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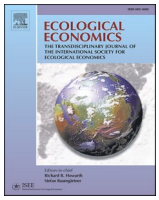

Methodological and Ideological Options

Rhetoric, epistemology and climate change economics

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ABSTRACT

This paper explores the epistemological basis for economic prognostications of climate change activists arising from, arguably, the most important scientific problem confronting modern society: the facts, beliefs and theories associated with the measurement, causes, impact and mitigation of climate change. This facilitates identification of the role that rhetoric plays in activist claims associated with the economics of global warming and climate change. Following a rudimentary discussion of ancient views on rhetoric, the connection of rhetoric with anti-foundational epistemology and language is identified. Criteria for determining when language is rhetorical are specified. Exploiting this philosophical background, mitigation proposals of climate change activists derived from models of climate change economics are critiqued.

1. Introduction

Almost a century ago, the eminent Chicago economist Frank Knight (1925, p.373-4) observed:

> Human beings act, not on the basis of fact and reality as such, but on the basis of opinions and beliefs about facts, and what is called knowledge, but which at best falls notoriously short of the implications of that term. From a logical point of view therefore, one who aspires to explain or understand human behavior must be, not finally but first of all, an epistemologist.

Though Knight was concerned with economic 'knowledge', a few decades later the influential experimental psychologist Edwin Boring (1954, p.639) observed such a claim applies, more generally, to scientific 'knowledge' because: "science is a human activity and that you have, therefore, to take into account the properties of human beings when you are assessing facts and theories." Though such epistemic observations have ancient roots, in recognizing the impact of the "personal equation" on scientific 'facts' and theories, Knight and Boring provide insight into the influence that language has on the production and interpretation of 'scientific' knowledge about climate change and global warming. More precisely, the ability to influence human behavior using 'the art of persuasion' — rhetoric – raises essential questions concerning the validity of economic knowledge claims made by climate change activists. Though modern references to rhetoric are typically pejorative, such references usually fail to recognize the epistemic foundations required to distinguish what is 'rhetorical language' from legitimate scientific knowledge claims.

This paper explores the epistemological basis for economic prognostications arising from, arguably, the most important scientific problem confronting modern society: the facts, beliefs and theories associated with the measurement, causes, impact and mitigation of climate change. This involves identifying the role that rhetoric plays in activist claims associated with the economics of global warming and climate change. In deference to the ancient origins, the following narrative commences with a rudimentary discussion of ancient views on rhetoric. The connection of rhetoric with epistemology and language is identified and subsequent evolution up to the influential contribution of McCloskey (1983, 1985) is summarized and epistemic criteria specified for determining when language is rhetorical. In contrast to McCloskey and others where all economic discourse is perceived as rhetorical, this paper distinguishes rhetorical from legitimate non-rhetorical language forms employed in the economic discourse that climate change activists use to exert significant influence over mitigation initiatives. Building on an observation by Fish (1998) that "another word for anti-foundationalism *is* rhetoric", criteria for distinguishing anti-foundational rhetoric from non-rhetorical scientific language are informed by the naturalized epistemology proposed by Quine and others asserting that 'propositions that are not confirmable by experiment or by

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direct empirical observation are not scientific'.

Exploiting this philosophical background, mitigation proposals derived from models of climate change economics are critiqued. Such strategies fall into two general groups: GHG emissions reduction; and, atmospheric GHG removal. Support for specific mitigation strategies reveals a central feature of climate change activism: the belief that Science can save the world from environmental catastrophe. This leads to emphasis on 'soft strategies': switching from fossil fuel to green(er) energy sources, especially in electricity generation and transportation; expanded use of nationally-based carbon pricing and cap-and-trade schemes; and, development and introduction of carbon capture and removal technologies. Clarification of the role that rhetoric plays in support of such strategies reveals systemic epistemic difficulties in key mitigation proposals. In the context of climate change, there is a complex layering of beliefs associated with: *ex post* scientific knowledge of climate change; *ex ante* theories about causes and effects of such change; and, rhetorical claims about the effectiveness of mitigation proposals. While evidence from scientific measurements of climate change justifies knowledge claims that such change is happening, other layers of belief concerned with the feasibility of 'soft' policies to combat climate change raise legitimate questions about the possibility of belief outstripping the evidence that such policies will be effective.[2]

2. Classical rhetoric

Despite attempts by Shi (2004), Shaw and Nerlich (2015) and Goul (2020) to keep the flame alive by continuing a critique of mainstream methodology employed in economic ecology, the 'rhetorical turn' promised by McCloskey (1983, 1985) and explored in ecological economics by Luks (1998) has seemingly faded into relative obscurity.[3] This failure of the rhetorical turn to gain traction in ecological economics is unsurprising to those familiar with the sociology of intellectual revolutions (e.g., Frickel and Gross, 2005). While the cynical critique of accepted methodology in economics by McCloskey is amusing and, at times, brilliant, there is no proposal for an alternative 'new and improved' approach that can be identified. As Butos (1987) observes, the 'anything goes' relativist approach to methodology in economics advanced by McCloskey attracts critiques akin to those made against the 'postmodernism' that has invaded other branches of the human sciences. By focusing negatively on the styles and devices of language used in economic discourse, such as the general use of metaphors emphasized by McCloskey, and by Shaw and Nerlich (2015) in ecological economics, there is a failure to adequately develop the epistemic implications of claims that the language of economics is rhetorical.

One useful aspect of the critique provided by McCloskey, Luks and others is the attempt to rehabilitate the modern perception that 'rhetoric' necessarily has negative connotations. This rehabilitation revives the roots of rhetoric in the ancient writings revealing decidedly more ambiguous, complex and disparate views of rhetoric. Recognizing that the Foucauldian *episteme* of the ancients is distinct and that ancient sources are scarce and 'often so one-sided', historians of rhetoric are split, sometimes acrimoniously, on whether to date the origin to either the 5th century BCE appearance in Athens of two Sicilians – Corax and Tisias, authors of long lost Sophist handbooks on oratory – or the introduction of the term *rhētorikē* by Plato in *Gorgias* (c.380 BCE) (Schiappa, 1990; Poulakos, 1990; Reames et al., 2017).[4] In either case, this history begins during a period where ancient traditions of rhetorical oratory were being augmented by the literary rhetoric that, fueled by a slowly expanding body of textual sources, was gaining familiarity with educated Athenians. As little has survived that can be directly attributable to the Sophists, itinerant Greek teachers and orators of the fourth and fifth centuries BCE, much of what is known about Sophistic views on rhetoric is due to the Socratic dialogs of Plato.

If there are fundamental differences in rhetorical practice between oratory and literary communication, what ancient features of rhetoric are relevant to modern interpretation? In contrast to the Aristotelian perception that rhetoric can be a neutral tool available to both the virtuous and the devious, Plato expressed general suspicion toward rhetoric. In the refutative dialog of *Gorgias* pitting Socrates against the Sophist rhetorician Gorgias and his possibly fictional students – Callicles and Polus – the substance of rhetoric as persuasion rather than with determining 'truth' is dialectically debated. As depicted by Plato, Sophists such as Gorgias considered rhetoric to be an end, rather than a means. Plato describes Socrates as troubled by the possible abuse of rhetoric. For Gorgias the Sophist teacher of rhetoric, it is not necessary to know the truth about topics of debate. What is necessary is some method of persuading the ignorant that the orator has more knowledge than those who might possess more knowledge. Consequently, the interpretation of rhetoric is closely connected to epistemology.

For Socrates of the Plato dialogs, rhetoric is more about techniques of persuasion rather than with truth and justice. In contrast to Plato, Aristotle interprets rhetoric as a potentially useful civic art, necessary for the political discourse that shapes and sustains the *polis;* though Aristotle does recognize that rhetoric can have negative implications. For example, Aristotle quotes an Iambic poem in *Rhetoric* (Bk II, ch.23): "As things, most false, have often passed for true, so gravest truths will oft be disbelieved".[5] Keeping in mind the ancient emphasis on oratory, Aristotle classifies three modes of persuasion (*Rhetoric,* Bk.1, ch.2): *ethos* – "On all occasions we confide most in men of [moral character]; but in matters highly ambiguous this ground of conviction is paramount to every other"; *pathos* – "when the minds of the hearers are pre-occupied and changed through the excitement of some affection or passion"; and, *logos,* that "relates solely to the point in question, and is employed when this point is either proved, or disproved, by the arguments respectively adapted to these opposite purposes."

How does language of ecological economists relate to the classical interpretation of rhetoric? Aristotle (Bk 1, ch.1) provides a starting point situating the rhetorician between the sophist seeking to deceive, presumably for some form of personal gain, and the logician seeking truth. This interpretation differs from the conventional pejorative modern view identifying rhetoric with sophistry, e.g., Danisch (2012). The alternative epistemological approach proposed by Fish (1998) of connecting rhetoric with anti-foundationalism permits a connection with the Aristotelean origins of foundationalism, an epistemology associated with the logical empiricism that is commonly reflected in the writings of ecological economists. Using epistemological criteria to determine whether language is rhetorical facilitates examination of alternative methodologies such as the instrumentalism associated with the

[2] This approach to specifying "evidence" differs from Bird (2010, p.8) where "anything less than knowledge will not do as evidence". In this context, 'evidence' involves both the propositional input and the reasoning for a truthful scientific claim. This differs from the present usage where 'evidence' can be either the propositional input, such as a global temperature measurement, or the reasoning, such as the theory associated with a climate change model, or both. In this case, the 'evidence' may or may not be sufficient to qualify as knowledge.

[3] The rhetorical turn is not confined to economics. Schiappa (2001) provides an insightful overview and critique of the critiques of 'Big Rhetoric'.

[4] An alternative perspective on the origins of rhetoric, more relevant to the modern use of rhetoric, has a much later origin associated with the development of literacy: "rhetoric, as a self-conscious study of language and its effects and as a meta-discursive practice that is both more systematic and more self-aware than merely intuitive eloquence, could only have truly taken shape with the externalization of language in literacy" (Reames et al., 2017, p.3).

[5] Aristotle makes this point clearly in *Rhetoric* (Bk.1,ch.1): "That rhetoric is an useful art, cannot be a matter of doubt, if truth and justice be allowed to be better things than falsehood and iniquity, which must often prevail against us, unless rhetoric supplied us with arms to oppose and surmount them."

'methodology of positive economics' advanced by Friedman (1953). The upshot is that careful attention to the methodological plurality of ecological economics is required to sort out whether the language used in specific economic discourse is unscientific rhetoric, or not.

The evolution of rhetoric in the centuries following Aristotle was substantial. Whereas the rhetoric of oratory was perceived with suspicion by Plato and as amoral by Aristotle, for Cato, Cicero and Quintilian rhetorical skill was "a by-product of a focus on goodness and truth" (Fish, 1998, p.35). As Quintilian observes (*Institutio Oratoria, II, xv*): "*bene dicere non possit nisi bonus*" ('It is not possible to speak well unless he is good'). This typical Roman approach to rhetoric as "generating and employing probable arguments based on reasoned opinion" (McComiskey, 2015, p.19) was overwhelmed in subsequent centuries of Western civilization dominated by the Christian Church when the techniques of oral rhetoric were adapted to conveying the certain wisdom of the word of God in sermons delivered by orators of unreproachable character. Though rhetoric formed one of the seven liberal Arts of medieval and Renaissance church school and university education, techniques of literary rhetoric were subordinated to conveying the wisdom in the Holy Bible: "truth … resides in the holy scriptures, not in the rhetorician's … power of invention, which results in false reasoning and sophistry if not grounded in Biblical exegesis" (McComiskey, 2015, p.20).

3. Epistemology and language

Despite being from an era that is centuries in the past, the perceived a priori truths of medieval Christian faith provide helpful insight into the interpretation and identification of rhetoric in modern academic discourse. Medieval scholasticism represents an extreme historical instance of foundational epistemology. Since being advocated by Aristotle, foundationalism has evolved different variants involving demarcation between basic belief and non-basic belief. Basic beliefs are 'characterized by infallibility where the possibility of error is radically circumscribed in contrast to the fallibility of non-basic beliefs' (Margolis, 1977, p.121). Justification of belief proceeds one-directionally from basic beliefs to non-basic beliefs that are logically derived from basic belief. Empiricism represents one form of a posteriori foundationalism where basic beliefs concern an individual's sensory states or immediate experiences. Rationalism represents a form of a priori foundationalism where basic beliefs are based on innate intuitions. Different approaches to foundationalism can be identified by answers given to three questions: which kinds of beliefs are taken to be 'basic'? how are such basic beliefs justified? And, how is the logic of deriving non-basic belief to be characterized? (Philipse, 2004, p.14).

Rhetoric is fundamentally concerned with language. In the twentieth century, language played a key role in debates over the demarcation between: foundational and anti-foundational epistemologies; analytic and synthetic statements; and, scientific versus non-scientific theorizing. These debates include significant contributions from logical positivists of the Vienna circle, such as Ludwig Wittgenstein and Rudolph Carnap, philosophers of science such as Karl Popper and Thomas Kuhn and the theoretical philosopher Willard Quine. Gleaning insight about the role of rhetoric in the economics of climate change from these often confounding debates requires recognition of fundamental differences between 'natural sciences' – where experiments that are fixed in repeated samples can be conducted – and 'social sciences'—where the ability to conduct such experiments is not usually available.[6] Consequently, a central point of debate in philosophy of natural science – "Propositions that are not confirmable by experiment or by direct empirical observation are simply not scientific propositions" (Rodych, 2003, p.323) – has much different implications for economics. Absent experimental evidence, the process of 'direct empirical observation' assumes central importance.

In contrast to non-experimental natural sciences, such as astronomy and geology that rely on direct empirical observation of physical objects, economic phenomena, such as the unemployment rate, inflation rate, income distribution, gross national product and the like are intangible objects seemingly difficult to satisfy the requirement of 'direct empirical observation'. On the other hand, with appropriate qualifications many prices and quantities are directly observable. Compared to intangible objects such as 'social class' or 'personality and intelligence', the basic building blocks required for direct empirical observation in economics would seem to be more amenable to the formation of 'scientific propositions' than in other social sciences. However, there is considerable intellectual distance to travel from observable prices and quantities to scientific models capable of predicting the future behavior of prices, quantities and other variables. Statements such as 'the inflation rate measures changes in the cost of living' or 'increasing the minimum wage is an ineffective anti-poverty initiative' or 'carbon pricing is needed to combat the impact of climate change on economic growth' rely on theoretical models with deeply nested assumptions and basic beliefs. This begs the question: can there be 'scientific' truths about economic phenomena that are unbiased and independent of a specific point of view or historical context?

At this juncture, epistemological criteria for determining when language is rhetorical need clarification. The semantical observation by Fish that 'another word for anti-foundationalism is rhetoric' is helpful, but insufficient. In contrast to the a priori truths of ancient, medieval and early Enlightenment foundationalism, at least since Wittgenstein and Carnap it has been acknowledged that "truth is a property of sentences within theoretical discourse". Absent 'a neutral vantage point' outside the language and theories used to make statements about objects in the external world, truth depends on linguistic and theoretical context, e.g., 'Snow is white'. This leads to the penetrating question posed by the foundational naturalized epistemology of Quine: can 'the merits of any answer to any question be answered without appeal to the methods of the natural sciences?' Quine confounds any answer to this question by denying the distinction between analytic and synthetic statements undermining the basis for developing a priori reasoning for knowledge claims (Almeder, 1997, p.349–50). Consequently, Quine regards epistemology as a branch of natural science, implicitly identifying 'anti-foundational' with 'unscientific'. This also amounts to a rejection of a 'first philosophy' that uses a priori 'non-scientific' perceptions to make normative assessments of scientific statements.

An important implication drawn from the naturalized epistemology of Quine regarding the process of applying 'the methods of the natural sciences' extends a proposition originally advanced by Duhem in the context of physics More precisely, the Duhem-Quine hypothesis claims it is not possible to test a hypothesis in isolation, e.g., Sawyer et al. (1997). Any test of a hypothesis is also a test of the assumptions and basic beliefs used to formulate that hypothesis. A crude application of Duhem-Quine arises with a linchpin of climate change activism (Reay, 2018): the perceived causal connection between climate change measurements and the Keeling curve which measures increasing carbon dioxide (CO_2) in

[6] Not every natural science is experimental, e.g., astronomy relies on direct observation of physical objects to formulate and test hypothesis. Similarly, as evidenced by the award of the 2002 Nobel memorial prize to Vernon Smith, experimental economics is an active research area in economics. Many studies in this subject are extensions of cognitive psychology and connect with game theory, expected utility and auction performance. Hence, the statement that economics is non-experimental requires some qualification related to intangible objects that are the subject of the experiments.

the atmosphere.[7] Scientific evidence of a relationship between increasing Keeling curve measurements and climate change propels proposals to mitigate future climate change by reducing CO_2 emissions. If such proposals are effectively implemented and climate change is not impacted, Duhem-Quine would require that both the causal connection and the methods of measurement be rejected. The intangibility of most economic phenomena raises additional complications about whether and how the 'scientific method' can be applied to verify or falsify specific economic propositions.

What is the connection of this background with the rhetorical critique of economics advanced by McCloskey, Luks and others? It is more than apparent that McCloskey is an anti-foundational relativist, where any truth, if available, involves context not dependent on the methods of the natural sciences (McCloskey 1983, p.488):

> Modernism promises knowledge free from doubt, metaphysics, morals, and personal conviction; what it delivers merely renames as Scientific Method the scientist's and especially the economic scientist's metaphysics, morals, and personal convictions.

Such relativism elevates the importance of rhetoric. If truths are relative to context then the ability to persuade takes precedence over 'scientific knowledge' across a range of human interactions. Using a broad and loosely defined notion of modernism that largely ignores the diversity of epistemological implications, McCloskey primarily engages with methodological issues arising from the prevalence of 'modernism' in economics. There is only underdeveloped attempts to explore the implications of alternative avenues to relativism that range from the linguistic relativism of Wittgenstein where "the meanings of sentences are relative to the rules of a prevalent language game because it is impossible to determine authorial intent outside a particular language game" to the claim of Kuhn that the pursuit of 'normal science' is "governed by a paradigm the truth of which is not ascertainable by the scientific method" to the extreme position of Rorty that scientific "knowledge" is a 'belief system that is a ritual which has been agreed on by the scientific community' (Munz, 1990, p.123–4).

In contrast to McCloskey, the relativist perspectives of Wittgenstein and Rorty are decidedly more nuanced. For Wittgenstein, all language games need to adopt and adhere to an internal logic. The internal logic for statements about climate change could be defined by an academic field, an administrative policy, a school of thought or some other epistemic domain. Relativism in this sense is not a matter of rhetoric but a matter of internal logic that keeps a specific Wittgenstein language game meaningful. Rhetorical discourse is needed when the internal logic of that language game is insufficient. In turn, neopragmatists like Rorty or neopositivists like Quine cannot be simplistically dichotomized as anti-foundationalist or foundationalist. Both acknowledge the 'external world', with Rorty identifying the 'paradigm of truth' with the dominant discipline of the day – with obvious implications for climate science and climate change economics. Alternatively; in denying the distinction between analytic and synthetic statements, Quine stresses the role of language in generating useful predictions at the sensory level: rhetoric is only needed when contextual truth provided by the scientific method is not evident enough to sustain convincing and articulate reasoning.

4. Evidence, knowledge and belief

Concepts of evidence, knowledge and belief are central to traditional epistemology. At least since William James and Durant Drake, philosophers have debated whether and under what conditions 'belief can outstrip evidence' (Sharadin, 2015; Talbot, 2014). In contrast to the anti-foundational relativist approach to rhetoric advanced by McCloskey and Luks where "what really counts in scientific discourse is good argument: rhetoric" (Luks, 1998, p.141), a belief statement in naturalized epistemology is rhetorical only where satisfactory supporting 'scientific' evidence is insufficient. It is widely acknowledged that certain *ex post* 'scientific' observations made by climate change scientists can only be dismissed by unscientific rhetoric that gives little weight to 'scientific knowledge'. Measurement of physical objects is a core capability of scientists and observations such as increasing global temperatures, receding glaciers and polar ice-caps, rising sea levels and the like justify the "despair" of climate scientists (Reay, 2018). Beyond the scientific knowledge from such *ex post* measurements are *ex ante* theories about the economic effects of climate change that underpin proposals for mitigation. Knowledge claims for such economic theories provide considerable room for epistemological diversity and debate, e.g., Schinckus and Gasparin (2019).

Due to the intangibility of economic phenomena, knowledge claims associated with climate change economics differ substantively from those based on *ex ante* theories derived from climate science. This begs the epistemological question: what constitutes 'scientific' evidence for *ex ante* prognostications associated with the economics of climate change? Understanding possible answers to this question requires clarification of conditions for belief to qualify as a 'scientific knowledge' claim. Belief is a necessary but not sufficient condition for knowledge. Beliefs can be true or false. To qualify as scientific knowledge in naturalized epistemology, a non-basic belief must be justified and, in some sense, verifiable or falsifiable using the scientific method. Truth and justification of belief are independent characteristics. An *ex ante* belief can be turn out to be true, but not justified as it was not determined appropriately, e.g., the belief was based on a lucky guess. An *ex ante* belief can be justified but not true, e.g., arrived at by logical deduction from seemingly credible scientific evidence but not true, *ex post,* due, say, to faults in the evidence or fallibility in the method of deduction. "Rational belief" is justified belief, arrived at by logical or other rational thought process, that may or may not be true. In naturalized epistemology, establishing the truth of rational belief requires 'appeal to experiment or direct empirical observation'.

In contrast, anti-foundationalists deny, ignore or downplay the possibility of 'truth' associated with an immutable objective 'reality' that can be discovered by the scientific process. Early variants of anti-foundational philosophy are traceable to idealism ("A belief is true if and only if it coheres with other ideas") and pragmatism ("A belief is true if and only if it is useful in practice"). For example, Dewey proposed that, in scientific inquiries, "warranted assertability" is a more sensible concept to apply to rational belief than 'truth'. An important modern pragmatic version of anti-foundationalism, especially relevant in economics, is 'instrumentalism' that maintains the scientific basis for evaluating theories is the ability to predict and describe phenomena of interest. In addition to predictive ability, other desirable theoretical features could include simplicity, parameter parsimony and ability to be generalized. Recognizing that an initial motivation for instrumentalism in physics advanced by Duhem – the underdetermination of theory by the data – the 'working out' of instrumentalism in economics is further confounded by intangible economic phenomena being used as proxies for physical objects.

Lying at the intersection between natural sciences – such as physics, chemistry and astronomy – and human sciences – such as sociology,

[7] This causal relationship is part of the climate science that determines "baseline scenarios" which estimate future temperature changes without explicit additional efforts to constrain emissions. These estimates are for 450 ppm (ppm) CO_2 equivalent of greenhouse gases in the atmosphere by 2030 and reach CO_2 equivalent concentration levels between 750 and more than 1300 ppm by 2100. This baseline results in an estimated global temperature increase of 2.5 °C to 7.8 °C by 2100 when accounting for climate uncertainty (IPCC, 2014, p.8). To benchmark these estimates, NOAA measurements of (only) atmospheric CO_2 taken at the Mauna Loa observatory in Hawaii increased from 400 ppm in Feb. 2015 to 411.75 ppm in Feb. 2019. This estimate is slightly higher than the global estimate of 409 ppm in Dec. 2018, compared to 406.53 for Dec. 2017, determined by averaging over various estimating sites. https://www.esrl.noaa.gov/gmd/ccgg/trends/index.html

psychology and history – ecological economics, in general, and climate change economics, specifically, pose an epistemological quandary. Debate over whether methods of the natural sciences are applicable to the human sciences can be traced to the contributions of Wilhelm Dilthey at the end of the 19th century that critiqued the 'unity of science' project initiated by Auguste Comte, e.g., Poitras (2020). More recent providers of insights in this debate include Hans-Georg Gadamer, e.g., Gadamer (1960), and the anti-foundational sociological contributions of T.S. Kuhn, especially Kuhn (1962), that emphasize scientific beliefs are "constructed" by "external" social factors. The 'deconstruction' of such beliefs is a key concern of post-modernists such as Michel Foucault and Bruno Latour. For Foucault, the "complexity of the epistemological configuration" (Foucault, 2002, p.380) arising in the human sciences lies not with the truth of statements, per se, but with the history of social and institutional conditions under which authorized statements can be made to count as true.

5. Ecological economics and climate change activism

What are the social and institutional conditions that sustain rational belief in mitigation strategies derived from climate change economics? When targeted to climate change there is a vast 'scientific' literature replete with 'scientific evidence' that provides an evidentiary foundation for climate change activism.[8] An important forum for this evidence is the United Nations Framework Convention on Climate Change (unfccc.int) formed in 1992 that has produced touchstones of climate change activism: the Kyoto Protocol (1997) and the Paris Agreement (2015). (The 24th meeting of the UNFCCC in Katowice, Poland concluded in Dec. 2018.) The tenor of these ongoing bureaucratic initiatives is captured by an editorial in *Nature*: "political cooperation remains the only effective defence we have against the worst effects of climate change — which would mean a more hostile world for us all … Delay is fundamentally contrary to reason" (Nature, 2018). An important source of the 'evidence' for such statements is the Intergovernmental Panel on Climate Change (IPCC) (www.ipcc.ch) tasked with providing 'regular scientific assessments of the implications and potential future risks of climate change' and 'adaptation and mitigation options'. Climate change economics is fundamental to the adaption and mitigation proposals advanced by the IPCC.

Does the *pathos* inspired by scientific evidence of climate change influence adherents to make knowledge claims that cross beyond the boundary of belief justified by the *ex post* measurements of natural science? Does the rhetoric of climate change activists exert sufficient influence to inflate the 'rational beliefs' of individuals? In the context of climate change, there is a complex layering of beliefs associated with: scientific evidence of climate change; causes and effects of such change; and, the effectiveness of mitigation proposals. At one level, evidence from scientific measurements of climate change justifies knowledge claims that such change is happening. Other layers of belief, such as those about the economic implications of climate change or the appropriateness of policies to combat climate change, raise legitimate questions about the sufficiency of evidence; about the possibility of belief outstripping the evidence. Where does rational belief of individuals based on 'science' end and the "folk psychology" of social group activism take hold? Does the potential 'global risk' of climate change justify mitigating actions based on beliefs that lack enough scientific evidence to be justified? Can moral intention justify belief when evidence is lacking?

Macroscopic social concepts of climate change activism are a direct challenge to the microscopic approach of methodological individualism. Answering this challenge involves constructing essential features of such activism from the rational actions of individuals. In the spirit of von Hayek (1955), failure to incorporate an individual actor-theoretic perspective runs the risk of overestimating the ability of rational planning and control to achieve a socially desirable objective. For individuals, scientific evidence identifying increasing global temperature measurements, receding glaciers, increasing CO_2 in the atmosphere and the like are not "present at hand". There is a disconnect between the day-to-day action of individuals and global outcomes that result from the actions of billions of individuals, e.g., Dickinson (2009); Morton (2018). At least since Olson (1965) it has been recognized that groups of individuals sharing a common interest, such as controlling the impact of climate change, will not necessarily promote that interest due to the 'free-rider' phenomenon. The upshot has been the difficulties confronting transnational entities such as UNFCCC and the IPCC getting nations to enforce various multilateral agreements aimed at limiting the impact of climate change.

Upon closer inspection, methodological individualism fails to fully capture the essence and influence of rhetoric on the relationship between evidence and rational belief. As Førland (2008, p.55) observes: "insisting on treating and explaining all action on a methodologically individualist basis run[s] the risk of depriving ourselves of the social or collective element". Absent a social or collective element, it is difficult to explain climate change inspired social activism such as: tens of thousands of high school and college students skipping school over four weeks in early 2019 throughout Europe to protest climate change; numerous protests throughout the US and Canada seeking to stop construction of the Keystone, Dakota Access, Northern Gateway and Trans Mountain pipelines; and, a swath of other anti-fossil fuel protests against fracking and oil ("tar") sands extraction. The difficult to formalize social or collective element captured in climate change activism is a potentially useful construct to explain the disconnect between belief and evidence identified by Foley (1991, p.99): "Belief in accordance with the evidence can itself affect the evidence, and when it does, evidence and epistemic reasons for belief can come apart". In other words: "if you don't have adequate evidence for a proposition, then you don't have an epistemic reason to believe it, unless believing it would itself create adequate evidence for it."

6. Climate change: evidence, causes, effects and mitigation

For all but a chosen few with the resources to engage in climate science, evidence about climate change originates from the testimony of external sources. Sources of basic belief available to the individual alone – perception, memory, consciousness and reason – are incapable of generating much knowledge of climate change. As with the sources of basic belief available to an individual, external sources of evidence can be subject to error. However, in the realm of climate change, the *ethos* of scientific testimony available from external sources is overwhelming. The reputation and quality of external sources is impressive. In addition to the IPCC and research initiatives at numerous prestigious universities, the list of organizations providing detailed scientific reports on climate change and implications include: the Royal Society, NASA, US National Academy of Sciences, the Oak Ridge National Laboratory, the National Oceanic and Atmospheric Administration (NOAA), the World Bank, the FAO, the Union of Concerned Scientists, and the International Science Coalition. This list is far from complete. So much information is available that some method of grouping the treatment of climate change is necessary.

NASA (https://climate.nasa.gov/) groups information provided about climate change into four categories: Evidence; Causes; Effects;

[8] In addition to generalist journals such as *Nature, Scientific American, Science* and the Royal Society publications, the vast literature includes contributions to specialist academic journals such as: *Climatic Change; Climate Dynamics; International Journal of Greenhouse Gas Control; Climate Research; Greenhouse Gases: Science and Technology; Ecological Economics; Forest Policy and Economics; Public Understanding of Science; Journal of Environmental Sciences; Journal of Cleaner Production.*; and, *Environment, Development and Sustainability.*

and, Solutions. The production of knowledge – justified belief about (true) 'facts' – in each category differs, as does the potential sources of error. For example, 'Evidence' of climate change is based on *ex post* scientific measurement. This evidence is frightening: rising global atmospheric temperature (est. 1.62° F. since the late 19th century); rising ocean temperature (est. 0.4° F. since 1969); shrinking tons of ice sheet in Greenland, Antarctica, and the Arctic Ocean; receding glaciers; decreased northern hemisphere snow cover; rising sea levels (8 in. in the last century); increase in extreme weather events; and, an increase in surface ocean acidity due to increased CO_2 absorption (est. 30% increase since early 19th century). There is little if any room for legitimate scientific skepticism about possible errors in such evidence, epistemological grounds for beliefs that reject knowledge claims for such scientific evidence, in whole or in part, are narrow. Pure skepticism – rejection of all knowledge claims – or Humean skepticism – rejection of justified beliefs based on stability of physical objects not directly observed by the individual – are two such potential grounds. Such extreme variants of anti-foundationalism can be generously characterized as 'naive climate change skepticism'.

In contrast to denial of *ex post* scientific evidence associated with 'naïve climate change skepticism', rational belief associated with denial of *ex ante* theories about 'Effects' of climate change is more complicated to assess. Consider the scientific evidence that global climate change is a result of the buildup of greenhouse gases (GHGs) in the atmosphere. As the climate science community has observed: "There is no question that increased levels of GHGs must cause the Earth to warm in response" (NASA 2019). Beyond the scientific certainty of this causal physical relationship, some climate modeling is needed to translate predicted GHG increase to temperature change and, ultimately, to climatic, economic, social and cultural impacts. Based on a meta-analysis of such modeling exercises, the IPCC (2013) concludes: "Taken as a whole, the range of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time". Qualifications to this general statement include:

> a large number of uncertainties in scientific understanding of the physical sensitivity of the climate to the build-up of GHGs [and] profound uncertainties aris[ing] in the socioeconomic factors [that] … include the development and deployment of technologies, prices for major primary energy sources, average rates of economic growth and the distribution of benefits and costs within societies, emission patterns, and a wide array of institutional factors such as whether and how countries cooperate effectively at the international level (IPCC, 2013, p.113-4).

Rational belief in such modeling exercises characteristic of climate change activism cannot ensure enough accuracy to deflect obvious and not so obvious criticisms that question the 'internal logic' of such "damage costs" assessments.

7. Mitigation, adaption and IPCC AR5[9]

The recent Fifth Assessment Report (AR5) (IPCC, 2013; IPCC, 2014) prepared by the United Nations body responsible for assessing the science related to climate change provides a complicated deductive chain starting from *ex post* scientific knowledge about temperature change, to theories about causes, to *ex ante* estimates of climate change effects nested with proposals for mitigating and adapting to such effects. At what point in this chain, if any, does scientific knowledge transition to unscientific rhetoric? In contrast to the almost universal agreement on *ex post* scientific evidence of climate change, consider the epistemological basis for *ex ante* claims about mitigation proposals in the Paris Agreement. For example, using the standard MAGICC climate change model, Lomborg (2016) finds that: "All climate policies by the US, China, the EU and the rest of the world, implemented from the early 2000s to 2030 and sustained through the century will likely reduce global temperature rise about 0.17°C in 2100". In effect, a 'scientifically' accepted *ex ante* climate modeling procedure finds that mitigation proposals of the Paris Agreement will have almost no impact on global temperature increase. Such modeling exercises raise questions about whether AR5 mitigation proposals qualify as 'scientific' 'Solutions'. Absent experimental evidence or direct physical observations, what is the basis for avoiding the claim that mitigation solutions of climate change activists, such as those advanced in AR5, are unscientific rhetoric?

The construction of climate models requires assumptions about a range of *ex ante* variables such as growth in population, per capita income by region, the rate of technological change, the amount of afforestation or deforestation and the like that will contribute to future atmospheric GHG growth. Even if such variables could be accurately predicted, the difficulty of incorporating the impact of, arguably, the most important GHG – water vapor – remains. In climate science, water vapor is responsible for a positive feedback loop generated by the "forcing variables" that are the result of anthropogenic GHG gas emissions – forcing GHG contributions to global warming are currently estimated at about 76% CO_2, 16% methane, 6% nitrous oxide and some remainders (IPCC, 2014).[10] By increasing global temperature, these produce water evaporation which further exacerbates the global warming process creating a feedback loop spiral. While scientific evidence indicates the heat-amplifying effect of water vapor could be potent enough to double the climate warming caused by increased levels of anthropogenic GHG emissions in the atmosphere, "even relatively small errors in its magnitude can lead to large uncertainties in predicting climate response to anthropogenic forcing" (Gordon et al., 2013, p.435). At present, only short-term evidence on the water vapor feedback spiral is available, even though climate model predictions about Paris Agreement mitigation proposals involve long term predictions.

The further along the climate change evidence-causes-effects-mitigation deductive chain, the weaker is the scientific basis – the internal logic – for the validity of mitigation proposals central to climate change activism. Where estimates for mitigation 'net benefit'are concerned, *ex ante* calculation is difficult (IPCC, 2014, p.6):

> Accurately estimating the benefits of mitigation takes into account the full range of possible impacts of climate change, including those with high consequences but a low probability of occurrence. The benefits of mitigation may otherwise be underestimated (high confidence) … The choice of mitigation actions is also influenced by uncertainties in many socioeconomic variables, including the rate of economic growth and the evolution of technology.

[9] The IPCC is currently in the Sixth Assessment cycle during which three Special Reports, a Methodology Report and the Sixth Assessment Report will be produced. The time line is for Working Group I to produce "The physical science basis" report in April 2021, Working Group III to produce "Mitigation of climate change" report in July 2021 and Working Group II to produce "Impacts, adaptation and vulnerability" report in October 2021 with the final Synthesis report in April 2022. Reports from the three IPCC working groups are not limited to the Assessment Report. For example, working group I produced an important Special Report "Global Warming of 1.5 C.", revised version of Jan. 2019. Copies of IPCC reports are available at: https://www.ipcc.ch/

[10] The relative sizes of these percentages obscure the differential warming impact of the different gases. Though CO_2 is the largest GHG source of global warming, it is estimated that a nitrous oxide molecule has almost 300 times the warming capacity of CO_2, methane at about 25 times and hydrofluorocarbons (HFCs) as much as 15,000 times (HFCs replaced ozone depleting CFCs in refrigerant and related applications). The larger global warming impact of CO_2 is due to the much larger amount of this GHG being produced.

Rational belief in such mitigation net benefit estimates involves an expected value calculation. Significantly, this empirically driven ideal is confounded by the 'non-repeatable' experiment that characterizes most observed "socioeconomic" data. There is quandary posed by having only a single observed *ex post* time path to estimate the distributional parameters and associated probabilities for the ensemble of *ex ante* time paths. The 'fixed in repeated samples' assumption that pervades estimates obtained from the experimental approach associated with 'scientific inquiry' does not translate to the socioeconomic realm: "low probability" outcomes with "high consequences" are involved in the expected value calculation; timelines are decades in the future; and, there are a buffet of competing mitigation strategies.[11] Absent the internal logic for well-grounded scientific foundation, such claims regarding mitigation net benefit estimates are rhetorical.

AR5 rhetorically claims with "high confidence" that net benefits of mitigation proposals advanced by climate change activists might be 'underestimated'. (What is the possibility net benefits are 'overestimated'?) This directs attention to the various possible mitigation strategy alternatives. Strategies identified by AR5 fall into two general groups: GHG emissions reduction; and, atmospheric GHG removal. Implementation within each group involves both currently available strategies and those depending on future technological improvement. Support for specific mitigation strategies reveals a central feature of climate change activism*:* the belief that Science can save the world from environmental catastrophe. This leads to emphasis on reducing the production of GHGs that involves: switching from fossil fuel to green(er) energy sources, especially in electricity generation and transportation; expanded use of carbon pricing and cap-and-trade schemes; and, development and introduction of carbon capture and removal technologies. On balance, such 'soft' mitigation strategies pose only mild risk to the 'good life' of those societies that exhibit the most strident social activism associated with climate change and, ironically, are the source of the bulk of past and a significant part of present GHG emissions.[12]

Has the bureaucratic process guiding climate change mitigation "gone beyond science and economic policy into the realm of ideology"? Consider the implications of various IPCC statements, such as (IPCC, 2014, p.5):

> Issues of equity, justice, and fairness arise with respect to mitigation and adaptation. Countries' past and future contributions to the accumulation of GHGs in the atmosphere are different, and countries also face varying challenges and circumstances, and have different capacities to address mitigation and adaptation. The evidence suggests that outcomes seen as equitable can lead to more effective cooperation.

As an entity of the UN, the UNFCCC shares the global poverty elimination mandate set out in the Millennium Development Goals established in 2000 to be achieved by 2015 and the subsequent launch of the UN Sustainable Development Goals undertaken in 2016 and set out in the "2030 Agenda for Sustainable Development". In allowing "Nationally Determined Contributions", the Paris Agreement explicitly recognizes that "national governments are addressing climate change in the context of other national priorities, such as energy security and alleviation of poverty" (IPCC, 2014, p.113). This perspective raises substantive issues that undermine the goals of social activism aimed at addressing climate change. The largest (China) and 4th largest (India) current producers of anthropogenic GHGs, both with significant growth in emissions over the last decade, require access to cheap sources of energy provided by fossil fuels, especially coal, to sustain development goals.

Closer examination of mitigation proposals advanced in UNFCCC-driven agreements reveals conflict between addressing climate change and development goals for alleviating poverty. Consequently, the internal logic of climate change activism fails to incorporate two of the most important non-Science drivers of climate change. Specifically, correlating scientific evidence of climate change with direct empirical observation of population growth and deforestation suggests the need for a different complex of 'hard' mitigation strategies than the 'soft' strategies that focus on the derivative problem of controlling emissions of CO_2. Even if the per capita emission of anthropogenic GHGs can be reduced, can climate change mitigation be achieved without the rate of population growth being sufficiently curtailed (Petroni, 2009; Bongaarts, 2016)? If the current annual growth rate of 1.1% is extrapolated, the UN Department of Economic and Social Affairs estimates the 2017 global population of 7.6 billion will rise to 9.8 billion in 2050 and 11.2 billion in 2100. Much of this growth is expected to occur in the high GHG growth, least developed countries, with population growth from roughly one billion in 2017 increasing by 33% between 2017 and 2030 to reach 1.9 billion persons in 2050. The population of India, one of the highest emission growth countries, is expected to surpass China around 2025.

Unlike mitigation of population growth that conflicts with development goals, interferes with the rights of individuals to procreate and is inconsistent with right-to-life ideology, the rhetoric of UNFCCC-driven agreements does identify the importance of deforestation. This is not surprising given that: "Deforestation is the second largest anthropogenic source of carbon dioxide to the atmosphere, after fossil fuel combustion" (van der Werf et al., 2009).[13] Specifically, the agenda for the 11th session of the UNFCCC in 2005 introduced discussion of "Reducing emissions from deforestation in developing countries" (REDD). This commenced a sequence of initiatives that led to a more detailed REDD+ in 2007, and the 'Warsaw framework on REDD+' in 2013, culminating in Article 5 of the Paris Agreement encouraging all countries to implement and support REDD+. Yet, over a decade after REDD was introduced, deforestation continues unabated in Brazil, Colombia and Indonesia (Hein et al., 2018). Unlike soft, science-driven strategies that focus on switching to 'green energy' sources incentivized by carbon pricing and cap-and-trade schemes to reduce reliance on burning of fossil fuels causing climate change, harsher and less science-driven mitigation strategies aimed at deforestation would impact the rights of logging companies, cattle ranchers, subsistence farmers and the like – led by Brazil and Indonesia – to engage in deforestation (Bennett, 2017).

The rhetorical bias in climate change activism toward 'soft' science-driven mitigation strategies is, arguably, based more on the bureaucratic goal of achieving agreement rather than adopting harsh mitigation proposals that address key drivers of global warming. The AR5 statement about nuclear energy provides further evidence of failure to address the need for 'harsh mitigation': "Nuclear energy is a mature low-GHG emission source of baseload power, but its share of global electricity generation has been declining (since 1993). Nuclear energy could make an increasing contribution to low-carbon energy supply, but a

[11] AR5 (IPCC, 2014, p.10) identifies "900 mitigation scenarios [that] have been collected in a database based on published integrated models".

[12] Using data from the *BP Statistical Review of World Energy* (June 2018) for CO_2 emissions (in millions of tonnes), leading emitter nations are for 2017 (with annual growth rate over 2006–2016) in brackets: China 9232.6 (3.2%); US 5087.7 (−1.2%); EU 3541.7 (−2.0%); India 2344.2 (6.0%); Russian Federation 1525.3 (−0.2%); Japan 1176.6 (−0.6%); South Korea 679.7 (2.5%). The negative growth rates in the US, EU and Japan can be partially attributed to the export of emissions growth to other countries, especially China.

[13] Estimates of deforestation and forest degradation vary with 20% of anthropogenic emissions being a commonly accepted value. Such estimates are misleading in various ways. For example, the estimates do not benchmark for the CO_2 reduction of forest cover that has been removed over the 19th and 20th centuries. As the forest canopy is removed and degraded the ability to act as a carbon sink is reduced, estimates of emissions impact will be lessened. Removal or drainage of tropical and arboreal peat land and wet lands is not counted in the estimates.

variety of barriers and risks exist" (IPCC, 2014, p.20). Events at Three Mile Island, Chernobyl and Fukushima Daiichi, have eroded public support for this risky source of baseload power that, arguably, has the highest *ex ante* climate change mitigation potential. Instead of expanded use of nuclear energy that provides low GHG electricity for a needed shift to electric powered transportation and a reliable backstop for the variable electric power supply of solar and wind, current 'soft' mitigation strategy rhetoric emphasizes implementation of cap-and-trade and carbon pricing, carbon capture technology and the like that do not pose serious threat to 'the good life' of wealthier nations.

8. Economics of climate change mitigation

Knowledge about climate change due to global temperature warming, caused by increased levels of anthropogenic GHG emissions in the atmosphere, originates from the collective of climate scientists. This scientific knowledge is a powerful motivator for climate change activism. In contrast, the economics associated with *ex ante* estimates of effects and mitigation of climate change lacks the scientific foundation necessary to rise above the status of rhetoric. The epistemological transition from natural science to social science – from 'things' to 'words' in Foucauldian terms – is challenging. As AR5 recognizes (IPCC, 2014, p.15): "Estimates of the aggregate economic costs of mitigation vary widely and are highly sensitive to model design and assumptions as well as the specification of scenarios, including the characterization of technologies and the timing of mitigation." Similarly (IPCC, 2014, p.5): "Among other methods, economic evaluation is commonly used to inform climate policy design. Practical tools for economic assessment include cost-benefit analysis, cost-effectiveness analysis, multi-criteria analysis and expected utility theory ... The limitations of these tools are well-documented". The wide epistemological void between the *ex post* knowledge from temperature measurements of climate science and the unscientific rhetoric of *ex ante* predictions derived from theoretical models of climate change economics has significant implications for the beliefs of climate change activists about effects and mitigation.

Having established a solid scientific foundation for knowledge about the occurrence of climate change, it is apparent that the beliefs of climate change activists regarding effects and mitigation outstrip the evidence provided by climate change economics: "The next IPCC report needs to be based on a much more robust body of economics literature, which we must create now. It could make a crucial difference" (Stern, 2016). Yet, given the potential of economic models to produce fallible results, how much credence can be given to efforts such as those in Pretis et al. (2017, p.3):

> Projections of climate impacts on the levels of GDP per capita … exhibit high uncertainties, with median projected global GDP per capita being approximately 5% lower at the end of the century under 2 °C warming relative to 1.5 °C. Relative to a scenario without additional warming, global average GDP per capita is estimated to be 8% lower under 1.5 °C warming and 13% lower under 2 °C at the median.

These rhetorical "difficult to estimate" estimates of global economic impacts by "the end of the century" are made despite recognizing such attempts depend on many "disputable" assumptions. As stated in AR5: "There is a wide range of possible adverse side-effects as well as co-benefits and spillovers from climate policy that have not been well-quantified" (IPCC, 2014, p.17). Such statements reference long-standing debate about whether statements based on 'economics' can be elevated to scientific status by employing 'scientific' methods involving econometric estimation and axiomatic modeling of economic behavior.

Rhetorical focus on the economics of climate change provides a convenient diversion from the possibly unresolvable and, ultimately, fatalistic implications of climate change. Consider the following *ex post* identification of the "most important drivers" of climate change from AR5 (IPCC, 2014, p.8):

> Globally, economic and population growth continue to be the most important drivers of increases in CO_2 emissions from fossil fuel combustion. The contribution of population growth between 2000 and 2010 remained roughly identical to the previous three decades, while the contribution of economic growth has risen sharply.

Such *ex post* theoretical claims assume a naive independence between economic growth and population growth. The decomposition of a scientific measurement for CO_2 emissions into 'economic' and 'population' components involves a nesting of assumptions that, seemingly, relies on linear estimation of drivers. Yet, both the geographical distribution of population growth and the method of measuring 'economic growth' require attention. Population growth centered in regions with higher GHG emissions growth and lower income per capita with economic growth centered in regions with declining GHG emissions growth and higher per capita income can give the misleading impression that global economic growth is driving GHG emissions. Contrary evidence is not considered, such as the steady increase in NOAA reported CO_2 emissions measured at the Mauna Loa observatory not abating during the severe economic downturns of 2008-9 and 2020 and or accelerating as the global economy improved in decade following 2008–9. In contrast, steady population increase during this period in the higher GHG emissions growth and lower-income per capita countries mirrored the steady increase in CO_2 emissions measurements.

Despite the beliefs of social activists motivated by rhetorical claims that global warming can be averted by national programs restricting CO_2 emissions associated with burning of fossil fuels, there is an insufficiency of supporting *ex ante* evidence that such activism can succeed. Does scientific knowledge that climate change is happening justify belief in rhetorical statements derived by combining climate science models and economic theorizing to specify mitigation strategies? What are the implications for such modeling exercises of unknown factors that could generate catastrophic changes and tipping points? Alternatively, what if international efforts, due to 'free rider problems' or inaccurate estimates of mitigation strategy effectiveness, are insufficient to restrict global warming? In such cases, scarce resources currently being dedicated to 'green energy' conversion and the like would be more efficiently spent on initiatives aimed at adaption. This would provide increase in physical resources for adaption strategies dedicated to flood and coastline erosion control; fighting forest fires; enhanced disaster relief from tornados, hurricanes and typhoons; relocating agricultural production; restricting deforestation; and, allowing immigration from areas negatively impacted by climate change. Will current mitigation and adaption strategies result in a tragic misallocation of scarce resources among competing ends?

The extant rhetoric of climate change activism fails to recognize that the largest GHG emissions producing country, China, is also the largest gainer from the process of high per capita income countries converting to green energy. Despite inherent natural and economic advantages in the production of solar panels and turbines for wind power, e.g., Humphries (2010); Cusick (2016); Ong (2012), China continues with an increasingly heavy reliance on lower cost thermal coal for energy production. More generally, if implementation of national climate change mitigation increases the cost of energy needed for industrial production and other high GHG emission activities, this incentivizes the movement of such activities to locales where lower cost, higher GHG emission energy is available due to weaker national implementation of climate change mitigation efforts. While the 'economics' of this situation suggest that carbon-based tariffs on the movement of goods across borders are needed to legitimize carbon pricing and cap-and-trade within national or regional boundaries, such a proposal would almost certainly conflict with the UN poverty reduction objective and multilateral trading agreements. Exploring the 'how' associated with the rhetoric of mitigation strategies proposed by climate change activists reveals the

profound ideological and cultural barriers to effectively addressing global climate change.

9. Conclusion

What can epistemology contribute to understanding human behavior toward climate change? Where does rational belief of individuals based on 'science' end and the "folk psychology" of social group activism take hold? Knowledge about climate change based on *ex post* scientific measurements and observations is deeply disturbing. Such knowledge can lead to dark and depressing 'nihilism, despair, and disenchantment'. Being beyond the capacity of the individual to provide a solution, the frightening progress of climate change leads to competing rational beliefs based on *ex ante* theories about causes, effects and appropriate mitigation and adaption strategies. Belief, justified or not, has a psychological basis. By creating 'a mythical, culturally and socially informed world view', the folk psychology of climate change activism goes 'beyond rational belief' to provide 'a context for self-esteem' that transcends individual despair. Failure of national and transnational government initiatives, spearheaded by the UNFCCC, to adequately address the buildup of anthropogenic GHG emissions propels paradoxical social activism at the local and individual level. Beyond rational belief in the inevitability of future environmental catastrophe, there is still the rhetorical *pathos* that, somehow, Science will save the world.

What sharp recommendations for policymakers, scholars and climate change activists does this to-and-fro about rhetoric and epistemology produce? Failure to incorporate possibly unresolvable climate change drivers – the impacts of global population growth, atmospheric water evaporation and deforestation – into *ex ante* economic modeling exercises undermines the internal logic of such 'scientific' exercises. The resulting anti-foundational rhetoric sustains 'soft mitigation strategies' based on 'national' programs that encourage the shifting of GHG intensive economic activity to national jurisdictions with weak environmental oversight, exacerbating not mitigating global warming. Failure to recognize the conflicting goals of economic development for poorer regions and GHG emissions reduction in wealthier regions is institutionalized in multinational initiatives spearheaded by the UNFCCC and the IPCC. The 'zero carbon' rhetoric supporting 'soft mitigation' national programs silences rational belief in 'hard mitigation' strategies aimed at averting the frightening progression of global warming and climate change. Is the 'complexity of epistemological configuration' in climate change economics systemically capable of predicting the real income reduction from: penalizing the shift of global production to national jurisdictions dependent on high GHG energy production; adopting risky nuclear energy; effectively implementing reforestation; and, controlling global population growth?

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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