

## ARTICLE OPEN



# Economists are not engaged enough with the IPCC

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The representation of Economics in IPCC Assessment Reports (ARs) has evolved over time and is currently declining. This is especially noticeable in Working Group 2 (WGII), where economists were never very well represented. It is also noticeable that the economists who have participated in the writing of the recent ARs are typically not employed in traditional academic economics departments and are therefore not operating in the mainstream of the profession. Economic research can contribute a lot to overcoming the complex challenges posed by climate change, and therefore it is worthwhile to assess why economists are not more heavily involved. This is both a supply problem (not many economists focus on climate change) and a demand problem (the IPCC does not seem to want more economists). Here, we first try to argue that economists should be part of the IPCC. We then digress to look at what economic research looks like, and therefore why economists are not that interested in contributing meaningfully to the research on climate change. We also briefly discuss why the IPCC seems not to welcome economists, and why we think the future may be looking brighter for this needed collaboration between economics and the IPCC.

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## INTRODUCTION

Economics, a social science discipline focussed on human decision-making and resource allocation in conditions of scarcity, has the potential to provide many potentially useful insights to better support climate action and protect, mitigate, and adapt to climate change. Here, we therefore focus on the role economics has played in developing this agenda and try and assess why economists are not more heavily involved with the Intergovernmental Panel on Climate Change (IPCC). We focus on Working Group 2 (WGII), which focuses on impacts and adaptation, but believe our arguments are also valid for the evolution of economics involvement in WGIII (which focuses on the mitigation of greenhouse gas emissions).

The first Assessment Report of the IPCC (AR1) from 1992 starts with the following statement:

"We are certain of the following: (1) there is a natural greenhouse effect which already keeps the Earth warmer than it would otherwise be; (2) emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases.... These increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface."<sup>1</sup>

While this may have been a novel observation at the time it was written in 1992, this is no longer the case, and the broad parameters and the many details of the climate change problem are well understood, and this understanding is well within the consensus both within and outside of the earth sciences. However, by some measures we may not be any closer to solving this climate change challenge today than we were in 1992. The main remaining challenge, and therefore the role of the IPCC, should be in shaping the adaptation and mitigation agendas that are required in the face of this challenge. The challenges involved in adaptation and mitigation are, in our view, more closely related to the social sciences than earth science. As such, we posit that economics, as a social science, needs to acquire a much bigger role within the IPCC than it currently has. Therefore, exploring why economists are not so involved in the IPCC, as the next section shows, is urgently needed. This is our aim here.

There are obviously two sides to this problem of mismatch between the climate change research and the IPCC, on the one side, and economics on the other. It is easiest to consider it as both a supply problem (economists do not focus nearly enough on climate change and do not want to participate in the IPCC) and a demand problem (the IPCC does not seem to recruit enough economists). Consequently, after showing that economists are not very present (in section, 'Is it at all a problem that economists are not that involved?'), we argue that economists should be more involved in the IPCC (and climate change research more broadly) in the section, 'What does economic research look like? A short digression'. In the section, 'There are few climate change economists', we digress to look at what economic research looks like, as that can explain why economists are not that interested in climate change, and even when they are, they are not that motivated to join the IPCC (in section, 'The IPCC does not want climate change economists'). We follow up with a specific examination of the IPCC and ask why it is not as welcoming to economists (in section, 'Is this changing? What does it mean for the future of the IPCC?'). In the last section, we identify what we think is the current trajectory of this problem, what might need to change, and what we think this implies for the future of the IPCC.

## How involved were economists in the IPCC AR6?

The IPCC is the leading international authority for summarizing the current state of knowledge on climate change, which it delivers mainly through a series of Assessment Reports (ARs) published approximately every 6-8 years. For each assessment cycle, the IPCC elects a Bureau of scientists, who then select authors nominated by member governments and observer organizations. The author selection is intended to reflect a range of backgrounds and expertise (in both natural and social sciences) and may also reflect the specific needs of the reports, whose structure and topics are established during the scoping meetings preceding author selection.

The natural science disciplines were the originators of climate change research, and they spearheaded the efforts to understand of this phenomenon. The social sciences, including economics,

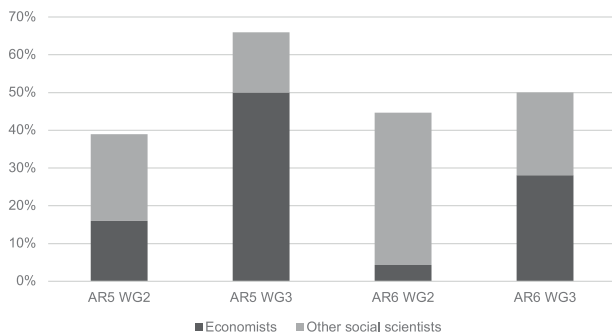
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which can inform us, among other things, about how societies interact with environmental change or how societies might ameliorate or prevent that change, have become increasingly more involved in climate change research, and in the IPCC<sup>2</sup>. However, climate change policies, and the IPCC's Sixth Assessment Report (AR6), are still both mostly guided by insights from earth and atmospheric sciences, as has been the case since the work on climate change began<sup>3</sup>. This dominance of natural science applies both with regards to the ARs authors' professional backgrounds<sup>4,5</sup> and the literature cited in these reports<sup>6,7</sup>.

The representation of economics, a social science discipline, in the IPCC reports has evolved over time. AR1 consisted almost entirely of natural scientists and included only a handful of academics from the social sciences and the humanities<sup>8</sup>. Relatively more economists were included in the AR2 and AR3<sup>3</sup>, but Kowarsch<sup>9</sup> suggests that by AR4, economists' representation was already waning, apparently also because of disputes that occurred in the two previous assessment reports. Nevertheless, an apparently still prevailing view is that economics remain the dominant non-natural science in the IPCC; a recent assertion of this apparent truth cites an outdated observation from 15 years ago – see Peterson<sup>10</sup> who cites Yearley<sup>11</sup>).

While we focus on WGII, even WGIII, which is typically associated with the highest ratio of economists among the three Working Groups, was and still is disproportionately dominated by engineers<sup>9</sup>. By AR5, economists appear to have a considerable representation within WGIII, as they constituted approximately half of Coordinating Lead Authors (CLAs)<sup>4,5,12</sup> and together with engineers comprised close to half of all authors<sup>12</sup>. Economics was also the most prevalent discipline among a group of prominent WGIII authors who participated and were cited in previous IPCC reports<sup>13</sup>. However, in the AR5 Working Group 2 (WGII), authors were largely natural scientists, with economists constituting approximately 18% of Coordinating Lead Authors (CLAs)<sup>4,5</sup>.

Importantly, it appears that in AR6 the representation of economists fell both in WGII and WGIII (Fig. 1) – the definitions we use to categorise 'economists' are detailed in the CESifo working paper version of this paper. In WGIII, the number of economists fell to approximately 28% in terms of CLAs and to 26% in terms of all authors. More noticeably, in WGII, the number of economists was very low at only 4% of CLAs and 6% of all authors. As Fig. 1 shows, the representation of non-economist social scientists increased in both WGII and WGIII, indicating a change in author composition called for by observers such as Carey et al.<sup>4</sup> or Victor<sup>5</sup> and potentially reflecting a shift in the discussion towards the social aspects of the climate change issue. For the fraction of social scientists in AR5 we use the estimates from Carey et al.<sup>4</sup>.



**Fig. 1 Percentage of economists and other social scientists among CLAs in recent ARs.** Similar percentages also characterise all authors, and not just the coordinating lead authors. For AR6, in WGII there were economists (6%), and other social scientists (30%); with the rest coming from other disciplines (the equivalent figures for WGIII were 26% and 15%). Source: Carey et al.<sup>4</sup>, Victor<sup>5</sup> and Corbera et al.<sup>12</sup> for AR5; author's calculations for AR6.

As we discuss later, it is also noticeable that the economists who participated in the writing of the recent ARs are not prominent in the discipline (as measured both by their citation counts, the journals they publish in, and the location of their employment). Rather, they mostly publish in climate change or environmental science journals (and not economics journals nor even environmental economics journals), and are typically employed not in academic economics departments, but in schools of the environment or other multi-disciplinary entities. Out of the 15 identified economist authors of AR6 WGII, just over a half have ever worked in an economic/financial institution or unit (Table 1). Less than a half have published in a highly ranked economics journal and approximately a quarter do not have a doctoral economics degree. For 40%, none of their 10 most-cited publications were published in an economics journal and 71% have less than 5000 scholarly citations (as measured by Google Scholar). If one were to ask in most mainstream economics department, one very frequently hears that economists not working in economics department are not "real" economists, and that only publishing in the top disciplinary journals in Economics should "count" (indeed, in many Economics departments, a publication in *Science* or *Nature* will be perceived as irrelevant for tenure and promotion decisions).

Economics also appears to constitute only a relatively small part of the literature cited across the ARs. Overall, references are dominated by natural sciences (65.9%) and engineering and technology (26.1%). Social science references (including economics) constitute only approximately 10% of the cited literature<sup>7</sup>. In AR3, economics constituted roughly 40% of social science journal references<sup>6</sup>. Assuming that this ratio is similar for non-journal references and in the other ARs, economic references might constitute maybe 4% of the literature cited in the ARs. With respect to individual WGs, economic references do appear much more prominently in WGIII with approximately a 40% share on total references (in AR3)<sup>6</sup>.

### Is it at all a problem that economists are not that involved?

There are several aspects of Economics, as a discipline, that can enable it to contribute much needed understandings of the climate change problem and consequently to the IPCC itself. In ethical frameworks concerned with human wellbeing, human flourishing, or human capabilities, the achievement of social goals is at least partly determined by economic constraints. For example, in the New Zealand Living Standards Framework, four capitals are tracked: environmental, human, social/cultural, and financial. Economists are needed, at the very least, to examine what happens to financial capital, but also because financial resources also determine, to some extent, what happens to human and social/cultural capital. In addition, financial resources and their use can determine the evolution of environmental capital.

It is therefore crucial that when we examine the impacts of climate change, we understand its economic impact, and we understand the myriad ways in which economic considerations also weigh in in decisions about mitigation and adaptation. For example, there has not been enough research on the economic impact of climate change through extreme weather events, or through ecosystem deteriorations, and that has led the available IAM models to resort to very reductive and simplistic damage functions<sup>14</sup>. Similarly, economics, as a discipline, emphasizes the identification of causal mechanisms, using methodologies such as difference-in-difference, instrumental variables, regression discontinuity, and matching algorithms. These methodological approaches have hardly been employed in the climate change impacts literature.

Equally, evaluating adaptation options typically requires a more formal cost-benefit analysis, or some other form of weighing of

**Table 1.** Analysis of the 15 identified economists in AR6 WGII based on 8 criteria.

Have they ever worked, after completing their doctoral studies, in an institution or an institutional unit whose name includes a word containing 'econ' or 'finance/financial'?	8/14	57%
Has their work title ever included the word 'economist'?	6/14	43%
Did they ever publish in a Top 5 economics journal (R.Econ.Stud., Econometrica, Q.J.Econ., Am.Econ.R., J.Pol.Econ.)	0/15	0%
In the past 10 years, did they publish in a highly ranked economics journal (i.e., any top 200 journal in the IDEAS journal ranking)	7/15	47%
In the past 10 years, did they publish in a top 1000 economics journal (i.e., a top 1000 journal in the IDEAS journal ranking)	15/15	100%
Were any of their 10 most-cited publications published in an economics journal (a journal that has economics in its title)?	9/15	60%
Does the title of any of their publication in the last 10 years include a term containing "econ" or "finance/financial" in its title?	11/15	73%
Does their bio include the word 'economist' or list economics or its subfields as their area of expertise when describing themselves?	9/15	60%
Do they have a doctoral economics degree?	11/15	73%

Source: Authors' analysis.

costs and benefits (e.g., with multi-criteria decision analysis). Economists, with their disciplinary emphasis on trade-offs and opportunity costs, are therefore well suited to undertake these kinds of assessments. Indeed, much of the practice of cost-benefit assessments, and related topics like second-best choices, have been developed by economists.

More generally, WGII has become progressively more qualitative and less quantitative in its approach. Economics is a purely quantitative discipline, and mainstream journals will almost never publish qualitative analysis of a problem, or a qualitative discussion of a causal mechanism. By 'quantitative' we mean either involving statistical (econometric) analysis of quantitative data or relying on a mathematical modelling (or a combination of the two). A more thorough discussion of this description of economics can be found in Noy and Noy<sup>15</sup>. As such, the direction WGII has taken only makes it more difficult for economists to 'fit in.' Economists are largely uninterested, and typically are also unqualified to take part in qualitative discussions, as their training is purely focussed on developing quantitative skills. We caveat that our observation is not premised on any hierarchy between quantitative and qualitative research. We only argue that economists are almost exclusively only involved in the former.

Clearly, as indeed economists have been more prominent in WGII, the recognition that efficient mitigation requires economic insights is not controversial. The dramatic changes in economies and in energy markets that climate mitigation require are inherently economic phenomena. They therefore require, among other things, an economic assessment. Generating a sufficiently aggressive transition also involves changing incentives, and aligning them with the mitigation goals, while also remaining concerned about unintended consequences and second bests. Admittedly, the IPCC reports do currently include many different economic insights and concepts ranging from discussions on mitigation and adaptation costs and benefits, policy instruments, international coordination, and some ex-post policy analysis. Generally, our premise is that the extent of economic considerations employed within the IPCC reports is still limited because economists are not involved as much as they were in the early IPCC report rounds. In as much as a few economists (mainstream or otherwise) are included, still many of the detailed insights that the discipline has to offer are not included.

In general, our argument that economics should be important in understanding climate change impacts, adaptation, and mitigation should not be that controversial. Other social sciences quite frequently cite economic research<sup>16</sup>, so there is a general acknowledgement that 'economics has something useful to offer'. Indeed, Economics is the most highly cited social science in Political Science, Sociology, Operations Research, Mathematics, Accounting, Finance, and Statistics, and is close to the top for Psychology and Computer Science. It is the second most cited,

after Psychology, in the big-3 multidisciplinary science journals (*Science*, *Nature* and *PNAS*) and in Physics and Medicine<sup>16</sup>. Some of the basic ideas that the discipline has developed and refined over the last century are important in the climate change impacts, adaptation, and mitigation contexts. These include trade and comparative advantage (esp. mitigation), behavioural economics and nudges (esp. adaptation), the role of incentives (both adaptation and mitigation), negative and positive externalities, provision of public goods (esp. mitigation), coordination and coalition formation, moral hazard (esp. adaptation), asymmetric information and other market failures, and monopolistic competition. In addition, economists have developed practical tools in some specialised fields of economics that could be useful for climate change research (e.g., mechanism design for auctions, tools for time series statistical analysis, or field randomized control trials for adaptation interventions).

### What does economic research look like? A short digression

The production of academic economics research is constrained by a set of norms, which Noy and Noy<sup>15</sup> divide into norms of what is considered legitimate research (inclusion), what is considered illegitimate (exclusion), and what economists choose not to do much of (omission). This section relies heavily on the insights from Noy and Noy<sup>15</sup>, who in turn rely on Akerlof<sup>17</sup>, to explain how these normative types of economic research might restrict what economics, as a discipline, perceives as legitimate contributions to the climate change research agenda. Practically, all published economic research can be classified into one of the following three categories: (1) theory; (2) empirical causal inference; and (3) structural modelling. We briefly describe these three types below, as it is then easier to see how economic research on climate change cannot be situated easily within this typology.

A typical *theory* project investigates some new mechanism, describes the conditions under which it arises, and illustrates its consequences. In the climate change context, it might be, for example, an aspect of a hypothetical Emissions Trading Scheme (ETS) that can make it more (or less) efficient. Alternatively, economic theory introduces a conceptual framework for thinking about a particular problem and show what can be proven about that problem from that conceptual framework. For example, this might be to consider the outcome of climate negotiations if groups of countries organise themselves in 'clubs' of countries with similar interests.

Economic theory, as currently practiced, requires mathematical formalization, and aims to be as general as possible (i.e., relevant to many different situations). It consequently attempts to refrain from delving into specific institutional setups. As such, a theory paper will analyse the general format of negotiations in 'clubs' rather than examine it within the institutional details of UNFCCC negotiations, for example. It is easy to see how this emphasis on

mathematization and generality does not lend itself very well to the concrete uniqueness of the climate change problem and prevents theoretical economists from contributing more to the climate change literature and its specificities.

An *empirical* project would attempt to estimate the causal effect of a particular shift, change, or intervention on a given outcome. For example, in the context of climate change impacts, it might attempt to estimate the impact of increases in temperature on worker productivity. Clear and robust identification of the causal inference is considered the aim of this type of research; and that is the main determinant of its value by the profession. Thus, a clearly identified causal mechanism describing an intervention of minor importance is preferable to an analysis of a much bigger and more significant intervention if the causal mechanism cannot be so cleanly and clearly identified.

This emphasis on causal identification narrows remarkably the scope of what is acceptable, since identification usually relies on either a randomized controlled experiment (where the allocation of ‘treatment’ is randomized, as is done in medical drug trials), through a ‘natural experiment’ where some quirk of the data generating process led to a quasi-random assignment of treatment, or through an identification of an ‘instrument’ that is well correlated with the treatment but not with the outcome that is being investigated.

Most climate change economic questions do not easily lend themselves out to a randomized control trial, and neither do they usually involve clearly identified exogenous randomization or a useful instrumental variable that could be utilized for identification. As such, papers that are mostly descriptive or explanatory (as is common in papers that attempt to quantify impacts), or predictive (as is needed in much of the adaptation or mitigation research) are not really welcomed by the profession, and economists are dis-incentivized from producing them. These constraints restrict the questions that can be asked to ones in which causality can be identified (typically well-defined and narrow interventions and policy changes) and restrict the number of contextual details that can be included so that generality is maintained.

*Structural modelling work*, the third type, occupies a middle ground between the theoretical and empirical work, and is thus a little less easily categorised. A typical structural-modelling paper sets up a model to describe a particular economic context, usually drawing on economic theory. This type of research is much more common in macroeconomics. The model will feature various ‘parameters’ that could have a variety of values—for example, the responsiveness (the elasticity) of an economy to a change in energy prices. The model then uses these parameters to ‘solve’ the model and reach a set of conclusions that aim to shed some light on the question the model is designed to answer. For example, it might try to estimate the optimal magnitude of a carbon tax based on a macroeconomic model and a set of functions that describe the impact of the environment on the macroeconomy, and the impact of energy prices on the economy and consequently on GHG emissions.

The one type of economic research that does play a significant role in the IPCC is Integrated Assessment Modelling (IAM), which relies on structural modelling methodologies. There is a wide variety of IAMs; though they are typically divided into two groups: cost-benefit IAMs that are used in WGII, and energy system IAMs that are the focus of mitigation work in WGIII. Broadly speaking, though, the IAMs include macroeconomic modelling approaches as these were developed in the macroeconomic literature some years ago. Given the computational demands of the climate and sectoral parts of the IAMs, the prevailing choice for the macroeconomic half was to resort to older and simpler modelling approaches. Because of that, and because structural modelling is not as prestigious, among economists, as the other two methodological approaches, the papers describing IAMs, and

their development are rarely, if ever, published in economics journals. Besides the IAMs, a lot of the research that the IPCC reports on, or indeed requires to inform the economic dimension of its work, does not fall so neatly into the three types we just described.

One last notable observation is that economics is the least interdisciplinary of the social sciences, by a wide margin. Compared to sociology, political science, and anthropology, economists are much less likely to cite papers from other disciplines, and accordingly view interdisciplinarity as less important<sup>18</sup>. Our anecdotal impression is also that economists are much less likely to co-author with scholars from other disciplines and to publish papers in other disciplines’ journals, as the discipline does not seem to value extra-mural publications (even publications in *Science* or *Nature* are generally viewed with disfavour). Within the discipline, there is tremendous prestige in publishing in the ‘top 5’ economics journals (*American Economic Review*, *Quarterly Journal of Economics*, *Econometrica*, *Journal of Political Economy*, and *Review of Economic Studies*)<sup>19</sup>.

### There are few climate change economists

Given what we described above, we think economists can usefully contribute to the assessment of the socio-economic consequences of climate change, about efficient and effective ways to reduce greenhouse gas emissions, and about ways to structure adaptation to the consequences of the resulting (or residual) climatic changes (for example, how to structure payments for adaptation programmes or for Loss & Damage compensation). However, the norms we described in the previous have led economists to make very narrow contributions to the literature on climate change. These norms, and other constraints and mis-incentives, have also prevented economists from successfully participating more in the IPCC Assessment Report process more specifically, and from influencing the agenda of the UNFCCC negotiations process more broadly.

Economists’ preference for not setting normative goals is also part of their discomfort with the IPCC. The IPCC has been progressively calling for more and more aggressive (and evidence-based) action on climate change, but economists often pretend that their role is in shedding lights on trade-offs, and quantifying them, rather than in siding with any specific call to action (even if perceived as urgent).

As we briefly mentioned earlier, one of several areas where economists did contribute substantially to both WGII and WGIII in the past has been the IAMs – and specifically the cost-benefit IAMs such as the DICE<sup>20</sup> or FUND<sup>21</sup> models. These have been the mainstay of much economics discussion of the climate change problem since the pioneering work of William Nordhaus<sup>22,23</sup>. Yet, the IAMs have been widely criticized by many climate change researchers (in and outside the IPCC), as well as by some economists. This is mostly for neglecting many important connections and pathways and thus materially underestimating the costs of climate change, and therefore underestimating the urgency of the problem and its magnitude<sup>24–26</sup>.

This underestimation in the IAMs is directly related to the methodological straitjacket we described above. As an example, in the current 2016 version of Nordhaus’s Nobel-winning and pioneering IAM (DICE), the link between the climate and the economy is modelled by the equation:  $D = \alpha \Delta T^2$ ; with  $D$  defined as the damage to the global economy from climate change (as a share of global GDP) and  $\Delta T$  denoting the difference in degrees (Celsius) between global annual average temperature today and at pre-industrial time. The parameter  $\alpha$  is a short-cut that aggregates the various channels through which climate change has an impact on economic activity<sup>20</sup>, and is parameterised as  $\alpha = 0.00236$ . As Nordhaus<sup>20</sup> describes it, his team “examined different damage estimates and used these as underlying data

points and then fitted a regression to the data points. We also added an adjustment of 25% for omitted sectors and nonmarket and catastrophic damages.” (p. 1). Somewhat tautologically, some of the damage estimates that Nordhaus used were from other IAMs. This setup does not allow for any uncertainty around the preordained magnitude of  $\alpha$ .

IAMs cannot, as a rule, accommodate extreme tail risks, tipping points, cascades of impacts, and irreversibilities, nor can they estimate the key parameters involved in modelling phenomena that have not repeatedly happened and whose likelihoods are uncertain. This is not very dissimilar to the weaknesses in the traditional macroeconomic modelling approaches that were exposed by the failure to predict the Global Financial Crisis in 2008.

The other popular approach adopted by economists to examine the impacts of climate change is based on empirical causal inference from, typically, aggregate macroeconomic data collected across both different geographies and different times. These panel data investigations can provide identification of the causal impact of the annual (or more frequent) fluctuations in the weather<sup>27–29</sup>. But this is a partial equilibrium approach (assuming only one dimension is out of equilibrium, and everything else is held constant). Clearly, the climate change problem is a ‘general equilibrium’ problem, with a myriad set of markets and prices, in different locations, adjusting simultaneously. Furthermore, these backward-looking papers necessarily assume that the recent past is directly predictive of the future.

Economists’ refusal to intensively engage with subjective data (like aggregations of expert forecasts in Delphic surveys), as these approaches do not fit the types of acceptable research described above, means that these risks and phenomena all too often are ignored. The DICE model’s  $\alpha$  short-cut exemplifies the straitjacket within which economics operates. Modelling of the economy-climate link including tipping points, irreversibilities, and multiple equilibria is obviously a significant challenge. But the self-imposed constraints, associated with economists’ research practices, mean they do not seriously engage or sufficiently acknowledge the complexity of this problem. If economists were to take this issue more seriously and include the myriad caveats and qualifications that are necessary, this research would be difficult to publish in all mainstream economics outlets.

To summarize, the few economists who have worked on WGII and WGIII issues have done so by deviating from the narrow path of acceptable research in economics. The IAMs, the mainstay of the economics used by the IPCC, is not part of the toolbox of standard academic economics as it is practiced today. This has probably led to a lack of interest, within the economics profession, in spending more intellectual capital on the climate change question. The straitjacket that economists work with has prevented them from addressing some questions and has also consequently prevented them from being interested in concentrating on climate change research more generally. Indeed, many of the people who nowadays work on the IAMs are not trained economists or were trained as economists but now work in professional environments that do not treat them as economists anymore. Unfortunately, as we detail in the next section, this narrow focus and absence of engagement on other issues has alienated researchers from other disciplines within the IPCC toward economics and economists.

But before we move on to discuss why the IPCC does not want economists, we also need to emphasise that even economists who are focusing on the climate change issue, seemed to have largely chosen not to work with the IPCC. Maybe like Groucho Marx, economists have decided that they do not want to belong to an interdisciplinary club that would have them as a member and have consequently decided not to engage with the IPCC.

### The IPCC does not want climate change economists

There is plenty of criticism of conventional climate change economics, mostly centred around criticisms of the IAMs, and for mitigation, around the almost universal insistence among economists that cap-and-trade (emission trading) or carbon taxes are the only first-order solutions to the climate change challenge. This criticism does come also from mainstream economics, but it mostly originates from heterodox economists and other social and natural scientists.

One obvious reason for the disagreement between economists and other climate researchers is what appears to be a significant discrepancy between the expected biophysical and ecosystem impacts of climate change projected by natural scientists, and the economic impacts, typically measured by economic output or decreases in annual growth rates. This difference is apparent for relatively lower levels of future warming (e.g., 2 °C) and becomes even starker with higher levels of warming<sup>30</sup>. It is easy to see why many natural scientists would consider the damage projections from economists’ IAMs as gross underestimates. In an admittedly older survey by Nordhaus, natural scientists’ estimates of future climate damages were 20–30 times higher than the estimates of non-environmental economists<sup>31</sup>.

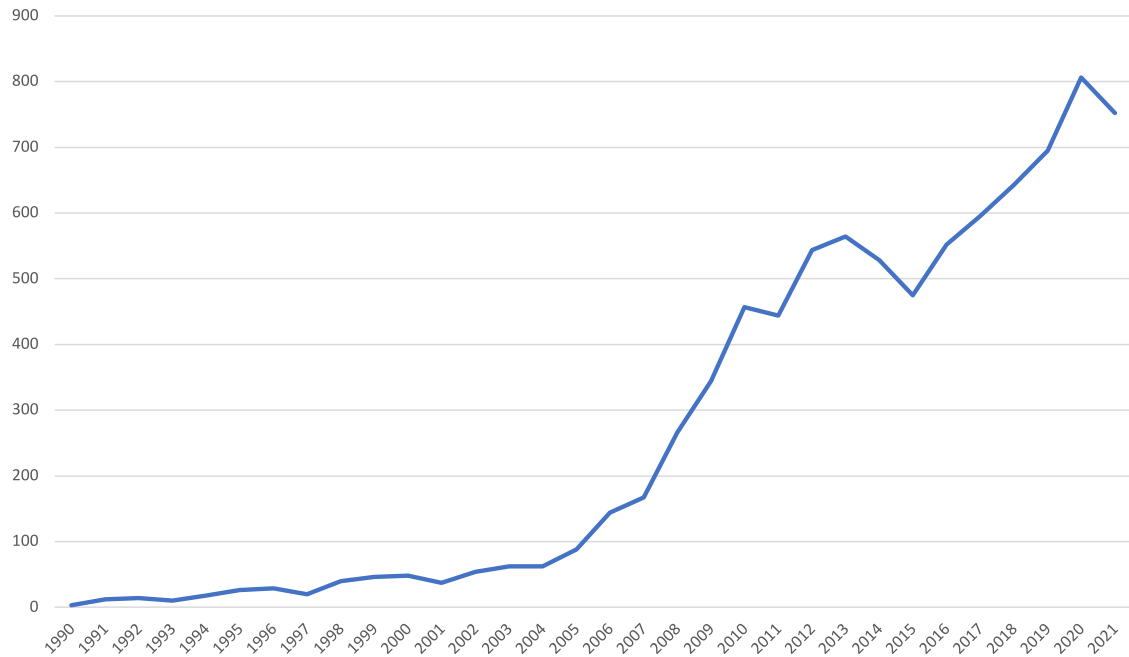
Given the disparity in the estimates of expected damages, it is not surprising that many natural scientists are sceptical of what economists can offer or may produce with respect to the potential gravity of the long-run threat climate change may pose. Considering this scepticism and the dominance of natural scientists within the IPCC, could this be affecting the IPCC’s demand for economists?

We do not know, as we have no data to examine that question quantitatively. The selection process of IPCC authors is in most cases very opaque, and the selection process that predates it at the national level is even more obscured. This selection is an inherently political process, and it is run in each country very differently. In some countries, all potential candidates’ names, if they submit their interest to the country’s focal point, are forwarded to the IPCC, but in others the focal point (usually a government unit) chooses a short list to nominate. According to Chan et al.<sup>32</sup>, in many low- and middle-income countries, it is frequently researchers who are working for the government (for example as climate negotiators) that are nominated. See also Standing<sup>2</sup>. We therefore do not know if the process is biased against economists at the national level in any country. The second step in the nominating process is as opaque and is run differently for each main chapter in each working group<sup>2</sup>.

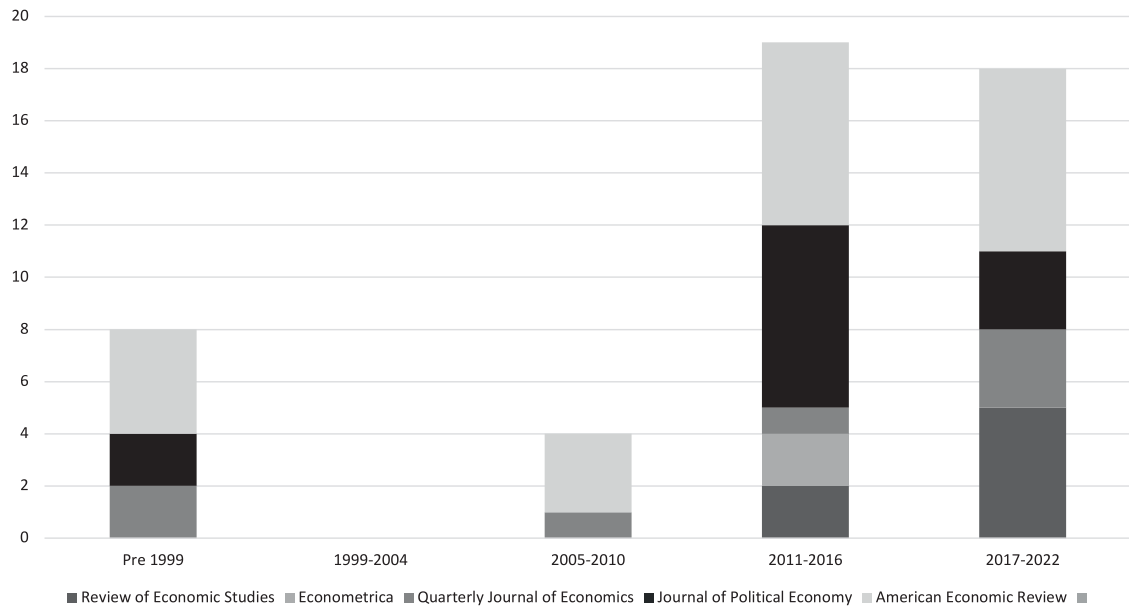
### Is this changing? What does it mean for the future of the IPCC?

There is no doubt that more economists are shifting their interests and are now working on climate change issues, and more research is now being published in this area (Fig. 2). The 2021 dip in published research is probably because, after the emergence of COVID-19, many environmental economists transitioned (temporarily) to work on that issue. However, while the trend is definitely of an increasing interest in the area, it is important to note two points: (1) The trend increase observed here is also associated with an increasing amount of published economic research more generally. (2) While the number of research articles is increasing, it is still relatively small in absolute terms.

We compared the number of articles on climate change published in academic economics journals during the 1990–2021 period to the number published on sport. Over this period, 8545 articles were published on climate change, and 7,637 were published on sport. In 1990, there were 19 articles on sport and only 3 on climate change. In 2021, 752 published articles included climate change in their abstract, the equivalent for sport was 390, and the equivalent for ‘trade’ was 2901. Apparently, even



**Fig. 2** Number of academic economics articles about climate change. Articles that contain either ‘climate change’ or ‘global warming’ in their abstract. Data collected from EconLit by the author in September 2022.



**Fig. 3** Number of articles on climate change published in the top-5 economics journals. Data until 2019 were collected by Richard Tol<sup>37</sup>, data from 2020 onwards were collected from EconLit and Google Scholar by the author in November 2022.

today, the economics of climate change is only about twice as important as the economics of sport, in terms of the amount of research it generates.

The increasing amount of climate change economic research has not yet proliferated to top economics journals<sup>33</sup>, with the vast majority being published in field journals of environmental and ecological economics or in multidisciplinary journals that explicitly include economics in their scope, and including the only two journals that are specifically focussed on the economics of climate change. One of these (*Climate Change Economics*, published by World Scientific) started in 2013, and the other (*Economics of Disasters and Climate Change*, published by Springer Nature) started in 2017. [Disclosure, the latter one was founded by the author].

According to Oswald and Stern<sup>34</sup>, in 2019 only 57 out of approximately 77,000 published articles in top general interest economics journals involved the subject of climate change. Figure 3 shows that while the number of climate-change-related articles in the top 5 economics journals (see footnote 4) has been increasing in the last two decades, the absolute numbers are very low, with 49 published articles to date (November 2022) and an average of approximately 2 articles/year during the 1999–2022 period. In 2021, the Top 5 economics journals published between them only one paper that includes the term ‘climate change’ in its abstract; this single paper looked at the CO<sub>2</sub> embedded in trade<sup>35</sup>.

It may be the case that apart from the previously mentioned reasons economists are less inclined to engage with the topic of

climate change, they might also be avoiding the topic because most of their colleagues have been doing the same, suggesting that the discipline may be stuck in a sub-optimal Nash equilibrium with respect to climate change<sup>34</sup>. We believe, however, that the increasing prominence of climate change in both public and academic discourse more generally, and the increasing volume of economic research on the topic may gradually change these dynamics. We have seen a similar but more abrupt change occur with respect to the economics of pandemics, after the beginning of the catastrophic COVID-19 pandemic in 2020<sup>36</sup>.

This increasing interest among economists to get involved in climate change research will inevitably lead to a more diverse set of contributions, both in terms of the topics economists are looking at, and the methods they will use to do so. We already see this diversity emerging in new working papers that are being circulated, for example in the NBER series. As such, since the discipline will have even more to contribute, it is even more important that the engagement of the IPCC with economics will increase.

Several issues may impede this encouraging new engagement between academic economics and climate change from converting into a re-engagement with the IPCC. First, the economics discipline, and especially its journals' editors and editorial boards, will need to welcome this new interest in climate change research, and agree to publish its future fruits. A more accommodating acceptance of alternative and multi-disciplinary methods may be required when pursuing this welcoming agenda, as young academics will need to be suitably incentivized to remain engaged with the climate change question. Academic economic departments, and their leadership will also need to become more interested in the topic, and in the fruits of this research agenda.

More importantly, however, we believe that the main challenge will be a re-engagement with the IPCC, rather than a new engagement with climate change research more broadly. Economists both need to want to join, and to re-earn the trust of other academic disciplines that economists can usefully contribute to the IPCC's efforts. Neither of these, we believe, is currently happening. We do believe that the stakes here are quite high, as economics can offer many insights that will align well with the IPCC's mission. However, whether this happens also depends on the future shape the IPCC takes, a topic that is being considered elsewhere in this special issue.

## DATA AVAILABILITY

All data used in this article are available upon request.

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## COMPETING INTERESTS

The author declares no competing interests.

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