



The liberal order in complex societies marred by climate change

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Received: 6 June 2025 / Accepted: 13 May 2026
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Abstract

In this essay, I develop a complexity-oriented research program outlining an approach to classical liberal thought that highlights how rule-of-law institutions enable cooperation even in the face of intricate political and economic pressures from activist groups, diverse stakeholders, firms, and the general public. This research program outlines how government-imposed constraints, when guided by stable and uniformly applicable frameworks, can help shape group agency and collective choice—social features essential to tackling social and environmental externalities caused by human action, such as climate change. To ground this discussion, I adopt a lens focused on heterodox economics through incorporating methods from anthropological legal theory and the history of economic thought—namely their Austrian and classically liberal dimensions. By addressing different facets of traditional classical liberalism—decentralized decision-making, social choice, and the need for robust, free market institutions—this essay sets the stage for a broader inquiry into how development efforts, both in emerging and developed country contexts, can align with the ideals of republican social order and economic stability through changing political conditions. My conclusion will argue that stochastic economic and political shocks, which originate in worsening climate change, impair efforts for international development and create additional feedback loops which slow progress in areas like social justice, global inequality, and international cooperation across countries and communities at varying levels of wealth and income. This combination deserves greater academic attention.

Keywords Liberal order · Climate change · Government

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1 Introduction

The central challenge of any environmental research program in mainline economics is to reconcile liberal principles of freedom and legality with the collective action required to address climate change. This paper asks: How can liberal, rule-of-law institutions adapt to govern complex environmental systems without collapsing into technocracy or losing their normative legitimacy in the court of public opinion? To explore this, I draw on classical liberalism, public choice theory, and complexity economics, and together these traditions serve to frame a roadmap for future interdisciplinary work on climate governance.

The enduring question of how individuals and groups make decisions in complex political economies is intricate, embodied by the work of cadres of scholars, and has made continuous progress in economics, political science, and philosophy since the advent of modern social thought (Arthur 2021; Rosser 2009; Rescher, 1998). The psychological structure of beliefs, options, and choices between those options is crucial to develop descriptions of complex political and social institutions, organizations, and individuals as they work, live, and die in the Anthropocene (Lam and Rousselot 2024). Within these broad and interdisciplinary strokes, I pose the following thematic proposal to guide future inquiries on this subject: How should classical liberal legal and economic theorists discriminate between proposals that maintain the ethical standards of libertarian *laissez faire* and the principles of economic freedom, while considering the necessity to proactively manage ecosystems and societies within the framing of the urgent necessity for climate action? In addition, there remain questions in the literature surrounding inquiries related to how liberal legal and economic theorists discriminate among climate policy proposals such that ethical standards of generality, predictability, and equality before the law are preserved while enabling adaptive, polycentric governance of environmental risk. In other words, this agenda seeks to determine whether the design of markets can accelerate free market entrepreneurial discovery in low-carbon technologies while respecting rule-of-law constraints imposed by canonical democratic legal norms.

In order to embark on this project, researchers need a comprehensive understanding of social mechanisms that facilitate or hinder cooperation among agents and must consider not only the formal institutions of government but also the informal, often ethically laden, market processes that undergird everyday life. Climate change, in particular, represents a challenge that transcends traditional market failures and poses unique questions regarding the discursive space between individual liberty and collective responsibility. As the economy faces ongoing and rolling shocks—from environmental disruptions to geopolitical upheavals—the mechanisms by which agents cooperate and make choices come under increasing scrutiny. Indeed, such shocks are not only due to market forces (A. Atkinson and Stiglitz 2015), the invisible hand (Smith 1976), or exogenous natural events (Haeffele-Balch and Storr 2015); they are caused by agentic human interference in economic and social affairs. Where classical liberal theories of the rule of law, economic freedom, and social liberty play a role is not in understanding degrees

of separation between the human, the social, and the natural; instead, it is in managing this novel scientific knowledge project through prudential governance of innovation and careful management of the theoretical social constructions and tangible institutions which power ongoing growth and civilizational development.

I examine both individuals and social groups making environmental and economic decisions that create political outcomes which are themselves based on the details of individual and organizational psychology (Langlois 2025). These are, typically, economic coordination problems (Wittman and Paulus 2009) to do with scarcity and abundance—a result of resource constraints and the fragility of earth’s ecosystems. Structured collective choices are what makes political problems like climate change (Bernauer 2013) both a function of the options individuals and organizations have, and a decisive factor in creating the environmental conditions for decisions based on those options. By incorporating complexity theory into an Austrian and Hayekian (Angner 2007; Hayek 1973) analytical framework, it becomes possible to explore how emergent properties of economic and social systems (Schenk 2005) can influence the efficacy of both market mechanisms and the governmental interventions that structure those mechanisms, introducing, at times, both order and inefficiency.¹

The structure of the paper is as follows. This introductory section has outlined the overarching themes in the domains of law, public choice, and the drivers, impacts, and implications for climate change, based on these theories. The next section surveys key contributions in the fields of public and social choice theory, political and classical liberalism, mechanism design, and complexity theory as they apply to discourses on natural law and the rule of law in democratic polities marred by climate change. It also addresses the emergent literature on climate change as an economic and political challenge, thereby situating this essay as a contribution to what Adler (2023) calls “climate liberalism.” In later sections, a proposal for a new theoretical framework will be developed that integrates the complex drivers and implications of climate change with a theory of rights, obligations, and moral invectives issued by agents subject to social choices between decision-theoretic public goods and private luxuries. The paper concludes with a discussion of the implications for contemporary policy debates—with particular reference to the moral and political theories dealing with the Anthropocene, which shape international rule of law in a climate-changed world (Williston, 2015). In the conclusion, I argue that the research community needs to better understand the social mechanisms underlying heterogeneously endowed cooperation among agents operating under social constraints defined by environmental externalities. By drawing on the rich intellectual heritage of classical and political liberals among a variety of other, ideologically and intellectually diverse thinkers, and by incorporating contemporary challenges such as climate change (Dessler 2022) and economic complexity (Arthur 2014) as cornerstones to a descriptive analysis of current civilization-scale challenges, this paper aims to offer

¹ The fault of bureaucratic structures for ineffective and wasteful policies is heavily documented in the Austrian literature (see, e.g., Cordato 1980).

both a roadmap for theoretical advancement and a normative blueprint for balancing market freedom with necessary regulatory oversight within research programs.

2 Work on complexity-driven social theory

The literature on public and social choice theory at its intersection with political and classical liberalism is extensive and multifaceted.² In developing a framework that connects these bodies of work with modern challenges including climate change and economic sophistication or complexity (Rind 1999), it is essential to trace the evolution of key concepts and to identify the areas where traditional economic models—including inherited Heterodox ones—have to be extended or revised. This section reviews classically liberal opposition to “global governance,” theories of group agency and collective decision-making, the tradeoff between political liberalism and the notion of the “original position” (Hinton, 2015), and life projects shaped by resource endowment (De Geest and Kingsley 2019). Later, I also discuss inequalities and policy limitations stemming from scarcity and want, as well as applications of structured choice environments found in the game theory literature (Gailmard 2020). By sketching a theory of local and community-based solutions to the mechanism design problems (Ostrom and Ostrom 2004) faced by creators of systems and market-based platforms,³ researchers can shed light on the kinds of algorithmic complexity theory that reveal the true nature of market processes subject to political decision-making in the context of the environment (Rosser 2012).⁴

The intellectual roots of the present inquiry lie in Heterodox economics as well as in the history of economic theory. This approach departs from the classical view of political processes, like those developed, in part by Rousseau, Montesquieu, and Burke, typically thought to be guided solely by abstract notions of the public good (See Olson, 1965). In these framings, politics and public life move together, driven by the benevolence of leaders who exemplify moral values and communal virtues in their ascription and dedication to the founding pillars of democratic life and order. This theory emphasizes the role of individual preferences (Hayek 1952), strategic interaction (Schelling, 1981), and the inherent trade-offs that arise when collective decisions are made. In the context of the contributions by Mancur Olson (Olson, 1965) and Thomas Schelling (Schelling, 1981), the development of an economic analysis which is cognizant of, and attuned to social order—including the kinds and mechanisms of social structures described by Coleman (1990)—can be applied directly to political institutions, institutional design, and the ways that personal values serve to legitimize power (Arrow 2012), an approach that has since become a cornerstone of the field of public choice.

² Public choice emphasizes strategic behavior in politics, while social choice focuses on the logical foundations and limitations of collective decision-making (Mueller 2003).

³ I.e., devices to manage climate change efficiently and effectively, like carbon taxes or cap-and-trade mechanisms.

⁴ The complexity theory I have in mind is of the Santa Fe variety (Krakauer 2024).

While development of Marxian and Keynesian, bourgeois and neo-liberal lines of inquiry would be useful, the most I can offer is an examination of the implications of natural forces on a topographically diverse social order. Scholars have extended the original economic framework of tradeoffs, opportunity costs, and marginal gains and losses to examine issues such as rent-seeking behavior (Rowley et al. 1988), the design of voting rules (Koford 1982), and the impact of institutional arrangements on policy outcomes. While this body of work has provided a rich analytical toolkit for understanding how collective decisions are made, it becomes a cumbersome and ideological burden under a new form of analysis which is agile, adaptable, and dynamic, used as a workhorse by social philosophers as a unit of analysis under the aegis of the Anthropocene. This description of the state-space, or landscape of inquiry, is particularly notable in work by Austrians and evolutionary economists who have emphasized the emergent nature of economic systems (Nelson and Winter 1985) when vary large groups of individuals work together or in tandem on projects in science or politics (Lavoie 1989). While the concept of group agency is not simply reducible to the sum of individual preferences, but is shaped by social interactions and institutional contexts, what instead shapes the road going forward for classical liberals is a spirit of individuality, one which accepts difference, celebrates it, and competes with the cacophony of agents seeking to innovate in new and unorthodox manners.

The notion of group agency has undergone significant refinement in recent decades (Vincent 1990). Early treatments of collective decision-making tended to focus on the aggregation of individual preferences, often relying on simplistic models of structured voting incentives and consumption decisions (see MacClelland 2020). However, more sophisticated analyses have revealed that the dynamics of group agency are deeply influenced by factors such as power and information asymmetries (Martin 1992), institutional constraints (Lomasky 2002), and the strategic behavior of actors within groups. In this regard, political theory serves as a starting point for the program outlined in Sect. 4, by enabling an understanding of the metaphysical nature of complexity-based scientific discovery in the social sciences. However, later scholars have also sought to incorporate insights from sociology, psychology, and network theory to better capture the complexity of collective action (Drury et al. 2012). Next, I move from these philosophical foundations to begin to explicate the radical political implications of this style of interdisciplinary inquiry.

3 Political and classical liberalism within the framework of radical social change

The literature on political and classical liberalism has long grappled with the tension between idealized models of justice and the lived moral realities of individuals (Moore 1982, 1992). The rule of law, considered in its application to the legal, social, and economic effects of climate change and environmental discourses, provides researchers in this burgeoning field with the normative foundation for outlining the principles of ecological, social, and political justice that are free from the distortion of particular or homegrown epistemic social conditions. Distortions, like

those of polarization (Brown 2023), information asymmetry (Stiglitz and Kosenko 2024a, 2024b), or imperfect markets for environmental goods (Cararro 1999), serve to increase the complexity of social systems and obscure solutions to problems which plague those systems in a systemic fashion. In the legal philosophy of John Rawls (see Dworkin 2004 on this), fairness and impartiality depend on a capitulation to ignorance (the initial position), a societal-scale retreat to the absence of knowledge and veridical information creating limited latitude for a priori theorizing. I argue that researchers can interpret Rawls in this context as proposing a rudimentary form of the very conditions that are paramount in adjudicating structural justice in an Anthropocene defined by collective trade-offs. These conditions are demarcated by a mirage of impartiality, agnosticism to heritage and inheritance, and neglect of the difference principle—whereby any change that makes the worst-off better-off should be implemented.

Ethical perspectives on the implications of highly interdependent economic, social, and natural systems must cope with the fact that many individuals do not start life on an equal footing and therefore are subject to inequalities and develop claims to justice that must be addressed by the law (Pesch 2024). While individuals are “endowed” with varying degrees of capital, education, and social networks, what shapes their opportunities and constrains their choices is not the initial conditions of their relative social and economic endowments. Instead, scholars in this tradition should acknowledge that it is market forces which are constrained or enabled by the law that determine the international status of individuals and demographic groups (Jensen et al. 2011). In this view, political choice is not an abstract exercise in fairness but a concrete process of navigating the opportunities and limitations imposed by one’s social and economic background. At this stage, I am bracketing issues of the environment for later discussion.

The divergence between these perspectives has important implications for the study of market mechanisms (Hammond 2011). Conflict between different ideological standpoints—with one (Rawlsian) emphasizing a reconstructive approach to failing, unable to adapt, institutional centers, and the other (complexity and social chaos) aiming for objective, network-based solutions with or without the support of traditional governance mechanisms—will likely define the state-of-play for the next generation of climate scientists who must inevitably grapple with increased risk, siloed and adversarial information, and political apathy. In practice, social scientists must also contend with both a diversity with respect to ideals and ideologies about how to define fairness, and the constraints of globally endemic inequality (Piketty, 2014), making it essential to develop analytical models that synthesize these perspectives (Brighouse 1997). Before I examine the true nature of the existing literature in order to assess the battlefield of nature and scientific capitalism, I would like to raise a compatible solution.

Game theory is a powerful tool for analyzing strategic interactions in a wide range of contexts, including political decision-making and market behavior (Schellenbach and Schubert 2015). The central insight of game theory—that individuals’ choices depend not only on their own preferences but also on their expectations about the actions of others (Nash 1951)—provides a natural framework for studying political choice under the real constraints political and social actors face. Such

constraints are prominently manifested in organizational responses to crisis (Diaz and Larroulet 2021; Meyler 2007). Early applications of game theory in political science focused on strategic actions including conflict, barter, exchange, cooperation, consensus-building, negotiation, coalition formation, and the dynamics of all manner of legislative bargaining (Riker 1992). Indeed, by creating the conditions for efficient, fair, and collaborative agreement and exchange, it might be possible, using tools such as game-theoretic mechanism design—auctions, platforms, and matching algorithms—to actually make social progress by shifting societal institutions closer to what science tells us an ideal utopia would look like—one that has overcome the challenge of climate change.

In more recent years, the integration of mechanism design into game-theoretic analysis has opened up new avenues for understanding and improving collective decision-making processes. In theory, mechanism design asks: How can institutions be structured so that individual incentives lead to socially desirable outcomes? Within the context of public choice and the rule of law, this question takes on added significance (Miller 2010). For example, if government interventions in emergencies and times of crisis are to be justified ethically and practically—being guided by legal justification and justified political conviction (Fatovic 2019)—they must be designed in such a way that they correct market failures without imposing undue burdens on individual freedoms while still working to rebuild concrete social and political infrastructure of foundations that are made to last beyond the next business cycle (Greene, 2018). The literature in this area has produced a range of ideas that suggest ways to balance efficiency and equity, particularly in settings where the costs and benefits of interventions are widely distributed across society (Moffitt 2001). While there exist, in this context, powerful arguments for equity and justice, within the bounds of reason, the limits of legislative action and political motivation, and the solutions that the tools of mechanism design provide us with, more justification is needed to understand how to make changes in competitive and high-stakes real-world situations where equity is not guaranteed.

While the analysis and the mathematics behind complex systems science has proved useful in economics and computer science (P. Anderson et al. 1988), among other fields—including evolutionary biology, quantum physics, and finance—some nuance is required to apply the broad strokes I have been developing in this paper to climate change (Lamperti et al. 2018). As a rejoinder, complexities managed through strategic applications of game theory and mechanism design have proved fruitful in analyzing and reacting to issues related to regulatory policy—in some cases environmental regulation (Hsu 2002). For instance, in the realm of environmental economics, scholars have used these tools to model the behavior of polluters and to design regulatory mechanisms—including competition in auctions for cap-and-trade permits, among other applications—that incentivize reductions in greenhouse gas emissions (Nordhaus 2007). These models have not only enhanced our understanding of market dynamics in the presence of externalities but have also provided normative guidance for when and how regulatory interventions should be implemented. By drawing insights from these theories for the current political and scientific debates over climate change, in the following sections, I aim to develop a comprehensive framework that accounts for both the strategic behavior of agents

and accounts for the ethical and technocratic market imperatives that justify strong government intervention to slow and eventually stop climate change (Borre and Viegas 1995).

4 New and existing pathways

This section outlines pathways for operationalizing the research program focused on the complex implications of climate change for classical liberalism around a fundamental philosophical contribution and the limits that guide the scope of the program itself. In the broader picture more generally, I aim to advance a line of inquiry by proposing criteria and testable questions for a politically salient, network sensitive approach to climate governance, and sketch how to evaluate institutional design under environmental rule-of-law constraints. The aim of this section is to surface limitations and accelerations that follow from the program's premises and methods, and to flag foreseeable pitfalls or opportunities within the interdisciplinary path ahead. Interdisciplinarity itself is indispensable here—the blueprint links political theory, public choice, mechanism design, complexity economics, and climate change—but this very breadth invites well-known risks: conceptual slippage across fields, “model monocultures,” and the temptation to over-generalize from stylized simulations to institutional prescriptions. Recent contributions underscore both the promise and fragility of cross-field integration—from calls to widen macro modeling toolkits beyond computational modeling toward agent-based approaches (Cincotti et al. 2022), to arguments for a pluralist, heterodox role in integrated climate-economy modeling (Proctor 2023), and to the challenges of embedding digital transformation into sustainability transitions (Nieddu et al. 2022). The program I propose embraces that pluralism while expanding the space within ideological guardrails: clear definitions of liberal complexity, explicit ethical criteria guiding free market environmentalism, and economic hypotheses that can be falsified through philosophical deduction.

Conceptually, the framework depends on operationalizing a substantive conception of high-quality theorizing that stands on foundations of generality, predictability, continued revision, linking the framework to climate outcomes—this requires careful design of measurement, idea generation, and comparability of social phenomena and interventions across political jurisdictions. Empirically, identification of the causes of climate externalities is hard. Climate policy is endogenous to politics, capacity, and shocks; potential solutions include staggered adoption of treatments and synthetic thought experiments regarding counterfactuals but will not fully resolve limited understanding of environmental and economic network effects that scale nonlinearly. Institutionally, the dynamics of environmental investment, risk, and distribution are central yet increasingly volatile in modern markets. Evidence on investors' reactions to decarbonization policies and “derisking” instruments suggests heterogeneous responses with potentially critically distributive consequences (Monasterolo et al. 2022). Policy delay rooted in political economy and institutional frictions can erode even well-designed price or mechanism-based auction designs (Chou et al. 2025). The context of compound crises—e.g., climate-amplified

disasters interacting with governance fragmentation and the degradation of democracies—complicates both inference and design (Chester 2020). These constraints call for modesty in the philosophical claims of researchers and motivate my emphasis on transparent rules, contestability of theoretical instruments, and independent measurement and practical validation of policy outcomes as criteria for the success of the research program as a whole.

Looking ahead, three clusters of issues stand out. First, there is a rising need to understand and model risk. As agent-based environmental, macroeconomic, and network models gain traction (Cincotti et al. 2022; Nieddu et al. 2022), the research community must avoid overtheorizing within simplified and stylized environments, must seek to standardize the geography of ideological dissent—defining where the field as a whole stands politically—and prioritize robust ethical values and rigorous economic thought aligned with institutional, political, and mathematical structures already present in the literature. Second, governance–finance coupling is crucial. Climate policy mixes (pricing, procurement, disclosure) can shift financial portfolios in ways that generate feedback loops—credit spreads, collateral values, and sectoral employment—that are poorly captured unless key values in political economy research are endogenized (Monasterolo et al. 2022). Third, political feasibility and intertemporal credibility are paramount. Even rule-bounded, polycentric designs can be undermined by strategic climate action delay or jurisdictional veto—including in the undertheorized power of the judiciary and executive within classical liberalism (Chou et al. 2025). The research agenda should therefore incorporate stress tests under crisis scenarios, diversify the heterogeneity of acceptable economic solutions, and be contextually aware of media-driven attention cycles (Chester 2020) because of their rising influence in politics and economic policy. In short, the program projects a path of cumulative progress—building robust and diversified practical evidence, codifying the topological structure of legal-institutional variables, and benchmarking mechanism design and the performance of theory against real-world benchmarks; indeed, there is still a need to remain alert to the limits of inference and research design. With these constraints in view, I wish to reiterate this paper’s agenda: liberal, rule-bounded adaptation is a plausible organizing principle, but it must be continuously tested against a priori evidence, Heterodox institutional contextualization, and evolving technological, environmental, and financial conditions (Proctor 2023).

5 Complexity theory and its implications for environmental political economy

Austrian insights on dispersed knowledge and spontaneous order map naturally onto complex adaptive systems, and decentralized coordination emerges predominantly from local discovery under changing constraints in mainline economics. Complexity models add formal tools—nonlinearity, feedback, tipping, path dependence—to Hayekian economic theory, clarifying why policy should favor creativity and discovery yet be rule-bounded. See Axtell (2016) and Phelan (2016) on creative entrepreneurship through a complexity lens.

From a complexity-based macro lens, financial markets may exhibit sudden crashes or booms as a result of the interconnectedness of global economic actors (Centeno et al. 2015; Evanoff et al. 2009)—a phenomenon that linear models struggle to explain. Similarly, the impacts of climate change on economic systems are often nonlinear, with tipping points that can lead to abrupt transitions in market behavior, as is often recognized in environmental economics and environmental and ecological science more generally (C. Li et al. 2024). Climate change has emerged as one of the most pressing challenges of our time, intersecting with issues of economic policy, social justice, and political decision-making (Nordhaus 2019). The environmental disruptions caused by climate change not only affect ecological systems but also have profound implications for efficient market behavior (Hong et al. 2016) and effective public policy (National Research Council, 2010) including efforts to mitigate pervasive conflict that threatens civil society and public order (Hsiang et al. 2011). Rising global temperatures, more frequent extreme weather events, and shifting ecological patterns create a context in which traditional market mechanisms are put to the test (Acharya et al. 2023). As agents face increasing uncertainty and new risks, the choices available to them—and the institutional arrangements that govern those choices—must be reexamined.

The literature on climate change and political economy has expanded rapidly over the past two decades. Early contributions focused on the economics of environmental regulation and the design of policies to internalize the external costs of pollution (Oates 1996). More recently, scholars have explored the ethical dimensions of climate policy (Gardiner 2010), asking questions about intergenerational justice (Parfit 2012, reprinted from Parfit 1984), the distribution of costs and benefits, and the role of government in mitigating risks that are not adequately addressed by market forces alone (Ahrens and Rudolph 2006; Kong 2020). This body of work has highlighted several key challenges. First, the global nature of climate change means that no single government or market can address the problem in isolation (see the seminal paper by Houghton and Woodwell 1989). Instead, international cooperation—and the design of mechanisms that can facilitate such cooperation—becomes essential. Second, the uncertainty inherent in predicting climate impacts necessitates regulatory frameworks that are both resilient and flexible. Finally, the ethical imperatives underlying climate policy call for a rethinking of how economic freedom and social responsibility can be balanced in the face of existential environmental risks. The following sections offer a normative foundation for regulatory intervention that is responsive to the nuance of ethical considerations exhibited by the adverse environmental conditions we face.

6 How do new trends change regulatory frameworks?

I hope to have established the necessity to study conjointly economic and environmental complexity constituted by nonlinear networks and emergent systems and remediated through the technocratic design of policy. New economic thinking on the economy, democracy, and capitalism promises to hasten the industrial and economy-wide adaptations that must take place within democratic countries in response to the

multifaceted problem of climate change.⁵ The modern theory of democratic governance has been undergoing a fundamental upheaval wherein previously immutable economic, political, and scientific laws⁶ are being called into question by problems like climate change (or even finance, see Sornette 2017) which employ nonlinear, scaling, and emergent phenomena.

A democratic future, reshaped by nascent and heterogeneous networks of economic and political agents who have a wide range of goals (Mercure et al. 2016), will enable states and democratic institutions to manage critical social problems more effectively like climate change. This future requires adherence to classical liberal principles such as predictability and impartiality of legal processes, just as it requires respect for Heterodox Austrian and liberal theories, ensuring that institutional responses to climate challenges remain posed against freedom, fairness, and justice and are ethically and ideologically balanced. Ideals of communal morality and political structure from social contract theory and legal anthropology enrich this perspective by demonstrating how laws reflect cultural values and social norms—where the necessity of culturally sensitive and locally adaptable legal systems in managing complexity is a critical juncture.

The promise of interdisciplinary research on climate (Stern 2014a, p. 434) interacts with other critical economic needs such as inequality, global justice (e.g., Risse 2012), and population health. Theories that deal with these dimensions of natural and social complexity have spanned what are known as organized and non-organized complex systems (Elsner 2017; Weaver 1948). Crucially, economic and scientific complexity entails an intricate set of sources of political and economic transformation including competition, conflict, migration, trade, international regulation, growth, and the exercise of power, driving change well into and beyond the twenty-first century. Many open questions remain.

As I have discussed, recently, discussions on libertarian responses to global warming have been structured around the nature of complexity within the climate system itself—instances where tipping points and the nonlinearity of environmental feedback loops pervade and increasingly worsen natural processes on earth (Lenton et al. 2008; Armstrong McKay et al. 2022). Ensuring that governance structures adhere strictly to the rule of law—clear, general, and publicly accessible regulations—provides legitimacy and stability necessary to navigate these complexities effectively.⁷ Indeed, the space for mistakes within policy decisions regarding the political management of the human impact on the biosphere is rapidly shrinking (Stern 2007, p. vi-ix). With continued inaction, our impact on the environment may already be irreversible (Spiekermann 2022), with no possibility of substituting the natural environment with other goods (Neumayer 2007). The crucial implications of transnational environmentalism (Falkner 2021) for open societies are yet to be fully realized—as I mention below, preemptive policy solutions must be polycentric.

⁵ Yet, systems theory is a multidisciplinary tool, to be used to solve multidisciplinary political problems.

⁶ E.g., Moore's Law about the development of semiconductors, or the Phillips Curve describing the relationship between inflation and unemployment.

⁷ Concomitant to these discussions on tipping points and planetary boundaries comes critical research on the economics of population—in particular, the Earth's carrying capacity in respect to maximum human population it can sustain. This work originated in Malthus (1992) but see Seidl and Tisdell (1999).

Free markets are the main, and often the most efficient, way that Western democracies have of dealing with adverse economic and social problems—including problems of allocation, distribution, and optimal usage of scarce resources. Classical liberalism provides a framing to think about the climate crisis—one which treats human dignity, personal choice, and agency and autonomy, as the main drivers of innovation, growth, and progress. These interacting economic elements—shards of a larger picture—pertain both to groups like corporations and states who have either (a) contributed an outsize proportion of the emissions or (b) will bear the brunt of the harm, damages, and costs that will come with the increasingly devastating weather events that will be the result of increasingly high levels of greenhouse gas (GHG) emissions and surface-level warming (Stern 2014b). All the same, diversified and informal judicial practices—exemplified in the spread of acceptance or resistance to the diverse responses to crises like COVID-19 across the world—can complement formal institutions in swiftly addressing critical transitions.

Policy instruments, including recent prescriptions that call for cap-and-trade mechanisms as well as carbon taxes, are a promise that environmental complexity can be managed, governed, and controlled (e.g., Metcalf 2021; Timilsina 2022). Whether our democracies can be made more resilient through these crucial economic tools depends on the widespread and immediate adoption of these tools and the research that supports them. Technocratic democratic institutions incorporating policy mandates derived from scientific research will be better poised to detect and mitigate systemic environmental and economic risks. Solutions which promise to manage chaos and randomness have created new means to control complex, stochastic systems (Morimoto 2010, ch. 8) like the economy. Actors such as so-called governance entrepreneurs (Andonova 2017) promise innovative solutions to democracy in the face of uncertainty. Further, some researchers have explored the mechanisms through which our psychology affects the way we decide between the systemically flawed options that we perceive as being available to us (Kahneman 2012; Tversky and Kahneman 1974). Modern democracies are affected by diverse natural and artificial shocks, but there are sensible solutions available.⁸

Is a “managed transformation” of complex economic, social, and political structures possible (Young 2021, p. 34)? The reliability of our models, theories, and institutional mechanisms which aim to deal with both complicated and complex systems is constantly being reframed in new and more detailed and involved ways (Hulme 2023).⁹ As a public, non-excludable, and non-rivalrous good (Samuelson 1954),¹⁰ the environment occupies a space in which states are loathe to create legislation

⁸ See Alchian (1950) and Nelson and Winter (1985) for evolutionary arguments in the economic context of rational choice theory. Alchian specifically describes the economic system as an “adoptive mechanism”—one which rationally chooses among options available to it so as to maximize some function of social welfare, “success,” or “profits” within “perfectly optimal situations.” He also notes the “relationship between changes in the environment and the consequent observable results...”.

⁹ Mercure 2023, p. 133 distinguishes between the abstract levels a) of systems where individuals decide under conditions of uncertainty, and b) the level of models, which experts use to represent those choices.

¹⁰ Non-excludable goods are public in the sense that people who have not paid for their provision may still use them, and non-rivalrous goods are public in a similar way, through their limitless ability to be consumed by as many people as want to consume them (Ostrom 2010).

because of the costs involved and because of the large time delay in the realization of benefits from cleaner production processes. Complex systems require active management through representative democracy. Mercure (2023, p. 123) explains in the context of financial markets that “as the complexity of financial instruments and their contingency on others, and total debt accumulates (entities move closer to the insolvency limit), the financial system reaches self-organized criticality where unexplained price fluctuations of all magnitude arise.”¹¹ Once scientists or policymakers do detect a breach of the planetary boundaries, and civil decision-making structures understand the scale of the paradigmatic change in the climate system, it is up to democratic procedures—informed by research in this tradition—to employ political action immediately.

As Scheffer et al. (2009) shows, our best scientific and economic instruments can manage the complexity of natural systems. Systems of inquiry and empirical research based on democratic principles that can interpret and forestall critical climatic phase-transitions (Scheffer et al. 2009) are crucial because deliberative procedures need time to respond to ecological crises in a safe and controlled manner.

7 Synthesis and emerging themes

In synthesizing the effects of complex climate systems—economic, social, and political—several emergent themes relevant to legal scholarship as well as economic theory become apparent. First, there should be a transition from a focus on individual rationality, defined by game-theoretical concepts which shape interaction, rewards from interaction, and incentives to constructively interact or defect (Wood 2011) to nonlinear and nested dynamics of networked systems. This analysis of collective behavior—derived from static models as well as those incorporating dynamic changes and uncertainty—is essential for understanding contemporary climate challenges under a legal regime characterized by capitulation to inaction.

Second, the tensions between idealized models of political liberalism and the practical realities of endowed life projects (Rawls, 1971) underscore the need for frameworks that integrate normative ideals of progress, social justice, and legal and social equality with empirical realities. While we should not be opportunistic in characterizing social life across the democratic-authoritarian spectrum—and nor should we gloss failed efforts at tangible change (Latin 2012)—policymakers and researchers need, instead, to be guided by realism about the nature of the choices states, institutions, and socio-economic groups face, as much in cooperation and collaboration, as in war and conflict (Hirshleifer 1978). As Hirshleifer (1978, p. 240) poignantly asks “How can the analog of exchange, mutualism, be viable in the realm of natural economy without any system of law to guarantee repayments?” Political choice, in this sense, is a multidimensional phenomenon that cannot be fully

¹¹ As such, a critical management tool of systems engineering, is control (mentioned above), as well as the ability to “steer” processes and agents through complex, uncertain, and stochastic manifolds of (economic or otherwise) reality. See Keating et al. (2023).

understood without considering both abstract principles of fairness and the concrete constraints imposed by predominant social and economic inequality (Hirsch 1976). While in many societies these issues of agency and freedom are shaped by asymmetric markets, concentrated industry, and disparities in regional innovation, wealth, and economic growth, it is also crucial to account for the legislative role played by parliamentarians and diplomats in crafting binding obligations in service of a better, safer, and less polluted world (Seib, 2016).

Third, the application of game theory and mechanism design has historically and fundamentally altered our understanding of how institutions can be structured to align individual incentives with collective welfare. Research in the liberal tradition needs to account for this quantization of choice. Simultaneously, without egalitarian legal provisions for equality and justice, social order will break down into fractional groups vying for control of increasingly scarce basic resources.¹² Indeed, as early as 1994, Sandra Postel (1994, p. 4) argued that: “The earth’s capacity to support humans is determined not just by our most basic food requirements but also by our levels of consumption of a whole range of resources, by the amount of waste we generate, by the technologies we choose for our varied activities, and by our success at mobilizing to deal with major threats.” The challenge is to design mechanisms that not only promote efficiency but also safeguard fundamental values such as autonomy and justice. Future visions of ensuring autonomy in the labor market in the context of a progression of labor-augmenting technological change will be essential in ensuring decentralized justice (see the assorted chapters contained in Antonelli, 2011). Whether we, as individuals and societies shaped by the ethical choices we face—including choices about consumption and with an increasing awareness of the externalities of our consumption, i.e., pollution—rise to the challenge of developing forward looking altruistic legal structures based on freedom structured by incentives (Widerquist 2003) to safeguard the lives of future generations (Page, 2006), remains to be seen.

Finally, the issue of climate change itself serves as a catalyst for reexamining traditional models of market regulation and political choice (Grundig 2010)—in a Heterodox direction. The environmental and economic disruptions wrought by climate change demand a rethinking of the ethical and political criteria for government intervention in the market process. In this context, the integration of normative and empirical approaches is not merely an academic exercise, but a necessary response to one of the most urgent challenges of our time.

8 Concluding remarks

This paper provides a research roadmap that looks to inform both policymakers and the general public on the mainline ideology which guides solutions to “wicked problems.” From the classically liberal texts of Buchanan and Tullock (1962) and Hayek

¹² The result of a society which has not transitioned away from fossil fuels before meeting the objective resource constraint of the Earth’s carrying capacity—eventually there will be no more oil to drill or ore to mine.

(1960), to the latest developments in complexity theory and climate economics, the body of research on public choice economics and complex systems offers both theoretical tools and normative guidance for analyzing political choice under political, institutional, and resource constraints (Kanbur and Myles 1992; Rogowski 1999). This literature shows the need for adaptable and dynamic regulatory frameworks in the face of systemic uncertainty about the state of the natural world, and the ethical imperatives that must guide public policy in instances where instability and uncertainty are the *modus operandi*. Furthermore, by acknowledging the impact of classical liberalism within a framework of Heterodox economics broadens this analytical framework by challenging conventional regulation-centric paradigms and emphasizing the role of institutional, historical, free-market, and social factors in shaping economic behavior.

Complex climate systems—including systems developed to manage climate—call for and force society to realize the urgent necessity for policymakers to grapple with global challenges that are derived from nonlinear system dynamics, emergent phenomena, and tipping points that defy straightforward predictive modeling (Schneider and Dickinson 1974; Katzav and Parker 2015). While the legal anthropology of climate disasters and human responses to ongoing climatic change contributes an essential layer to this analysis by illuminating how different legal traditions and cultural practices that shape environmental governance, it is crucial to remember that legislative, economic, and political phenomena jointly influence societal responses to climate challenges (Crate and Nuttall 2016).

While much work has been done on the mechanics of collective decision-making and the design of incentive-compatible institutions, less attention has been paid to the moral and ethical dimensions of these processes. Albert (1999, p. 92) argues that the “[d]e-bordering and the evolution of world society do not express themselves in a simple disappearance of territorial borderlines, but in their conversion from places of separation to places at which the chance of the development of ‘communal society’ is most visibly present.”

Complex climate reality and the science that documents it further emphasizes the ethical urgency of action, as the inherent uncertainties and potential catastrophic consequences of climate change demand normative clarity in policy decisions (Magill 2011). Awareness of dependence and nonlinearity within political mechanisms deepens the Heterodox critique of social management of natural systems by showing how the ethical dimensions of environmental governance are mediated through culturally diverse legal systems. This is how researchers should approach universalized ethical prescriptions that may fail without sensitivity to local contexts and traditions (Baer and Singer 2018; Crate 2011). One could ask, how, for instance, we can reconcile the tension between market freedom and social justice in an era marked by rapid environmental change and spiraling economic complexity? It remains to be seen how normative criteria can be integrated into formal models of political decision-making to ensure that regulatory interventions are both effective and ethically justified. These questions should be at the heart of the inquiries that are still being formulated.

To conclude, research on a new tract of democratic political systems needs to take account of new innovation—and risks—which promise to transform our social

and economic structures, political discourse, and the structure of both the social and natural sciences. This is necessary if those in power are to govern by prioritizing ecosystem preservation and environmental justice. Systems theory deals with “Physics, Chemistry, Biology, Psychology, Sociology, Economics and so on [which] all carve out for themselves certain elements of the experience of man and develop theories and patterns of activity (research) which yield satisfaction in understanding...” (Boulding 1956, p. 197). If democracies are to be truly plural and truly constitutive of the range of human lifestyles present in the population, they need to face difficult-to-manage environmental problems, and they need to embrace transformative technological change—the fourth industrial revolution and the paradigm shift (or phase transition) in social, political, and legal culture it entails (Cole 2020). Adherence to the classically liberal ideal of diffused and autonomous rule of law, which ideally guarantees ethical yet competitive markets, equality before the law, and protection against arbitrary decision-making, strengthens the legitimacy and resilience of democratic governance systems amidst the uncertainties of the Anthropocene.

Author contribution J.R. wrote, edited, and conducted the research for the entire submission.

Funding No funding was received for this study.

Data availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

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