Beyond Continuationism: Climate Change, Economic Growth, and the Future of World (Dis)Order

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Abstract
An apocalyptic zeitgeist infuses global life, yet this is only minimally reflected in International Relations (IR) debates about the future of world order and implications of climate change. Instead, most approaches within these literatures follow what I call a "continuationist" bias, which assumes that past trends of economic growth and inter-capitalist competition will continue indefinitely into the future. I identify three key reasons for this assumption: 1) a lack of engagement with evidence that meeting the Paris Agreement targets is incompatible with continuous economic growth; 2) an underestimation of the possibility that failure to meet these targets will unleash irreversible tipping points in the earth system, and 3) limited consideration of the ways climate change will converge with economic stagnation, financial instability, and food system vulnerabilities to intensify systemic risks to the global economy in the near-term and especially later this century. I argue that IR scholars should therefore explore the potential for "post-growth" world orders to stabilize the climate system, consider how world order may adapt to a three or four degree world if Paris Agreement targets are exceeded, and investigate the possible dynamics of global "collapse" in case runaway climate change overwhelms collective adaptation capacities during this century.

Keywords
Climate Change, Economic Growth, World Order

Introduction

An apocalyptic zeitgeist infuses global life, with the specters of runaway climate change, widespread challenges to multilateral cooperation, and the COVID-19 pandemic feeding a growing sense of a looming era of global turbulence. In 2019 over 11,260 scientists issued a warning that "planet earth is facing a climate emergency" that is "accelerating faster than most scientists expected" (Ripple et al, 2019: 1-2). The Intergovernmental Panel on Climate Change (IPCC) released a report in 2018 that calls for "rapid and far-reaching" changes to meet the Paris Agreement targets of 1.5 or 2 °C

above pre-industrial levels (IPCC, 2018: 21), considered necessary by some to ward off irreversible tipping points in the earth system (Steffen et al, 2018; Lenton et al, 2019). Yet a 2019 UNEP report shows that "countries' planned fossil fuel production not only exceeds 1.5°C and 2°C pathways," but also exceeds levels consistent with the implementation of their (already inadequate) pledges under the Paris Agreement (UNEP, 2019: 4). On top of this, the latest global climate models suggest that the "climate equilibrium sensitivity" (the amount of warming that would follow a doubling of pre-industrial CO2 levels) may be higher than previous estimates (Lenton et al, 2019: 595). Overall this means that the earth is likely on pace for around four and possibly more degrees of warming by the end of the 21st century (Vince, 2019), which Kevin Anderson argues would be "incompatible with an organized global community…likely to be beyond 'adaptation'…devastating to the majority of ecosystems, and has a high probability of not being stable" (Anderson, quoted in Spratt & Dunlop, 2018: 14).

The discipline of International Relations (IR) has not been immune to the apocalyptic zeitgeist, most evident these days in the discourse proclaiming a "crisis in the liberal international order" and others investigating the implications of climate change for world politics. Yet we should ask whether these discourses have an adequate understanding of the challenges posed by the climate crisis and the possible transformations ahead. On one hand, debates about the present crisis and future of world order continue to either ignore climate change or treat it as an issue that can simply be solved through greater international cooperation (e.g. Ikenberry, 2018; Haas, 2017; Buzan & Lawson, 2014; Keohane & Colgan, 2017; Hurrell, 2018). On the other hand, while many IR scholars have made climate change central to their analysis of world

politics (e.g. Victor, 2011; Biermann et al, 2012; Galaz, 2014; Newell & Paterson, 2010; O'Brien et al, 2013; Burke et al, 2016; Cudworth & Hobden, 2011), this literature tends to under-estimate its transformative implications for at least three key reasons: 1) a lack of engagement with evidence that meeting the Paris Agreement targets is incompatible with continuous economic growth; 2) an underestimation of the possibility that failure to meet these targets will unleash irreversible tipping points in the earth system, and 3) limited consideration of the ways climate change will converge with economic stagnation, financial instability, and food system vulnerabilities to intensify systemic risks to the global economy in the near-term and especially later this century.

In contrast to these approaches, I will argue that IR scholars should more deeply investigate the potential for structural discontinuities in world order resulting from climate change and its intersection with political-economic, financial, and food crises. In particular, most IR scholars have not yet recognized the unprecedented challenge that the climate crisis poses to the growth-based liberal capitalist world order, instead assuming that it can be solved without any structural political-economic transformations in the order itself (e.g. Ikenberry, 2018; Buzan & Lawson, 2014; Haas, 2017; Victor, 2011; Biermann et al, 2012; Galaz, 2014). I use the term "continuationism" to refer to this assumption: that coming decades will see no dramatic transformations of world order outside the basic parameters of economic growth, inter-capitalist competition, and the shifting balance of power that have defined the past two centuries of world politics. While some IR scholars *do* recognize the transformative implications of the climate crisis (e.g. Burke et al, 2016; Newell & Lane, 2018; Dalby, 2015; Friedrichs, 2013; Grove, 2019; Di Muzio, 2015), they do not demonstrate why it will likely force an end to

economic growth during this century or explore the possible contours of a more sustainable "post-growth" world order.[1] In contrast, the key contributions of this article will be to first demonstrate why climate change will likely bring an end to the growth-based liberal capitalist world order, and then to explore three subsequent sets of questions and possible futures that have to date received minimal attention by IR scholars: 1) How might a post-growth world order capable of meeting the Paris Agreement targets be designed, and how might it emerge? 2) If a near-term post-growth transition fails to materialize and the Paris targets are exceeded, then how might states and the global economy as a whole adapt to maintain resilience in a 3 or 4°C world? And 3) If states and the global economy are unable to adapt to 3 or 4°C of warming this century, then what would be the possible dynamics of a global-scale "collapse"?

I will begin with an overview of recent work on the future of world order and climate change in IR, highlighting the limitations and blind spots that result in continuationist assumptions. I will then elaborate the key reasons why the climate crisis will likely force a structural discontinuity beyond the growth-based liberal capitalist order. Finally, I will explore three possible futures of world (dis)order that may result from this discontinuity, which will suggest possible pathways forward for the study of IR in an age of climate emergency.

Continuationism in the Future of World Order and Climate IR Literature

[1] The work of Friedrichs (2013) and Di Muzio (2015) come closest in this regard, though they focus primarily on the role of "peak oil" and energy scarcity in forcing an end to growth. While this scenario should not be discounted, the rise of unconventional oil and the current supply glut suggests that oil depletion is unlikely to be the critical factor that cripples the growth trajectory, though they may play an important role in conjunction with climate and other stressors in the future.

The argument that the modern world system will eventually face an epochal discontinuity in its trajectory of continuous growth has a long lineage, though it became most prominent in debates from the 1970s centering on the "limits to growth". In particular, the (in)famous Club of Rome report from 1972 concluded that

> if the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years (Meadows et al, 1972: 23-24).

The combination of techno-modernist faith in capitalist markets and innovation, alongside critiques of the original report based on misrepresentations of its actual claims (e.g. the mistaken perception that the report claimed we would "run out" of resources), have led to frequent dismissals of its continuing relevance in the 21st century (Higgs, 2016: 258-259). Yet multiple studies demonstrate that the world system remains squarely on the "business as usual" path it anticipated, while the looming climate crisis lends support to its conclusion that limits to growth will most likely be reached during the 21st century (as I'll demonstrate below) (Higgs, 2016: 266; Jackson & Webster, 2016).

While limits to growth thinking has flourished in recent years within the heterodox fields of steady-state and post-growth economics (e.g. Daly, 1996; Jackson, 2018; Kallis & Hickel, 2019; Parrique et al, 2019), it has for the most part failed to penetrate the field of IR. In contrast to these fields, IR scholars have rarely considered the potential for discontinuities in the trajectory of endless growth and often appear beholden (whether implicitly or explicitly) to the neoclassical and techno-modernist faith in markets and innovation to sustain this trajectory.[2] In this sense, the discipline of IR largely follows what I call "continuationist" assumptions, or the view that there will be

[2] Exceptions to this tendency include Burke et al, 2016; Dalby, 2015; Friedrichs, 2013; Falk, 2016; Grove, 2019; Di Muzio, 2015.

no deep transformations in the political-economic structure of world order in the foreseeable future. Continuationists, in this sense, do not expect much change beyond a decline in cooperation and/or shifts in the balance of power between states and often assume that 21st century problems can be solved without any deep political-economic transformations in world order. Following Richard Falk and Jörg Friedrichs, it characterizes approaches – whether of realist or liberal stripes – that depict the future as "essentially confined to an incremental continuation of the past" (Falk, 2016: 102), or that "project past economic growth and technological progress" indefinitely into the future (Friedrichs, 2013: vii).

In particular, in this essay I focus on approaches that – either explicitly or implicitly – assume that global capitalism and continuous economic growth will remain the taken-for-granted context in which geopolitical competition and/or international institution building takes place. While it has arguably been central to world order since the 19th century industrial revolution, the pursuit of economic growth explicitly became a key, arguably *the* key, foundation of liberal world order since it was adopted in the post-World War II era as the primary goal of economic policy and a "core state imperative" (Barry, 2020; Pettifor, 2019; Schmelzer, 2016; Higgs, 2016). As Bentley Allan explains, economic growth – understood as annual increases in Gross Domestic Product (GDP) – provided "the lynchpin of the design" of the Bretton Woods system, which enabled the institutionalization of global trade and investment regimes based on the pursuit of collective gains, thereby weakening realist assumptions of a "zero-sum" geopolitical landscape while replacing the "explosive ideological conflict between labour and business" with a "broad social consensus on policies to expand production" (Allan, 2018:

222-223). More deeply, economic growth became "equated with human progress itself", involving not simply a key policy goal of states but a worldview that reconceives time as "a linear, unending plane upon which economic progress unfolds" (ibid: 209, 25). While it is rarely identified explicitly as a key component of the contemporary world order, the expectation of continued economic growth constitutes what Donella Meadows calls one of our society's "great but unstated assumptions – unstated because unnecessary to state" (Meadows, quoted in Pettifor, 2019: 72). However, it is precisely this dynamic and assumption of endless growth that is being called into question by contemporary environmental crises – particularly climate change. Yet few scholars of IR, both those investigating the current crisis and future of world order as well as those focused on the implications of climate change for world politics, have begun to seriously consider the possibility that economic growth may come to an end during the 21st century.

Starting with the first set of approaches, scholars of "world order" study changes in the practices, institutions, and norms through which particular patterns of inter-state behavior are regulated and reproduced (Allan, 2018: 5; Ikenberry, 2011: 13; Haas, 2017: 22). While the literature is vast, we can roughly distinguish between approaches that focus on the crisis of the contemporary liberal order and rise of protectionism (Ikenberry, 2018; Haas, 2017), the shift of geo-economic power to East Asia and potential for counter-hegemonic conflict (Mearsheimer, 2018; Layne, 2018), and the rise of a "decentered globalism" (Buzan & Lawson, 2014; Acharya, 2015; Hurrell, 2018). John Ikenberry, for one, argues that recent shocks to the liberal order, from Brexit to the Trump election, can be explained as in part a "crisis of authority" and in part a "crisis of social purpose" resulting from the end of the Cold War and the entrance of a wide

diversity of states into the order (Ikenberry, 2018). Rather than a "crisis in the deep principles of the order itself" (Ikenberry, 2011: 6), Ikenberry believes that contemporary problems – from rightwing populism to climate change – are no more challenging than previous threats to the liberal order and can be solved without any transformations in the political-economic principles of the order itself (Ikenberry, 2018: 22). Others argue instead that world order is likely to devolve into regional spheres of influence. Buzan & Lawson, for example, argue that we are today witnessing the emergence of a "decentered globalism" in which "no state will be able to replace the United States as a superpower, because none will be able to acquire enough relative power to dominate the system as a whole" (Buzan & Lawson, 2014: 75). They claim that this will usher in a multipolar world in which the core problematic becomes one of managing the relations between diverse modes of capitalist governance, with the hegemony of capitalist economic organization being firmly settled for the foreseeable future (ibid: 72). While realists argue that the decline of American leadership will usher in a world of renewed regional rivalry and potentially hegemonic war (Mearsheimer, 2018; Layne, 2018), others argue that a more multi-polar or "posthegemonic" world offers opportunity for more egalitarian cooperation between the global north and south (Acharya, 2015; Hurrell, 2018).

The problem with these approaches is not that they are unaware of climate change. Many of them explicitly recognize it as a significant problem, though they tend to believe it will promote cooperative problem-solving and international stability (Ikenberry, 2018; Buzan & Lawson, 2014; Haas, 2017). The primary problem is that they do not consider the possibility that solving the climate crisis may require a radical political-economic restructuring of world order, or that it may force such changes later

this century (or sooner) if states fail to reduce emissions quickly enough. Ikenberry, for example, in thinking that contemporary challenges to the order are no greater than past crises, doesn't grasp the scope or speed of the changes needed to stabilize the climate system. As I will discuss below, evidence suggests this will require more than just rejuvenating international cooperation; rather, a transformation in the "deep principles" of the global economy – particularly the core principle of economic growth – is likely necessary (Kallis & Hickel, 2019; Parrique et al, 2019; Jackson, 2018). Similarly, Buzan and Lawson don't consider the possibility that climate change and its convergence with political-economic crises may threaten assumptions of perpetual economic growth and force more radical political-economic transformations over the course of this century. Even realists who perceive an imminent end to the liberal order do not consider the possibility that capitalism and economic growth may be destabilized and transformed, instead assuming that the current crisis represents merely the continuation of cyclical dynamics of hegemonic rise and fall (Mearsheimer, 2018; Layne, 2018). Overall, as I will demonstrate below, these scholars have yet to grasp the epochal significance of the climate crisis, at best seeing it as merely one issue among many rather than an existential threat that likely cannot be solved within the framework of a growth-based liberal capitalist world order.

Of course, many IR scholars have made climate change central rather than peripheral (or non-existent) in their analysis of world politics. The emerging climate IR literature can be roughly divided between those focusing on climate governance strategies and mechanisms and those investigating its implications for national and global security. The first set of approaches, as Jennifer Clapp and Peter Dauvergne show, is

primarily composed of descriptive approaches illuminating the complex array of international treaties, institutions, and market mechanisms that form a nascent global architecture of climate governance (Clapp & Dauvergne, 2016). There are also more prescriptive approaches, with some like David Victor arguing for incrementalist approaches based on carbon taxation imposed by a "club" of key states (Victor, 2011: 23), and more radical approaches arguing for reform and empowerment of the UN system to "mainstream" environmental goals into economic policy (Galaz, 2014; Biermann et al, 2012) or to more radically shape global corporations and markets through state intervention to accelerate decarbonization efforts (Newell & Paterson, 2010; Dauvergne, 2018). The climate security literature is also distinguished by more descriptive and prescriptive approaches. Many of these scholars detail the ways in which national security agencies are preparing for a climatically changed world (Busby, 2008). Others investigate the connection between climate impacts and violent conflict in order to assess whether or not climate change will intensify conflict in the future (Mazo, 2010; Selby, 2014). Finally are more critically oriented scholars who focus on the implications of climate change for human security across the domains of agriculture, natural hazards, health, and migration and emphasize the need for more transformative approaches to solve climate change in a truly just and sustainable manner (O'Brien et al, 2013; Dalby, 2015; Barnett et al, 2013; Cudworth & Hobden, 2011).

While climate IR scholars often have a deeper appreciation of the challenges confronting world order in the 21st century, they also tend to follow continuationist assumptions and have given very limited attention to the possibility that climate change will bring an end to the growth-based liberal capitalist world order. David Victor, for

example, proposes minimally disruptive approaches for decarbonizing the global economy, believing that a low and rising carbon tax would be sufficient to manage climate change (Victor, 2011: 28). However, as I will elaborate below, evidence demonstrates that such incrementalist reforms would be incapable of reducing emissions with the needed speed to meet the Paris Agreement targets (Anderson & Jewell, 2019; Kallis & Hickel, 2019). Even more radical approaches – e.g. those of Frank Biermann, Victor Galaz, Matthew Paterson, Peter Newell, and Peter Dauvergne – do not systematically consider the possibility that the persistence of compound economic growth may be incompatible with climate stabilization, nor do they investigate how failure to meet the Paris targets may provoke catastrophic transformations in world order.

In the climate security literature, most approaches focus on current and possible future impacts though without foregrounding the growth imperative as a key structural impediment to mitigating the crisis. For example, Karen O'Brien and colleagues claim that it is necessary to identity the "root causes" of the climate crisis (O'Brien et al, 2013: 2). Yet they do not identify the growth-based global economy as a key structural cause. Similarly, Jon Barnett and colleagues, in their anticipations of possible adaptation strategies in a four degree world, do not consider the need to restrain economic growth, and even their best case scenario of radical and equitable adaptation assumes that this will involve "dematerialized and decarbonized" growth (Barnett et al, 2013: 229). Simon Dalby and co-authors of the "Planet Politics" manifesto, along with the work of Stephen Hobden and Erika Cudworth, may go furthest by foregrounding the political-economic structures fueling the climate crisis and the need for rapid transformative action (Dalby, 2015; Burke et al, 2016; Cudworth & Hobden, 2011). However, these scholars do not

systematically demonstrate why preventing catastrophic climate change most likely requires an end to economic growth, envision or advocate for more egalitarian "post-growth" world orders that could potentially meet the Paris targets, or think through the likely consequences for world order if a post-growth transition fails to materialize.

Overall, we can identify three key limitations of both future of world order and climate IR scholars: first, that they have yet to systematically engage the evidence that meeting the Paris Agreement targets will require structural political-economic transformations that are incompatible with continuous economic growth; second, that many (though not all) of them ignore or downplay the evidence that failing to meet these targets would unleash irreversible tipping points in the earth system that would be catastrophic for human security and international stability; and third, that they ignore how climate change will feedback on and exacerbate other global systemic risks – e.g. in global economic, financial and food systems – that may trigger global-scale "synchronous failures" in the near-term and especially later this century (Homer-Dixon et al, 2015). Once we take this evidence and these feedbacks into account, the challenges facing the liberal-capitalist world order become more daunting, and the need to at least consider the potential for structural political-economic discontinuities – including the possibility of "collapse" – becomes evident.

I will now elaborate these three arguments and will then explore their possible implications for the future of world order.

The (Likely) Impossibility of Meeting Paris Agreement Targets in a Context of Compound Economic Growth

The assumption that climate change can be solved within a growth-based capitalist framework rests on the hope of "decoupling" economic growth from greenhouse gas emissions by substituting fossil fuels with carbon-free energy and improving energy efficiency. Proponents believe not only that climate protection need not come at the expense of economic growth, but also that it will be a boon to growth through creating jobs and investment opportunities in the energy and "green" industrial sectors (Figueres, 2017). However, the problem with these claims is that they don't rigorously consider the question of *speed*, or of whether decoupling from carbon emissions can happen fast enough in a context of compound growth to meet the Paris Agreement targets (Kallis & Hickel, 2019; Antal & Van den Bergh, 2016; Jackson, 2018).

The IPCC claims that emissions need to peak in 2020 and thereafter fall at a rate of 7-8% annually, reaching net zero by 2050, to provide a 50% chance of meeting the 1.5°C target, whereas they need to fall 3-4% annually, reaching net zero by 2075, to meet the 2°C target (IPCC, 2018: 15). However, there is a bulk of modeling evidence suggesting that a 7% emissions reductions rate would be incompatible with compound economic growth. For example, the C-ROADS model developed at MIT projects that the fastest possible rate of decarbonization in a context of compound growth is likely around 4% per year, which would require "the most aggressive possible abatement policies, high subsidies for renewables and nuclear power, plus high taxes on oil, gas and coal" (Hickel, 2019: 55). Other approaches, including Nicholas Stern's influential Review of the Economics of Climate Change, similarly conclude that 3-4% annual reductions would be the fastest rates compatible with economic growth (Anderson & Bows, 2011: 40). While this would be far from capable of meeting the 1.5°C target, such rates may be capable of

meeting the 2°C target according to IPCC projections, assuming that an ambitious globally coordinated mitigation program begins in the year 2020 (or very shortly thereafter). However, given the likely conservatism of IPCC projections, which do not consider positive carbon-cycle feedbacks (Steffen et al, 2018), there is good reason to be skeptical that 3-4% annual decarbonization would be sufficient to meet even the 2°C target. Other approaches accounting for these feedbacks argue that 7% reductions per year, reaching net zero emissions by 2050, would give us a 66% chance of stabilizing temperature increases at 2°C (Rockstrom et al, 2017).

In short, the problem is that so long as the economy continues to grow, the mountain of energy consumption that carbon-free energy must conquer only gets higher, requiring even faster rates of decarbonization. Kevin Anderson starkly summarizes the implications of these findings:

> Ongoing failure to mitigate emissions has pushed the challenge from a moderate change in the economic system to a *revolutionary overhaul of the system*. This is not an ideological position; it emerges directly from a scientific and mathematical interpretation of the Paris climate agreement (Anderson & Jewell, 2019: 348; italics added).

Technological optimists would counter that climate stabilization can be made compatible with economic growth by ramping up "Negative Emissions Technologies" (NETs), including direct air capture, Bioenergy plus Carbon Capture and Sequestration (BECCS), and afforestation. Indeed, all of the IPCC's "Representative Concentration Pathways" compatible with 1.5 or 2 °C rely on a significant rollout of NETs (IPCC, 2018). However, the problem is not only that many of these technologies are presently hypothetical and unproven at scale, but also that they would entail massive land, energy, and water requirements to put a dent in global emissions (i.e. removing 5 gigatons or more of

carbon per year by 2050 and up to 20 annually by 2100). For example, the IPCC's fifth assessment report estimates that the scale of BECCS plants needed would "require plantations covering land two to three times the size of India, which raises questions about land availability, competition with food production, carbon neutrality, and biodiversity loss" (Hickel & Kallis, 2019: 10). Furthermore, the costs and energy requirements for direct air capture are "currently prohibitive and can be anticipated to slow deployment", which would make this technology very difficult to scale up rapidly enough to meet the Paris targets (Smith et al, 2015: 48). Such schemes might be possible through a massive globally coordinated effort, and technological innovation is to be expected. But those who confidently expect NETs to eventually make climate stabilization compatible with economic growth, simply put, are "taking a very large risk with our common future" (Antal & Van den Bergh, 2016: 171).

The Potential for Irreversible Tipping Points if we Cross 1.5 or 2 °C

Due to the challenges of rapidly reducing carbon emissions in a context of economic growth, economists and climate policy analysts are increasingly arguing that we need to prepare for a hotter-than-2°C world (e.g. Nordhaus, 2013). From a *gradualist* or linear understanding of climate change, such an approach may appear reasonable, even though 3°C is projected to double the number of people exposed to overlapping climate stresses relative to a 2°C world, with the vast majority of them concentrated in the global south (Byers et al, 2018). However, the potential for positive feedbacks unleashing a trajectory of runaway warming, which numerous planetary scientists believe will become

more likely as we cross 1.5 and 2°C, reinforces the importance of meeting the Paris Agreement targets (Lenton et al, 2019; Steffen et al, 2018; Wadhams, 2017).

Due to scientific uncertainty and lack of precision about the dynamics of tipping elements in the earth system – including ice albedo reduction, tropical and boreal forest dieback, and permafrost carbon and methane release – these dynamics have been excluded in IPCC projections of future warming (IPCC, 2018: 103-104). Yet Tim Lenton and colleagues show there is mounting evidence that many of these tipping elements are already being activated – seen in accelerating arctic ice loss and some tropical forests becoming net sources rather than sinks of CO_2 – and will be increasingly active at 1.5 and 2 °C (Lenton et al, 2019). Their analysis supports the conclusion of Will Steffen and colleagues who consider 2 °C as the point beyond which the earth system would enter a "Hothouse Earth pathway", defined as a state in which

> biogeophysical feedbacks in the Earth System…become the dominant processes controlling the system's trajectory… raising the temperature further to activate other tipping elements in a domino-like cascade that could take the Earth System to even higher temperatures (Steffen et al, 2018: 3).

The potential for unleashing a hothouse earth pathway is further supported by evidence that the risk posed by carbon and methane release from both sub-sea and terrestrial permafrost may be under-estimated by mainstream climate science (Wadhams, 2017; Farquharson et al, 2019; Neumann et al, 2019). For example, Peter Wadhams argues that the loss of arctic sea ice will likely accelerate the melting of sub-sea methane hydrates by removing the "air conditioning layer" that previously kept arctic waters close to 0°C (Wadhams, 2017: 123). This could unleash an abrupt methane "pulse" of 50 gigatons from the shallow East Siberian Shelf that rapidly raises global temperatures by 0.6°C, which would "speed up all the other global warming effects", "bring forward by

fifteen to thirty-five years" the date at which the global temperature increase exceeds 2°C (getting us there between 2035 and 2040), and potentially unleash a chain reaction of further hydrate collapse and methane release (ibid: 125-126). Other scientists believe that a catastrophic methane release from sub-sea hydrates is unlikely due to microbial consumption and other "sinks" that prevent sub-sea methane from reaching the atmosphere (Ruppel & Kessler, 2017). However, evidence suggests that the microbial sink may be less effective than previously thought (Thurber et al, 2020), and it remains uncertain to what extent these sinks could counteract widespread hydrate collapse and methane release in a 2°C+ world. The terrestrial permafrost may pose a more long-term threat, though recent studies show that it is already thawing much faster than IPCC models anticipate due to "abrupt thawing" events associated with thermokarst lakes (Farquharson et al, 2019), and will likely continue to thaw more quickly than expected due to increased precipitation over the arctic driven by higher temperatures (Neumann et al, 2019).

In sum, cutting edge research on permafrost, methane hydrates, and other tipping elements continues to demonstrate the likely conservatism of IPCC projections. This is not surprising given that, as Naomi Oreskes and colleagues observe, IPCC projections "have systematically underestimated key climate change drivers and impacts", which they attribute to the tendency among scientists of "erring on the side of less rather than more alarming predictions" (Oreskes et al, 2013: 327-328). However, due to the limits of scientific knowledge about these processes, it is impossible to say with any certainty what the risks are. We should not conclude that the worst-case "methane bomb" scenarios are the most likely to materialize (though neither should they be discounted) (Wadhams,

2017), but evidence indicates that crossing the 2°C threshold would likely trigger significant carbon and methane feedbacks over the course of this century and in subsequent centuries that would make it difficult if not impossible to stabilize the climate system (even with the aid of NETs).

The Convergence of Climate Change with Economic, Financial, and Food Crises

The threat of climate change *by itself* may not pose catastrophic threats to currently powerful states until later this century (though it is already destroying livelihoods and adding further stress to conflict zones around the world and especially in the global south) (Ahmed, 2017). However, once we consider how these impacts will feedback on existing vulnerabilities in global economic, financial and food systems, the likelihood of *near-term* systemic crises increases. As Will Steffen and Aled Jones warn, the global political-economy

> has been designed around assumptions of a stable world…But it now sits on top of a hugely unstable and complex platform – our physical world, increasingly disrupted by climate change…we know relatively little about just how fragile the various parts of our clockwork global economy are in the near-term (Steffen & Jones, 2019).

Steffen and Jones build upon work done by Thomas Homer-Dixon and colleagues on what they call the emerging "architecture of global crisis", which refers to an intricate structure of causal feedbacks between financial, food, and energy systems in which shocks in one sub-system can propagate outwards into "synchronous failure" for the global economy as a whole (as in the 2007-08 financial crisis) (Homer-Dixon et al, 2015). Their analysis can help us anticipate the possible dynamics and trajectories of

future crises, but we must go further by anticipating how this crisis architecture will intersect with climate impacts over the coming years and decades.

First, many analysts show that the global economy is in a structurally precarious position where mediocre growth is reliant on unprecedented debt expansion and a corresponding build-up of financial systemic risk, which may be further exacerbated by the COVID-19 pandemic and the crisis-fighting measures adopted by states and central banks (Ahmed, 2017; Mason, 2020). Once we bring climate change into the equation, the risks of prolonged stagnation and financial instability intensify. The economic impacts of climate change include capital shifted from production to infrastructure repair and adaptation, heightened uncertainty for investors and consumers, increasing health care costs, and diminished labor productivity (particularly for outdoor workers) (Burke et al, 2018). There is great uncertainty concerning projected total damages in different mitigation scenarios, though many believe they are currently being under-estimated in most Integrated Assessment Models (e.g. Nordhaus, 2013) – due mainly to their inability to represent potential tipping points in earth and human systems, ignorance of how climate impacts will constrain economic growth, and assumption that losses from climate impacts are perfectly substitutable with increased consumption and can be fully compensated by higher incomes (Diaz & Moore, 2017). Taking into account the feedbacks on economic growth, Marshall Burke and colleagues estimate that a 2.5-3°C temperature rise by 2100 would reduce per capita output by 15-25% relative to a world without warming and by more than 30% with 4°C warming, though even these projections don't account for tipping points (Burke et al, 2018). Extreme natural disasters will also pose risks to financial stability that are poorly understand. The Cambridge

Centre for Risk Studies anticipates that superstorms in New York and Florida could each produce over $1 trillion in losses from infrastructure damages and their spill-over effects on real estate values, neighboring regions, and trading partners, which could generate further financial instability by triggering a higher-than-expected frequency of insurance claims and debt defaults among affected homeowners and businesses (Mahalingam et al, 2018). They note that these events would be unlikely to trigger a financial crisis and/or global recession on their own, though they also assume that markets would "react rationally and proportionately" (ibid: 8), which suggests that, especially in an environment of high debt and weak growth, more destabilizing dynamics should not be discounted. Additionally, rising temperatures will increase the probability of multiple extreme events occurring in a short time frame, as well as the probability that such events would coincide with ongoing recessions or financial crises, in which case "the consequences could be very much more severe" (ibid: 7-8).

Second, the global food system is already under threat from unsustainable groundwater depletion, soil degradation, and the increasing homogeneity of crop varieties and production techniques designed for efficiency rather than resilience, which will be further stressed by the climate crisis (Cribb, 2019; Ahmed, 2019). The IPCC's projects that, for each degree C of temperature increase, wheat yields will be reduced between 2.9 and 6%, rice by 3.2-3.7%, maize by 4.5-7.4%, and soybeans by 3.1% (IPCC, 2018: 236). Intensified drought and unsustainable groundwater depletion will also have critical implications that aren't factored into the IPCC's projections. For example, a recent study projects that 40% of all irrigated crops will face "acute water stress" as early as 2040 (Ahmed, 2019). Around the same time, the National Center for Atmospheric Research

projects that nearly all of the US and much of Europe could regularly face "extreme drought" conditions, and large parts of Asia responsible for producing much of the world's wheat and maize may face similar conditions even earlier (ibid). The implications for overall crop yields are uncertain, though they signify that the IPCC's projections – which also exclude the impacts of extreme weather, pests, and declining insect pollinators – are likely to be conservative (IPCC, 2018: 237). Overall, food security analysts believe that crop yields will need to double between 2005 and 2060 to meet increasing demand from population growth (Cribb, 2019: 64). However, Challinor et al, analyzing data from over 1,700 models, demonstrate "a majority consensus that yield changes will be negative from the 2030s onwards" (Challinor et al, 2014: 289), suggesting that meeting growing demand will be a huge political-economic and technical challenge, and that global food system shocks may happen sooner than many analysts believe (Ahmed, 2019).

Overall, due to existing (and mounting) vulnerabilities in financial and food systems, climate impacts already pose the threat of cascading global crises, which will only intensify at 1.5-2 (and especially 3-4) °C. As Homer-Dixon and colleagues show, any crisis in one sub-system would likely cascade outwards into shocks for the other sub-systems (Homer-Dixon et al, 2015). For example, a financial crisis could spark food crises by fueling speculation on land and agricultural commodities (deemed "safe assets" in times of uncertainty), thereby further exacerbating price rises (as we saw in 2007-08) (ibid). Conversely, food system shocks could spark a financial crisis and recession by triggering widespread social unrest, weakening consumer demand, and undermining investor confidence. While such crises could spur the kind of emergency mobilization

needed to accelerate emissions reductions, they may also reinforce a "growth at all costs" mindset, thereby further exacerbating climate change. The COVID-19 crisis is currently demonstrating how vulnerable the global economy is to cascading crises across ecological, financial, food, and energy systems, and we can expect that similar shocks will become more likely and severe if global temperatures are not stabilized at 1.5 or 2°C.

Implications for the Future of World (Dis)Order

Given the likely impossibility of meeting the Paris Agreement targets in a context of compound growth, the likelihood of near-term climate tipping points, and the risks they pose to our already fragile political-economic, financial and food systems, what then are the likely implications for the future of world order? I will suggest that these conclusions should lead us to investigate three possible futures and associated questions that have only received minimal attention by IR scholars: 1) Is a near-term transition to a "post-growth" world order possible to stabilize the climate system? If so, how might it be designed and implemented? 2) If we accept that humanity is on course for three or four degrees of warming this century, then how might states and the global economy as a whole adapt to maintain resilience and prevent mass mortality? And 3) If states and the global economy are unable to adapt to 3 or 4 °C , then what would be the possible dynamics of a global-scale "collapse"?

First, if it is true that a transition to a post-growth world order is necessary to meet the Paris Agreement targets, then it is important to consider what this could look like and how it might come about (however unrealistic it may appear). This should lead liberal IR theorists interested in global institutional design, as well as constructivists interested in

the influence of ideational change on world order (e.g. Allan, 2018), to engage with scholars working in the heterodox fields of steady-state and post-growth economics (Daly, 1996; Hickel, 2019; Jackson, 2018; Pettifor, 2019). These approaches share two key arguments: 1) that perpetual economic growth is incompatible with climate stabilization and impossible on a finite planet, since evidence suggests GDP growth cannot be "absolutely decoupled" from growing resource use and associated environmental impacts (Kallis & Hickel, 2019; Parrique et al, 2019); and 2) that, beyond a certain threshold, growth ceases to be necessary for improving collective welfare and causes more harm than benefit (Daly, 1996; Jackson, 2018). A post-growth political-economy, in contrast, would involve global caps on resource consumption, new metrics to measure economic welfare (e.g. the "Sustainable Development Index" or "Genuine Progress Indicator"), redistribution through progressive taxation, new public ownership structures that prioritize ends other than shareholder value, a reduction in the work week and greater emphasis on employment in the social and non-market economy, and more radical welfare policies (e.g. "Universal Basic Income" or the expansion free public services) to reduce poverty and improve collective welfare in the absence of economic growth (Hickel, 2019; Pettifor, 2019; Jackson, 2018).

Overall, a post-growth transition would constitute a structural political-economic transformation that radically reconfigures the power relations, worldviews, and goals of states and world order as a whole. As Ann Pettifor describes, it would require an overhaul of Bretton Woods institutions, along with the global assemblage of multilateral and bilateral trade agreements, to ensure equitably shared global consumption caps, reconfigure trade by prioritizing national self-sufficiency in the production of goods

where possible, institutionalize capital controls to enhance national autonomy over economic policy, and overhaul global finance by consigning the powers of credit-creation to democratically accountable public and central banks (Pettifor, 2019: 74-77, 91). This could be considered a form of progressive "deglobalization" in which supply-chains are relocalized, capital mobility is weakened, and economies are re-oriented towards sustainable production for local needs rather than financialization and export-led growth. While radical, elements of this agenda (particularly supply-chain relocalization) are being pursued today in response to the COVID-19 pandemic (Gray, 2020), and the growing movement to shrink and democratize the financial sector may find a window of opportunity for transformation in the wake of another (arguably inevitable) financial crisis (Pettifor, 2019: 64). Furthermore, the OECD's "Beyond Growth" initiative and growing skepticism towards GDP among influential economists and heads of state demonstrate that cracks are emerging in the growth consensus that may be creating the preconditions for an eventual post-growth world order (OECD, 2019). While there are challenging questions on how a post-growth transition could materialize in a competitive international system in which growing GDP is critical to economic and military power (Barry, 2020), it is possible in the coming years that a convergence between political-economic and climate-induced crises will overwhelm the efforts of leading states to restore economic growth. Combined with strong pressure from grassroots movements like Extinction Rebellion and the Climate Justice Alliance to abandon GDP in favor of a just emergency transition,[3] this context may enable the emergence of new international

[3] Climate justice groups like the Climate Justice Alliance have long called for abandoning GDP in favor of alternative notions of well-being, while leading Extinction Rebellion strategists agree that this will be necessary to meet the Paris Agreement targets (Read & Alexander, 2020: 16, 23). Furthermore, survey data suggests that the wider public may already be receptive to such demands. A recent YouGov poll, for example, found that 8 out 10 people in the UK would

norms and institutions to rapidly reduce emissions and redesign economies around the principles of well-being and steady-state economics.

Second, if we dismiss the feasibility of a near-term post-growth transition to stabilize the climate system, then we should consider the implications of a three or four degree temperature rise for world order and how the latter may adapt to retain stability and prevent mass mortality. While there is much uncertainty, current projections are that agriculture across the planet would be severely threatened in a three and especially four degree world (possibly involving 20-40% yield reductions in key staples), which multiple scientists believe could only support a global population of four billion or less (Vince, 2019; Cribb, 2019: 79). Furthermore, scientists project that, due to a combination of sea level rise and population growth, up to 300 million people will be at risk of displacement from regular coastal flooding by 2050 (Kulp & Strauss, 2019), while populations across North Africa, the Middle East, and South Asia would be regularly subjected to lethal "wet-bulb temperatures" (the 35°C threshold beyond which sweat-based cooling mechanisms lose their effectiveness even for healthy individuals) (Raymond et al, 2020). Thus, preventing international conflict and mass mortality in this context would likely require "cooperating as never before to radically reorganize our world" through massive programs of resettlement and relocation to shift population centers and agricultural production to more habitable regions (Vince, 2019). There is great uncertainty regarding projections of total "climate refugees" in the future, which range widely from 40 million to 1 billion by 2050 (and would likely increase by the time we reach 3-4°C), though much of this would involve domestic rather than international migration (Cribb, 2019:

prefer the government to "prioritize health and wellbeing over economic growth" during the COVID-19 pandemic, whereas 6 in 10 would prefer to *permanently* prioritize health and wellbeing over GDP (Harvey, 2020).

170-171). Entire states would also need to be relocated, particularly the low-lying island nations of the Maldives, Marshall Islands and Kiribati, which would be submerged – along with much of Bangladesh – by the 1-2 meter sea level rise projected by 2100 (Femia & Werrell, 2017). Whether and how this could be peacefully managed, particularly in a context of rising rightwing populism and food-water-economic crises stressing all regions of the international system, is a daunting challenge.

However, the most difficult challenge in a three to four degree world may be how to prevent warming from escalating ever further, given the likelihood of tipping elements being intensified across the earth system by this time (Lenton et al, 2019). Luck will undoubtedly be necessary, in particular that carbon and methane feedbacks will unfold slowly. This may provide states the breathing room they need to coordinate a global plan for accelerated NET expansion and possibly even temporary Solar Radiation Management (SRM) to hold global temperatures constant and prevent a cascade of tipping points as atmospheric CO_2 levels are brought down. However, as many critics have demonstrated, SRM poses immense logistical and governance challenges – not only due to the geographically uneven distribution of costs and benefits and inherent climatic uncertainties, but also the need to sustain global cooperation to coordinate deployment and maintenance of a geographically dispersed SRM infrastructure for decades or longer to avoid "termination shock" (MacKinnon, 2019). Even if successful, such adaptations would be unlikely to enable states and the global economy to sustain compound growth. Given the immense economic damages and productivity losses that would occur in a 3-4°C world (Burke et al, 2018), the fact that many ecosystems are already on the brink of collapse at current levels of global resource consumption, and evidence that an "absolute

decoupling" of economic growth from growing resource consumption is likely impossible, limits to growth will most likely be reached by this time (Kallis & Hickel, 2019; Parrique et al, 2019). However, a transition to a post-growth global economy, combined with sustained global cooperation to massively expand carbon removal, permanently resettle climate refugees in more habitable regions, relocate and transform global food production, and govern a temporary SRM intervention, might enable a stable though radically altered world order to emerge (Vince, 2019; Cribb, 2019: 259).

Finally, if, as many scientists fear, positive feedbacks in the earth system will raise temperatures more rapidly and overwhelm collective adaptation capacities, then how might a process of global "collapse" unfold? Collapse is understood here, following Joseph Tainter, as a "pronounced loss of an established level of sociopolitical complexity", leading to declines in material standards of living and population levels (Tainter, 1988: 193). One key question is whether a global collapse would involve a slow and geographically uneven "long descent" punctuated by a series of severe crises over the course of decades (Greer, 2008), or a more rapid process of "synchronous failure" where mutually reinforcing ecological and political-economic crises cripple critical infrastructures and governance capacities (Homer-Dixon et al, 2015). This will depend on the precipitating "trigger" and the strength of amplifying feedbacks. For example, a major financial crisis in the next 10-20 years could converge with intensifying climate impacts – whether trillion dollar natural catastrophes or crop failures in key breadbaskets – in which case efforts to stabilize the financial system and restore investor confidence may confront insurmountable headwinds. The result may be a prolonged depression, critical infrastructure failure as governments at national and local scales are unable to mobilize

the resources to manage these multiple crises simultaneously, and widespread social unrest (Ahmed, 2017).

Such risks would be increasingly pronounced as we reach three and four degrees later this century, especially if realists are correct that global cooperation will continue to fragment in the coming decades (Mearsheimer, 2018). In a context of limited international cooperation and non-linear climate change that overwhelms incremental adaptation, this would mean agricultural collapse – potentially "reducing world grain production by about one third at the very time we are trying to double it" – and unprecedented food insecurity, intra-state conflict, and geopolitical tension across the international system (Cribb, 2019: 78; Spratt & Dunlop, 2018). The global economic and financial architecture based on assumptions of continuous growth would likely collapse, precipitating a breakdown of global trade and exacerbating resource scarcities in import-dependent states. Great powers (especially the US and China) may engage in "predatory militarism" to secure food, water, and energy supplies for their populations (Friedrichs, 2013: 96), and there is a significant danger that inter-state conflict over dwindling resources could escalate into a nuclear exchange. India-Pakistan is a major flashpoint, since both countries are not only highly vulnerable to extreme heat, water stress, and crop failures but could also see tension flare up over access to the shared Indus river (Cribb, 2019: 66). Thus we should not downplay the risk that global collapse would lead desperate states to flaunt international norms on conflict prevention and even nuclear deterrence. However, rather than assuming inevitable conflict, it may also generate new forms of cooperation to develop more simplified and localized political-economies based on rationing, redistribution, and securing basic needs (Friedrichs, 2013: 98).

Conclusion

To conclude, scholars of the current crisis and future of world order should make the climate crisis *central* rather than peripheral (or non-existent) in their analysis due to its likely transformative and/or catastrophic implications. Furthermore, climate IR scholars should more deeply investigate the potential for structural political-economic discontinuities induced by the climate crisis and its feedbacks on political-economic, financial, food and other critical infrastructure systems and explore their geopolitical ramifications.

To clarify, my argument is not that economic growth will *inevitably* come to end during this century. Unanticipated technological breakthroughs in renewable energy, battery storage, next generation nuclear reactors, and biofuels *may* enable a more rapid transition to net zero emissions than current models anticipate, thereby making the Paris Agreement targets compatible with economic growth. On the other hand, major breakthroughs in NETs, making them both cost effective and land-energy-water efficient, *may* enable us to overshoot the Paris Agreement targets while bringing atmospheric CO_2 back down to safe levels later this century. But it would be irresponsible to dismiss such scenarios completely due to confident expectations of future technological and political-economic solutions. Instead we need to grapple with the full range of possibilities, especially as climate action continues to be delayed ever further and evidence of near-term tipping points mounts.

The COVID-19 pandemic has demonstrated how systemic shocks made possible by the combination of ecological degradation and political-economic fragilities can

rapidly upend global capitalism and world order (Settele et al, 2020). While the near-term implications will involve the worst global economic crisis since at least the 1930s great depression, in the mid and longer term the likelihood of either a post-growth transition or global collapse have increased. On one hand, the shock and subsequent lockdowns may permanently alter patterns of production and consumption, thereby changing the values and expectations of citizens and policy-makers to prioritize well-being, security, and ecological protection over rising GDP (Gray, 2020). On the other hand, efforts to revive the growth engine at the expense of climate mitigation and other ecological considerations may further entrench a long-term trajectory of ecological and political-economic collapse, particularly if the crisis leads to increased concentrations of wealth and a return to financial austerity in the coming years. The current crisis should also make us reflect on how future pandemics – which may be more lethal than COVID-19 (Settele et al, 2020) – will converge with intensifying stresses posed by a continuously warming climate on political-economic, financial, food, and energy systems. In short, the COVID-19 crisis may provide a glimpse of how synchronous failures emerging from the climate-financial-food-energy-public health nexus may overwhelm the resilience of global capitalism and currently powerful states in the coming years and especially later this century. Therefore, the project of thinking beyond the continuationist view that capitalism and economic growth will persist indefinitely, even as its ecological foundations deteriorate, is more pressing than ever. In contrast, IR scholars should be open to more radically discontinuous trajectories in the international system, and the task of imagining a post-growth world order should be taken up by those hoping to actualize more just and sustainable political-economies from the unraveling of the current order.

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