of collecting past environmental data and linking them with traditional economic indicators to provide a precise measure of risk and to shape environmental economic policies, have failed in their endeavour. Taking the case of carbon taxation, the report points out that such ‘attempts to quantify in monetary terms the costs and benefit [. . .] varies considerably from one model to another’, in particular because the parameter values that inform ‘the rate of discount rely on arbitrary choices’ and are ‘subject to many interpretations’ (Bolton et al., 2020: 70, 71). As an indirect response to the theoretical underpinning of the IFRS Foundation’s project based on the accounting concept of (financial) materiality and, more generally, to the way finance sees the ecological crisis as a set of manageable risks, the report stresses the gap between ‘the increased acceptance of the materiality of climate-related risks by financial institutions, and the relative weakness of their actions in response’ (Bolton et al., 2020: 42). According to the authors, it is not possible to act against the ecological crisis solely on the basis of its expected financial impacts, since most of these impacts simply cannot be measured, priced and thus anticipated through strictly financial reasoning. More importantly, the report moves away from the strong belief in financial circles that better predictive models can always be produced (Lockwood, 2015):

In short, accounting for the multiple transmission channels of climate-related risks across firms, sectors and financial contracts while reflecting a structural change of economic structures remains a task filled with uncertainty. As a result, the question of how much asset values are affected and how much credit ratings should be impacted today in the face of future uncertain events remains unclear for *deeper reasons than purely methodological ones*. (Bolton et al., 2020: 42, our emphasis)

The report thus argues that ‘traditional approaches to risk management consisting in extrapolating historical data and on [sic] assumptions of normal distributions are largely irrelevant to assess future climate-related risks’ (Bolton et al., 2020: 3). As pointed out by Knight, such analyses fall far short of considering the full implications of true uncertainty. Rather, they exemplify the layer of risk identified by Knight as dependent on statistical probability computed empirically according to past data series. In the absence of such information, cost-benefit analyses ‘are unable to capture the full uncertainty and complexity of the effects [. . .]. In particular, they do not incorporate the high probabilities of extreme risks [. . .]’; furthermore, ‘their limitations with regard to economic modelling are increasingly recognised’ (Bolton et al., 2020: 26, 69).

Facing green swans thus ‘calls for alternative epistemologies of risk, grounded in the acknowledgment of uncertainty’, which entails an ‘epistemological break’ from the classical financial view on climate risks (Bolton et al., 2020: 3). This leads the authors to propose new approaches to imagine decisive moments of intervention: ‘Alternative approaches are needed to fully embrace the uncertainty and the need for structural

transformation at stake' (Bolton et al., 2020: 29): 'maintaining system stability consists in "going beyond models" and in developing more *holistic approaches* that can better embrace the deep or radical uncertainty of climate change as well as the need for system-wide action' (p. 43, our emphasis). Such a holistic approach reflects, for instance, scenarios that are epitomized in their more mainstream version under the label of 'stress-tests'. The Bank of England was the first central bank to experience stress-tests for climate risks in the context of the insurance industry, simulating large shocks to the value of shares in its life insurance portfolio (Bank of England, 2019), followed by the European Central Bank (European Central Bank [ECB], 2021). According to the BIS, scenarios should not be definitive, but rather 'illustrative and exploratory' (Bolton et al., 2020: 35). They 'are not associated with probabilities', and do not claim to 'represent a collectively exhaustive set of potential outcomes or actual forecasts' (Bolton et al., 2020: 35). Scenarios are thus identified as 'an explicit engagement with uncertain futures' (Taylor, 2022: 68), in the sense that they offer a 'flexible "what-if" methodological framework that is better suited to exploring the risks that could crystallize in different possible futures' (NGFS, 2020: 4). They allow to 'explore rather than predict' (NGFS, 2023b: 13).

At the same time, there is a mainstreaming in the use of scenarios against the threats of the ecological crisis. In the process, the open-ended space of possibilities tends to be lost. Some, for instance, bring probability assignments between alternative scenarios back into the picture (Hansen, 2022: 4). Similarly, stress-testing in finance is based on scenarios using historical data 'which inevitably limits the range of possible outcomes' (Chenet et al., 2021: 3), whereas scenarios are meant to politicize and thus expand the space for possible futures. This is how 'the exercise of judgment' can be realized – without assigning probabilities to possible outcomes, but by bringing 'unprobabilized' scenarios into the public fora. This is reminiscent of Reddy's interpretation of Knightian uncertainty, that it:

enables the indeterminate future to be transformed into an open political domain, rather than existing as an undemocratically and scientifically defined and 'mapped out' horizon of alternatives. It is in this sense that the Knightian distinction between risk and uncertainty may be viewed as potentially radical. (Reddy, 1996: 228)

Whatever the outcomes of these scenarios that central banks are only just beginning to implement, the major achievement of the *Green Swan* report lies beyond offering a concrete method for acting in uncertain times. Rather, it recognizes that approaches that have historically dominated the debates, aimed at transforming uncertainty into measurable risk, have not made it possible to do so. An effective moment of decisive intervention in the face of the ecological crisis has not emerged from the classification of instances and the calculation of risk. It is a situation that is so entirely unique, complex and that involves 'objects which are practically infinite in variety [. . . that] only an infinite intelligence could group all the possible combinations' (Knight, 1921: 207). The *Green Swan* thus offers a ground-breaking observation that grouping all possible combinations to claim knowledge for decision and action in times of crisis is not just impossible, but paradoxically represents a risk not to be taken. As the authors emphasize, 'there is

certainty about the need for ambitious actions despite prevailing uncertainty regarding the timing and nature of impacts of climate change' (Bolton et al., 2020: 3). This means that decisions and actions in times of ecological crisis must be taken, but given the situation of true uncertainty, they must be taken through the exercise of judgement, as well as with 'prudence and humility' (Knight, 1921: 375).

Conclusion

Contemporary crises are moments of decisive political interventions characterized by a high degree of uncertainty. This article has sought to disentangle how international actors face such uncertainty. We drew on Knight's methods of substituting risk for uncertainty to consider such decisive moments of intervention. We showed that they rest on three different ways to access information and the ability to interpret and evaluate this information to claim reliable knowledge to shape future states of the world. We illustrated our argument with the global politics of the ecological crisis and the three contrasting methods used by international actors to convert times of uncertain crisis into more or less risk-based decisions and actions. Two of our three illustrations represent attempts to integrate the ecological crisis into a world of 'calculable risks'. First, international biophysical statistics on environmental dimensions of economic activities, whose standards have been set by United Nations agencies, provide information in a form close to Knight's estimates of probability. Second, the IFRS Foundation's sustainability reporting project aims at producing information in the form of Knight's statistical probability. Finally, the *Green Swan* report published by the Bank for International Settlements takes distance from the world of 'calculable risks'; instead, it uses scenarios to appraise the ecological crisis – a method that echoes Knight's call for judgement in case of true uncertainty.

A core theoretical and meta-theoretical implication of our analysis is the consideration of uncertainty as the starting point for understanding crises in International Relations. Many studies make statements on future states of affairs, but fewer address the limits in which to respond to them. This is particularly true, for instance, of the growing attention paid by International Relations scholarship on the environment to studies on Earth System Governance anticipating the future (Biermann, 2007). We share with those scholars the recognition of the dangers of probabilistic frames that 'close down potential futures and possibilities for action in the present [. . .] while pretending to open them up' (Muiderman et al., 2023: 10). However, as we have shown elsewhere (Maechler and Graz, 2022), it is important to factor in intrinsic limits to such exercises as well as to distinguish clearly between risk and uncertainty. As Blyth pointed out regarding political scientists and economists: they 'talk a lot about uncertainty, but what they actually do is turn that uncertain world into a world of so-called calculable risk' (Blyth, 2009: 448).

At a more empirical level, our analysis may also inform contemporary ecopolitical debates between advocates of green growth and degrowth, debates which are coming under increasing scrutiny from International Political Economy scholars (Buch-Hansen and Carstensen, 2021; Green, 2023; Hasselbalch et al., 2023). While proponents of growth and degrowth advocate two radically diverging moments of decisive intervention, both perspectives involve the accurate measurement of risk in order to know and act accordingly. Degrowth advocates use calculus and models to account for the

impossibility of decoupling economic growth from environmental impacts (Hickel and Kallis, 2019). This prompts their plan to reduce ‘energy and resource use designed to bring the economy back into balance with the living world’ (Hickel, 2020: 1105). For their part, green growth advocates support the possibility of decoupling to fix the crisis with more or less complex models of internalization of market externalities.

Finally, Knight’s distinction between statistical probabilities and estimates of probabilities, as well as his call to use judgement in the face of uncertainty, chime well with the recent contribution of Fomin et al. (2021) on the problems that international studies face in analysing an unpredictable world. Fomin et al. suggest that idiographic forward reasoning and scenario thinking, as advocated 20 years ago by Bernstein et al. (2000), have not supplanted dominant nomothetic approaches in International Relations. While Bernstein and colleagues drew on the heuristic forms of evolutionary biology to support the relevance of narratives and scenarios based on contingent causal mechanisms (Bernstein et al., 2000: 53), our take is closer to the evolutionary tradition in political economy to which Knight belongs. Ultimately, such an evolutionary approach is well placed to support Green and Hay’s (2015: 339) argument that an interdisciplinary and holistic overture in political economy is a starting point for addressing uncertainty in times of crises. While these considerations might appear to be remote abstractions, they nevertheless show how the responses to the clear and present danger of our ‘polycrisis’ for the most vulnerable population of the world may be locked in robust, pre-defined path dependencies.

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Notes

1. See, for instance, Faulkner et al. (2021) for a recent appraisal.
2. Observation: European Business & Nature Summit 2022. Brussels: 18–19 October 2022. See https://environment.ec.europa.eu/european-business-and-nature-summit-2022_en (accessed 22 December 2023).

3. Satellite accounts are reserved for fields or aspects of economic and social life that could, in the future, be considered in gross domestic product (GDP), but whose methodologies still need to be improved – unpaid housework is one example (DeRock, 2019). They are officially ‘used to explore new methodologies and to work out new accounting procedures that, when fully developed and accepted, might become absorbed into the main system over time’ (Eurostat, 2019).
4. Observation: 26th Meeting of the London Group on Environmental Accounting. Online: 05–08 October 2020. See <https://seea.un.org/fr/news/26th-meeting-london-group-environmental-accounting> (accessed 22 December 2023). It should also be noted that European Union (EU) countries and some others have reached the final stage of the standard because they started to apply the methodology before it was officially recognized as an international standard.
5. Observation: 26th Meeting of the London Group on Environmental Accounting.
6. Interview: environmental economist, employee of UNEP. Geneva: 8 May 2019.
7. Observation: We Value Nature 10-day challenge. Online: 11–24 March 2021. See: <https://wevaluenature.eu/10day-challenge> (accessed 22 December 2023).
8. Observations: European Business and Nature Summit: Building action for nature and people. Madrid: 07–08 November 2019. See https://green-business.ec.europa.eu/business-and-biodiversity/european-business-and-nature-summit_en (accessed 22 December 2023).
9. The speech can be viewed here: <https://www.youtube.com/watch?v=V5c-eqNxeSQ> (accessed 22 December 2023).
10. Observation: 36th session of the Intergovernmental Working Group of Experts on International Standards of Accounting and Reporting. Geneva: 30 October to 01 November 2019. <https://unctad.org/meeting/intergovernmental-working-group-experts-international-standards-accounting-and-reporting-6> (accessed 22 December 2023).
11. Interview: Head of Investment and Enterprise branch at United Nations Conference on Trade and Development (UNCTAD). Geneva: 27 November 2019.
12. The International Financial Reporting Standards (IFRS) Foundation made a consultation on possible future standards for biodiversity and ecosystem services, understood as ‘nature-related risks’. See <https://www.ifrs.org/projects/work-plan/issb-consultation-on-agenda-priorities/> (accessed 23 October 2023).
13. The IFRS applies the well-accepted distinction between ‘physical risk’ and ‘transition risk’, both considered under their financial dimension (Chenet et al., 2021: 2–3).
14. See the Network for Greening the Financial System (NGFS) publications here: <https://www.ngfs.net/en/liste-chronologique/ngfs-publications> (accessed 22 December 2023).
15. See the agenda of the 2023 conference: https://www.bis.org/events/green_swan_2023/overview.htm (accessed 22 December 2023).

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